

AAQ Antenna Controller

Users Manual

Revision R11.8.0

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Revision History

Revision	Date	Revision Description	Revision By	Approved By	AAQ.rom Software Version	AAQRemote Software Version	AAQ Web Server Software Version
Rev. 1.0.0.3	25 July 2012	Software Release 6			5775	1.1.2.182	N/A
Rev. 1.0.0.4	19 Sept 2012	Software Release 7			6112	1.1.3.22	N/A
Rev. 1.0.0.5	12 Dec 2012	Software Release 8			6348	1.1.3.74	1.0.0.3
Rev. 1.0.0.6	08 April 2013	Software Release 9			6869	1.1.3.160	1.0.0.3
Rev. 1.0.0.7	11 Oct 2013	Software Release 10			7069	1.1.3.187	N/A
Rev. 1.0.0.8	02 May 2014	Rewrite			8564	1.1.3.224	N/A
Rev. 1.0.0.9	31 Aug 2015	Rewrite for Release 11.4			10542	1.1.4.324	N/A
Rev. 11.5.0	5 Jan 2016	Update for Release 11.5. Change in Revision Sequence			10649	11.5.342	N/A
Rev. 11.5.1	14 Jan 2016	Update message section chapter 8			10649	11.5.342	N/A
Rev. 11.6.0	21 June 2016	Updates for release 11.6			10738	11.6.364	N/A
R11.8.0	12 December 2016	Updates for R11.8, added revision and approved by in revision history	JF	MF	10784	11.8.382	N/A

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Chapter 1 - Introduction

1.1 Controller System Overview

The AAQ controller is a unique highly flexible, cost effective, purpose built embedded antenna controller. The primary application for this controller is for transportable satellite antennas exposed to harsh environments with demanding performance requirements. The small form factor packaging of the controller enables its use in a wide range of antenna types – large and small. By embedding the controller into the antenna pedestal, system cabling and connections are greatly simplified.

The controller is an IP based network compatible controller that has a single core base code that can be applied over multiple hardware platforms. Using parametric software that is configurable by user defined operational profiles, the controller can adapt to virtually any antenna size, positioner or sensor suite due to its modular approach in software and hardware. Consequently, many different combinations of sensors, modems, beacon receivers, motors, third party applications and other devices can be readily integrated and used with the basic system.

1.2 Standard Hardware Components

The hardware architecture employs multiple micro-processors to distribute processing tasks efficiently and to share processing burdens optimally. The standard hardware consists of two embedded components, the ACU (Antenna Control Unit) and the NAV RIOM (Navigation Remote Input Output Module).

The ACU contains a total of five (5) microprocessors – each dedicated to specific tasks. The main processor is an ARM9. With its extensive memory suite, it is capable of performing all administrative functions, networking, high level motion control commands, coordinate transformations, tilt compensation and communication with external devices via Ethernet or serial connections. A 44-pin dsPIC33 microprocessor is used to communicate with the on board pitch and roll sensor and to provide additional analog and digital Input / Output capability. Three 28-pin dsPIC33 microprocessors provide encoder quadrature, servo motion control and PWM (Pulse Width Modulation) output to each of three standard motors.

The ACU includes an internal 4-port Ethernet switch, an RSL (Receive Signal Level) power meter, bias tee to supply LNB (Low Noise Block-Downconverter) voltage, tone generator and three motor servo drives. The ACU is composed of a single PCB (Printed Circuit Board) enclosed in an aluminum housing with four (4) external connectors.

The NAV RIOM contains a GPS receiver and patch antenna, a 2-axis inclinometer and a magnetic compass. It also has a dsPIC33 microprocessor which communicates with these internal devices as well as with the ACU over Ethernet.

Both of these standard components are designed to survive in harsh environments and to be embedded in the antenna pedestal to simplify cabling.

More information on Controller Hardware can be found in Chapter 7, Theory of operation.

1.3 Software Architecture

AAQ software consists of a family of code which provides a scalable, extensible, modular capability using parametric driven antenna behavior enabling users to tailor system performance as they wish.

1.3.1 Operating System

The operating system for the controller is LINUX.

1.3.2 ROM

The ROM code comprises the core software and performs administrative functions, coordinates transforms, tilt compensation and communication between RIOMs and other external devices.

1.3.3 PIC

PIC (Programmable Integrated Circuit) code is written to utilize the MicroChip PIC microprocessors in the system. These are used for motion control, encoder quadrature, PWM motor input, various I/O connections. Two pieces of PIC code are used to communicate with the two versions of PICs in the controller.

1.3.4 CONFIG

CONFIG files contain parameters and variables set to configure a specific antenna to perform all necessary functions. There are several types of CONFIG files – see Chapter 6 for a detailed description of these files.

1.3.5 Remote – GUI (Graphical User Interface)

The Remote files are provided to enable a graphical user interface to the controller. There are two types of GUI; an XML Windows based .NET GUI (AAQ Remote) and a browser based HTML GUI.

1.3.6 Module – Device

A Device Module file enables inter-operability and communication between the controller and a specific device. An example of this type of vendor device module would be one created specifically for the iDirect Evolution 8000 Modem.

1.3.7 Module – Function

A Function Module enables specific unique functions in the controller. An example of a function module is the Step Track Module.

More details on the software architecture can be found in Chapters 4, 6 and 7.

1.4 Controller Hardware Specification

The two basic AAQ Controller components are the ACU and the NAV RIOM.

ACU

- Size: approximately 8.3" H x 7.4" W x 1.4" D
- Weight: 3 lb.
- Communication Ports: 2 RS-232 ports, 1 Ethernet port
- LNB Voltage Output: 0, 13 VDC, 18 VDC
- Input Power: 24 to 32 VDC, 14A maximum
- Operating Temperature: -40°C to +60°C
- Humidity: 0 to 95% RH Condensing
- Environmental Protection: IP65
- Circuit Protection: internal resettable 15A fuse

NAV RIOM (Remote Input Output Module)

- Size: approximately 4" H x 1 7/8" W x 1 1/2" D
- Weight: 0.5 lb
- GPS Receiver and Patch Antenna
- Magnetic Compass, with error correction
- Digital Inclinator – 2 axes
- Environmental Protection: IP66
- Operating Temperature: -40°C to +60°C
- Humidity: 0 to 100% RH Condensing

1.5 Definitions and Common Terms:

Antenna Bore Sight – line of sight passing through antenna vertex, feed phase center and satellite

Azimuth – angular orientation of antenna bore sight about vertical axis; typical range $\pm 200^\circ$;
positive direction clockwise looking down on pedestal

World Azimuth – angular orientation of antenna bore sight about gravity vector in local level
coordinate system

Pedestal Azimuth – angular orientation of antenna bore sight about tilted and yawed pedestal
vertical axis

Elevation – angular orientation of antenna bore sight about horizontal axis; typical range 0 to 90° ;
positive direction up

World Elevation – angular orientation of antenna bore sight about horizontal axis in local level
coordinate system with horizontal axis aligned with East-West plane

Pedestal Elevation – angular orientation of antenna bore sight about tilted and yawed pedestal
horizontal axis

Polarization – angular orientation of the plane of the electric field perpendicular to the plane of
propagation in the receive RF signal; can be linear or circular

World Polarization – skew angle of the feed relative to antenna bore sight plane and the equatorial
plane

Pedestal Polarization – skew angle of the feed relative to the tilted and yawed antenna bore sight
plane and the equatorial plane

Pitch – angular displacement of pedestal about local level horizontal axis that is fixed in the local
tangent plane

Roll – angular displacement of pedestal about local level transverse axis that is fixed in the local
tangent plane

Latitude – local latitude measured from Earth's Equator; latitude is typically determined from the
embedded GPS

Longitude – local longitude measured from Greenwich Meridian where East longitude is positive,
West longitude is negative; longitude is typically determined from the embedded GPS

Compass Heading - 0° = North, 90° = East, 180° = South, 270° = West; typically measured by embedded magnetic compass with declination adjustment or True North heading without declination adjustment

Tilt – non-level condition where pedestal horizontal and vertical axes are pitched and rolled so pedestal azimuth axis is no longer aligned with local gravity vector

Chapter 2 - AAQ System Architecture & Hardware Overview

2.1 Controller System Block Diagram

The basic AAQ Controller block diagram is shown in Figure 1.1. The AAQ communicates with the motors and NAV RIOM on an internal LAN. The ACU requires 28 VDC and communicates externally over a LAN or WAN. The User Interface can be any combination of personal computer (custom GUI application or web browser), 1 RU Control Interface or Hand Held Control Interface.

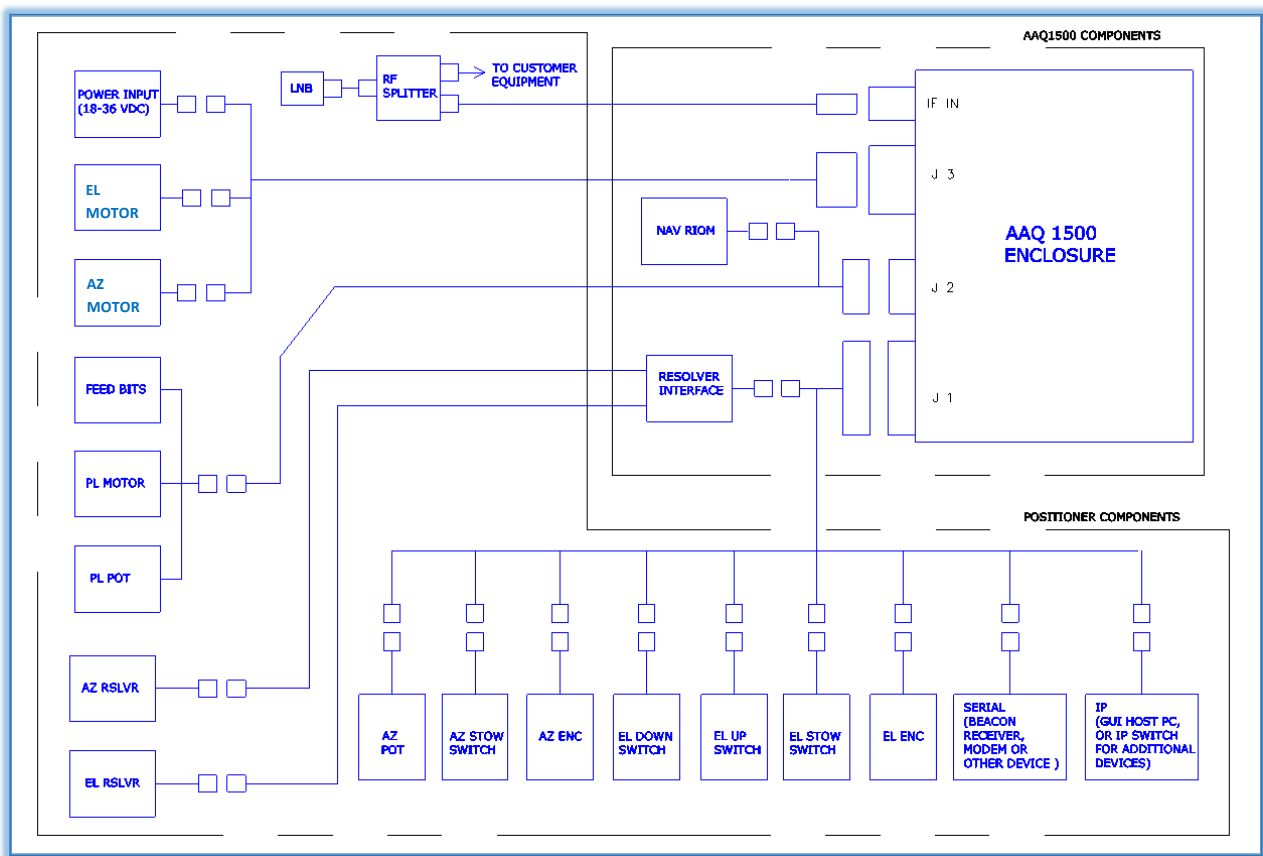


Figure 2.1 - AAQ Controller Hardware Components.

The AAQ consists of a single PCB (Printed Circuit Board) enclosed in an aluminum housing with four (4) external connectors. The 8-pin power connector (J3) receives 28 VDC power and distributes the PWM voltage to each of the three standard motors. The TNC coax connector (IF IN) receives RF signal from the LNB. Two D-sub miniature connectors, one 28-pin (J2) and one 44-pin (J1) provide connection to various sensors and other external devices, including the NAV RIOM, over serial and Ethernet. The AAQ Enclosure is shown in Figure 2.

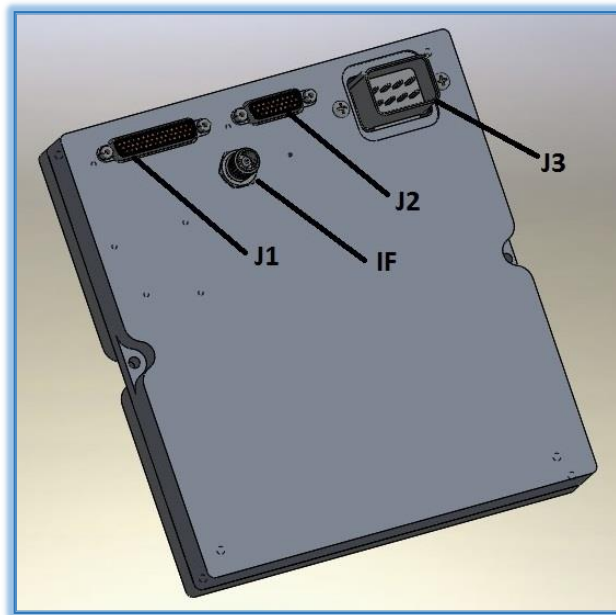


Figure 2.2 - AAQ Enclosure and Connectors

2.1.1 The AAQ enclosure contains:

1. CPU: ARM9 running the LINUX OS
2. Memory: 4 GB micro SD, 2 GB RAM, 4 GB NAND Flash w/battery backup
3. Servo Control: 3-axis Brushed DC Motors (EL 12A, AZ 8A, POL 5A)
4. Encoder Feedback: 3-axis quadrature encoder circuits
5. RSL: RF Signal Detector with Variable Attenuator
6. Tilt Sensor: 2-axis

7. Communication Ports: 2 RS232 and 2 Ethernet
8. Ethernet Switch: 4-port
9. Positioner Sensor Inputs: Digital and Analog
10. LNB Bias Tee and Tone Generator
11. Sensor Analog and Digital I/O Interfaces

The AAQ enclosure shown in figure 2.1.1 is generally mounted underneath the positioner AZ/EL cover. Each connector on the enclosure has a wire harness to connect to positioner components.

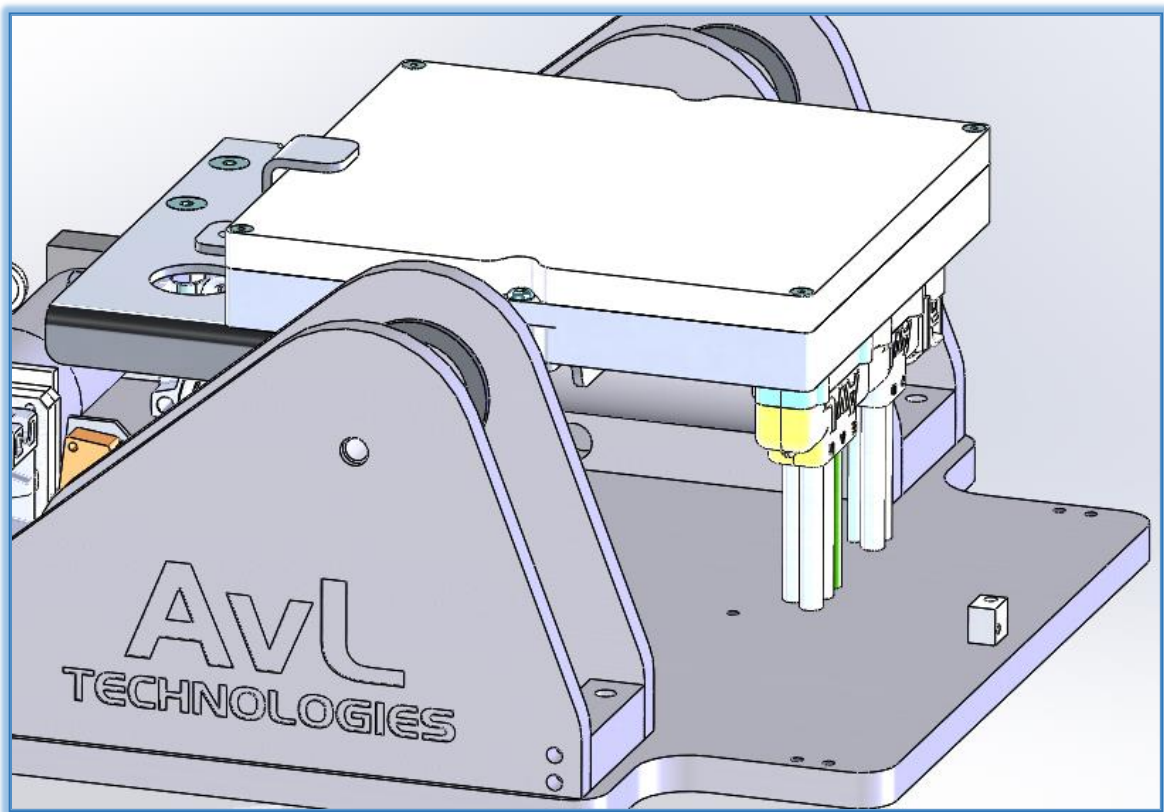


Figure 2.1.1 - AAQ Controller - Typical mounting in a positioner

2.2 AAQ Antenna System

The controller combined with the proven AvL pedestal provides a pure and simple solution for communications in any environment. The controller offers many intuitive features allowing the user to successfully maintain and operate the antenna both locally and remotely from anywhere in the world.

2.2.1 AvL Cable Drive System

The AvL cable drive system that is used with the AAQ Controller, utilizes highly reliable aircraft control cables in a redundant configuration to achieve a zero backlash, light-weight, very stiff drive system. It achieves this high-tech performance by wrapping the cable around the drive capstan several times before wrapping the larger drive drum. The method used to wrap the capstan results in a minimum free length of cable. The load in the cable on the main drum is exponentially reduced as it is wrapped around the drum. Therefore, the total elongation of the cable when under load is minimized. The AvL cable drive system results in stiffness of up to 10 times that of comparable gear or harmonic drive systems. The cables are pre-tensioned and spring loaded at the main drum attachment point which eliminates backlash at installation and backlash from any cable stretch in the future.

2.2.2 Motor Drives

Lightweight, reliable, DC motors with integral gearboxes are used for the Az, El and Pol drives. These motors were selected because they provide the best torque-to-weight ratio as well as allowing dual speed operation for slewing and peaking. These motors produce constant torque over a wide speed range, which ensures smooth operation when peaking the antenna.

Additional information on the AAQ controller, Cable drive & antenna systems can be found in the Theory of operation section Chapter 7.

2.3 AAQ Components

2.3.1 Navigation Remote Input Output Module (RIOM)

The NAV RIOM contains a GPS receiver and a 3 axis magnetic Compass. Depending on the model a 2-axis inclinometer may reside within the NAV RIOM. The NAV RIOM (see Figure 2.3.1) is plugged into the AAQ's J2 harness and it is typically mounted on the back of the reflector at the topmost point when deployed. At this location, the GPS antenna is afforded a good view of the sky, in order to provide accurate location and pointing information.

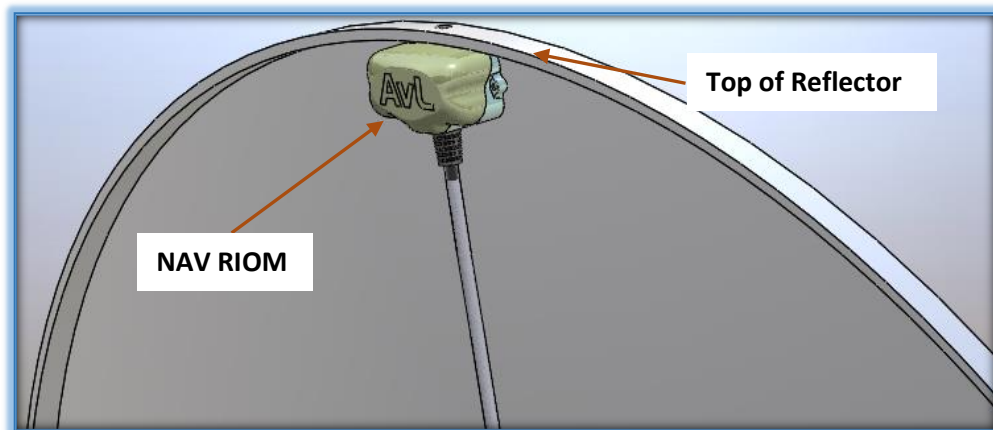


Figure 2.3.1 - NAV RIOM on Reflector

Chapter 3 - GUI Installation, Set-up & Network Configuration

This chapter describes the GUI “Graphical User Interface” installation and set-up as well as, how to configure the AAQ controller to communicate and function within a network of Ethernet devices. The available networking options on the AAQ controller are to ensure that the antenna controller is able to properly communicate with both clients (computers, mobile devices, CIP interfaces, etc.) and required devices (modem, beacon receiver, GPS device, etc.).

3.1 Requirements

Operating System:

- Microsoft Windows 10
- Microsoft Windows 8.1
- Microsoft Windows 8
- Microsoft Windows 7
- Microsoft Windows Vista
- Microsoft Windows XP (with appropriate service packs, updates, framework and settings)

.Net Framework:

- .Net Framework 3.5 or greater

Important Note - Uninstall any previous version

If a previous version of the AAQ Remote is installed on your system, always remove it before installing a newer version of the application.

Using Windows 8 or greater, select;

Path
Main Window → Start → Settings Button
Search “programs and features” in the search dialogue box

Using Windows 7, Vista, or XP, select;

Path
Main Window → Start → Control Panel
Programs ->Programs and Features

This will prompt the programs and Features screen. Uninstall the file by left clicking the “AAQ Remote” file, initiating the uninstall wizard.

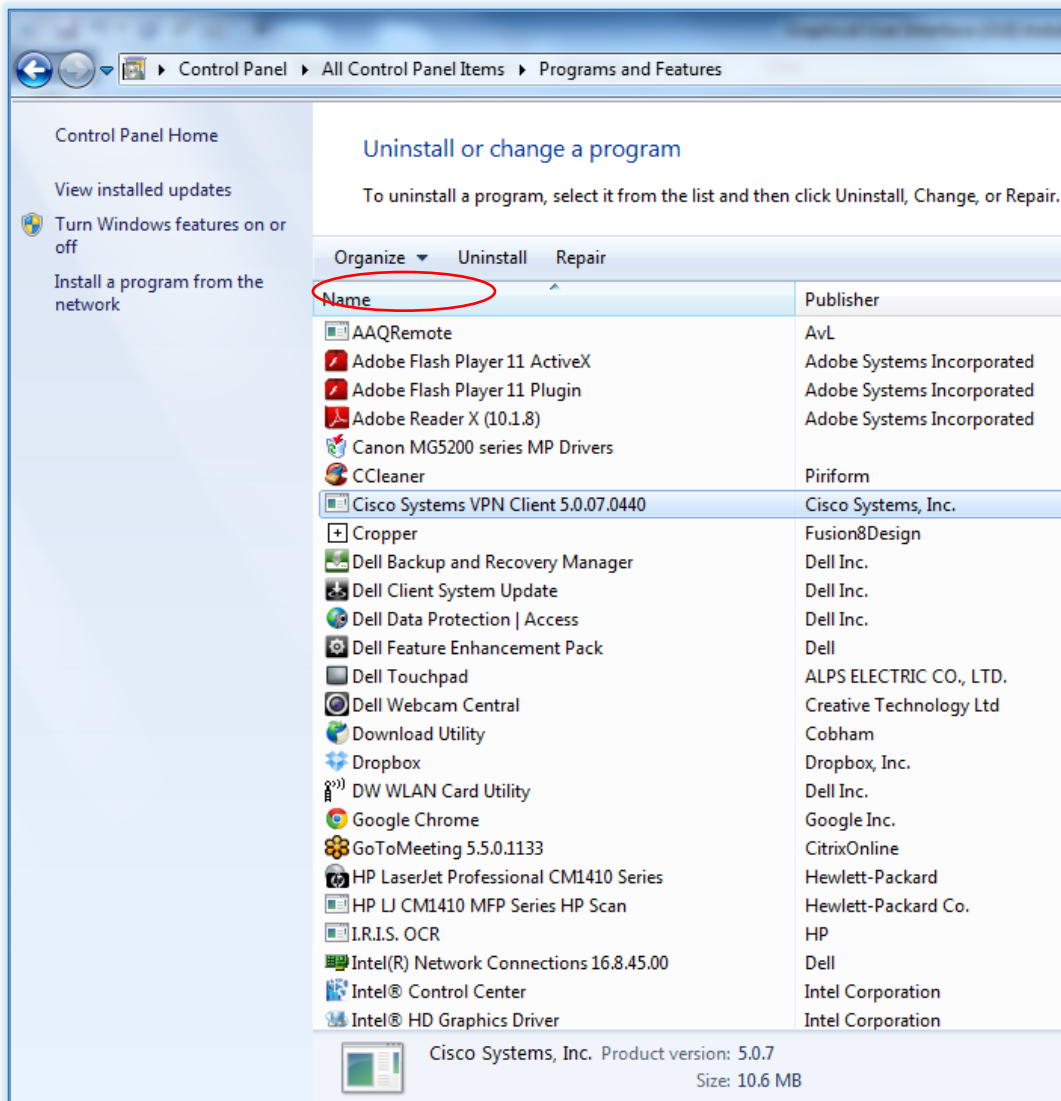


Figure 3.1 - Programs and Features

3.2 Installation

3.2.1 Windows installation file

Begin by installing the AAQ Remote on your operating system through the AAQRemoteSetup_X-X-X-X.msi (Windows installation file), provided in your Customer Documentation Flash Drive.



Figure 3.2.1 - Installation File

3.2.2 Installation Folder

By default the wizard will save the GUI under the PC's 'All Programs' menu located under: START > ALL PROGRAMS > AAQREMOTE.

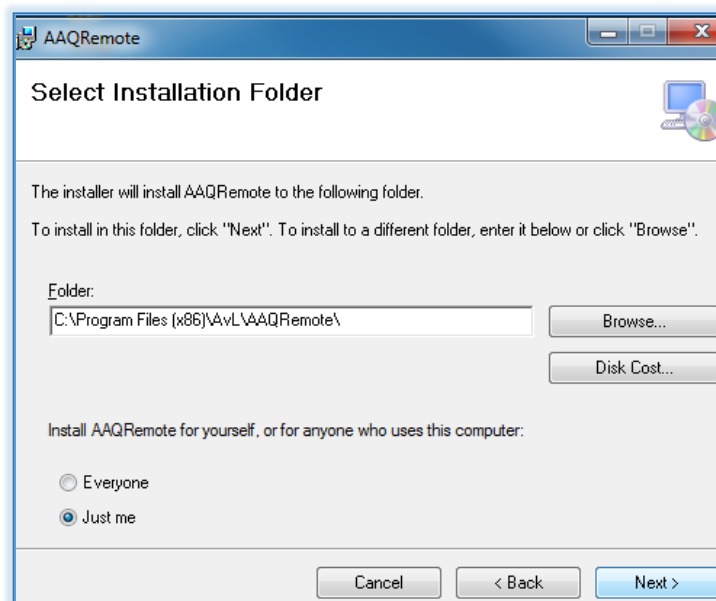


Figure 3.2.2 - Installation Wizard

Important - Use the Default location.

Once the installation is complete, a shortcut to the program will be located on the desktop.



Figure 3.2.2b - Remote Icon

3.2.3 AAQ Remote Access Settings

The AAQ Controller allows for different user interactions based on the access level of the user. This allows for the end user to engage in a simple to use experience (level 0), while keeping the customization available for knowledgeable users with higher level login privileges. The AAQ Remote application incorporates these login level rules. Depending upon the login level of the user various tools and interactions will become available.

Note - Integrators are typically set to access level 4 from the factory.

3.2.4 AAQ Remote Settings (Access Level 0)

The Remote Settings window displays the IP address, directing the Graphical User Interface (GUI) to the AAQ antenna controller unit (ACU). The default service address is shown.

Path
Main Window → File → Settings
AAQRemote Settings

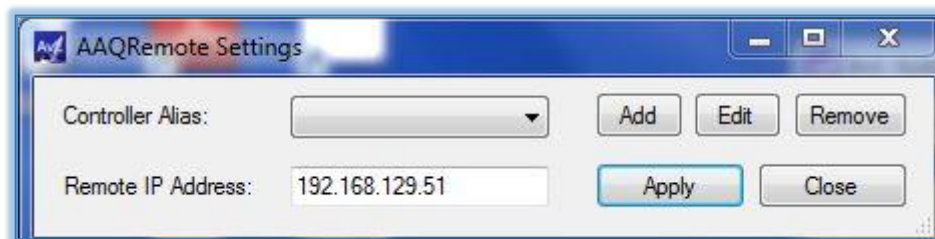


Figure 3.2.4 - AAQ Remote Settings (Level 0)

3.2.5 Editing Controller Alias

The “Controller Alias” pull down feature allows the user to associate an alphanumeric name with an IP address. This feature is accessed by clicking the “Edit” button in the AAQ Remote Settings window. This allows users to identify specific systems within a network.

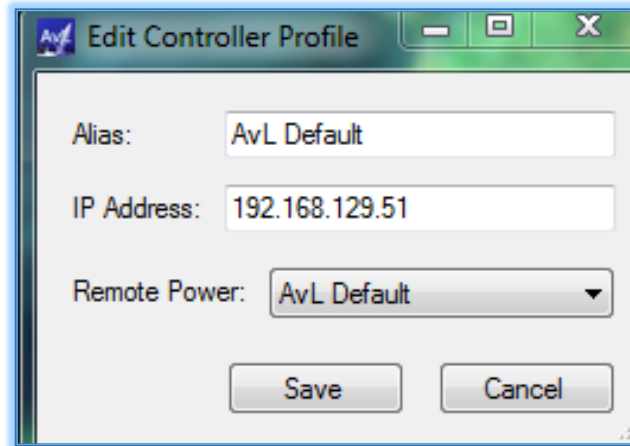


Figure 3.2.5 - Edit Controller (Alias) Profile

3.2.6 AAQ Remote Settings (Level 1-9)

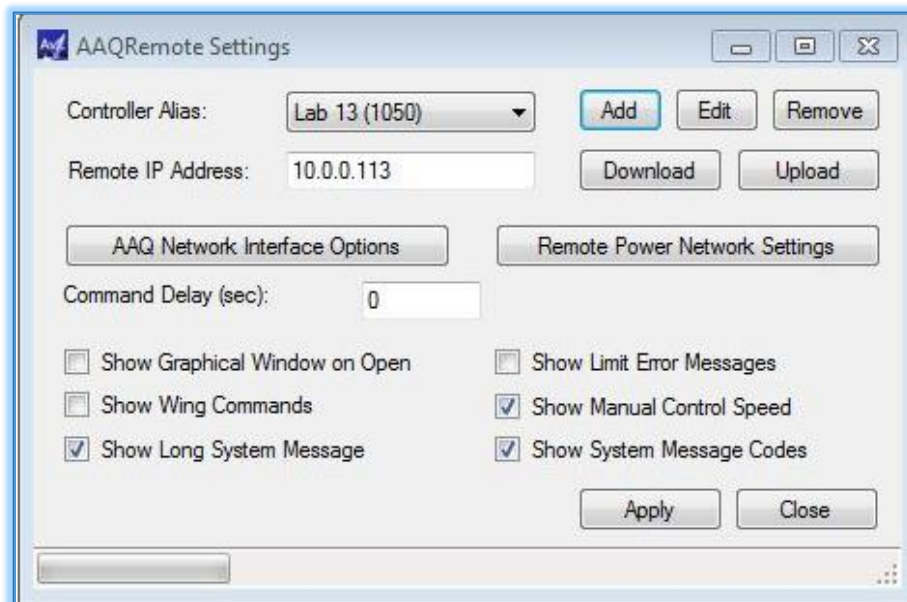


Figure 3.2.6 - AAQ Remote Settings (Level 1-9)

Note - See Chapter 4 for description of non-network GUI description & settings

3.3 Network Settings

3.3.1 Factory IP Addresses

The AAQ controller provides three interfaces to the customer's network:

Eth 1:0 – Interface #1, Configurable	(Factory Default IP: 192.168.129.50)
Eth 1:1 – Interface #2, Configurable	(Factory Default IP: 192.168.129.52)
Eth 1:2 – Service Interface, <u>Non-Configurable</u>	(Factory IP: 192.168.129.51)

Figure 3.3.1 – AAQ Controller IP Interfaces

For direct communication to the controller from a PC or Laptop, the computer attached must be on the same network and subnet. This can be done by changing the Local Area Connection Status (TCP/IPv4) of the Ethernet port on the user's PC.

IP address:	192.168.129.22 (1 to 254)
Subnet mask:	255.255.255.0

Figure 3.3.1b - Valid TCP/IPv4 Settings example

The controller address can be changed through the AAQ Remote application by left-clicking the File button on the File Bar and selecting "Settings". The Settings window is capable of setting the current IP address of the controller and setting a new IP address to the controller to use on the next power cycle. The controller will accept any valid IPv4 address in the following ranges:

Octet Range:	1 to 255 . 0 to 255 . 1 to 255 . 1 to 255
--------------	---

Figure 3.3.1c - Valid IP Address Range

Note – The Control Interface Panel display uses the 192.168.129.59 address and is Non-Configurable.

3.4 AAQ Remote Network Settings Tool

The AAQ Remote Settings tool is utilized to customize the AAQ Network IP settings using login level 4 or above.

Path
Main Window → File → Settings
AAQ Network Interface Options

Modems, beacon receivers, etc. will sometimes require the AAQ controller to be configured on the device network, enabling communications between the two devices.

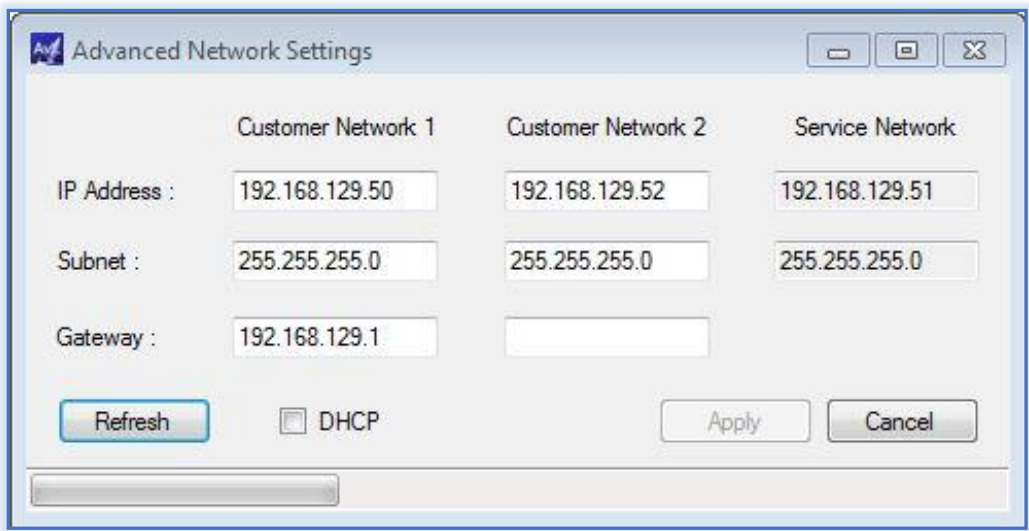


Figure 3.4 - Advanced Network Settings Tool

Window item	Description
DHCP	When the ACU is set to use DHCP, make sure that the server is also a DNS server. Using a DHCP server without a DNS server will cause the ACU to receive a valid IP address that is <u>unknown</u> to the user.
Customer Network 1 & 2	Customer IPs may be changed in accordance with customer device requirements. Once a new address is entered, click “Apply” to make the change.
Service Network	The service IP is permanent and available for recovery if necessary. If a fault has occurred in setting the new IP Address, the ACU defaults to the original 192.168.129.51 address.

Refresh	To query the current running network configuration, left-click the Refresh button on the left side of the window. *Note button will display as “Populate” if no IP addresses are visible in the window.
---------	---

3.5 IP addressing and Networking Examples

The following examples describe how to set up the AAQ controller to communicate and function within a network of Ethernet devices. The available networking options on the AAQ controller are to ensure that the antenna controller is able to properly communicate with both clients (computers, mobile devices, CIP interfaces, etc.) and required devices (modem, beacon receiver, GPS device, etc.).

The AAQ controller provides two configurable interfaces to the customer’s network; Eth1:0 (Settable interface #1) and Eth1:1 (Settable interface #2). These network interfaces can be configured using the provided AAQ Remote application. Each interface can be configured to use a specific IP Address, Subnet Mask, and Gateway. The use of two interfaces allows the user to configure the controller to be active on multiple networks communicating with multiple external devices, but keep the devices independent within the network.

The permanent non-settable “Service Network” interface is intended to remain available in the event the settable interfaces are unknown or an AvL Service Technician requires access to the system.

Note - Newer CIP units (Gray face) may be configured with router functionality either from the factory, or via the AvL Updater Tool. For the scope of this chapter, all examples are shown with CIPs configured as a simple network switch. See Appendix B of this manual for further information.

3.5.1 Factory Default Network Configuration

Equipment described:

- AAQ Controller
- Client Computer

Connection	Eth1:0 Customer Network	Eth1:1 Customer Network	Eth1:2 Service Network
IP Address	192.168.129.50	192.168.129.52	192.168.129.51
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0
Gateway	None	None	None

Fig. 3.5.1a - Factory Network Example

The default network configuration contains basic networking needed to set up the controller on the customer's network. The IP addresses are set on the 192.168.129.x network.

To communicate to the AAQ controller connect a computer to the controller as shown below:

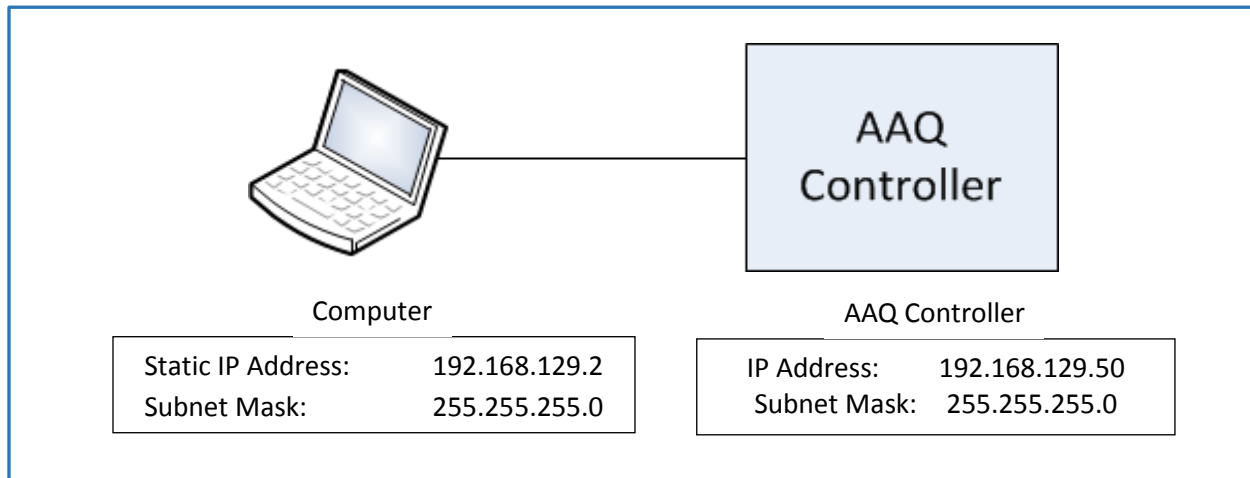


Figure 3.5.1b - Simple Network Configuration Example

In the above example, the computer may be set to any address within the subnet, 192.168.129.1 through 192.168.129.254 with the exception of the controller address.

3.5.2 Single Device Configuration

Equipment described:

- AAQ Controller
- Client Computer
- Standard IP Modem (external)
- Network Switch (or CIP)

Connection	Eth1:0 Customer Network	Eth1:1 Customer Network	Eth1:2 Service Network
IP Address	192.168.1.50	192.168.129.52	192.168.129.51
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0
Gateway	None	None	None

Figure 3.5.2a - Single Device Example

In this example, the controller is tasked with communicating with a modem that is used as feedback for acquisition of the satellite. The modem communicates on a standard IPv4 scheme. One of the controller's settable interfaces (Eth1:0 Customer Network) will be changed to communicate to the modem on the modem's preset or existing network. When connecting Ethernet devices to the controller it is necessary to use the network switch contained in the CIP so the controller can communicate with both the modem and client computer.

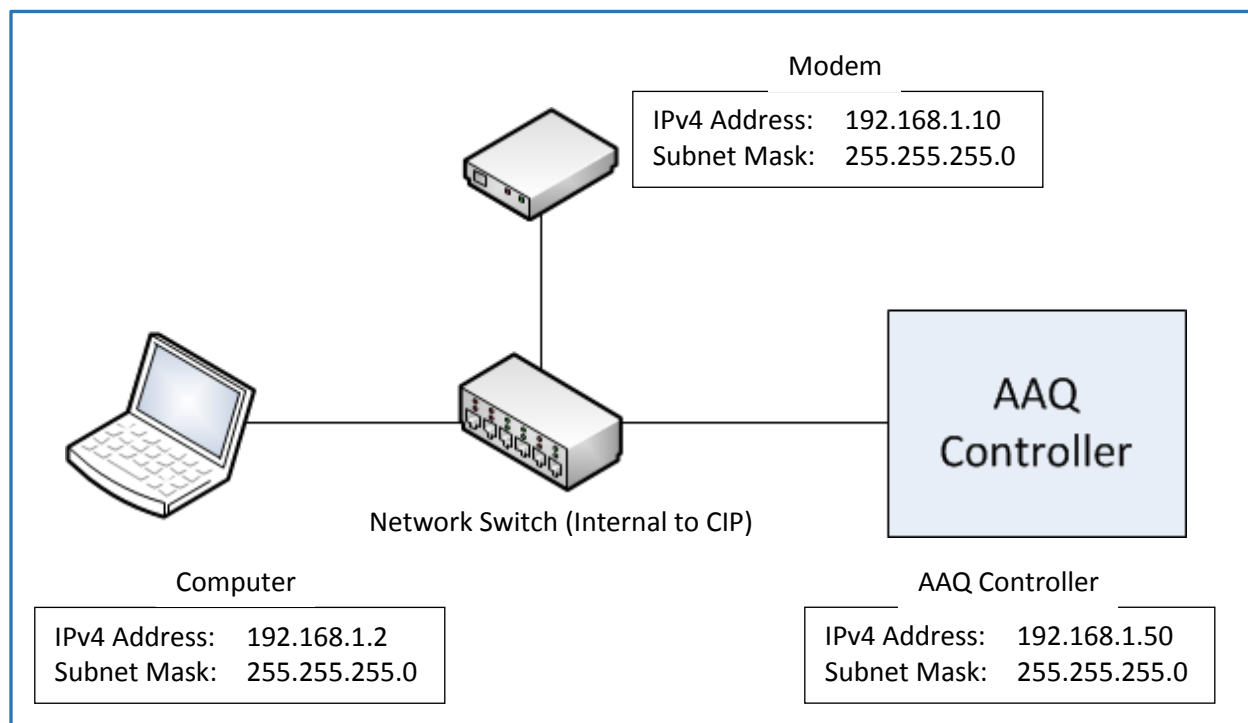


Figure 3.5.2b - Single Device Network

3.5.3 Dual Network Device Configuration

Equipment described:

- AAQ Controller
- Client Computer
- Standard IPv4 Modem
- Beacon Receiver
- Network Switch (or CIP internal)

Connection	Eth1:0 Customer Network	Eth1:1 Customer Network	Eth1:2 Service Network
IP Address	192.168.1.50	192.168.2.50	192.168.129.51
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0
Gateway	None	None	None

Figure 3.5.3a - Dual Network Device Example

In this example, the controller is tasked with communicating to two different acquisition devices, a modem and beacon receiver. Both devices communicate using an IPv4 scheme. Both settable controller interfaces must be used at this point, one for each device. The Eth1:0 Customer Network interface will be set to communicate to the modem and the Eth1:1 Customer Network interface will be set to communicate to the beacon receiver. Though each device is on a different IP network by setting both interfaces the controller will be able to communicate to both devices simultaneously.

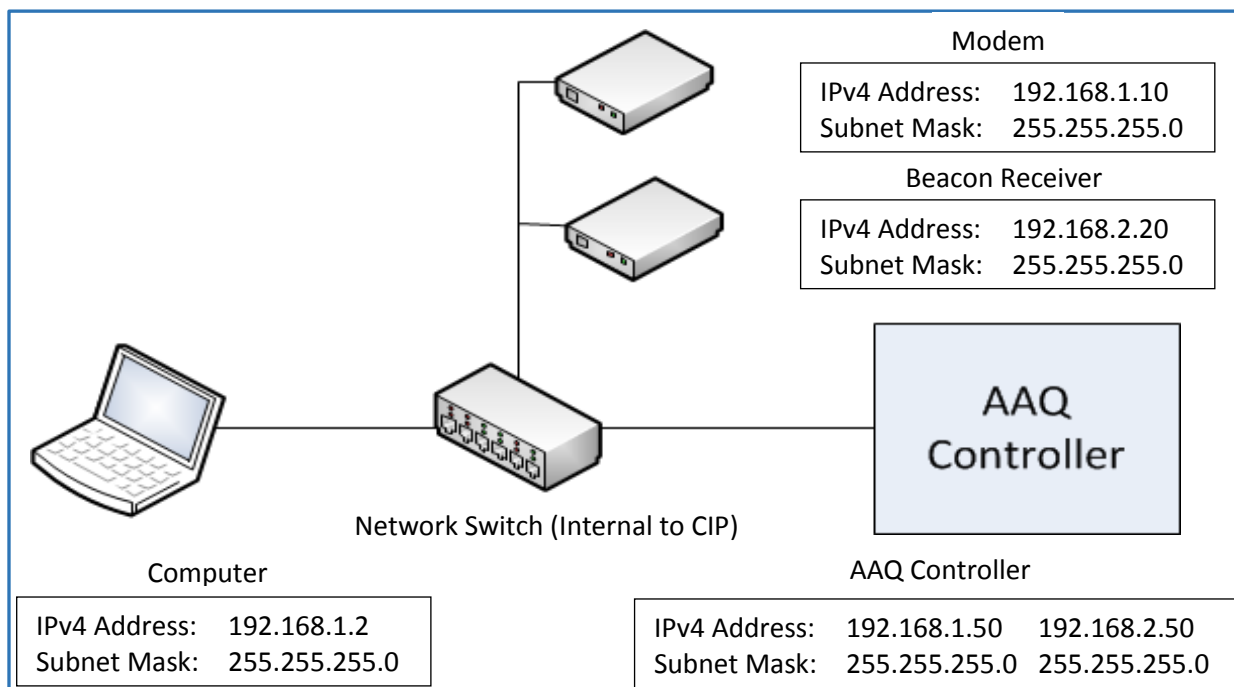


Figure 3.5.3b - Dual Network Device Configuration Example

3.5.4 Cross Device Network Configuration

Equipment

- AAQ Controller
- Client Computer
- Standard IPv4 Modem
- Network Switch (Internal to CIP)
- Network Router

Connection	Eth1:0 Customer Network	Eth1:1 Customer Network	Eth1:2 Service Network
IP Address	192.168.1.50	192.168.3.50	192.168.129.51
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0
Gateway	None	<u>192.168.1.1</u>	None

Figure 3.5.4a - Cross Device Network Example

In this scenario the controller needs to communicate with an acquisition device that is not on the same physical network as the controller. Cases like this would include the device being at a different location, or that the device handles sensitive data and cannot be on the controller network, or that networking on the controller's network interferes with the device's ability to function. In these and other examples, a network router must be added as a gateway to handle traffic to the external network. The controller is configured to use the router as a gateway to communicate to the modem that is located on the external network. This allows a physical separation of the controller networking from the modem's network.

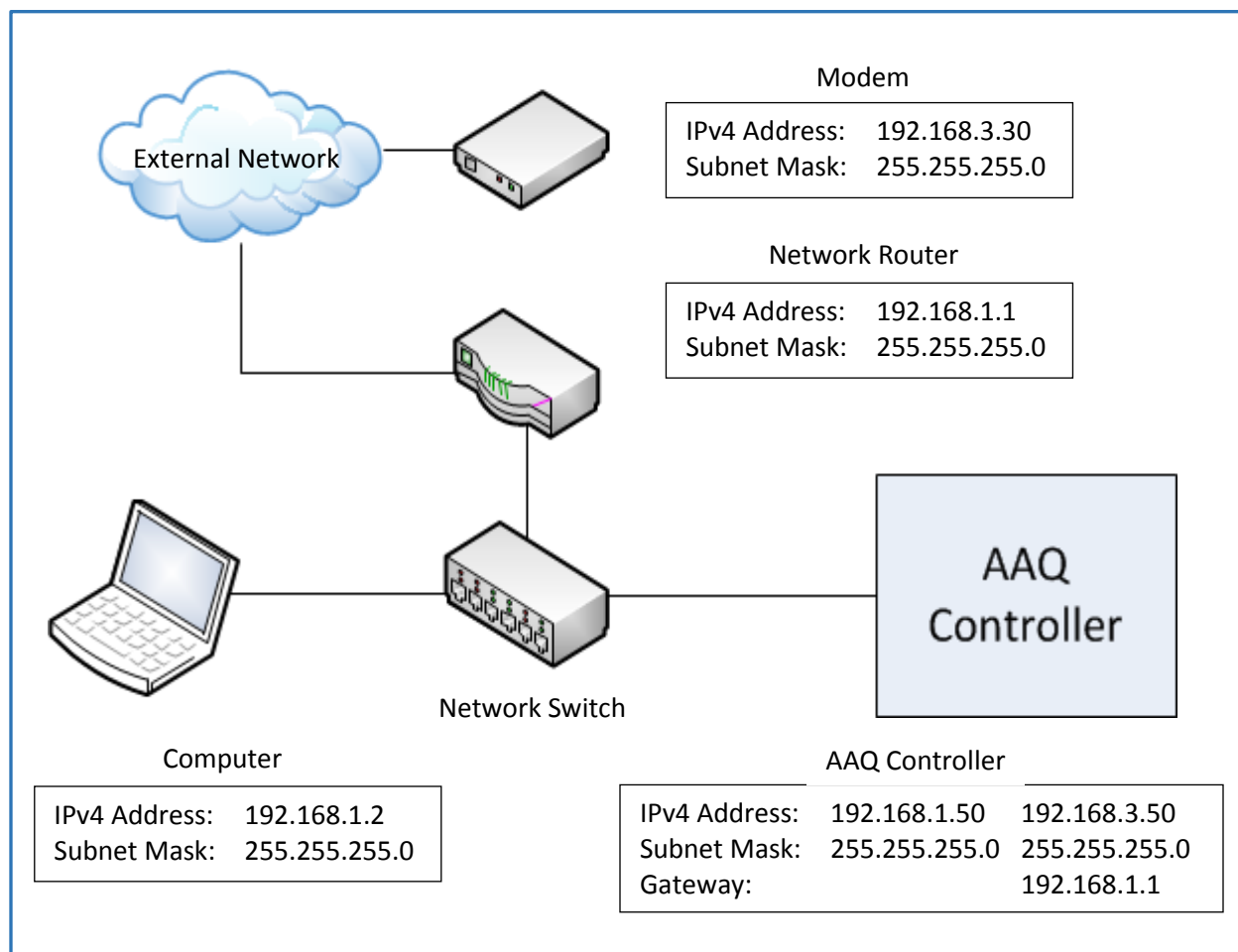


Figure 3.5.4b - Cross Device Network Configuration Example

Chapter 4 - AAQ Remote .NET GUI

This chapter is intended to familiarize the user with the various graphical views and associate functions of the AAQ Remote.NET interface.

4.1 Introduction

The AvL Technologies' Graphical User Interface (GUI) is designed for use with the AAQ controller system and uses the Microsoft .NET 3.5 framework. This framework allows the use of the AAQ Remote GUI across most Microsoft operating systems: Windows 10, Windows 8.1, Windows 8, Windows 7, Windows Vista, and Windows XP (provided XP users have proper service packs, updates, framework, and settings).

The AAQ system relies on an Ethernet (RJ45/Wireless/etc.) connection from the PC to the controller's ACU module. Once properly connected, the AAQ Remote GUI will provide communication with the AAQ controller and allow the user to monitor, configure & control the positioner.

4.2 Interpreting the Display

4.2.1 Main Window

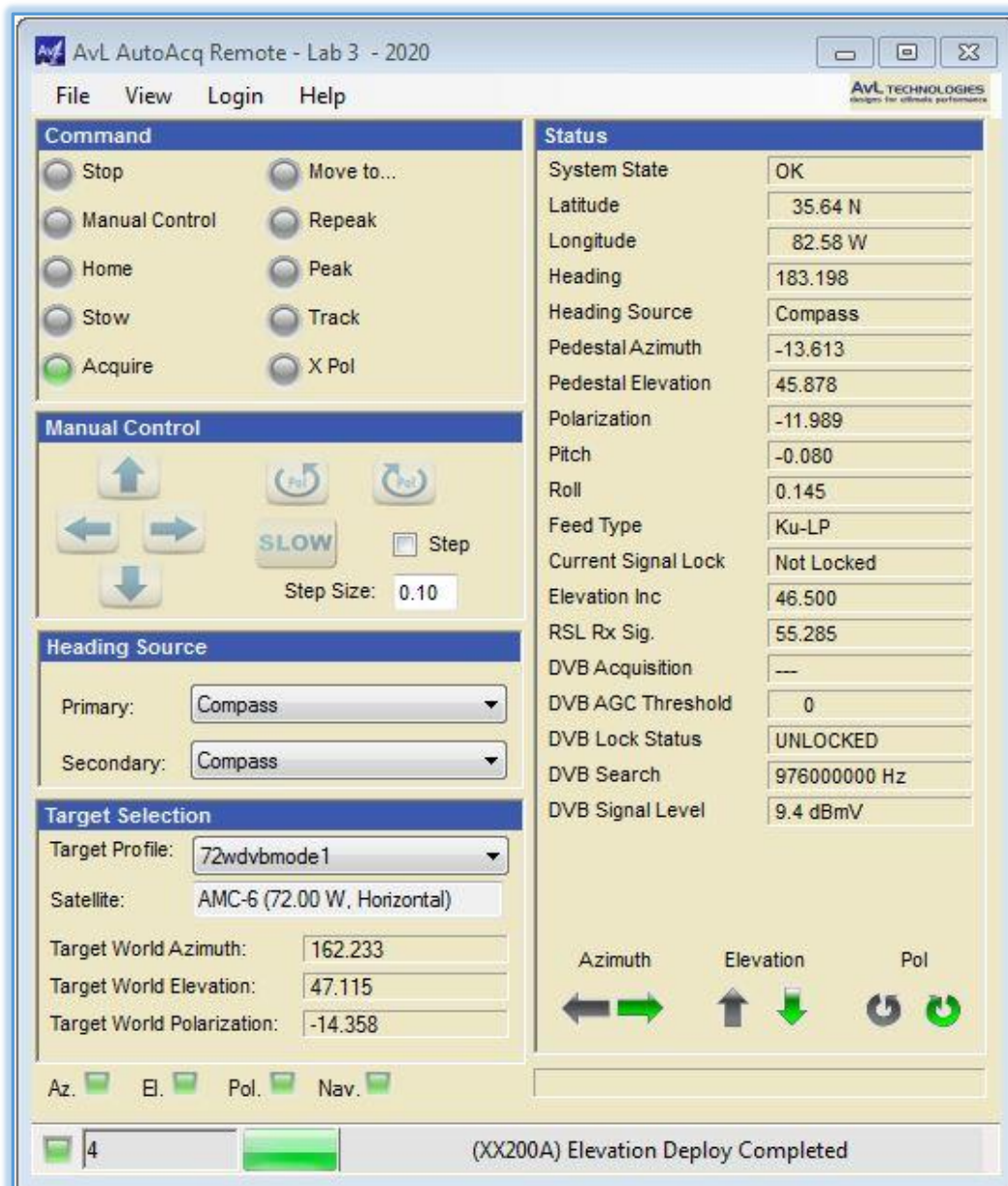


Figure 4.2.1 - AAQ Remote Front Panel

4.2.2 Connection Indicator

Upon opening the AAQ Remote application the program will attempt to establish communication with the connected AAQ Controller. Once connection is established the Connection Indicator LED located in the bottom left corner of the application will turn from inactive (grey) to active (green), shown in Figure 4.2.2.

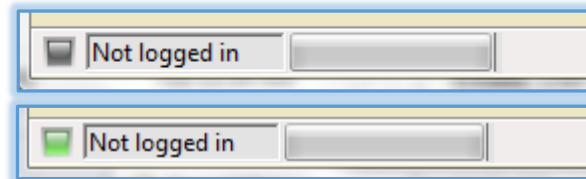


Figure 4.2.2 - Connection LED

If the connection light does not change to active (green), communication has not occurred between the controller and PC. Check to make sure the IP address of the application is correct (File → Settings), the computer's IP and subnet mask are valid, and the physical Ethernet connection is present. See Chapter 3 for network settings.

4.2.3 RIOM (Remote Input Output Module) Indicators

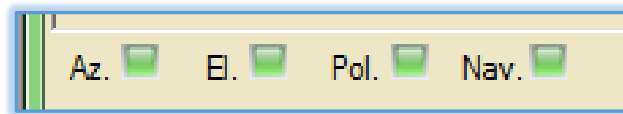


Figure 4.2.3 - RIOM Connection Indicators

The RIOM Connection Indicator LEDs will change from inactive (grey) to active (green) when the controller has negotiated a connection to each RIOM, these indicators give the user the ability to check system wide communication at a glance. If any of the RIOM Connection LEDs remain inactive there is a connection issue to that RIOM module and troubleshooting needs to be performed before system operation can begin.

4.2.4 Scrolling Alarms

Scrolling Alarms may be seen on the front panel to notify the user of a problem to be addressed. See Alarms and messages in Chapter 8 for more information.

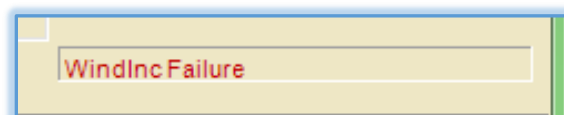


Figure 4.2.4 - Scrolling Alarm Indicator example

4.2.5 Command Pane



Figure 4.2.5a - Command Pane

The Command Pane contains the main controls for antenna movement. Each control is an LED indicator button with a descriptive label. When clicked the action associated with the control is performed. When the controller is performing an action the associated control LED will become active (green) indicating that it is the current command.

Command	Action Taken
Stop	Stops the controller
Manual Control	Activates the manual control functions
Home	Moves antenna to the “Home” position
Stow	Stows the antenna
Acquire	Acquires the selected satellite (Home must be completed first)
Move to...	Moves the antenna to a specific position (Home must be completed first)
Repeak	Finds the signal peak in accordance with fine pointing device
Peak	Peaks on the signal in accordance with coarse pointing device
Track	Tracks the signal in accordance with option specified
X Pol	Flips the pol 90 degrees to simplify “Cross Pol” testing

Figure 4.2.5b - Command List

4.2.6 Manual Control Pane



Figure 4.2.6 -Manual Control Pane

The Manual Control Pane contains the controls for manually jogging the antenna in any direction and axis. This pane is inactive until the controller is in manual control mode. To activate manual **control mode select 'Manual Control' control from the Command Pane.**

If the Step Mode Checkbox is unchecked the system will operate in a “jog until released” mode. While the button is pressed the antenna will move in that direction until the button is released.

If the Step Mode Checkbox is checked the system will operate in a “jog by step” mode. When the button is pressed the system moves the antenna in the direction of the button pressed by the amount listed in the Step Amount Display text box. While the antenna is moving to the position, button presses are ignored, steps are not accumulated by pressing the button multiple times.

Note – For Jog by step mode, home command must be run first to initialize encoders before operation.

4.2.7 Heading Source

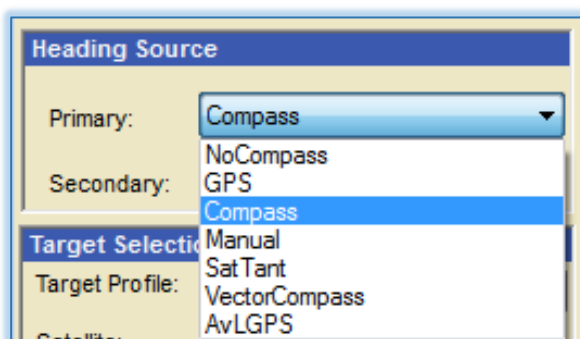


Figure 4.2.7a – Heading Source Pulldown

The heading source pane allows the user to select the device that will be used to determine heading coordinates for the controller. Available choices are described below.

Device	Description
No Compass	This is typically selected for locations where magnetic interference is expected. In this case, the antenna will make a wide scan in accordance with the “NoCompass Scan Width” parameter
GPS or AvLGPS	For future release.
Compass	This is the most common setting which uses the NAV RIOM built-in compass.
Manual	For manual compass, the pedestal is set physically due south (northern hemisphere). The heading is assumed to be at 180 degrees from this point.
SatTant	When selected, the antenna will base its heading on stored data from a previous SatTant acquisition. If no data exists, the antenna will attempt a SatTant acquisition. During this acquisition, initial heading info will be obtained from the Compass.
VectorCompass	To be used only when the Vector Compass option is installed for high accuracy systems.

Figure 4.2.7b – Heading Source Device Descriptions

4.2.8 Target Selection Pane

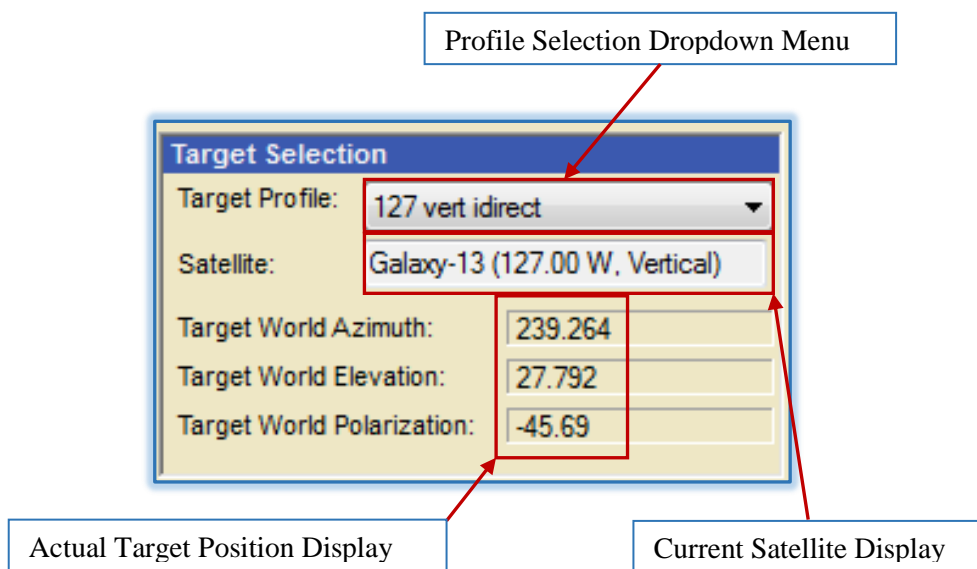


Figure 4.2.8 - Target Selection Pane

The Target Selection Pane contains the satellite profile currently active from the ACU’s onboard satellite profile list. Opening the Target Profile Selection Dropdown Menu displays all of the available profiles which may be selected for acquisition. Once a new profile is selected it becomes the running configuration and its target satellite will be shown in the “Current Satellite Display”.

Once the controller has entered acquisition mode the Actual Target Position Display will update to display the selected satellite’s position relative to the antenna.

4.2.9 Status Pane

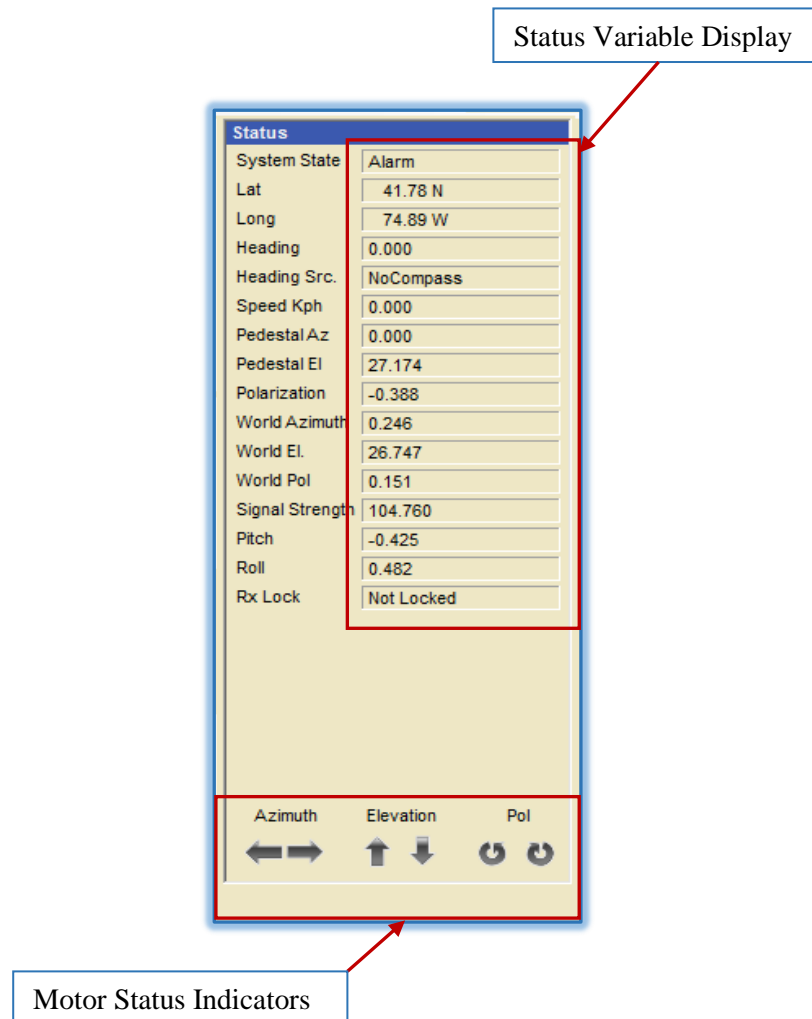


Figure 4.2.9a - Status Pane

The Status Pane displays commonly used sensor outputs from the controller. These are variables that the controller reports back to the application to be displayed for quick reference. Other variables can be accessed through the Sensor Output Window. The variables being displayed can be selected through 'File -> Edit Layout'.

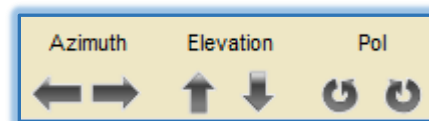



Figure 4.2.9b - Motor Status Indicators

The Motor Status indicators inform the user of the direction of motor movement, limit conditions reached, and safe move conditions reached. Each indicator represents a direction of movement possible by a certain axis and is styled to be in that movement's direction. When moving in that

direction the indicator will change to active (green)  to indicate that the motor is moving in that direction. The indicators also function as an indicator to the operator that a condition has been reached.

















































Condition	Motor Status LEDs Displayed
Azimuth Clockwise Limit Reached	     
Azimuth Counter Clockwise Limit Reached	     
Pol. Clockwise Limit Reached	     
Pol. Counter Clockwise Limit Reached	     
Elevation Up Limit Reached	     
Elevation is Below the Down Limit	     
Elevation is in the Stow Position / Elevation Limit Reached & Wings Open	     
Error Condition: Check Alarms	     

Table 4.2.9c - Motor Status Indicator Conditions

4.3 File Menu

4.3.1 Settings

Path
Main Window → File → Settings
Simple View: Level 0 / Advanced View: Level 1

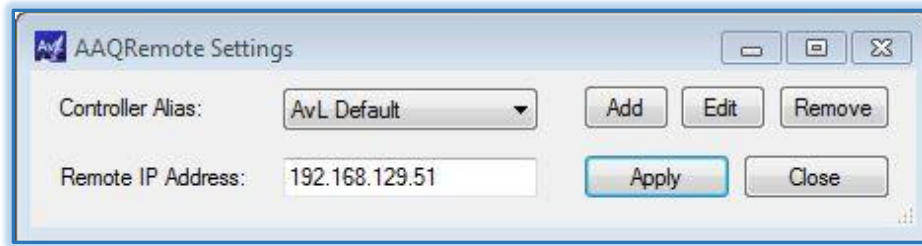


Figure 4.3.1a - Simple (Level 0) Settings Window

There are two versions of the Settings Tool. Users at level 1 or above are able to access the advanced Settings Tool while level 0 (or not logged in users) will only be able to access a simple Settings Tool. The simple version of the Settings Tool allows the user to change the I.P.v4 address pointing the application to the AAQ Controller's present address. This is the address that the controller is using for network communication. This setting is available in both versions of the Settings Tool.

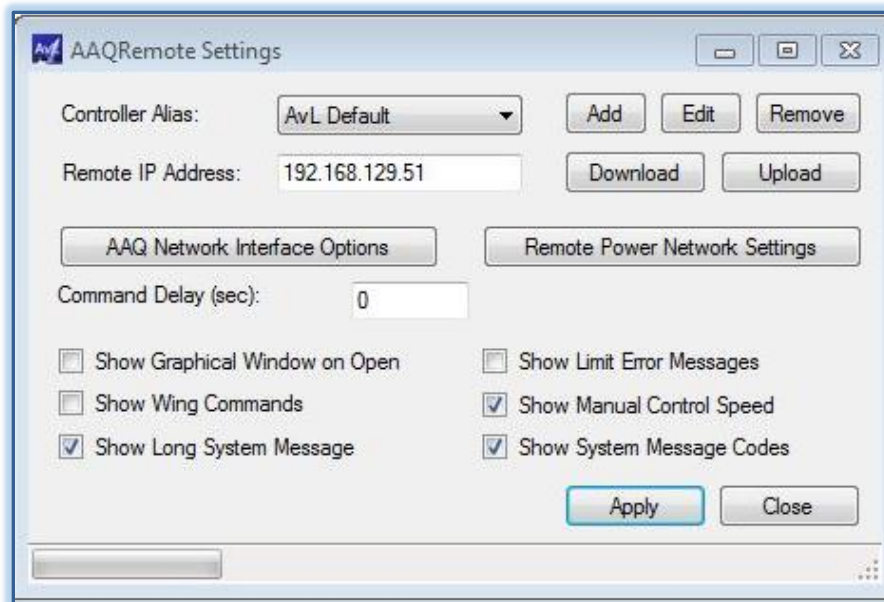


Figure 4.3.1b - Advanced (level 1) Settings Window

By default the AAQ Controller indicates the static TCP/IPv4 service address 192.168.129.51. The service address is permanent and cannot be changed. The configurable Ethernet interfaces can be changed through the AAQ Remote application by clicking the "AAQ Network Interface Options" button on the Settings window. The controller will accept any valid IPv4 address in the following ranges:

1-255.0-255.1-255.1-255

The controller's Subnet Mask and Default Gateway can also be set through this method.

If a failure has occurred in setting the new IP Address, the ACU defaults back to the original 192.168.129.51 service address.

IP Address	192.168.129.51
Subnet Mask	255.255.255.0
Default Gateway	192.168.129.1

Figure 4.3.1c - Recovery Network Settings

Command Delay (sec) represents the amount of delay that the application will wait before sending the command requested in the Command box, located in the main window, to the controller. Setting this text box to '0' eliminates any delay in sending the command from the application. Various application options are available to customize the user experience. These options are turned on and off by checking and unchecking the checkboxes located near the bottom of the window.

Checkbox	Action
"Show Graphical Window on Open"	When the application is opened the main window will be minimized and the graphical window will be displayed.
"Show Limit Error Messages"	Once the system has encountered any type of limit a message box will appear visually alerting the operator that they have reached a limit and must take action.
"Show Manual Control Speed"	When in manual mode, speed of antenna is displayed in control pane. (Slow or Fast)
"Show Long System Message"	Displays optional system messages which are longer and more descriptive.
"Show System Message Codes"	Displays system message reference codes along with messages.

Figure 4.3.1d – AAQ Remote Setting Options

4.3.1.1 – Advanced Network Settings

Path
Main Window → File → Settings, AAQ Network Interface Options Button
Advanced View: Level 1

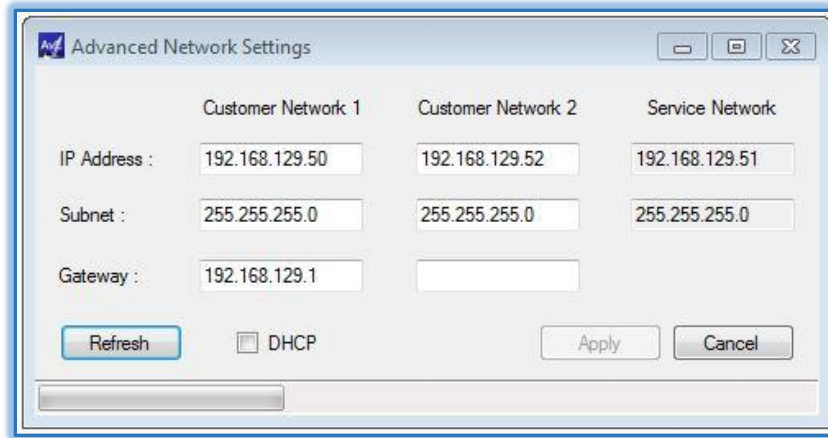


Figure 4.3.1.1 - AAQ Advanced Network Settings

Under the advanced network settings, the two customer networks are accessible to allow connection to system devices that reside on different networks. See chapter 3 on network settings for more details.

If your network setup allows for network devices to use a DHCP & DNS server you may set the ACU to obtain its network settings through the DHCP & DNS server via the DHCP checkbox.

Using a DHCP server without a DNS server will cause the controller to receive a valid IP address that is unknown to the user. Whenever the ACU is set to use DHCP make sure that the server is also a DNS server.

To check the current running network configuration click the refresh button on the left side of the window. The application will then query the current network settings on the controller and display them to the user.

4.3.1.2 – Remote Power Network Settings

Remote Power Network Set...

Alias: AvL Default

Current Settings

IP Address: 10.0.0.104

Subnet Mask: 255.255.255.0

New Settings

IP Address: 192.168.129.120

Subnet Mask: 255.255.255.0

Update Local Settings

Add Delete Close

Figure 4.3.1.2 – Remote Power Network Settings

The AAQ provides remote power control which is network accessible. The power control device has its own IP settings and defaults to those shown in figure 4.3.1.2. When the controller network is changed to a different subnet however, the Remote Power settings must be changed to this new subnet in order to maintain remote power control. Remote Power functions are described below. See chapter 3 for further details on setting system IP addresses.

Heading	Description
Alias	Addresses for multiple terminals may be added to a stored listing. Assigning an Alias to the IP address simplifies selection when the function is used.
Current Settings	Shows the IP of the remote power device currently connected.
New Settings	This allows the device address to be updated. Press “Update Local Settings” to save.
Add	When pressed, a window pops up allowing a new Alias as well as IP address information to be entered for a new terminal remote power device.

4.3.3 AAQ Support Files, Upload / Download...

Path
Main Window → File → Upload / Download ...
Level 4

Software, configuration, and firmware files for the AAQ Control system can be uploaded through the AAQ Remote application. To upload or download a file from the AAQ controller left-click the File button on the File Bar and select “Upload / Download ...”. This will open the Maintenance Window.

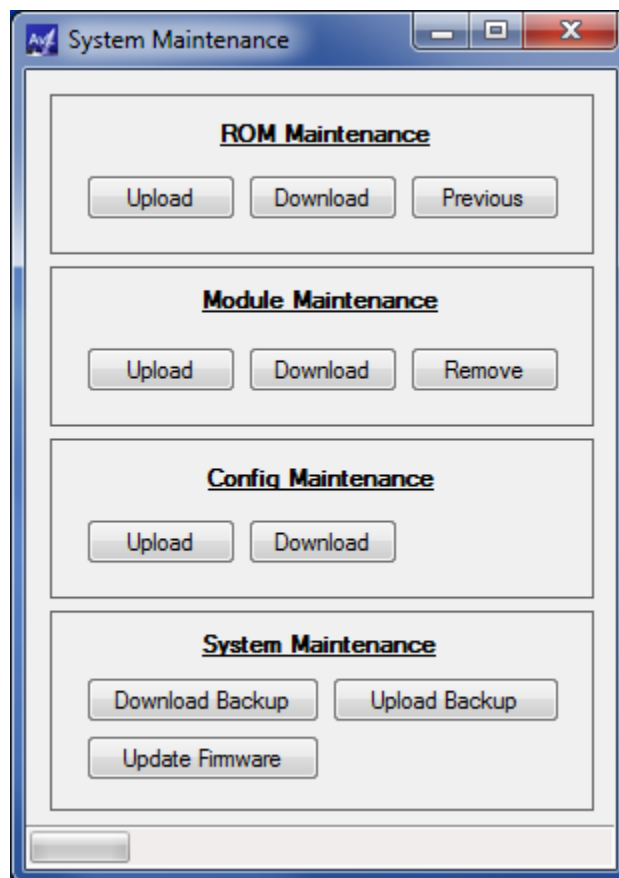


Figure 4.3.3a – System Maintenance Window

From the Maintenance Window there are various options of uploading, downloading, and resetting the software on the AAQ Controller. Files used by the controller include ROM files, Configuration files, and Module files. To **Upload** a new file or **Download the currently loaded** file left-click the appropriate button, the user will then be asked for a file location to upload from or download to.

Pressing **Previous ROM** will load the last used version which is stored in memory. Pressing **Remove Module** permanently deletes it from memory.

System Maintenance allows a “Master Restore” backup file to be created and uploaded if needed by pressing **Download Backup**. This file contains all types of files listed below which are necessary to run the controller.

AAQ File Types	
ROM	The AAQ software running on the controller.
Module	A file that contains information used by the AAQ software to interface with external and internal devices or software (Modem, Beacon Receiver, Tracking Libraries, etc).
Config	The complete configuration file used by the AAQ software that holds system parameters.
Firmware	A file that modifies the controller to add new features to the Linux kernel

Figure 4.3.3b – AAQ File Types

4.3.3.1 *Uploading an Encrypted Service Configuration File*

The AAQ Remote application has the capability to accept an encrypted service configuration file. This encrypted configuration file can be provided by AvL Technologies and is uploaded the same as a regular configuration file. When detected during a configuration upload, this will change configuration items as an administrator level user without the need to log in.

4.3.3.2 *Uploading, Downloading, and Removing Module Files*

Module files are specific files that allow the AAQ software to communicate with various interfaces. These interfaces include, but are not limited to, modems, beacon receivers, tracking libraries, and translators. This allows the system to implement end user specific hardware or software without the need for AAQ software change.

To upload or download a Module file left-click the Upload or Download Module button in the Maintenance window. This will bring up a Windows location dialog box.

When performing a module upload the controller software will be stopped and once the routine has completed uploading the module the power to the controller must be cycled to complete the process.

4.3.4 Calibration

4.3.4.1 *Compass Calibration*

Path
Main Window → File → Calibration → Compass Calibration
Level 4

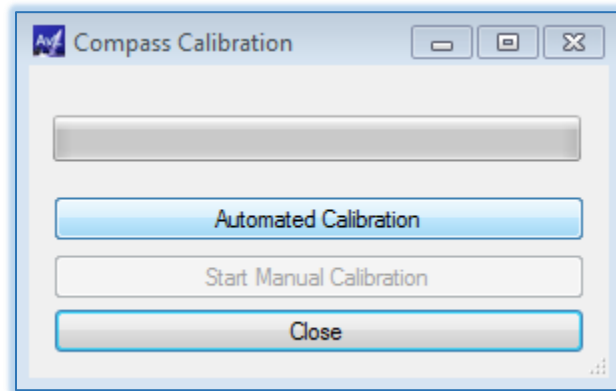


Figure 4.3.4.1 – Compass Calibration

Calibration of the module is generally used by AVL technical personnel only but may be suggested when an antenna system is being installed onto a permanent mount or vehicle for the first time. Calibration may also be required when an antenna system is moved into an area of high magnetic disturbance.

Caution - This function calibrates the compass device itself and cannot be removed. For setting compass read offsets to the controller, use the Compass Test Tool.

Pressing the Automated Calibration button starts the calibration process without any user assistance. The antenna will swing throughout its entire azimuth range and the process may take up to 10 minutes or longer. Once it is complete, the user will be informed and directed to run the **Compass Test Tool to determine the correct heading offset.**

4.3.4.2 Compass Test Tool

Path
Main Window → File → Calibration → Compass Test Tool
Level 4

The Compass Test Tool also calibrates the Compass however, user intervention is required and a tool window is provided which displays progress and allows some settings to be changed.

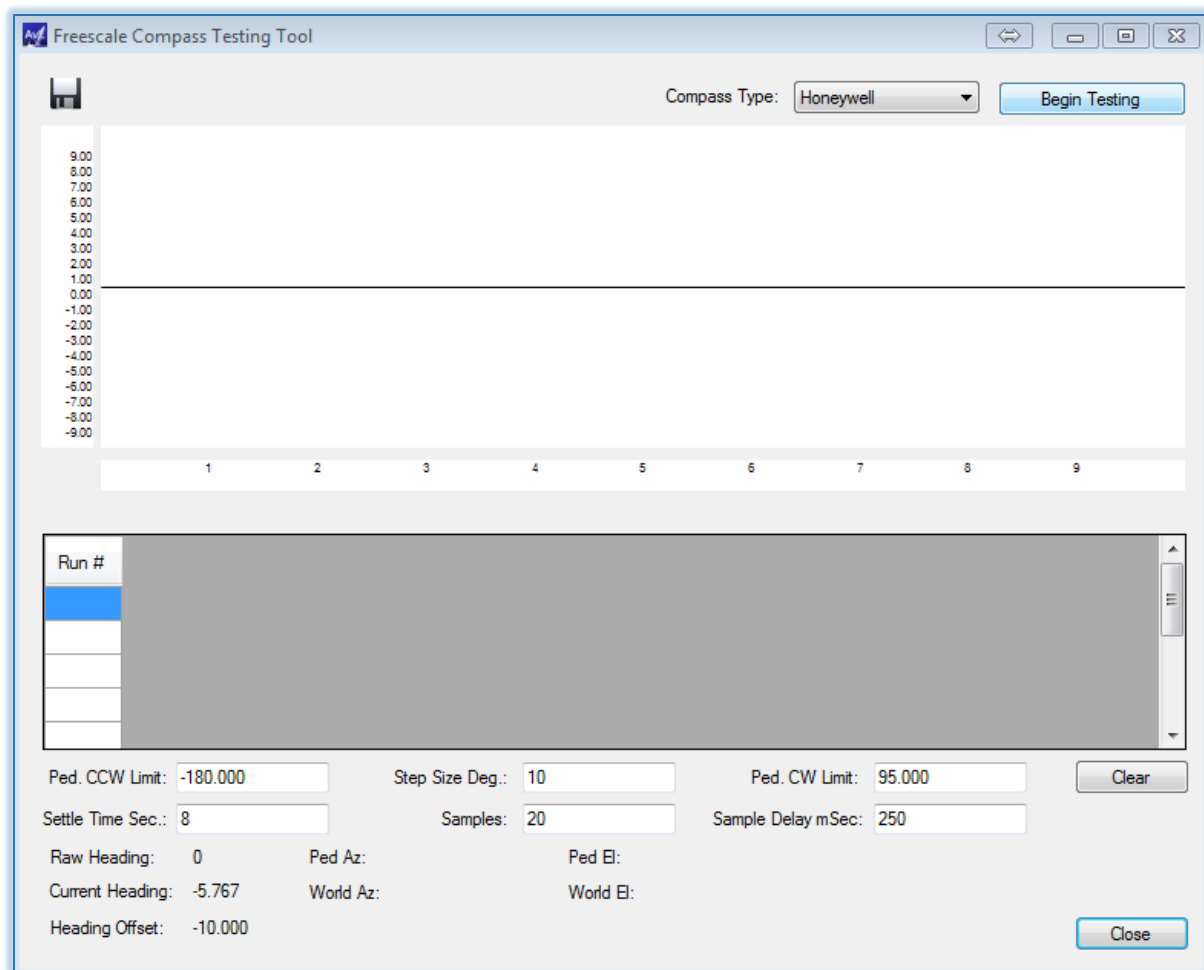


Figure 4.3.4.2a – Compass Test Tool Window

Once the window is open, check that “Honeywell” is selected at the top and press “begin Testing. By default the tool will scan from the CCW Limit to the CW Limit. If the system allows greater than 360 degrees of motion, it will only scan 360 degrees. Additionally, scanning will pause every 10 degrees to calculate the heading. This is configurable by the vendor, but it is recommended that it is left at the default setting.

Once testing has begun, you will be prompted to supply the Heading at the home position. This value does not have to be exact, but needs to be close. For example, if the unit is roughly facing south then a value of 180 will suffice:

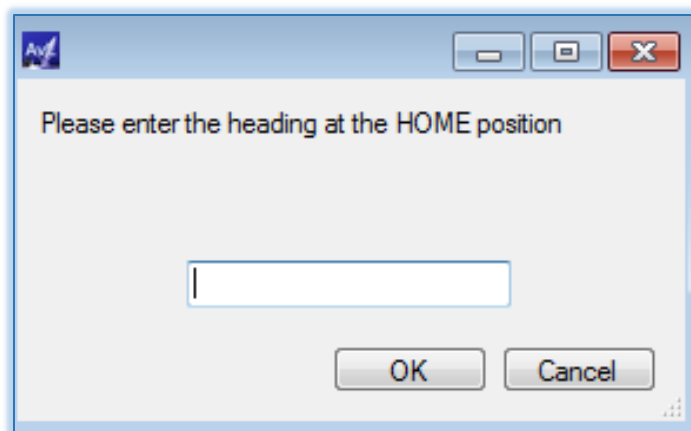


Figure 4.3.4.2b – Enter Heading

Once OK is selected the program will determine if the compass is within tolerance (± 10 degrees or 20 Peak-to-Peak). If the compass is within tolerance it will inform the user of the recommended Heading offset and ask them if they wish to apply it to the configuration item. Apply the offset to complete.

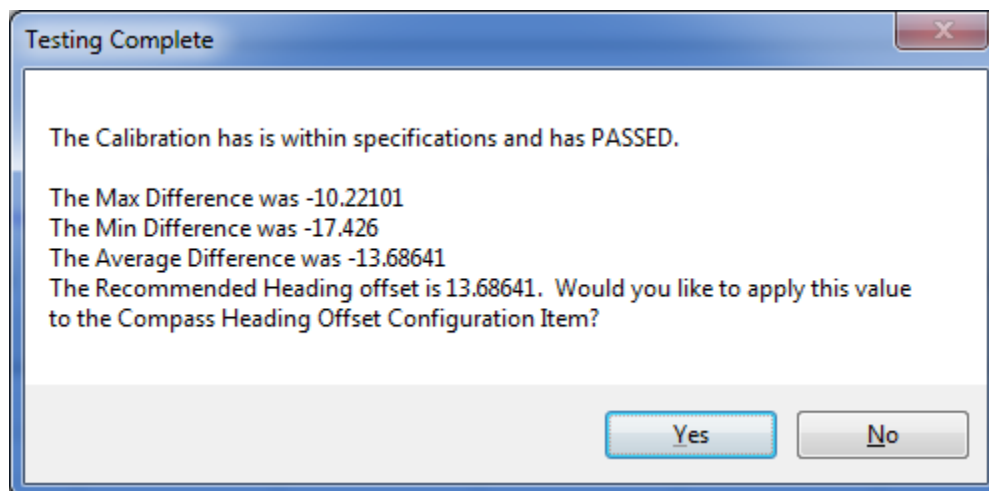


Figure 4.3.4.2c – Test Results

Note - If the program indicates that the compass is out of tolerance, repeat the calibration process.

4.3.5 RIOM Software Update

Path
Main Window → File → RIOM Software Update
Level 4

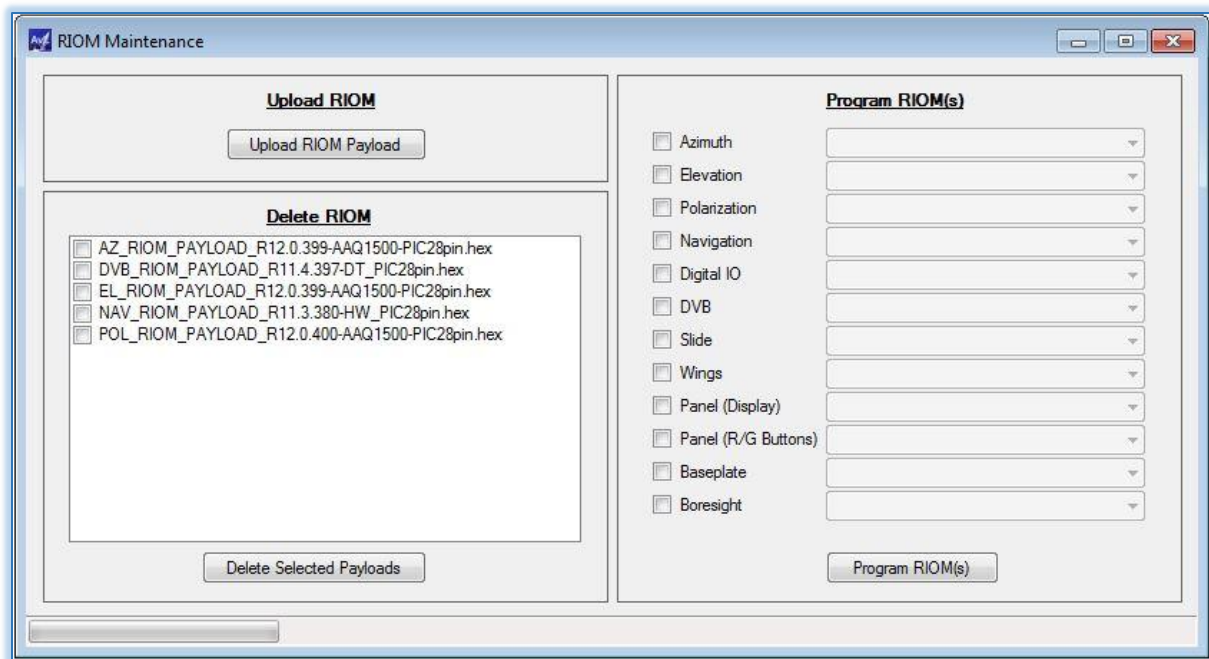


Figure 4.3.5 – RIOM Software Upload

From the RIOM Software Maintenance window, the user can update specific RIOM based devices on the system. When the “Upload RIOM Payload” button is pressed, the user is prompted to pick the location of the new file via a Windows location dialog box. Once the upload(s) are completed, the files will be shown in the “payload” box.

To program individual RIOMs, first make sure that the correct files have been uploaded. Then check the appropriate box in the right-hand pane for the device(s) to be updated. For each RIOM device, use the pulldown to select the appropriate file and press “Program RIOM(s) when ready

4.3.6 Show Movement

Path
Main Window → File → Show Movement
Level 4

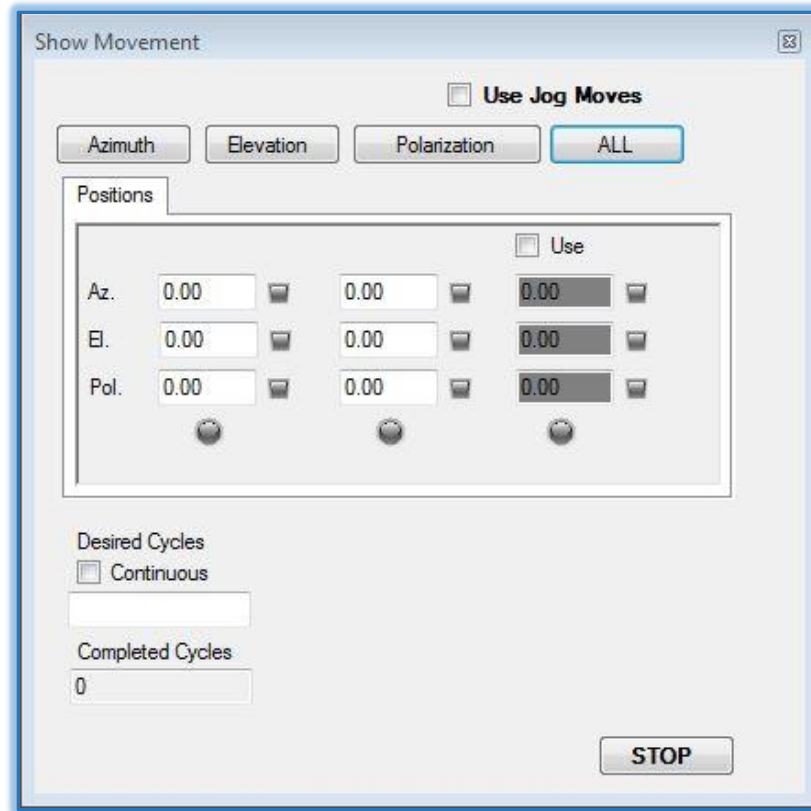


Figure 4.3.6 - Show Movement Tool

The Show Movement Window allows the demonstration of physical movements and actions. To setup a “Show Moves” routine simply fill in the text boxes for Azimuth, Elevation, and Polarization. These text boxes are the pedestal location where the antenna will move to during the routine. An optional third position is available for more dynamic movements. If a limited number of moves are required, type the desired cycle number in the Desired Cycles text box. If continuous motion is desired, check the “Continuous” checkbox. The routine has the capability of performing single or multi axis movements depending on the axis button pressed, located in the upper portion of the window. Movement will begin when the desired axis button is pressed.

4.3.7 Edit GUI Layout

Path
Main Window → File → Edit layout
Level 4

The Command box and Status box that appear on the main page of the application can be modified to show a variety of commands and status outputs at a glance. All outputs can be viewed through the application, but the layout of the main page can be changed for user convenience in the field. To change the layout presented on the main page open the Layout Editor.

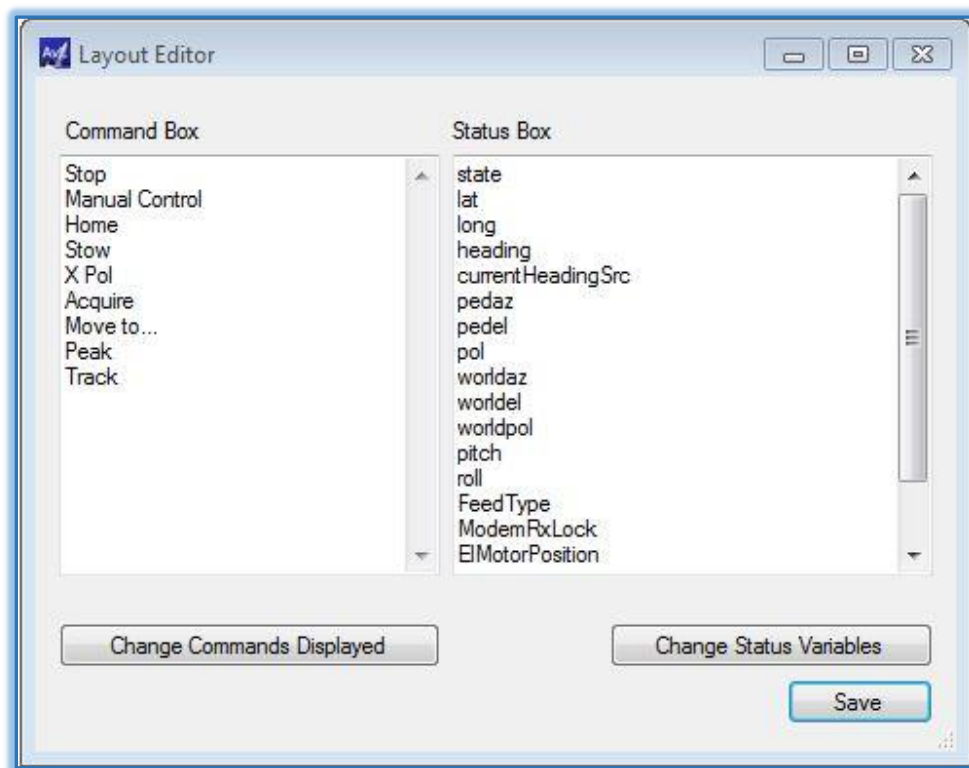


Figure 4.3.7 – Layout Editor

The Layout Editor lists the current commands and status outputs being displayed in the main window. The “Change Commands Displayed” function is reserved for Engineering Login only and does not function under user or integrator levels.

To change the status variables displayed in the Status box on the main window, left-click the ‘Change Status Variables’ button. The Status Variable Select Window will then allow the user to choose the status variables to display in the Status box on the main window. Once all changes have been made, left-click the ‘Save’ button to accept the changes. The application will now apply the changes the next time the application launches.

4.3.8 Change Status Variables Displayed

Path
Main Window → File → Edit layout, Change Status Variables
Level 4

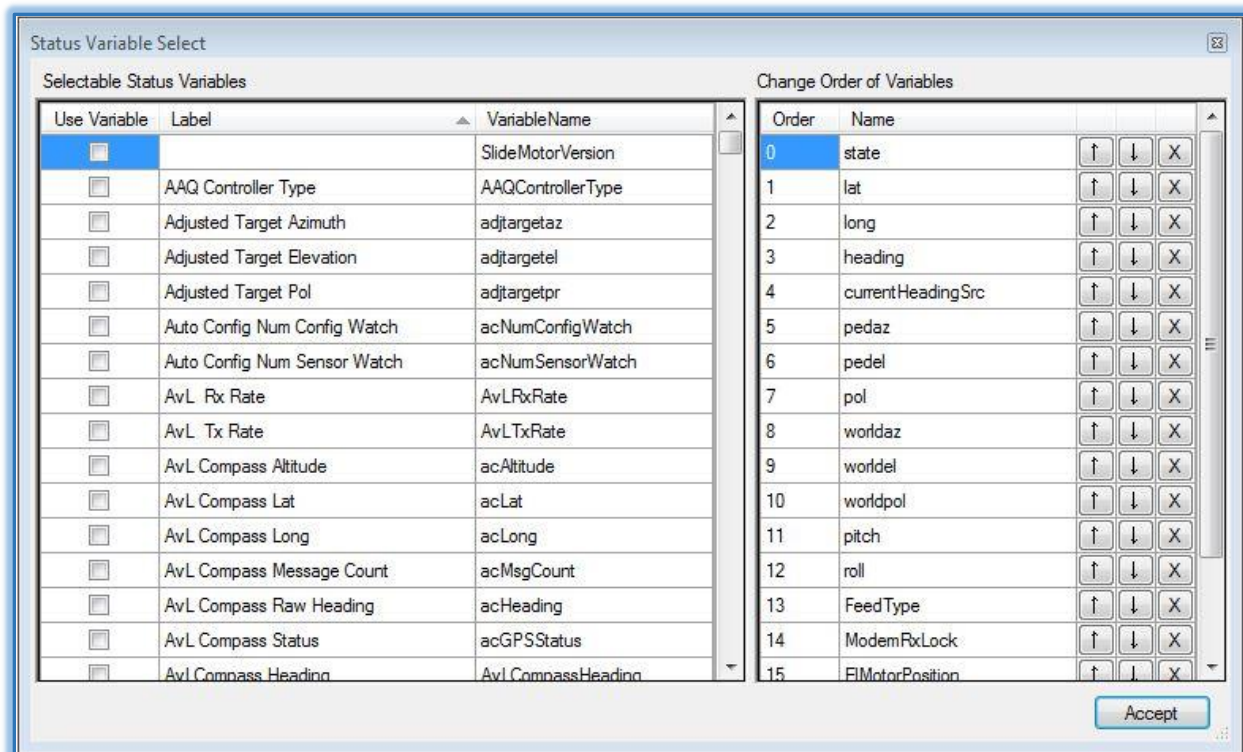


Figure 4.3.8 – Status Variable Select

The Status Variable Select Window allows the user to choose and order the status variables to display on the main window. The sub-window Selectable Status Variables, located on the left side of the screen, contains all status variables reported by the controller. To include a variable in the main window, check the 'Use Variable' checkbox beside the desired status variable. Once checked the variable will be included in the sub-window Change Order of Variables, located on the right side of the screen. From the Change Order of Variables sub-window the order of all selected variables may be changed. To move a variable up left-click the '↑' button beside the variable. To move a variable down left-click the '↓' button beside the variable. To remove the variable from the main window left-click the 'X' button beside the variable, this will remove it from the list and uncheck the variable in the Selectable Status Variables sub-window.

4.3.9 User Manager

Path
Main Window → File → User Manager
Level 1

Users have the ability to add, edit, and delete users depending upon their login level. Any user of a specific level may modify other users up to their login level. For instance a level 4 user may create a

level 3 user, but may not delete a level 9 user. Before performing any modification, log into the controller with your usage rights.

Note - Customer user profiles are typically set to access level “4”

4.3.9.1 Adding Users

Path
Main Window → File → User Manager → Add User
Level 1

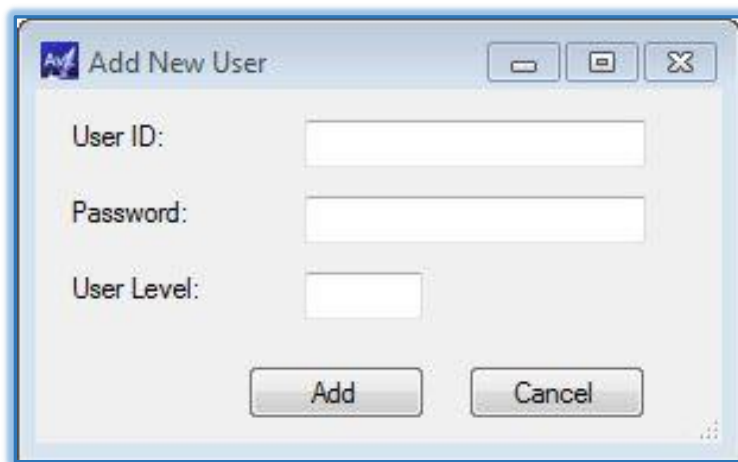


Figure 4.3.9.1 - Add New User

To add a new user, enter the desired credentials for the new user and click the 'Add' button. Upon successful completion, the new user ID may be used immediately.

4.3.9.2 Deleting Users

Path
Main Window → File → User Manager → Delete User
Level 1



Figure 4.3.9.2 - Delete User

To delete a user, enter the User ID of a user already known to the controller. The user will be removed from the system upon clicking the 'Delete' button.

A "User List" is also available which provides all user IDs and the level of access for each one.

4.3.10 Lock

Path
Main Window → File → Lock
Level 0



Figure 4.3.10 - Lock Window

The Lock tool opens a window that keeps all other windows from being used. This is meant as a preventative measure to keep stray keystrokes or mouse presses from unintentional actions, such as moving the antenna during communication. Once the window is closed the application returns to normal use.

4.3.11 Exit

The Exit command closes the application and all of its windows.

4.4 View Menu

4.4.1 Sensor Output

Path
Main Window → View → Sensor Output
Level 0

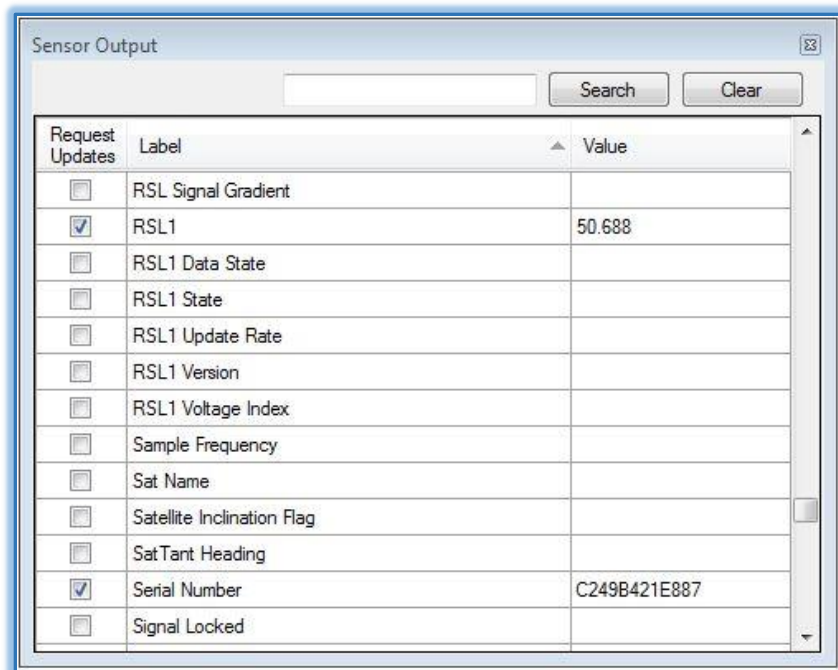


Figure 4.4.1 - Sensor Output Window

To view the list of sensor output variables left-click the View button on the File Bar and select “Sensor Output”. This brings up the Sensor Output Window which contains all of the output variables. To view an output variable simply check the variable and request updates on that variable. Variables that are available will depend on the user level. The search window allows quick location of a desired item.

4.4.2 Controller Configuration

Path
Main Window → View → Controller Configuration
Level 4

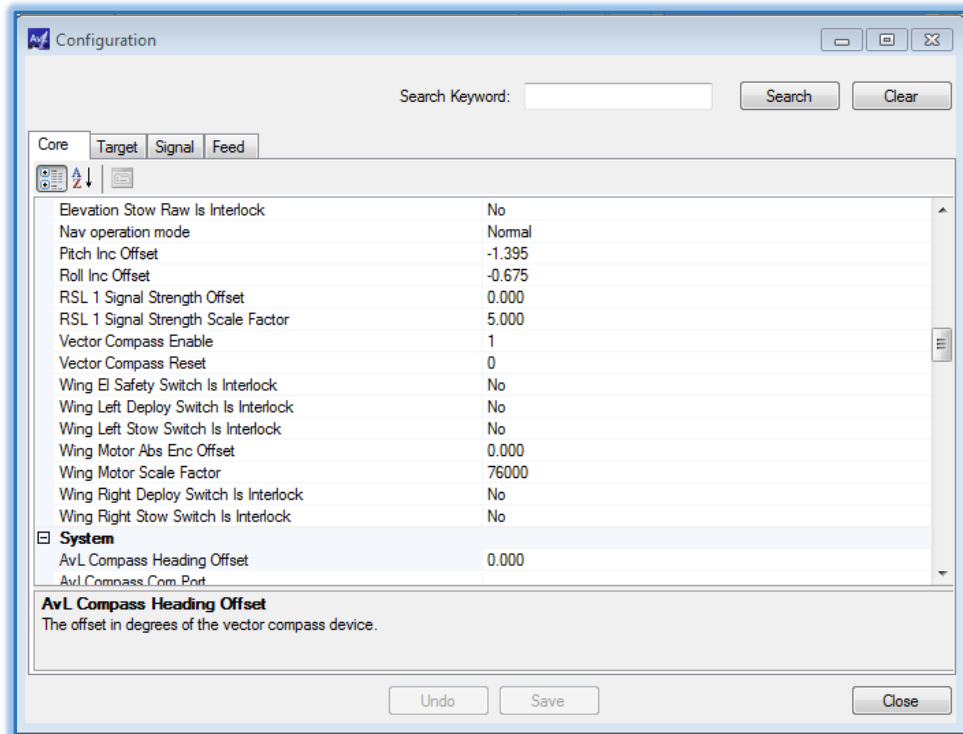


Figure 4.4.2 - Configuration Window, Core Tab

The configuration window allows the user to change all of the available configuration items (parameters) on the controller. There are two types of parameters, choice and non-choice. Items with choices have only a specific set of options to choose from, items such as signal sources contain choices (RSL/Modem/Beacon). Non-choice items allow the user to input a value, such as changing the interval that tracking is recorded, can be any value within range. Configuration parameter details are covered in Chapter 6.

The Core tab primarily displays “model related” items.

Configuration items changed will remain in the current working configuration only until power is cycled on the ACU unless saved. To keep any changes made, click the ‘Save’ button to write the configuration parameters to the controller. Configuration variables that are available will depend on the user level.

4.4.3 Profile System

Path
Main Window → View → Configuration, Target
Level 4

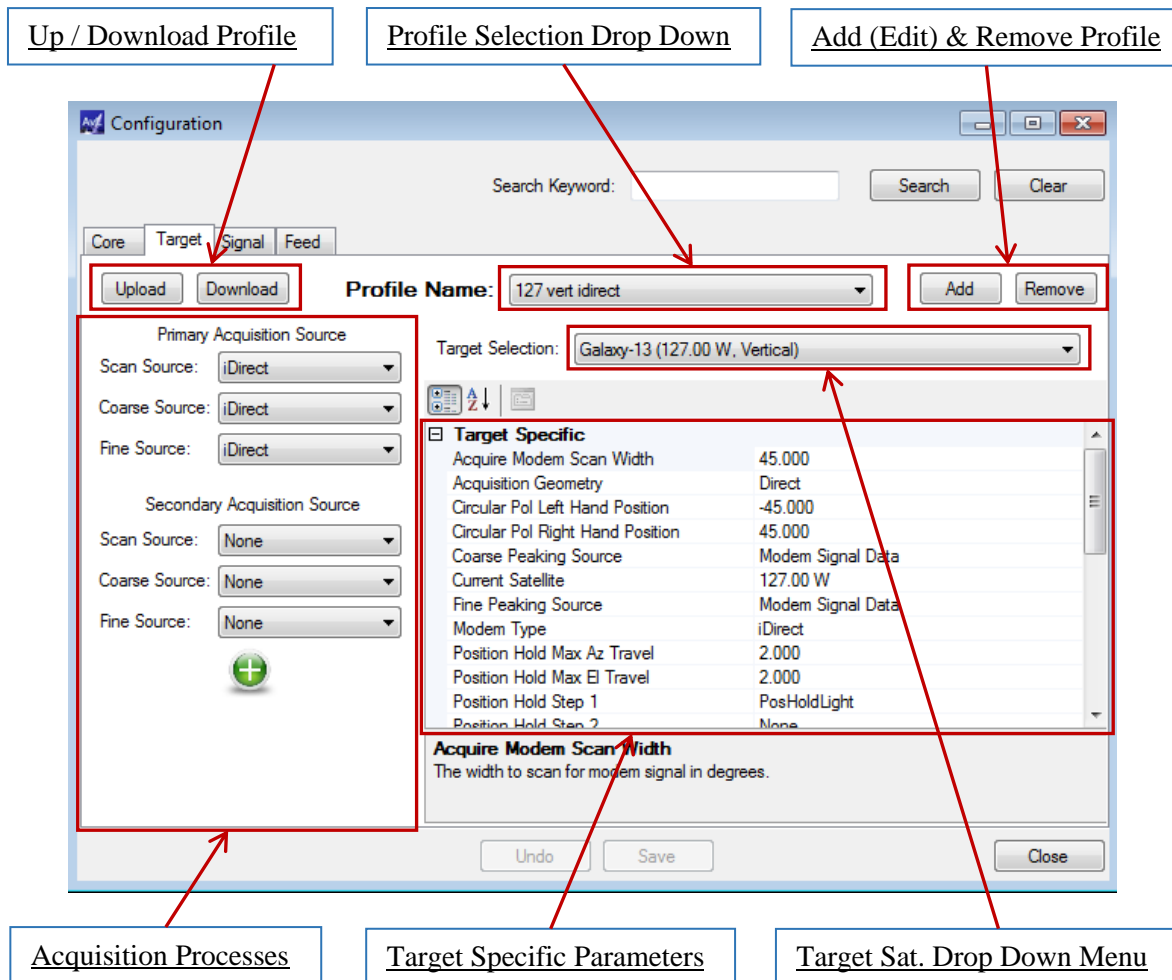


Figure 4.4.3a - Profile System or Configuration Window, Target Tab

The Target / Profile Tab is available via the Configuration window. This page allows the user to view & make various changes which relate to each of the available system profiles.

Acquisition of a target satellite begins with constructing, or more commonly, editing an existing profile that is specific for the method and target the user wishes to acquire. Profiles contain all the necessary parameters for acquisition.

The Profile System tool allows the creation or editing and removal of profiles. Profile creation is only available for users of level 1 or above. Profile selection is available to all users through the main window. Target and Profile functions are explained below.

Profile Function	Explanation
Profile Name	Can be any name. Combination of Satellite longitude, Signal device, Carrier & Pol is recommended
Upload / Download Config.	Allows the Uploading and Downloading of .conf files which contain all parameters for a specific profile
Add / Remove Profile	Allows Adding to (also editing) and Removal of existing Profiles
Acquisition Sources	Allows selection of acquisition source device for Primary and optional Secondary or Tertiary acquisition processes
Target Specific Parameters	Shows all Target related parameters and corresponding values. Parameter values are modified and saved here
Target Selection	Allows association of a Satellite to the new Profile. Target can be any Satellite included from the Satellite list. See: Main>View>Satellite List

Figure 4.4.3b – Profile functions

Selecting a profile to use or edit is done through the Profile Selection Drop-Down Menu. The drop-down menu contains all of the profiles on the system.

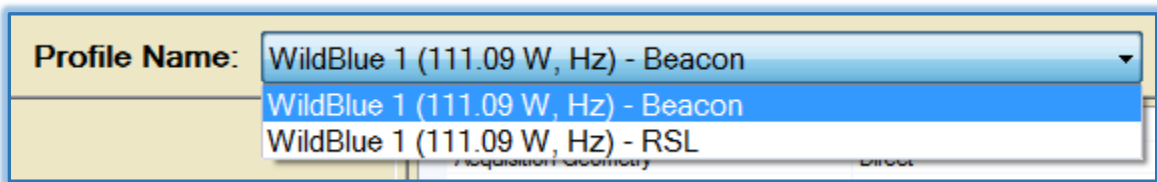



Figure 4.4.3c - Profile Selection

The AAQ Controller acquisition process contains up to three major processes: Scan, Coarse Peak, and Fine Peak. Each process may be configured to use a specific device as the source for acquisition. Devices available to be selected are based on a modules type system and are optional with the exception of the RSL detector. The device options include; various modems, Beacon receivers and a DvB receiver.

The controller has the capability to perform redundant acquisitions in the event the primary acquisition process fails. This enables a three tier safety net that keeps the system operator from guesswork in the field. If the secondary and tertiary tiers are not configured, they may be removed from the list on the next application startup. Selecting “None” for all devices in a source group results in the skipping of that section. The Green  button allows second and third tier sources to be added.

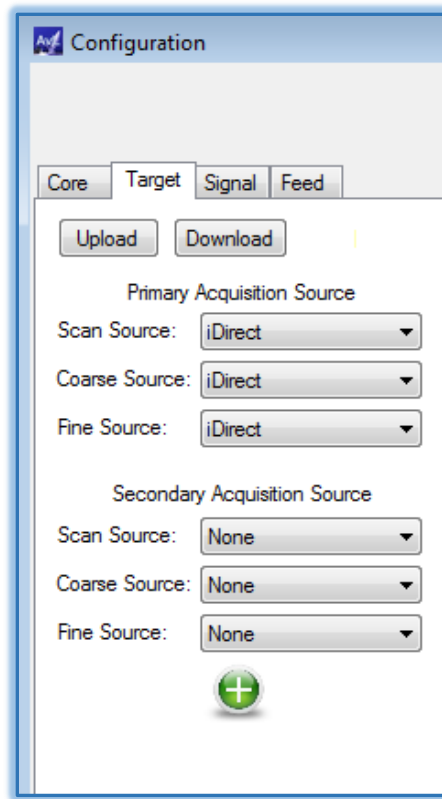


Figure 4.4.3d - Selecting Profile Acquisition Source

4.4.3.1 Creating a Profile

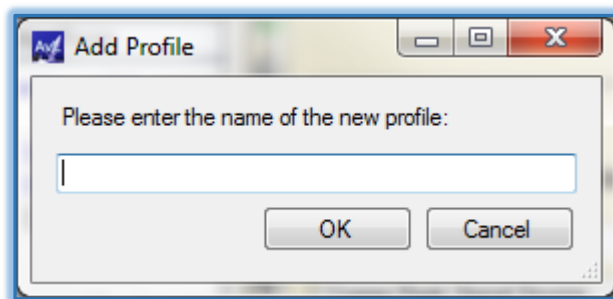


Figure 4.4.3.1 - Add Profile Window

To create a new profile left-click the “Add” button located in the top right corner of the Configuration Window/ Target tab. Once clicked the Add Profile Window will be shown, prompting the user to enter the name of the new profile. It is advised that the new profile be named based on the Target satellite, Signal device, Polarization or combination of these, but can be any name the user wishes. In addition, the newly created profile is initially populated with all of the same configuration items and values as in the currently selected profile. If multiple profiles exist on the system, start from a profile with a configuration closest to that which is desired for the one to be added.

4.4.3.2 Removing a Profile

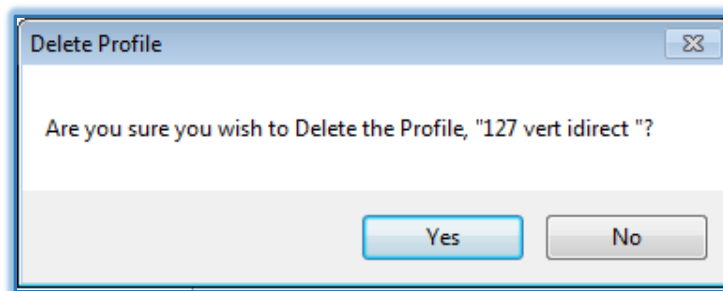


Figure 4.4.3.2 - Delete Profile Window

To remove a profile select the profile you wish to remove through the Profile Selection Drop Down Menu. Once selected, left-click on the "Remove" button located in the top right corner of the Configuration Window, Target tab. You will then be prompted to confirm that the selected profile is the one you wish to remove from the working set. Click "Yes" to save the change.

4.4.3.3 Editing Profile - Signal Source

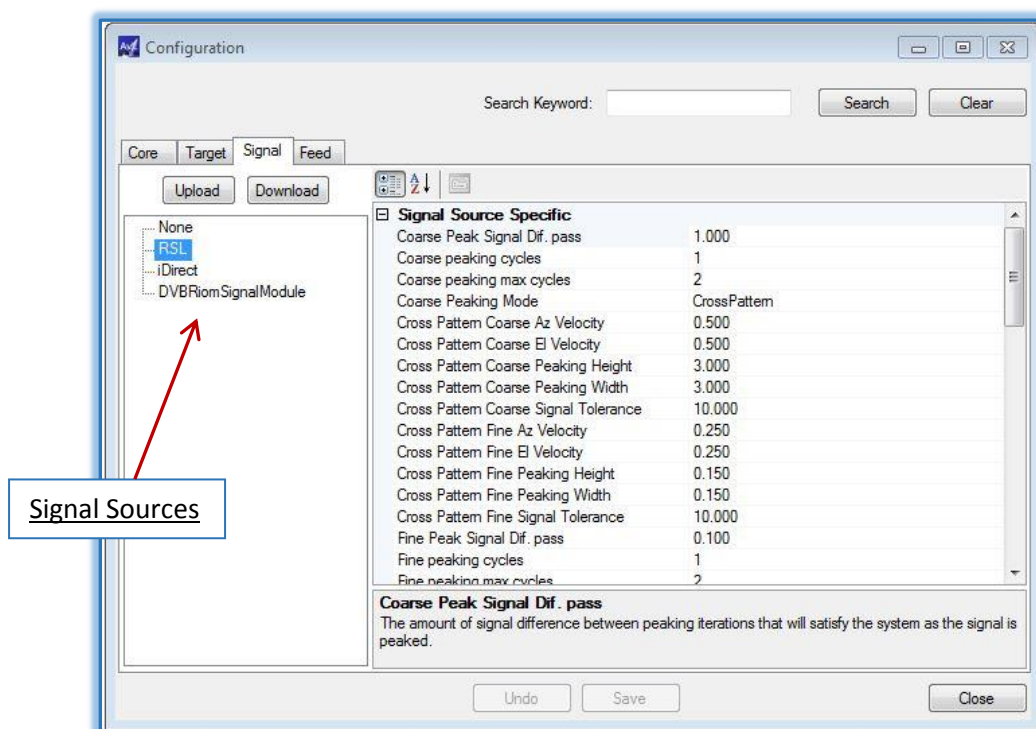


Figure 4.4.3.3 - Configuration Window, Signal Tab

The signal tab contains all of the signal specific parameters that directly control how the controller uses a device. A selection menu is available at the left side of the window to select between the various devices on the system.

Important – As different devices will have unique parameters, it is necessary to first select the Signal Device before modifying its parameters.

4.4.3.4 Editing Profile – Feed Parameters

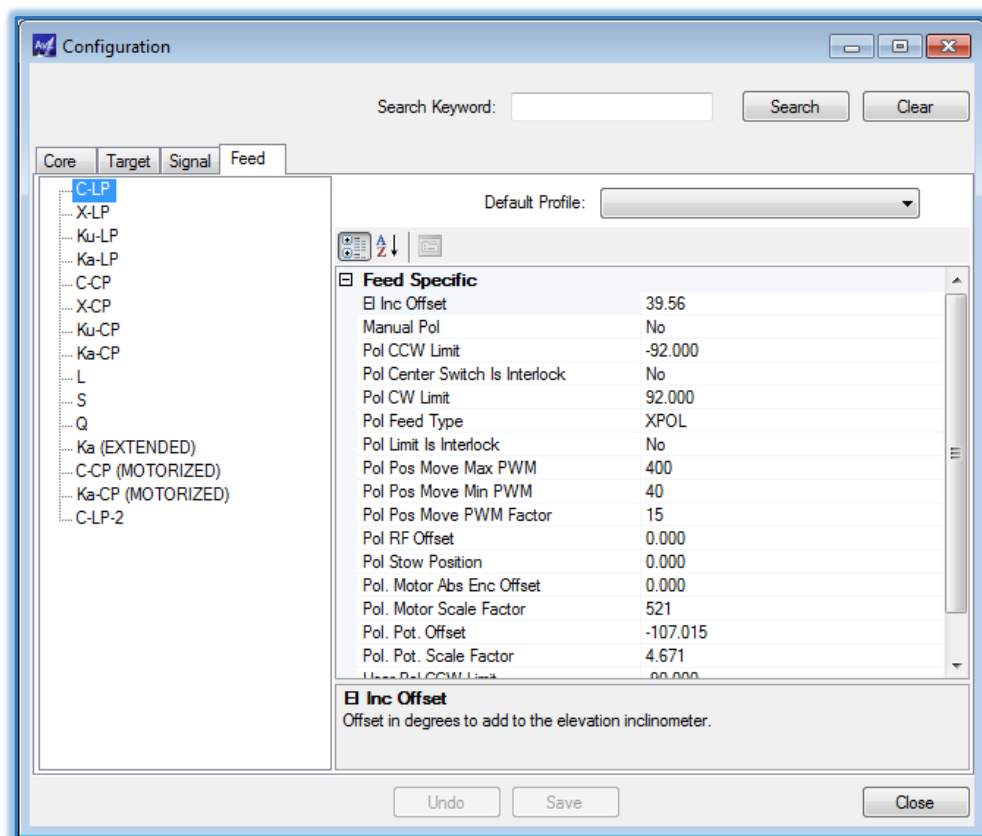


Figure 4.4.3.4 - Configuration Window, Feed Tab

The feed tab is located in the configuration window. This contains all of the feed specific parameters that directly affect how the controller interacts with the feed subsystem. A selection menu is available at the left side of the window to select between the various feed types on the system.

4.4.4 DvB-S2 Control

Path

Main Window → View → DvB-S2 Control

Level 4

The screenshot shows the DVB-S2 Control Window with the following parameters:

Parameter	Value
Acquisition State:	None
Signal Level:	22.1 dBmV
Lock Status:	DVB LOCK
Search Frequency:	1474012000 Hz
Acq Frequency:	1474012000 Hz
Bandwidth:	27000440 Hz
Receive Count:	15747
Transmit Count:	21166
Code Rate:	7/8
Bit Rate:	32.2554 Mbps
Symbol Rate:	20.0000 Msps
Info Engine State:	5
Stream ID:	4100
Network ID:	6571
Satellite Frequency:	12.22400 GHz
Orbital Position:	119.0
West East Flag:	West
Polarization:	Circular Right
Modulation System:	DVB-S
Modulation Type:	QPSK
SNR:	9.5 dB
Signal Inversion:	Normal

Lock State	IEE State	Signal Level	Search Freq	Acq Freq	Bandwidth	
DVB LOCK	2	21.5 dBmV	1470.0 MHz	1474.0 MHz	27.000 MHz	Assign Freq
UNLOCKED	0	33.8 dBmV	1535.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1540.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1545.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1550.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1555.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1560.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1565.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1570.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1575.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1580.0 MHz	0.0 MHz	0.000 MHz	
UNLOCKED	0	33.8 dBmV	1585.0 MHz	0.0 MHz	0.000 MHz	

Buttons: Frequency Scan, Capture Results

Figure 4.4.4 - DvB-S2 Control Window

The DvB-S2 control window allows full monitoring and captured carrier control of the AvL DvB receiver. The DvB receiver option functional modes and GUI details are covered in Appendix H of this Users Manual.

4.4.5 LNB Control

Path
Main Window → View → LNB Control
Level 4

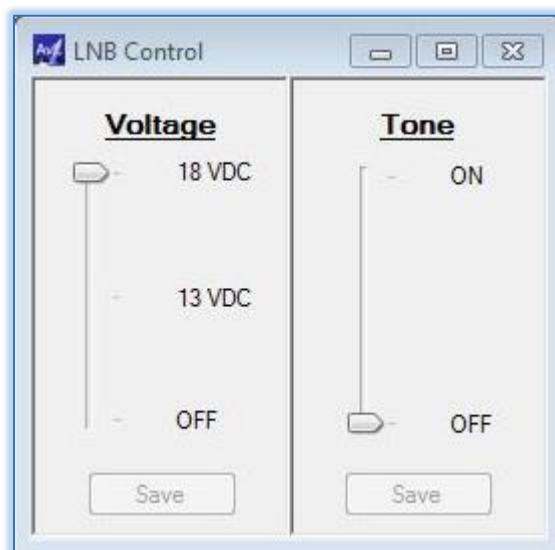


Figure 4.4.5 – LNB Control

As many different types of LNBs are supplied with AvL antenna systems, the LNB Control window allows the user to control either the supply voltage or control tone used by the device. Supply voltage may be changed to match that required by a single band LNB or adjusted to change band as required by some multiband systems.

4.4.6 Satellite List

Path
Main Window → View → Satellite List
Level 0

The Satellite List Window is populated by a list which is maintained on board the ACU controller. To add a satellite to the Profile “target selection” pane, select the checkbox of the satellite to be added, then click the ‘Save Satellite List’ button. Satellites should be added for target selection before creating an associated profile for simplicity. Unchecking the checkbox will remove the satellite from the target selection list. Remember to save all changes.

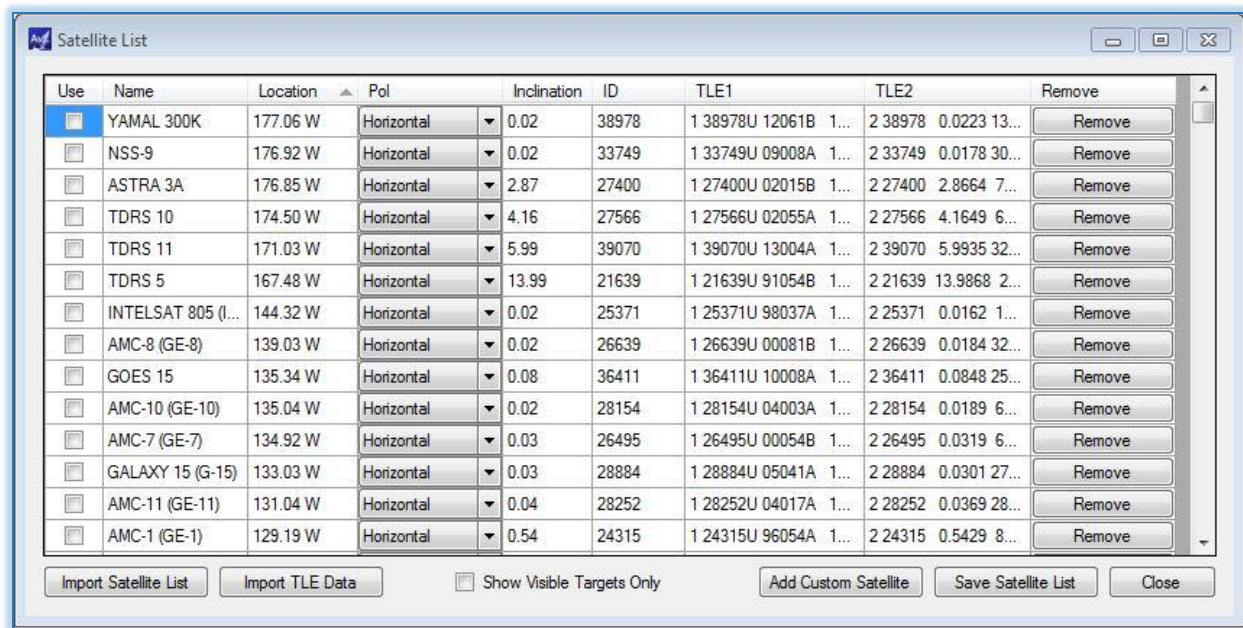


Figure 4.4.6a - Satellite List Window

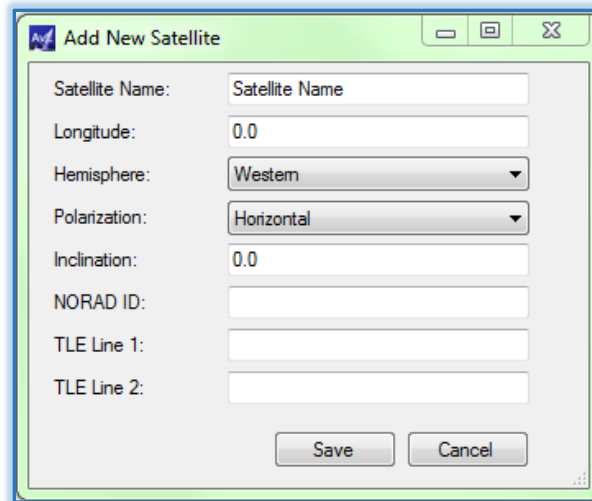
When selecting from the list, the receive polarization must be determined. Click the **Pol** setting arrow to activate the dropdown box and change the Polarization setting for the satellite to be acquired.

Note that in the above figure, certain satellites have information populated in the TLE 1 & TLE 2 columns. In order to use TLE tracking, the associated profiles must use a target satellite of this type.

To **import a satellite list or TLE data**, upload files or data strings in .txt format only. Note that importing a satellite list will clear all existing data. Importing TLE data will give the user the option to overwrite (Delete) the existing list or to append to the existing list.

TLE Data can also be typed or copied directly into the **TLE1 and TLE2** spaces in the Satellite List for any satellite. If any changes are made to information on a satellite that is already selected for use in a target profile, the user will have to re-select that satellite within the profile configuration.

To add a new satellite, press the **Add Custom Satellite** button. The window below will appear:



The 'Add New Satellite' dialog box contains the following fields and controls:

- Satellite Name:** Text input field with placeholder 'Satellite Name'.
- Longitude:** Text input field with value '0.0'.
- Hemisphere:** Dropdown menu with 'Western' selected.
- Polarization:** Dropdown menu with 'Horizontal' selected.
- Inclination:** Text input field with value '0.0'.
- NORAD ID:** Text input field.
- TLE Line 1:** Text input field.
- TLE Line 2:** Text input field.
- Buttons:** 'Save' and 'Cancel' buttons at the bottom right.

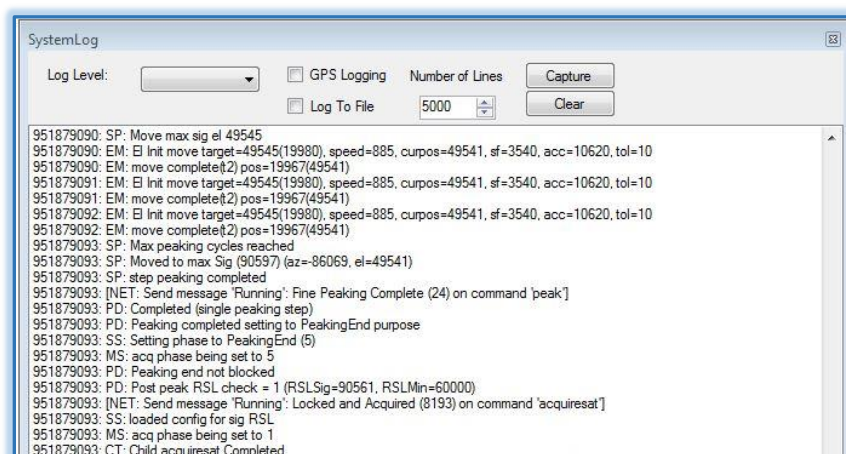
Figure 4.4.6b – Add New Satellite

Fill in all line items including the TLE Line 1 & 2 items. Line items should be copied and pasted from existing NORAD or equivalent ephemeris lists to assure accuracy. Should the TLE data be entered incorrectly, the data will populate the satellite list upon saving but operation for this satellite will not function for TLE tracking.

Once changes have been made, **save the satellite** list. This will make the new information available to the controller and preserve it in non-volatile memory, allowing the updated list to be retrieved even after a power cycle.

4.4.7 System Log

Path
Main Window → View → System Log
Level 4



The 'SystemLog' window displays the following controls and log data:

- Log Level:** Dropdown menu.
- GPS Logging:** Checkmark.
- Log To File:** Checkmark.
- Number of Lines:** Text input field with value '5000'.
- Buttons:** 'Capture' and 'Clear' buttons.

The log data shows the following sequence of events:

```

951879090: SP: Move max sig el 49545
951879090: EM: El Init move target=49545(19980), speed=885, curpos=49541, sf=3540, acc=10620, tol=10
951879090: EM: move complete(2) pos=19967(49541)
951879091: EM: El Init move target=49545(19980), speed=885, curpos=49541, sf=3540, acc=10620, tol=10
951879091: EM: move complete(2) pos=19967(49541)
951879092: EM: El Init move target=49545(19980), speed=885, curpos=49541, sf=3540, acc=10620, tol=10
951879092: EM: move complete(2) pos=19967(49541)
951879093: SP: Max peaking cycles reached
951879093: SP: Moved to max Sig (90597) (az=-86069, el=49541)
951879093: SP: step peaking completed
951879093: [NET: Send message 'Running': Fine Peaking Complete (24) on command 'peak']
951879093: PD: Completed (single peaking step)
951879093: PD: Peaking completed setting to PeakingEnd purpose
951879093: SS: Setting phase to PeakingEnd (5)
951879093: MS: acq phase being set to 5
951879093: PD: Peaking end not blocked
951879093: PD: Post peak RSL check = 1 (RSLSig=90561, RSLMin=60000)
951879093: [NET: Send message 'Running': Locked and Acquired (8193) on command 'acquiresat']
951879093: SS: loaded config for sig RSL
951879093: MS: acq phase being set to 1
951879093: CT: Child acquiresat Completed.
  
```

Figure 4.4.7 – System Log

The System log tool allows the user to monitor the function commands and indications as reported by the AAQ controller. This is typically used by AvL technical staff and is sometimes used for remote troubleshooting.

4.4.8 Data Log

Path
Main Window → View → Data Log
Level 4

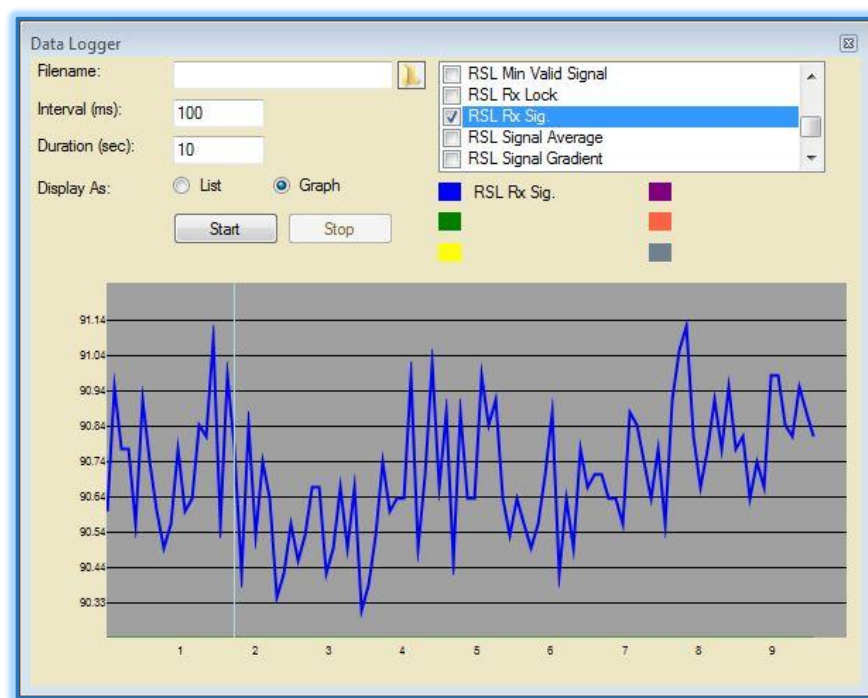


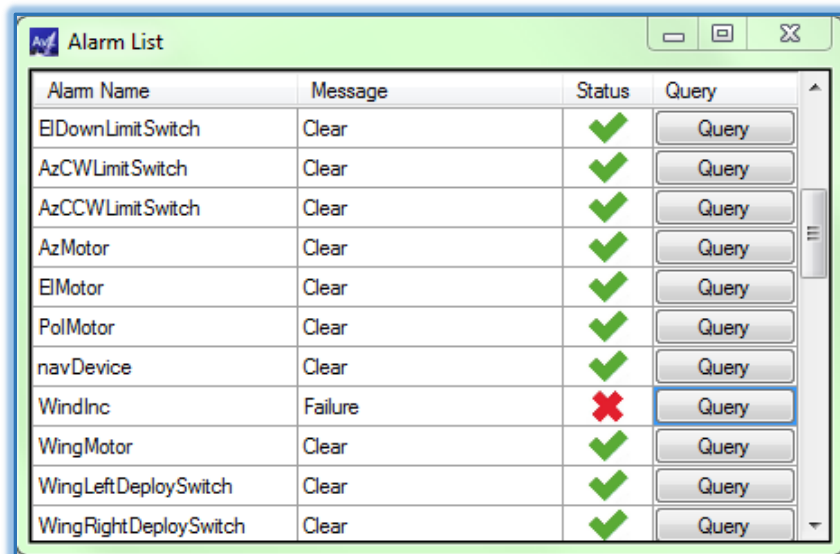
Figure 4.4.8 – Data Logger Example

The Data Logger window allows the user to plot up to six status variables over time. This can be used for testing, troubleshooting and plotting operational data over time. The sampling interval as well as the duration of the individual graph may be set to suit individual test requirements. These test samples may be saved as a graph (shown) or as a list of values if needed.

The results of the test can also be saved under the filename of choice by clicking on the folder icon next to “filename” and selecting both the name and location of the data file. The name will then show in the textbox.

4.4.9 Alarm List

Path
Main Window → View → Alarm list
Level 0



Alarm Name	Message	Status	Query
ElDownLimitSwitch	Clear	✓	Query
AzCWLimitSwitch	Clear	✓	Query
AzCCWLimitSwitch	Clear	✓	Query
AzMotor	Clear	✓	Query
ElMotor	Clear	✓	Query
PolMotor	Clear	✓	Query
navDevice	Clear	✓	Query
WindInc	Failure	✗	Query
WingMotor	Clear	✓	Query
WingLeftDeploySwitch	Clear	✓	Query
WingRightDeploySwitch	Clear	✓	Query

Figure 4.4.9 - Alarm Window

The Alarm Window displays the current alarms reported by the controller. If the window has no red “X” in the Status column, the system is not in an alarm state.

4.4.10 Device Window

Path
Main Window → View → Device window
Level 0

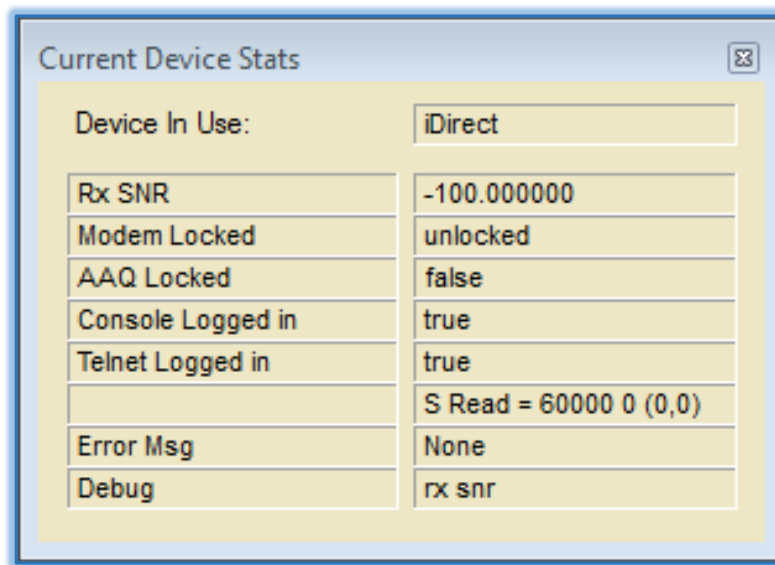


Figure 4.4.10 - Device Window, Modem Example

The Device Window displays the data and status of the connected “Signal Device” used for acquisition. The module that handles communication from the AAQ to the device reports up to 8 predetermined status labels and values. This information is placed in the “Device Data table” and can also be seen in the

Sensor Output Window. When multiple devices are used for acquisition, the window will automatically switch to the active device.

4.4.11 Graphic Controller Window

Path
Main Window → View → Graphic Controller Window
Level 0

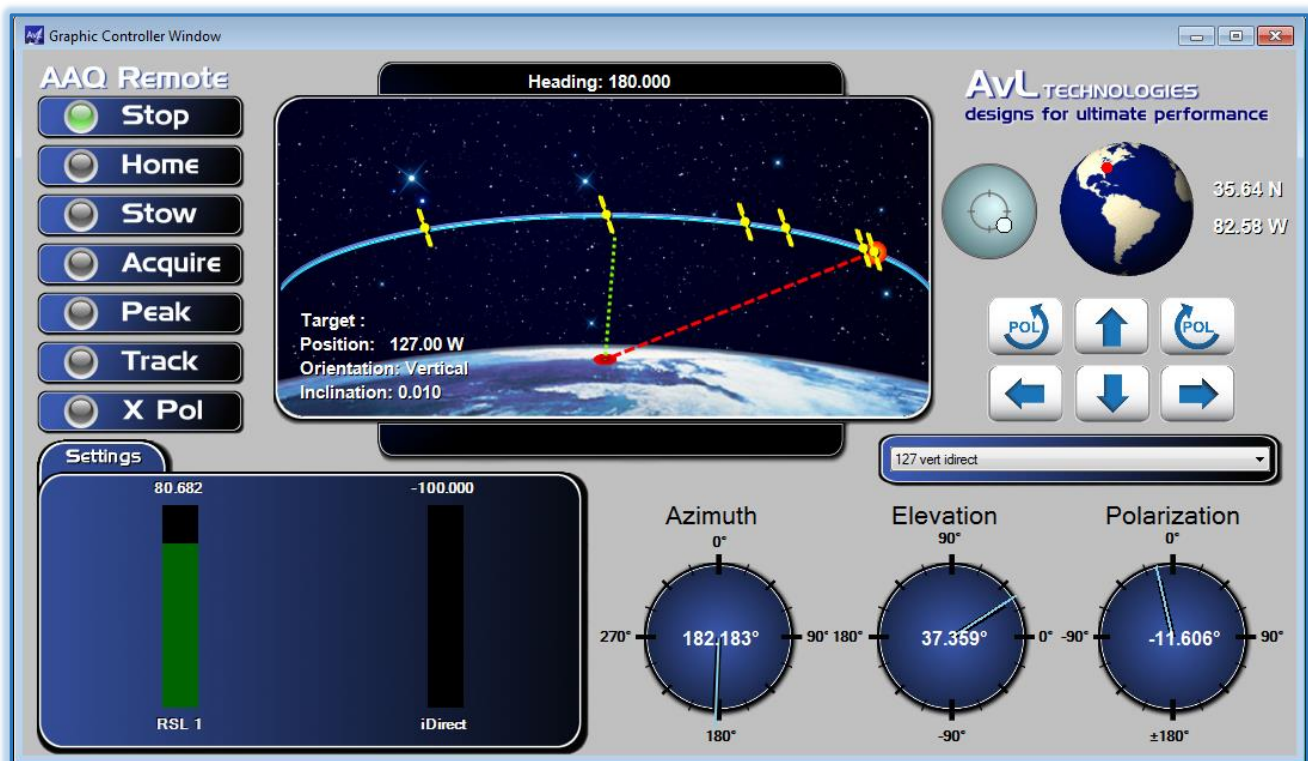


Figure 4.4.11 - Graphic Controller Window

The Graphic Controller Window is a simplified user friendly display of the main window. This window shows graphically all the necessary inputs and outputs for a normal user to select a Profile & acquire a satellite. Each graphical area represents a corresponding command or monitor point from the main .NET GUI window.

4.4.11.1 Movement Commands

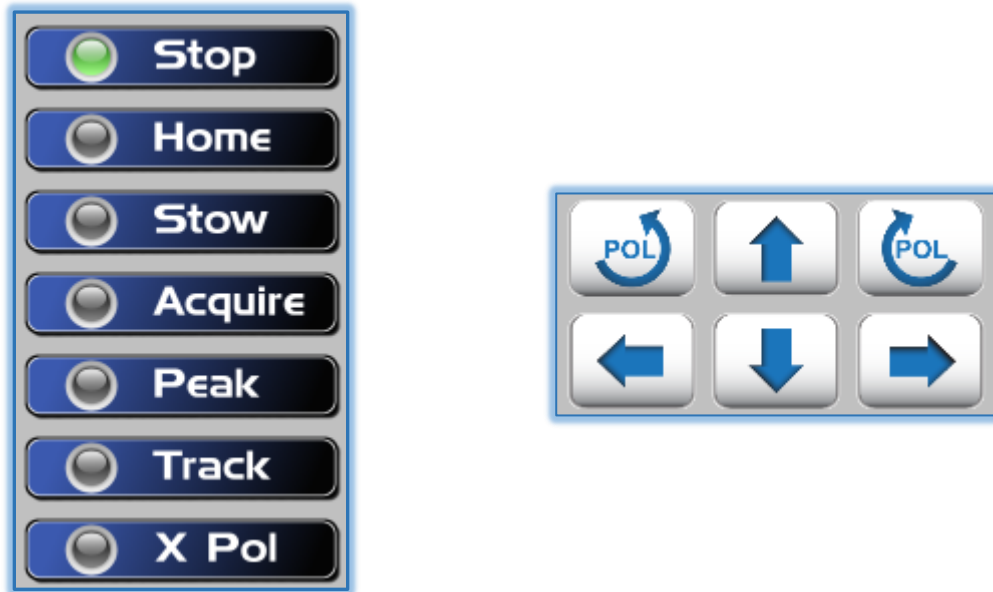


Figure 4.4.11.1 - Graphic Controller Window Movement Commands

The movement commands displayed on the Graphic Controller Window allow the same functions available in the Command Pane and the Manual Control Pane. This includes all of the basic commands with indicator LEDs showing which command is active and a group of jog buttons. In contrast to the main window there is no “Manual Control” button to activate the jog buttons. Jog buttons are always active on the graphic window and one left-click will jog the antenna.

4.4.11.2 Target Display

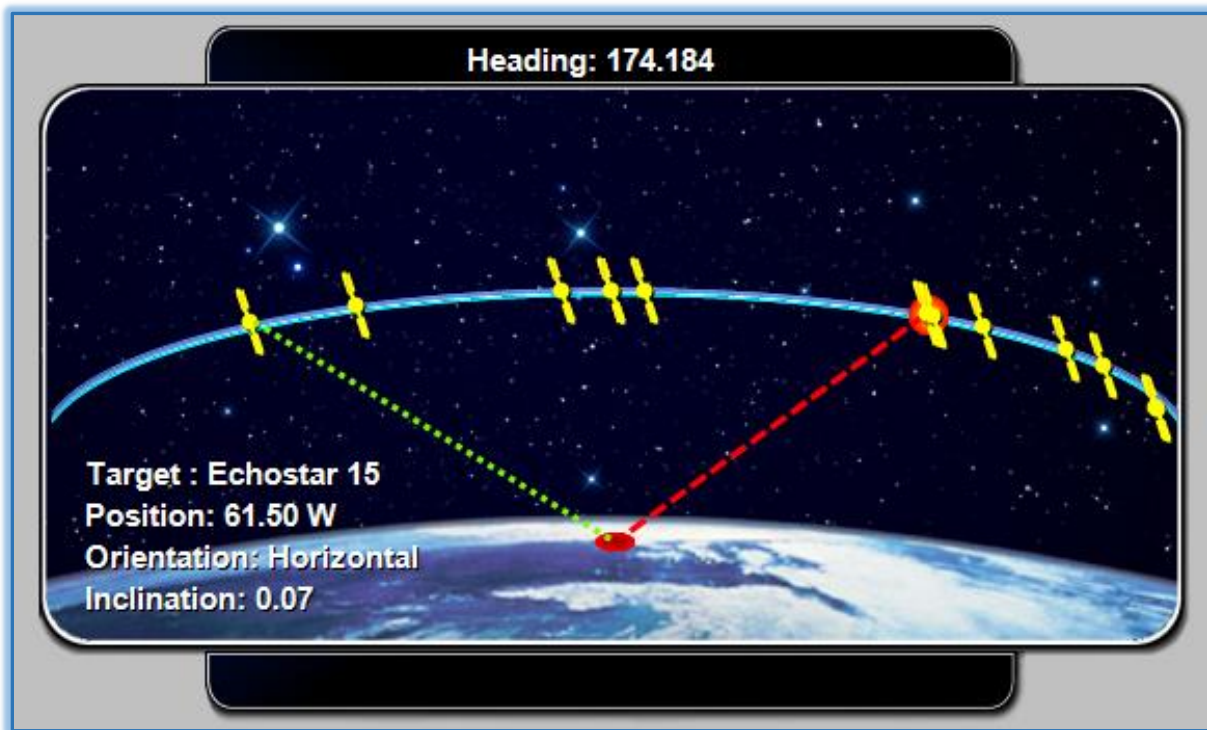


Figure 4.4.11.2 - Graphic Controller Window, Target Display

The target display shows a simulation of the visible sky from the controller's Latitude and Longitude position on the earth. The point on the earth currently occupied by the antenna is represented as a circle (red or green) on the earth's surface. An arc is displayed above the earth; this arc is populated with satellites that are currently in use by the controller. Use the [satellite list](#) (View > Satellite List) to add or remove satellites from the controller's list of selectable targets. The current heading of the antenna is shown at the top of the display. Any messages received from the controller are shown below the display. A green line indicates the current approximate pointing solution of the antenna.

4.4.11.3 Coordinate Dials

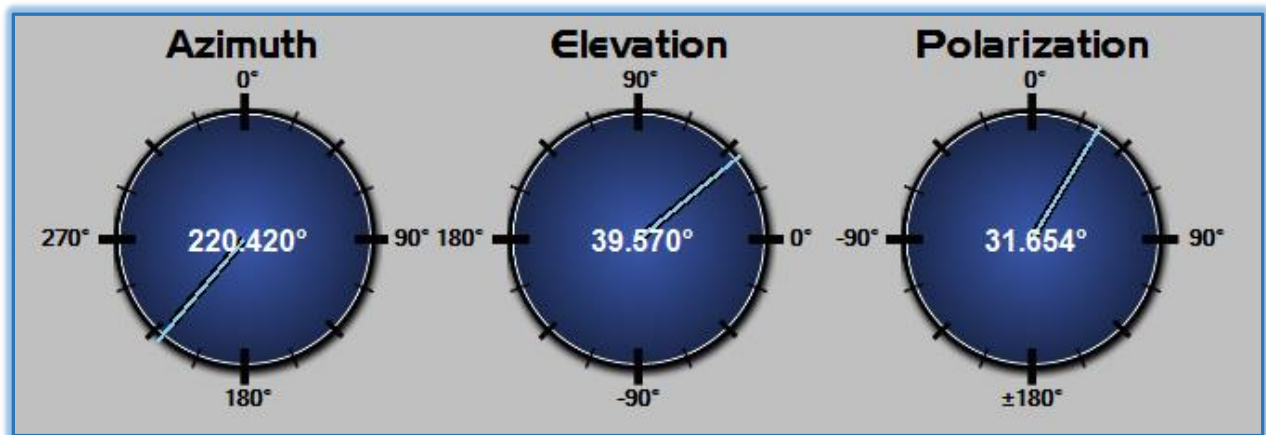


Figure 4.4.11.3 - Graphic Controller Window Coordinate Dials

Each axis of the positioner is represented by a graphic dial showing the current position of that axis in world coordinates. The current value of that axis is also displayed in the center of each dial.

4.4.11.4 Signal Strength Meter

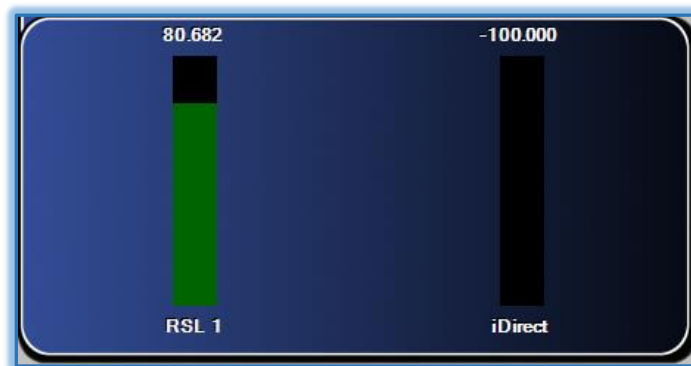


Figure 4.4.11.4 - Graphic Controller Window Signal Strength Meter

The signal strength of each signal source is represented as a bar chart in the signal strength meter. Depending on the strength of the source the associated color bar will increase and decrease. The sources included are shown below.

4.4.11.5 World Location



Figure 4.4.11.5 - Graphic Controller Window World Location

The current location of the controller can be seen as a red dot on a globe in the lower left corner of the window. This globe rotates to show the approximate position of the controller on the earth as well as showing the Latitude and Longitude coordinates in text.

4.5 Login Menu

The Login Menu is located on the toolbar in the upper left hand corner of the Main AAQRemote window.

Path
Main Window → Login
Level 0

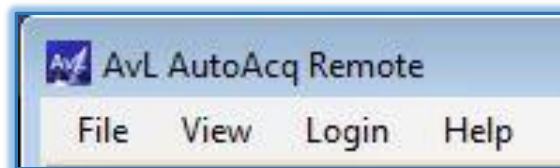


Figure 4.5a - File Login Menu Select

The AAQ Controller system provides the ability to have the user login to access various levels of interaction with the controller. This allows users of higher levels to access configuration parameters and sensor output variables that can change the functionality of the controller while users of lower levels can run the system but are limited in their ability to modify behavior. To login to the controller left-click the Login button on the File Bar (Login). This will bring up the Login window where the user can enter their credentials and send them to the controller.



Figure 4.5b - Login Window

Upon logging in, the controller will accept the user and allow that user access up to their level.

4.6 Help Menu

The Help Menu is located on the toolbar in the upper left hand corner of the Main AAQRemote window.

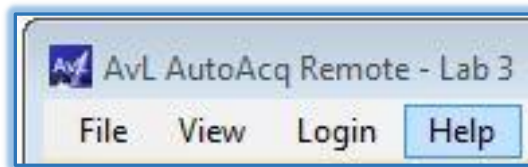


Figure 4.7 - File Bar Help Menu Select

4.6.1 About

Path
Main Window → Help → About
Level 0

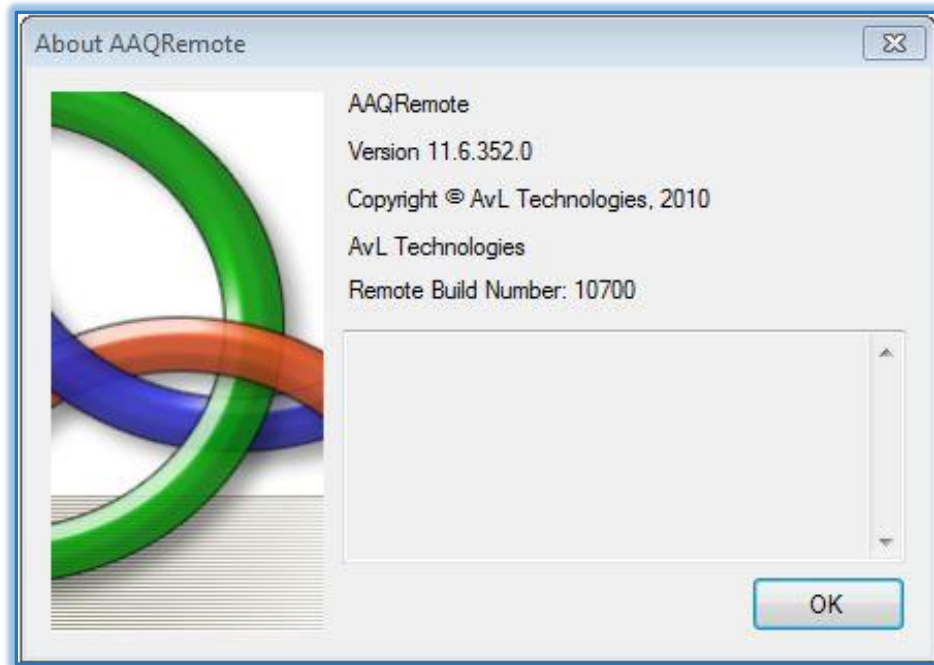


Figure 4.7.1 - About Window

The About Window shows the versions of the AAQ software and legal information. Additional information may be listed in the About Window pertaining to the build of the AAQRemote Software.

4.6.2 Version

Path
Main Window → Help → Version Info.
Level 0

AAQ Version Info.			
Filename	Type	Version	Build
AAQRemote	Remote Client	R11.8	380
AAQ.rom	ROM File	R11.8.0	10784
AAQ.conf	Config File	2636	
Azimuth RIOM	RIOM		431
Elevation RIOM	RIOM		431
Polarization RIOM	RIOM		432
Navigation RIOM	RIOM		440
Digital IO RIOM	RIOM		433
DVB RIOM	RIOM		435
/home/root/TLE_Module.R11.8.869-ARM9.mod	Tracking	R11.8.0	869
/home/root/SkyEdgeII.R11.8.314-ARM9.mod	Modem	R11.8.0	314
/home/root/IntelliTrack_Module.R11.8.246-ARM9.mod	Tracking	R11.8.0	246
/home/root/RSL1.R11.8.62-ARM9.mod	Modem	R11.8.0	62
/home/root/DVBRiomSignalModule.R11.8.164-ARM9.mod	Modem	R11.8.0	164

Figure 4.6.2 - About Window, Version example

The Version tab allows for the user to quickly locate all of the versions of code running on the system. This includes the application, ROM (main running code), RIOM, and module version.

4.6.3 Troubleshoot

Path
Main Window → Help → Troubleshoot
Level 4

Azimuth Variables		Elevation Variables		Polarization Variables	
Label	Value	Label	Value	Label	Value
Azimuth Motor Position	-10.399	Elevation Motor Position	47.151	Feed Type	Ku-LP
Azimuth Motor Raw Position	-70464	Elevation Motor Raw Position	293567	Polarization Motor Position	-13.838
Azimuth Motor Abs Position	0.000	Elevation Motor Abs Position	0.000	Polarization Motor Raw Position	-1051688
Azimuth Motor Raw Abs Position	30144	Elevation Motor Raw Abs Position	30144	Polarization Motor Abs Position	0.000
Azimuth Motor Raw Power	0	Elevation Motor Raw Power	0	Polarization Motor Raw Power	0
Azimuth Pot	-10.422	Elevation Inc	47.000	Polarization Pot	-14.629
Azimuth Pot Voltage Index	1954.000	Elevation Down Limit Switch	0	Polarization Pot Voltage Index	1723.000
Azimuth Stow	0	Elevation Up Limit Switch	0		
		Elevation Stow	0		

Figure 4.6.3 – Troubleshooting Variables

The Troubleshoot window displays specific variables for each axis that are commonly used in troubleshooting by AvL technical staff.

Chapter 5 – Initial Setup, Basic Operation & Profile Examples

This chapter describes the setup & basic operations of the AAQ controller & typical Antenna configurations, from unpacking to acquisition of the target. See Chapter 3 for additional Network configuration as well as Chapter 6 for system configuration details.

5.1 Unpacking

When unpacking your system, you will find taped to the CIP, an envelope containing the Customer Flash Card. This card contains generic and customer specific configuration documents needed to operate your AvL system. Your flashcard contains the following:

- Antenna manual
- Specifications sheet
- Interface control document
- Outline drawing of antenna system
- Overall Wiring Diagram
- Controller User Manual
- Controller Quick Start Guide
- Controller Module Documents (Modem, Beacon Receiver, Wings, etc.)
- AAQ Remote GUI Installation file
- Configuration Files (Created by Service)
- (Certificate of Compliance)

5.2 Basic Connections

Connecting Your Equipment

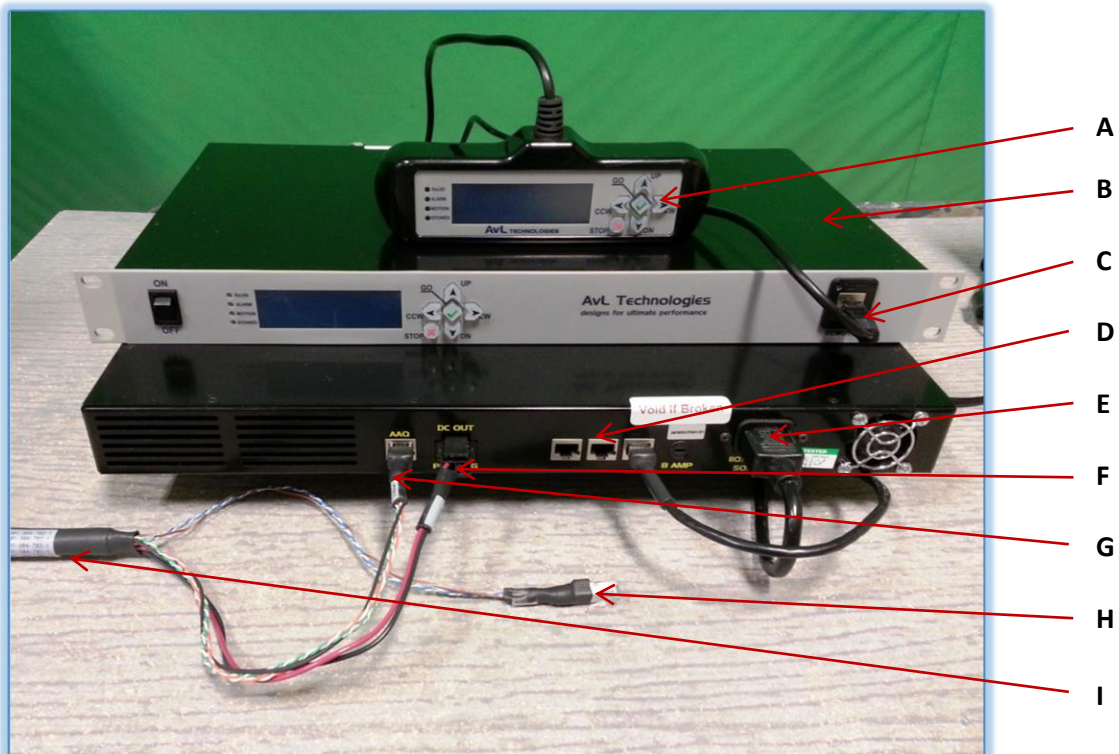


Figure 5.2 – CIP Connections

- A. HandHeld Controller
- B. Control Interface Panel (Front & Rear connections shown)
- C. Remote Controller (HandHeld) Cable
- D. Ethernet to PC , LAN, Modem or Beacon receiver *
- E. AAQ Power Connector
- F. Pedestal DC Power Connector
- G. AAQ Data Connector
- H. Serial for Aux Equipment such as Modem or Beacon receiver depending on system type
- I. Antenna Pedestal Control Cable

Note – If your CIP is configured as a “router” from the factory, the labeling and function of the Ethernet connections will be different. See Appendix “B” for more information.

5.3 AAQ Remote Application (GUI) Installation

5.3.1 Remove previous versions

If there are any previous versions of AAQ Remote GUI installed on your PC, remove them before continuing. For Windows7 and below navigate; Start > Control Panel > All Control Panel Items > Programs and Features > Uninstall or change a program, will bring you to the screen below. For Windows8 and above navigate; Start>settings button>search “Programs and Features” in dialogue box.

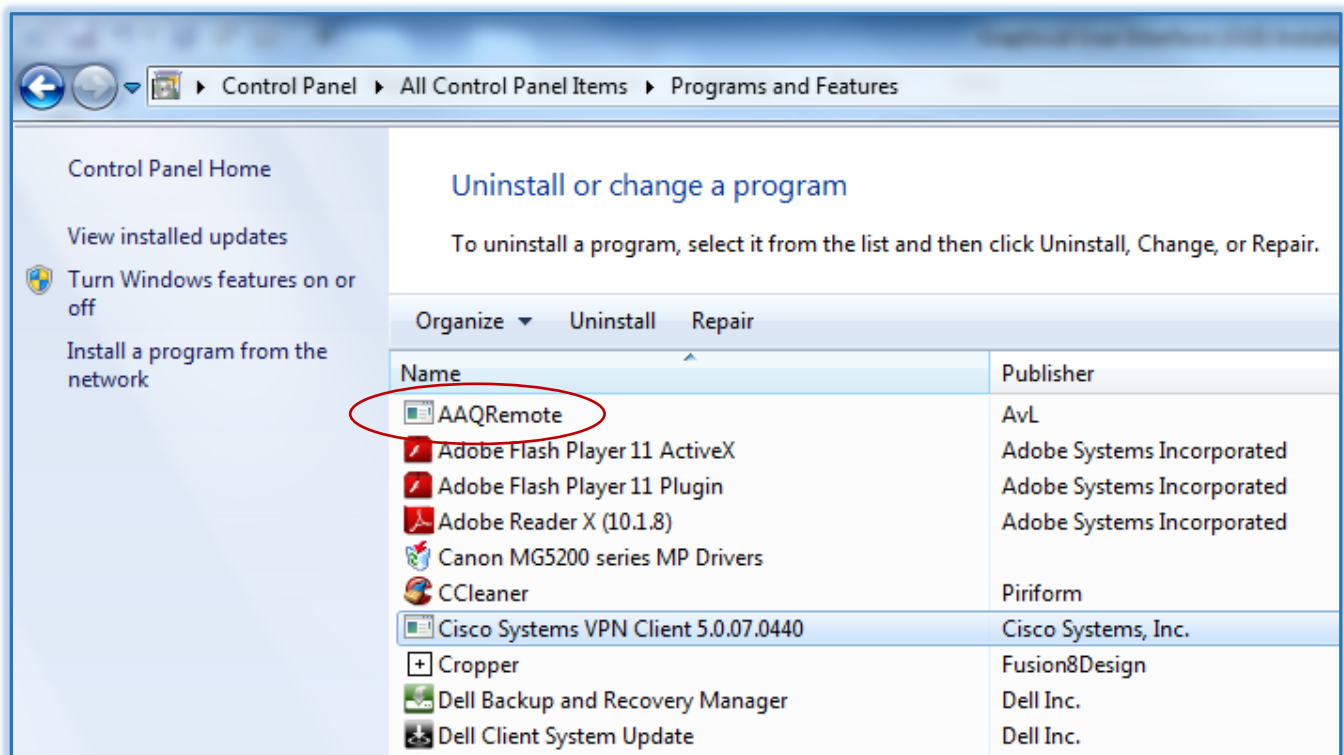


Figure 5.3.1 - Uninstall Prior Version

5.4 Install the AAQ Remote

Begin by installing the AAQ Remote on your operating system through the AAQRemoteSetup_X-X-X-X.msi (Windows installation file), provided in your Customer Documentation Flash Drive.

Note that For Windows 7 and above, the Wizard will install the application to the “C:\Program Files x86\AvL\AAQ Remote” folder.

For Windows Vista and XP, installation is to the “C:\Program Files\AvL\AAQ Remote” folder. Do not change location.

Once system cables are connected (photo) and the AAQ Remote software is installed and started, the system can be powered on.

5.5 Power on and Boot

The AAQ controller uses a Linux based operating system. When the controller is turned on, the system begins a boot process that loads the file system and application programs into RAM. This boot process requires 30-60 seconds to complete. Once the controller is booted, it is in an operational state and ready to accept commands.

All external equipment (software) modules are initialized during the boot process. During this process the modules are allowed to initialize specific devices or functions outside the normal AAQ operations. In order to ensure complete functionality, check that ancillary equipment is also powered on and initialized prior to powering on the controller.

5.6 Initial Login and IP settings

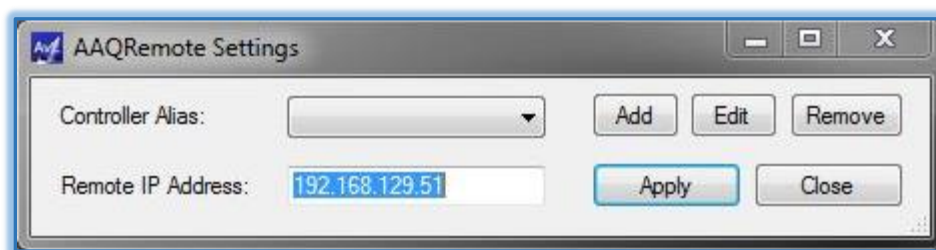


Figure 5.6a – Remote Settings Window (level 1)

As shown, the controller service IP address is 192.168.129.51. Once the connected PC is set to communicate on the same network through TCP-IP Settings, the GUI should show the lower left hand corner “coms LED” turn green.

Note - See Chapter 3 for advanced network settings details.

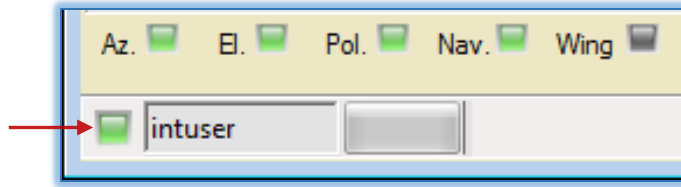


Figure 5.6b – Communication LED

Login (Top of main GUI) to the controller with your customer Username & Password (Located in your customer documentation package or flash drive). The typical integrator access is at a level 4. This level determines the commands and configuration items visible and available to be modified.



Figure 5.6c – Login Window

Once Login is accepted, you are ready to command the system.

5.7 Command Functions

Commands recognized by the AAQ controller (from the GUI) are shown on the main GUI page command pane:

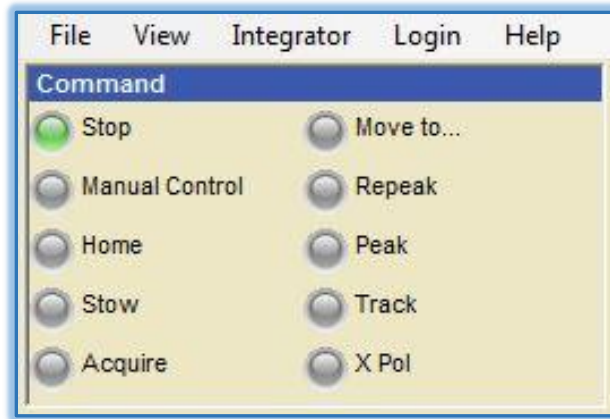


Figure 5.7 – Command Pane

- **Stop:** Stops the current running command.
- **Manual Control:** Enables the manual jog commands to be accepted.
- **Home:** Positions the antenna upright and initializes axis based sensors.
- **Stow:** Stows the antenna to the specified angular values.
- **Acquire:** Automatically points the antenna to the specified Target satellite.
- **Move To:** Moves to the requested pedestal coordinates.
- **Peak:** Performs peaking sequence using the current signal source.
- **Repeak:** Performs fine peaking sequence using the current signal source.
- **Track:** Performs the currently selected tracking mode. (option)
- **X Pol:** Moves the polarization 90 degrees from its current position.

5.7.1 Command Descriptions

The **Manual Control** command allows the user to move the antenna freely in any axis desired by way of the Manual Control pane which is directly below the Command pane. Note that manual movement via “step” requires a “Home” sequence first to initialize axis sensors.

The **Home** command determines tilt and initializes the motor feedback sensors (i.e. encoders and resolvers) needed for precision movements. The acquire command will initiate a “home” sequence before completing the acquisition.

The **Stow** command moves the antenna to a predetermined position. This is generally based on the model selected so the antenna and pedestal can be packed securely. The stow position is adjustable through configuration parameters if needed. The details of these are located in Chapter 6.

The **Acquire** command starts the antenna towards it's pointing sequence for the "Target" satellite. Acquisition runs in accordance with configuration details for the currently selected "Profile".

The **Move to...** command allows the user to move the antenna directly to a desired coordinate location. A "Move to" window will be presented for coordinates upon command. Note that manual movement to a coordinate location requires a "Home" sequence first to initialize axis sensors.

The **Peak** command performs a peaking sequence using the current signal source which begins with "Coarse" peaking sequence. This may be used to insure that the antenna pointing is optimum should the pedestal be bumped or moved slightly.

The **Repeak** command performs a peaking sequence using the current signal source which begins with "Fine" peaking sequence. This may be used to insure that the antenna pointing is optimum should the pedestal have moved slightly or if pointed under poor weather conditions.

The **Track** command performs the currently selected mode for satellite tracking. Tracking is an optional feature and the command will only function when the appropriate module is installed.

The **X Pol** command will move the antenna feed 90 degrees to receive the satellite's opposite polarization. This is typically used to simplify initial antenna cross-pol isolation testing. The direction of the feed movement will depend upon the initial feed angle when initiating the command.

Note - See the AAQ Remote GUI Chapters 4 & 7 for additional descriptions & information on command functions.

5.8 Profile System

5.8.1 Discussion on Profiles

Profiles are effectively a group of settings which are specific to the target or reference satellite you choose to acquire.

Reference satellite is used to correct any heading error from the compass.

Target satellite is the user's assigned satellite.

For a typical system, the Profile settings (also called Parameters or configuration items) will change very little, if at all for the various satellites in your target list.

One or more factory test Profiles are delivered with each antenna system. These contain all of the basic parameters needed for operating the system and are initially "copied forward" when adding a

new target profile to the list. Of course, each new target satellite needs a minimum of information to be updated for its unique profile:

- Profile Name
- Target Satellite & longitude
- Receive Polarization
- Reference satellite profile, if used

Information may be needed for the profile in accordance with satellite specifics, for example:

- Satellite inclination (if any)
- RSL Minimum Lock Threshold (minimum signal level to detect with RSL)
- Satellite Pol Offset (if any)
- Type of polarization (feed dependent)

If for instance, your new satellite will be acquired using a different signaling device (ie: modem), this information needs to be added to the new Profile. Some examples of parameters to be updated may include:

- Modem Type.
- Modem Scan Width
- Acquisition Sources for scanning and peaking
- Modem Lock Threshold

AvL technical staff works closely with our customers to insure that configuration details for system enhancements are captured and kept on file for reference. All equipment additions require AvL software “modules” to allow basic communication with devices.

5.8.2 Configuration Parameter Types

Parameters are broken up into four categories:

- The “Core” Parameters are based on the equipment “model” and do not typically change between profiles.
- The “Target” Parameters are Satellite specific and need to be updated unless the new profile will be used for a *different* carrier on the *same* satellite.
- The “Signal” Parameters will change with carrier type and any external signaling equipment specifics. (i.e. – modem, beacon rcvr.)

- The “Feed” Parameters will change polarization and frequency band settings where applicable.

Note - A complete alphabetical listing of configuration parameters can be found in chapter 6. All parameters available to customers (level 4 and below) are also defined in this chapter.

5.9 Profile Examples

The following section provides a number of examples of how to create new profiles.

5.9.1 Target Satellite selection

In preparation for making a profile, we need to select the satellite which we will be using for our Target.

From the main screen:

Path
Main Window → View → Satellite List
Level 1

Use	Name	Location	Pol	Inclination	ID	TLE1	TLE2	Remove
<input checked="" type="checkbox"/>	INTEL SAT 18 (IS...	180.00 W	Horizontal	0.02	37834	1 37834U 11056A 16180.66421213 .0000004...	2 37834 0.0245 75.7155 0001815 30.2673 23...	Remove
<input type="checkbox"/>	USA 108	177.10 W	Horizontal	3.34	0			Remove
<input checked="" type="checkbox"/>	YAMAL 300K V	177.06 W	Vertical	0.04	38978	1 38978U 12061B 16180.81885647 .0000006...	2 38978 0.0422 173.3067 0000462 71.6986 1...	Remove
<input type="checkbox"/>	NSS-5	177.00 W	Horizontal	0	0			Remove
<input type="checkbox"/>	NSS-9	176.95 W	Horizontal	0.02	33749	1 33749U 09008A 16180.63603388 .0000006...	2 33749 0.0156 7.9858 0002089 94.1548 22...	Remove
<input type="checkbox"/>	TDRS 10	174.35 W	Horizontal	4.42	27566	1 27566U 02055A 16180.87986828 .0000007...	2 27566 4.4181 60.0178 0005672 228.5953 1...	Remove
<input type="checkbox"/>	TDRS-6	171.40 W	Horizontal	8.74	0			Remove
<input type="checkbox"/>	TDRS 11	171.18 W	Horizontal	5.83	39070	1 39070U 13004A 16179.62271670 .0000008...	2 39070 5.8320 329.1500 0008326 279.3434 ...	Remove
<input type="checkbox"/>	TDRS 5	167.54 W	Horizontal	14.11	21639	1 21639U 91054B 16180.29632834 .0000007...	2 21639 14.1142 25.2481 0023806 335.8392 2...	Remove
<input type="checkbox"/>	TDRS-5	167.10 W	Horizontal	9.4	0			Remove
<input type="checkbox"/>	ASTRA 3A	160.63 W	Horizontal	3.14	27400	1 27400U 02015B 16179.87343357 .0000012...	2 27400 3.1388 70.4997 0000614 330.7427 2...	Remove
<input type="checkbox"/>	USA 162	143.90 W	Horizontal	2.51	0			Remove
<input type="checkbox"/>	INMARSAT 2 F1	142.10 W	Horizontal	6.24	0			Remove
<input type="checkbox"/>	AMC-8	139.00 W	Horizontal	0.03	0			Remove

Figure 5.9.1 – Satellite List

In this example, the “Factory Test Profile” was created using Satellite AMC-9 @ 83W with Horizontal Receive Polarization (selected). For the new profile example, we will use AMC-16 @ 85W using Vertical Polarization. Select the “use” checkbox and click on the Pol setting twice to change the receive Polarization. Once you press Save, the satellite will be available in the “Target Selection” pulldown.

5.9.2 Simple Profile Example

The “Target” tab of the Configuration window brings us to the Profile “tool” page.

Path

Main Window → View → Configuration, Target tab

Level 1

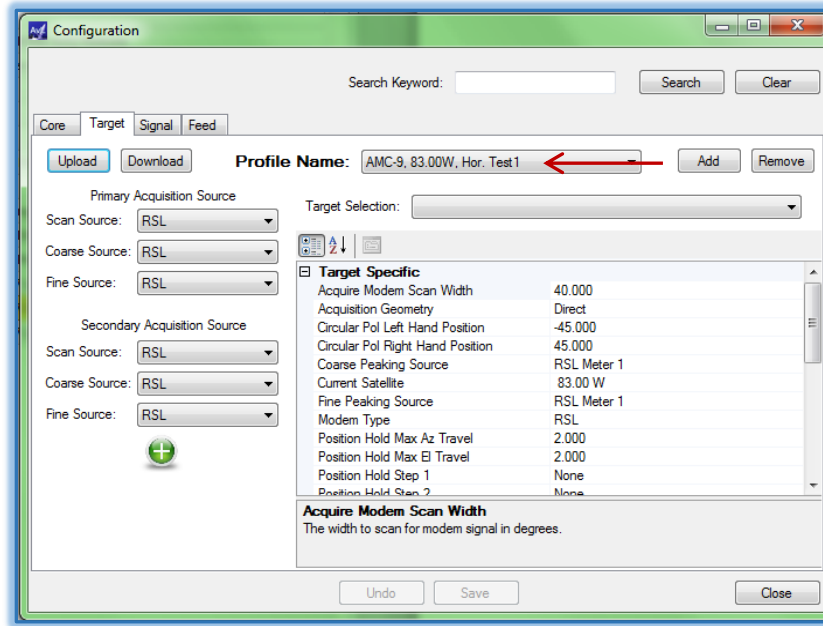


Figure 5.9.2 – Configuration, Target tab

Note that the factory test profile is shown in the “Profile Name” box.

Next, click “Add” next to the Profile name. The name you choose can be anything which has not been used before, however certain conventions are recommended:

- Satellite name
- Satellite longitude
- Receive Polarization
- Signaling device - ie: iDirect, Beacon, RSL
- Carrier ID (optional)

5.9.3 Add Profile

For this example, the following name has been chosen

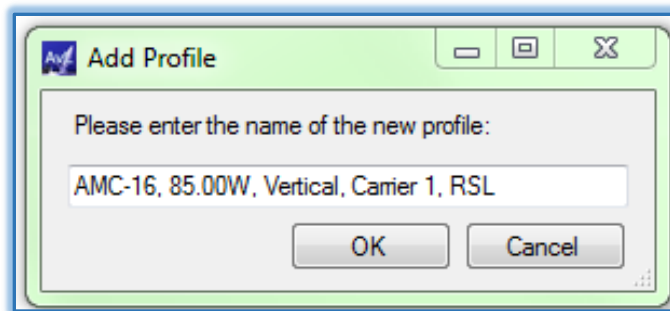


Figure 5.9.3 – Add Profile name

Once the name is chosen and you click on OK, your new profile is created with all parameters “copied forward”. We are ready to update some basic parameters to match your new Target choice:

5.9.4 Select Target

Keeping in mind that the profile added so far is just a name, use dropdown box under the Profile name to add the new “target satellite” which was added in 5.9.1:

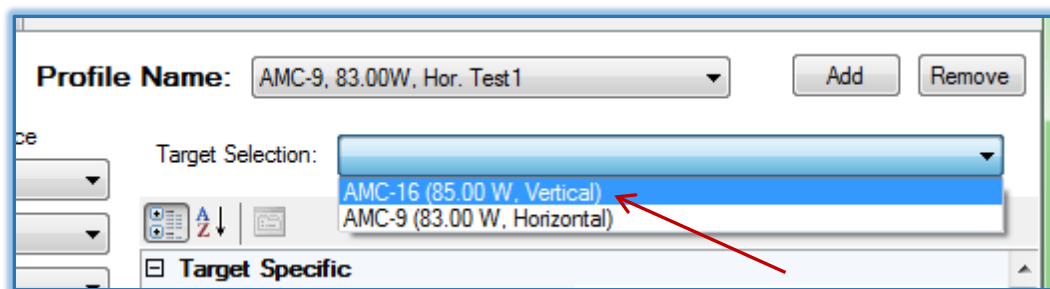


Figure 5.9.4a – Select Profile Target

Once the Target Satellite has been selected, you can see the changes in Longitude and Polarization have been automatically made in the “Target Parameter list”.

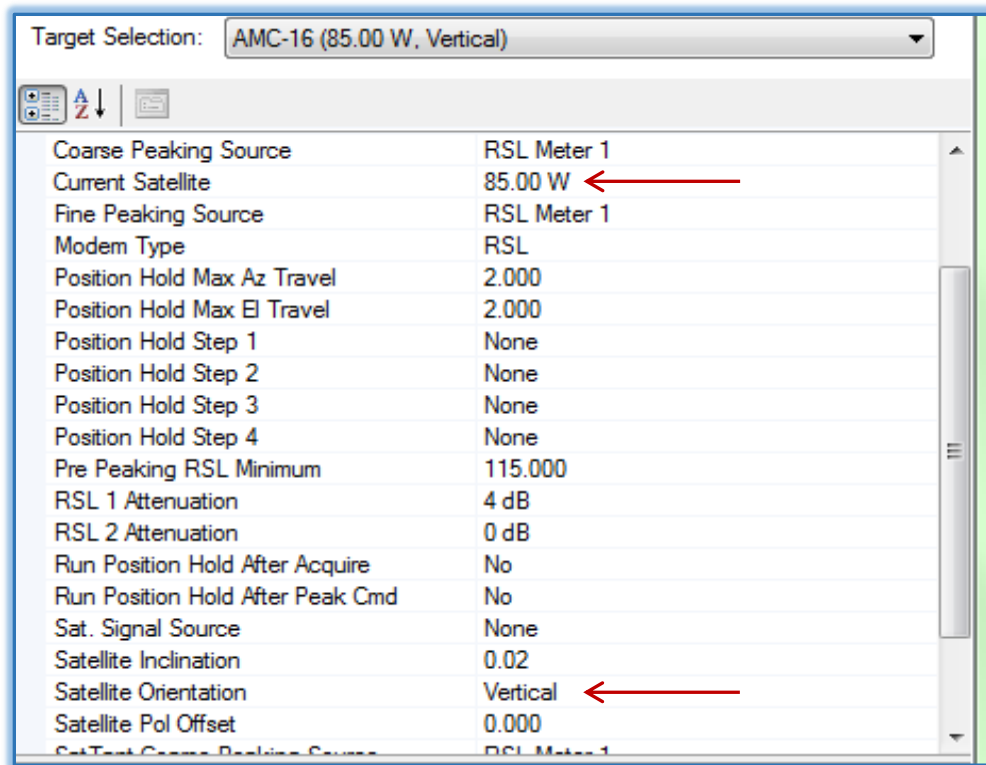


Figure 5.9.4b – Target Parameter Changes

In this example, no other changes will be made as we are simply moving to a new Target satellite using the same Acquisition Signaling Source (RSL). Click “Save” at the bottom of the Configuration window to save the new profile. Note that most other changes, when creating a profile, are entered manually to the listed parameters.

5.9.5 Common Profile Adjustments

When a currently used profile requires a simple configuration change, it is not necessary to create a new profile unless the user wishes to keep the original as a reference or alternate. In the latter case, add a new profile to the list and adjust the new profile name slightly in order to be able to distinguish between different configuration details.

In the following examples, we will not create a completely new profile each time, instead individual configuration parameters, which can be then saved as part of the new profile, will be discussed.

5.9.6 Adjusting Motion Limits

For this example, we will be installing new equipment on our “vehicle mounted system”. The original setting for maximum Elevation position (90 degrees) is now unacceptable to prevent mechanical interference. The following parameter will be updated:

- User El Up Limit (under core parameters, level 4)

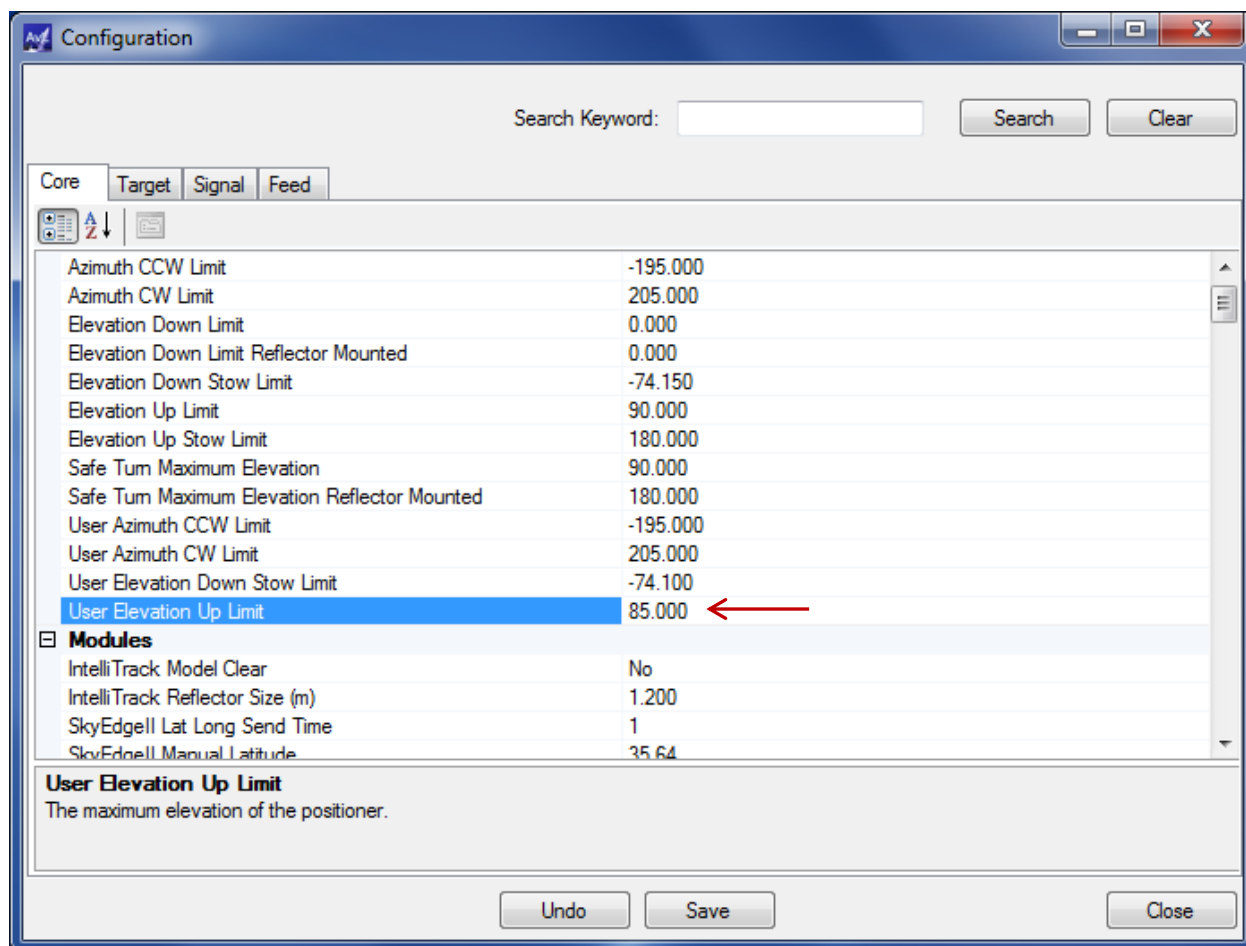


Figure 5.9.6 – User El Up Limit Parameter

Remember to click Save after entering the new value to your Profile.

~IMPORTANT~

Since positioner Limits are of a critical nature for the safety of any and all personnel that may be near to the antenna system, it is highly recommended that any change to

these limits be verified by a second operator who can observe the antenna to ensure that the intended changes function correctly.

5.9.7 Modem Acquisition, Low Power Carrier

In this example, we have created our new profile as in 5.9.1, however in this case we are using a modem signal for our Acquisition Source. In moving from the old satellite to the new one, we find that the modem reports back lower power (SNR) from the specified carrier than before. This is causing the system to sometimes miss the satellite, resulting in a failed acquisition. The recommended solution is to lower the following parameter to compensate. Keep in mind that multiple parameters may affect a specific acquisition issue; we might also adjust the modem lock threshold to improve the result.

- Scan Az Velocity (under signal parameters, level 4)

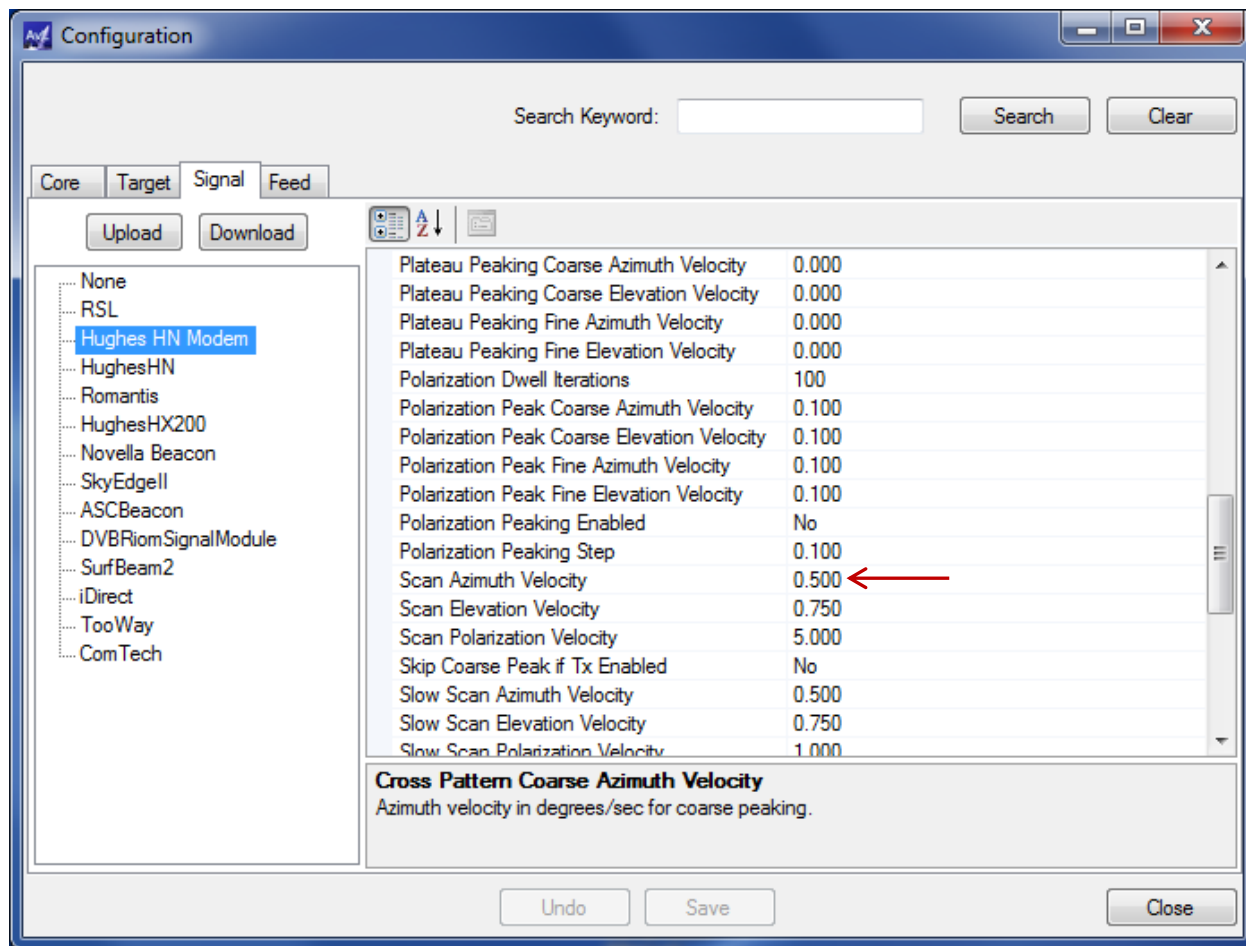


Figure 5.9.7 – Modem Scan Az Velocity

The Scan Az Velocity controls how quickly the antenna moves in Azimuth while looking for the first sign of a signal from the modem. Because of this, we want to reduce this value only to the degree required to obtain a consistent result without increasing scan times more than necessary. In this case, the best value will be found with some amount of trial and error.

It is recommended that adjustments to parameters similar to the above example are made in small steps. It is also advisable that a written log is kept with regards to any changes made for later reference.

Note – An alphabetical list of all user level 4 and below parameters can be found at the beginning of Chapter 6. For signaling devices and other options, check the appendix section of the manual.

5.9.7.1 Acquisition Redundancy

In order to improve the likelihood of a successful acquisition, a secondary scan & peak sequence (or tertiary) can be added in cases where the first attempt was unsuccessful.

From the Target & Profile tab:

Path
Main Window → View → Configuration, Target
Level 4

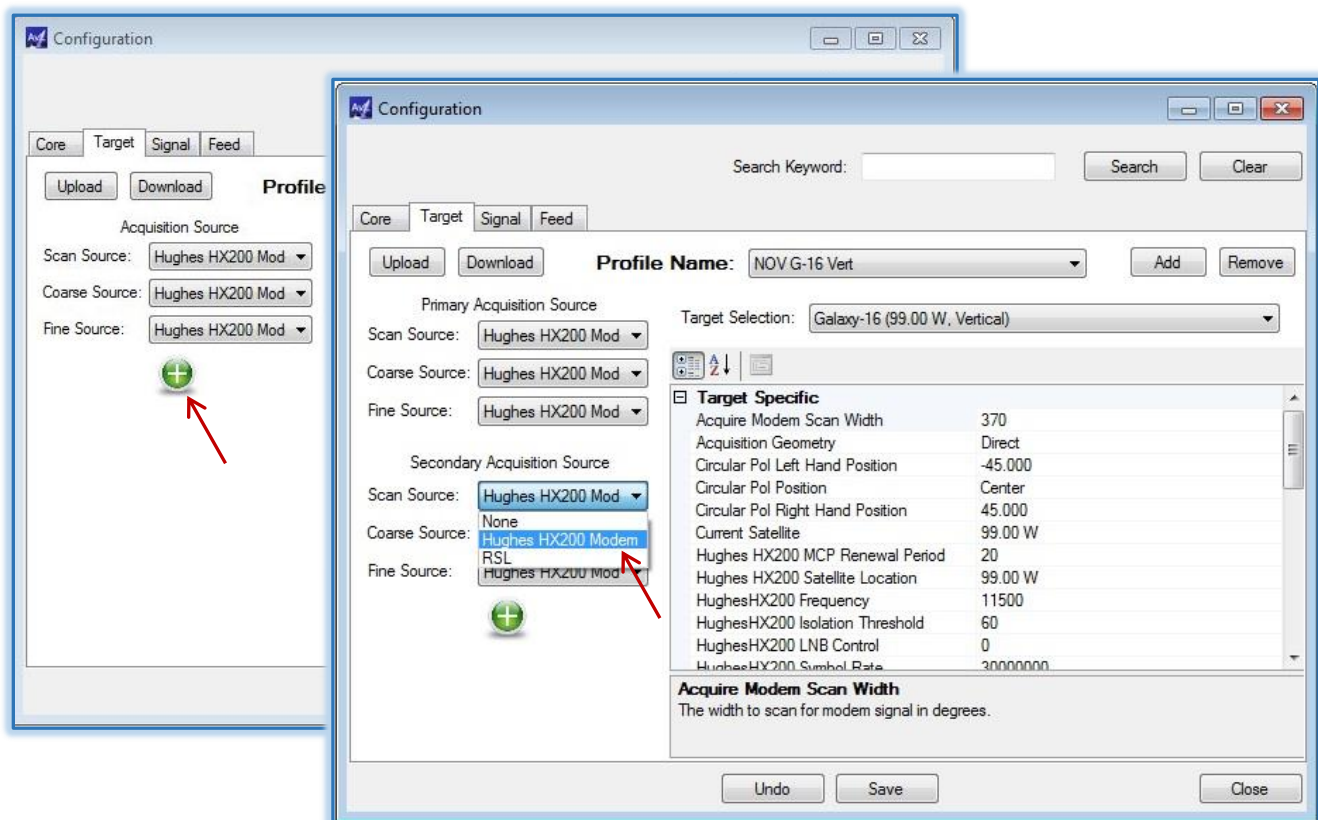


Figure 5.9.7.1 – Secondary Acquisition Source

Press the green “+” sign to add a secondary (or tertiary) “Acquisition Source”.

Then, use the dropdown to select the device for scan, coarse & fine peaking. For simple redundancy, it is recommended to duplicate the settings from the Primary Source as shown in figure 5.9.7.1.

Once the Secondary Source is saved to your Profile, it will function during each acquisition if needed.

To remove a redundant source, select “None” for all three Secondary Sources. Upon saving, the sequence will no longer be shown when the window is open.

5.9.8 Adjusting RSL Threshold

We will assume for this example that the Satellite information will be the same as previously discussed although we will be using the RSL power detector as our Acquisition Source. This new satellite however, has shown itself to be in a position of higher background noise (low elevation angle). This is bringing the noise level at the detector too close to its minimum threshold for lock detection. We will therefore adjust a parameter based on actual measurement:

-RSL Minimum Lock Threshold (under Core parameters for level 4, see figure 5.9.8b below)

RSL Minimum lock Threshold is defined as the minimum signal level needed to detect with RSL as the signal device.

As the antenna scans for the first indication of satellite signal power, this parameter is used to determine that the satellite has been approximately reached and that peaking can begin. If noise levels in the vicinity of the target are high, this threshold may be tripped early and cause the antenna to begin peaking sequence when off satellite. To get a better understanding of this relationship, bring up the “Sensor Output” window.

Path
Main Window → View → Sensor Output
Level 1

Request Updates	Label	Value
<input type="checkbox"/>	RIOM Rx Rate	
<input type="checkbox"/>	RIOM Tx Rate	
<input checked="" type="checkbox"/>	Roll	0.010
<input type="checkbox"/>	Roll at Home	
<input type="checkbox"/>	RSL Detected Noise	0.001
<input checked="" type="checkbox"/>	RSL Min Lock Signal	40.000
<input type="checkbox"/>	RSL Min Valid Signal	0.000
<input checked="" type="checkbox"/>	RSL Rx Lock	Locked
<input checked="" type="checkbox"/>	RSL Rx Sig.	63.001
<input type="checkbox"/>	RSL Signal Average	
<input type="checkbox"/>	RSL Signal Gradient	
<input checked="" type="checkbox"/>	RSL1	63.002
<input type="checkbox"/>	RSL1 Data State	

Figure 5.9.8a – Sensor output, RSL

Three monitor points are selected for this example:

- The RSL Min Lock Signal (parameter = RSL Minimum Lock Threshold),
- RSL Rx Lock &
- RSL Rx Signal.

Our “on satellite” signal level shows approximately 63.0 rel. which is well above the RSL Min Lock Sig. threshold setting of 40.0. However, if the antenna is moved off satellite, our Rx Signal indicates 38.0 which represents the background noise level in this location.

With the background noise this close to our Minimum Lock Signal threshold, false triggering of the RSL lock is likely and our threshold should be increased to insure a complete acquisition.

This setting is best determined empirically by first pointing to the satellite manually, then moving off center by a few degrees and noting the RSL “Signal Strength” on the main status pane. The parameter should be set a few units above this value. (5 to 10 units recommended depending upon “on satellite” aggregate signal strength)

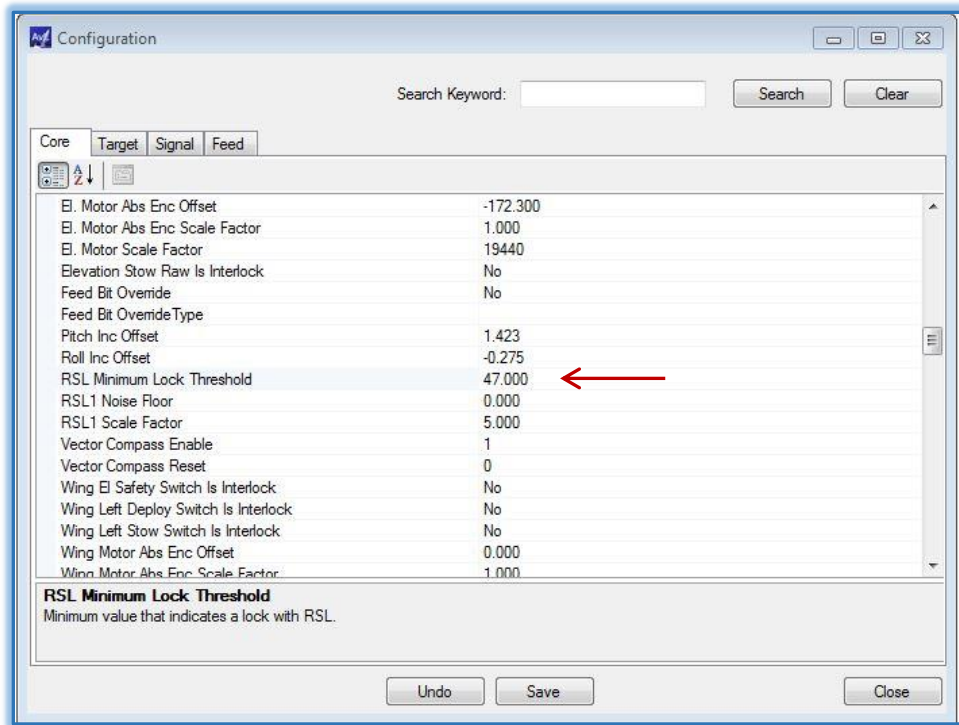


Figure 5.9.8b – RSL Min Lock Threshold

Once the new value is entered to the location shown in the above figure, click “Save” to write the changes to your Profile.

5.10 Adding a Reference Satellite

Adding a reference satellite (ref sat) to the acquisition process, corrects for any heading errors that may exist. The ref sat process performs an acquisition on a known satellite that is low on the arc. The compass heading is then corrected and the antenna can move directly to the target satellite’s location.

Two reference satellites may be associated with a given target profile.

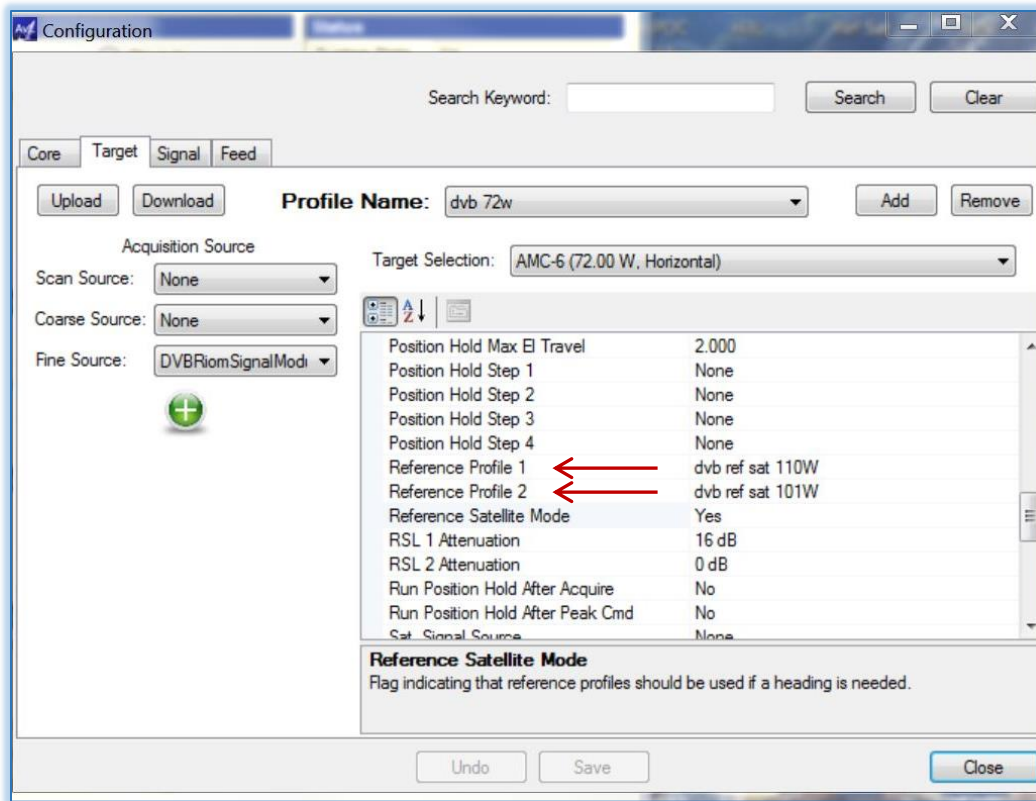


Figure 5.10 – Reference Satellite Profile

A ref sat must meet the following two requirements or it will not be used.

- 1) Must be outside the “SatTant Min Long Diff”, which is recommended to be set to 20 degrees. The “SatTant Min Long Diff” states that the referenced satellite must be this far from the longitude of the current location.
- 2) Must have a calculated target elevation above 0.0 degrees.

The ref sat selection process will choose the closest ref sat to the target satellite. If the closest ref sat does not meet the requirements, the second ref sat will be used. If the second ref sat does not meet the requirements, the SatTant process will be used to correct the heading.

Any profile may be used as a ref sat profile. The ref sat mode may be enabled or disabled. If disabled, the SatTant process will be used.

5.10.1 Using a DBS signal with the DVB receiver as a reference satellite

If your AAQ antenna system is fitted with the DVB receiver option, an improvement in acquisition reliability (over SatTant) can be obtained by using it to initially locate one of a number of available satellites. Also see Appendix H for further DVB receiver operation.

One means of using the ref sat process is to use DBS (Direct Broadcast) satellites. They have broad, high power carriers in the high band section of their transmitted signal. The spacing of

these satellites (in CONUS) makes it very unlikely that an adjacent satellite will be acquired. DBS type satellites are often used as their high carrier power simplifies acquisition in poor weather conditions as well.

In the following example our Target satellite is AMC-9 @ 83 degrees west and uses RSL for acquisition. For our location, this satellite is near the top of the geostationary arc, which is prone to greater pointing error. The DBS satellite Echostar-3 is at 61.5 degrees west, which is more than 20 degrees further east and considerably lower on the arc which makes it a good candidate for our reference. Other CONUS DBS examples are 101W, 110W & 119W.

5.10.1 Create a Reference Profile

When a profile is created for the Reference satellite, it can be then selected as the “reference” for our Target satellite. As this Reference satellite uses the DVB receiver, it will need to be configured as follows:

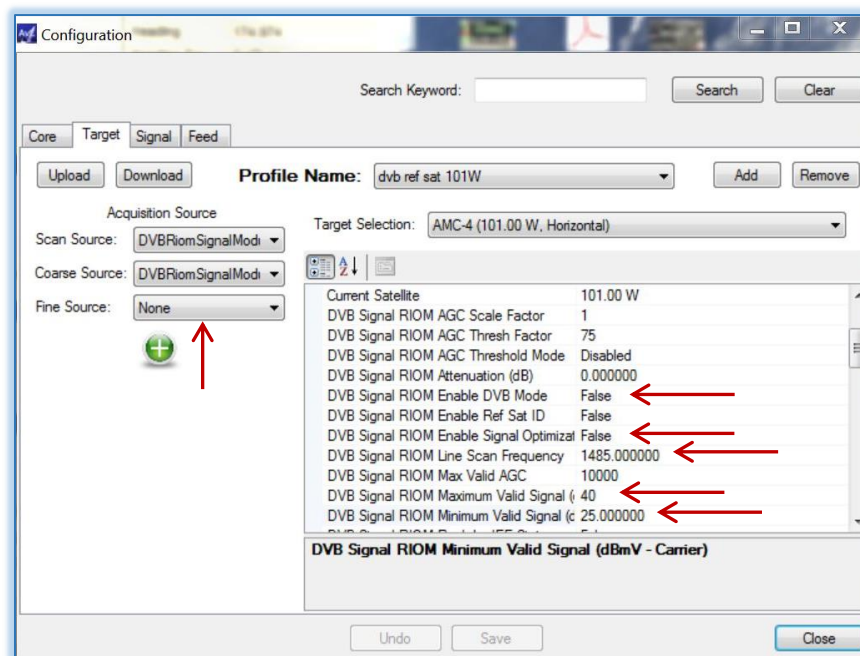


Figure 5.10.1 – Reference Satellite Profile Example

Notice that the profile name designated this as a Reference satellite profile. Also notice that all acquisition sources are selected for the DVB receiver, except “Fine Source”. For a faster (reference sat) acquisition, “Fine Source” may be set to none. Also see Appendix H for complete DvB ref sat setup.

Since the generic “high band” frequency of 12235MHz (1485MHz L-band with a 10750MHz LNB LO) is selected for level and not DVB coding, the “Enable DvB Mode” function of the receiver is turned off as well as the “Signal Optimization” function. In this mode, the receiver performs much like a narrow band beacon receiver.

The “Maximum Valid Signal” is set to its maximum value (40) to prevent saturation and the “Minimum Valid Signal” is set (25) to avoid false locking of the receiver. The values in the

example are those commonly used. We are now ready to configure our Target profile. Remember to save all changes.

5.10.2 – Update Target Profile

Our Target as mentioned before is 83W, using RSL. Update the 83W RSL profile as follows:

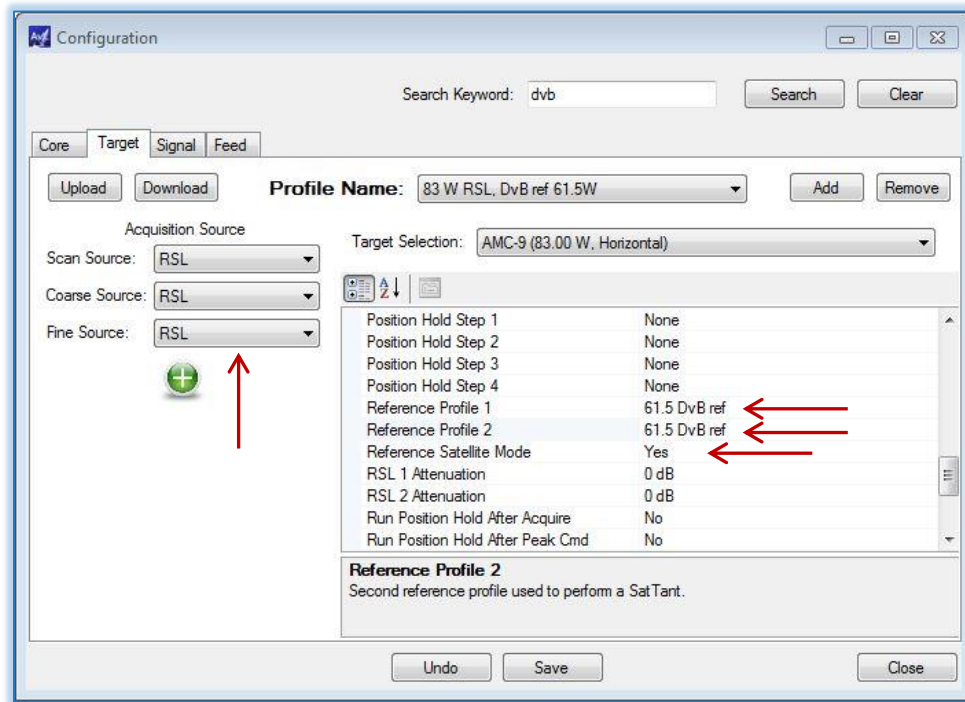


Figure 5.10.2 – Reference Satellite Selection

Notice in figure 5.10.2 that we have renamed (or added) the 83W profile with the same target and “RSL” acquisition sources. In the Target tab however, we have enabled Reference Satellite Mode and selected our DBS reference profile for Reference profiles 1 & 2. Here, the choice to use the profile for reference 2 is arbitrary and may serve as redundancy. Should Reference profile 1 fail, the system will then go to the second profile. Any profile (reference or otherwise) created may be used for either reference 1 or 2. It is recommended to use two different profiles created from 61.5W, 101W, 110W or 119W within the CONUS. Remember to save any changes.

Once the system is commanded to acquire, the profile name will show the Reference profile name from deployment until the Reference has locked and the antenna heading has updated. The profile name will then return to the target profile for final acquisition. See Appendix H for additional information about the AvL DvB receiver.

Chapter 6 – AAQ System Configuration Variables (Parameters)

6.1 Introduction

As mentioned in Chapter 1, the AAQ employs a complete set of configuration parameters that allow a single set of software instructions (ROM code) to control a variety of transportable antenna systems. In this chapter, all of the standard configuration parameters that are *visible and adjustable* by the system integrator and other users of the antenna system (Level 0 to 4) are discussed in detail. The purpose of each parameter, or group of related parameters, is described and the effect a change in that parameter will have is also discussed. A table is included in each section that provides the following information:

- Long Name – Parameter name as it appears when listed in the AAQ Remote application.
- Level – User log-in privilege level associated with that parameter. Only users at that level, or higher, will be able to view or modify that parameter's value.
- Type – The type of value associated with the parameter as listed:
 - Choice – Chosen from a drop-down menu listing fixed options.
 - Float – Floating point number with decimal point.
 - Integer – Whole number that is usually positive.
 - String – String of alpha-numeric characters.
 - Unsigned – Status flag, typically having a value of "0" or "1."
- Value Range – Upper and lower limit on parameter value.
- Documentation – "Tool-Tip" that appears when that parameter is selected in the AAQ Remote GUI. It offers a basic description of the parameter.

The following sections are arranged in a suggested order for review by a system integrator (Level 4 user) upon receipt of the AvL antenna system. The antenna system will arrive with all of these parameters set to a nominal value by AvL Engineering, Production and Service groups to facilitate system level testing in the factory. The vast majority of these parameters may not need to be modified. However, some of them do need the system integrator's attention to insure safe and optimal operation of the fully integrated antenna system.

Please be advised that the configuration parameters addressed in this chapter are not all inclusive and do not include those associated with some AAQ ACU features and are subject to change. Those parameters are addressed in appendices to this document and should also be reviewed by the system integrator upon receipt of the AvL antenna system for the same reasons cited above. The parameters addressed in this chapter are listed below alphabetically and by category:

6.1.1 Core Parameters

Core Parameters generally address the relationship between the pedestal mechanism, various related sensor devices and the code variables that control them. All parameters are listed here along with the section number where their information can be found.

Auto Stow On Movement – 6.2.2
Auto Stow Speed – 6.2.2
Auto Stow Speed Time – 6.2.2
AvL Compass Com Port – 6.3.7
AvL Compass Com Port Settings – 6.3.7
Azimuth CCW Limit Switch is Interlock – 6.2.4
Azimuth CW Limit Switch is interlock – 6.2.4
Azimuth Motor Abs Enc Offset – 6.3.6
Azimuth Motor Abs Enc Scale Factor – 6.3.6
Azimuth Motor Scale Factor – 6.3.6
Azimuth Pot Offset – 6.3.5
Azimuth Pot Scale Factor – 6.3.5
Azimuth Stow Is Interlock – 6.2.4
Azimuth Stow Position – 6.2.2
Bootup Logo – 6.3.1
Circular Polarization Center Position – 6.3.8
Coarse Peaking Source – 6.3.3
Compass Heading Offset – 6.3.3
Compass Scan Width – 6.3.6
Controller Name – 6.3.8
Controller Serial Number – 6.3.8
Cross Polarization Disable – 6.3.6
Declination Override – 6.7.1
Digital Input 0 (through 4) Is Interlock – 6.2.4
Digital Output 2 Digital Output 1 (though 6) – 6.2.4
Digital Output 3 Digital Output 1 (though 6) – 6.2.4
Elevation Compass Position – 6.3.3
Elevation Down Limit Reflector Mounted – 6.2.1
Elevation Down Limit Switch Is Interlock – 6.2.4
Elevation Down Limit – 6.2.1
Elevation Down Stow Limit – 6.2.1
Elevation Stow Position – 6.2.2
Elevation Up Limit Switch Is Interlock – 6.2.4
Elevation Motor Abs Enc Offset – 6.3.6
Elevation Motor Abs Enc Scale Factor – 6.3.6
Elevation Motor Scale Factor – 6.3.6
Elevation Stow Raw Is Interlock – 6.2.4
Elevation Up Stow Limit – 6.2.1
Feed Bit Override – 6.3.8
Feed Bit Override Type – 6.3.8
GPS Scan Width – 6.3.6
GPS Source – 6.3.3
Hand Held Connected – 6.3.1
Heading Averaged – 6.3.3

Heading For Manual Compass – 6.5.1
Magnetic manual Compass – 6.7.1
Manual Compass Scan Width – 6.3.6
Manual Control Allows Modem Tx – 6.3.5
Manual Control Azimuth Fast Speed – 6.3.5
Manual Control Azimuth Slow Speed – 6.3.5
Manual Control Elevation Fast Speed – 6.3.5
Manual Control Elevation Slow Speed – 6.3.5
Manual Control Polarization Fast Speed – 6.3.5
Manual Control Polarization Slow Speed – 6.3.5
Manual Latitude – 6.7.2
Manual Longitude – 6.7.2
Manual Pitch – 6.7.3
Manual Roll – 6.7.3
Modem Tx Enable On Rx Lock – 6.3.8
Modem Tx Restore On Open – 6.3.8
Nav Operation Mode – 6.3.3
NMEA Echo Input Com Port – 6.8.1
NMEA Echo Input Com Port Settings – 6.8.1
NMEA Server Com Port – 6.8.1
NMEA Server Enable – 6.8.1
NMEA Server Interval – 6.8.1
NMEA Server Message Source – 6.8.1
NMEA Server Com Port Settings – 6.8.1
NoCompass Scan Width – 6.3.6
NTP Server IP Address – 6.3.7
NTP Server Port – 6.3.7
Panel Connect Blocks Others – 6.3.8
Pitch Inc Offset – 6.3.6
Polarization Flip Amount – 6.3.6
Polarization Home Position – 6.3.6
Position Hold Run Acquire on Peak Fail – 6.3.7
Primary Heading Src. – 6.3.3
Rack Controller Field 0 (through 9) – 6.3.8
Rack Controller Label 0 (through 9) – 6.3.8
Reflector Mount Azimuth Position – 6.2.3
Reflector Mount Elevation Position – 6.2.3
Reflector Mount Elevation Switch Position – 6.2.3
Reflector Mount Polarization Position – 6.2.3
Reflector Mount Switch Elevation Offset – 6.2.3
Repeak On Power On When Rx Locked – 6.3.8
Roll Inc Offset – 6.3.5
RSL Com Port – 6.3.2
RSL Com Port Settings – 6.3.2
RSL Gradient Sample Time – 6.3.2
RSL Minimum Lock Threshold – 6.3.2
RSL Noise Sample Time – 6.3.2
RSL1 Noise Floor – 6.3.2

- RSL1 Signal Strength Scale Factor – 6.3.2
- Run Position Hold on Startup – 6.3.8
- Safe Turn Maximum Elevation – 6.2.1
- Safe Turn Maximum Elevation Reflector Mounted – 6.2.1
- Satellite Inclination Threshold – 6.3.6
- SatTant Heading Timeout – 6.3.4
- SatTant Type – 6.3.4
- Secondary Heading Source – 6.3.3
- Show Stow Warning – 6.2.2
- Signal Wait Time – 6.3.6
- Slide Motor Acquire Position – 6.8.3
- Slide Motor Abs Enc Offset – 6.8.3
- Slide Motor Abs Enc Scale Factor – 6.8.3
- Slide Motor Enable – 6.8.3
- Slide Motor Scale Factor – 6.8.3
- Slide Motor Stow Position – 6.8.3
- Slide Motor Switch 1 – 3 is Interlock – 6.8.3
- Slide Position (1 – 3) – 6.8.3
- Step Mode Sample Delay – 6.3.8
- Step Mode Wobble Correction – 6.3.8
- Time Service Maximum GPS Drift – 6.3.7
- Time Source – 6.3.7
- Use Fast Home – 6.3.3
- Use Manual GPS on Fail – 6.3.3
- Use Manual Tilt – 6.7.3
- User Azimuth CCW Limit – 6.2.1
- User Azimuth CW Limit – 6.2.1
- User Elevation Down stow Limit – 6.2.1
- User Elevation Up Limit – 6.2.

6.1.2 Target Parameters

Target Parameters relate directly to the scanning & acquisition of the target satellite.

- Acquire Modem Scan Width – 6.4.3
- Acquisition Geometry – 6.4.3
- Circular Polarization Left Hand Position – 6.4.4
- Circular Polarization Position – 6.4.4
- Circular Polarization Right Hand Position – 6.4.4
- Coarse Peak Signal Source 1 – 6.4.2
- Coarse Peak Signal Source 2 – 6.4.2
- Coarse Peak Signal Source 3 – 6.4.2
- Current Satellite – 6.4.1
- Disable Scans – 6.4.3
- Fine Peaking Source – 6.4.2
- Fine Peak Signal Source 1 – 6.4.2
- Fine Peak Signal Source 2 – 6.4.2

- Fine Peak Signal Source 3 – 6.4.2
- Modem Type – 6.4.2
- Position Hold Step 1 (through 4) – 6.4.4
- Reference Profile 1 – 6.4.1
- Reference Profile 2 – 6.4.1
- Reference Satellite Mode – 6.4.1
- RSL 1 Attenuation – 6.4.2
- Run Position Hold After Acquire – 6.4.4
- Run Position Hold After Peak Cmd – 6.4.4
- Satellite Signal Source – 6.4.2
- Satellite Inclination – 6.4.1
- Satellite Orientation – 6.4.1
- Satellite Polarization Offset – 6.4.3
- SatTant Coarse Peaking Source – 6.4.2
- Scan Signal Source 1 – 6.4.2
- Scan Signal Source 2 – 6.4.2
- Scan Signal Source 3 – 6.4.2
- Skip Acquire Sat State -
- SatTant Fine Peaking Source – 6.4.2
- Tx Enable Before Fine Peak – 6.4.4
- Use SECANT Correction – 6.4.3

6.1.3 Signal Parameters

Signal Parameters generally correlate to the relationship between RF level and movement of the antenna system.

- Coarse Peak Signal Dif Pass – 6.5.2
- Coarse Peaking Cycles – 6.5.2
- Coarse Peaking Maximum Cycles – 6.5.2
- Coarse Peaking Mode – 6.5.2
- Cross Pattern Coarse Peaking Height – 6.5.4
- Cross Pattern Coarse Peaking Width – 6.5.4
- Cross Pattern Coarse Signal Tolerance – 6.5.4
- Cross Pattern Coarse Azimuth Velocity – 6.5.4
- Cross Pattern Coarse Elevation Velocity – 6.5.4
- Cross Pattern Fine Peaking Height – 6.5.4
- Cross Pattern Fine Peaking Width – 6.5.4
- Cross Pattern Fine Signal Tolerance – 6.5.4
- Cross Pattern Fine Azimuth Velocity – 6.5.5
- Cross Pattern Fine Elevation Velocity – 6.5.5
- Fine Peak Signal Dif. Pass – 6.5.3
- Fine Peaking Cycles – 6.5.3
- Fine Peaking Maximum Cycles – 6.5.3
- Fine Peaking Mode – 6.5.3
- Line Scan Maximum Elevation Steps – 6.5.11

Line Scan Failure Elevation Step Size – 6.5.11
Modem Based Target Allowed – 6.5.11
Modem TX Disable Wait – 6.5.11
Modem Minimum Wait Time – 6.5.11
Modem Maximum Wait Time – 6.5.11
Peak Dwell Iterations – 6.5.4
Peaking Azimuth Travel Limit – 6.5.6
Peaking Elevation Travel Limit – 6.5.6
Peaking Ignore Noise Level – 6.5.1
Peaking Polarization Travel Limit – 6.5.10
Plateau Peaking Coarse Azimuth Velocity – 6.5.9
Plateau Peaking Coarse Elevation Velocity – 6.5.9
Plateau Peaking Fine Azimuth Velocity – 6.5.9
Plateau Peaking Fine Elevation Velocity – 6.5.9
Polarization Dwell Iterations – 6.5.10
Polarization Peak Coarse Azimuth Velocity – 6.5.10
Polarization Peak Coarse Elevation Velocity – 6.5.10
Polarization Peak Fine Azimuth Velocity – 6.5.10
Polarization Peak Fine Elevation Velocity – 6.5.10
Polarization Peaking Enabled – 6.5.10
Polarization Peaking Step – 6.5.10
Scan Azimuth Velocity – 6.5.1
Scan Elevation Velocity – 6.5.1
Scan Polarization Velocity – 6.5.10
Skip Coarse Peak If Tx Enabled – 6.5.11
Slow Scan Azimuth Velocity – 6.5.1
Slow Scan Elevation Velocity – 6.5.1
Slow Scan Polarization Velocity – 6.5.1
Step Pattern Coarse Peaking Azimuth Step
Step Pattern Coarse Peaking Elevation Step
Step Pattern Coarse Azimuth Velocity – 6.5.7
Step Pattern Coarse Elevation Velocity – 6.5.7
Step Pattern Fine Azimuth Velocity – 6.5.8
Step Pattern Fine Elevation Velocity – 6.5.8
Step Pattern Fine Peaking Azimuth Step – 6.5.7
Step Pattern Fine Peaking Elevation Step – 6.5.7

6.1.4 Feed Parameters

Feed Parameters relate to the movements and limits of the variety of feed based model options.

Elevation Inc Offset – 6.6
Line Scan Polarization Adjust Flag – 6.6
Manual Polarization – 6.6
Polarization Center Switch Is Interlock – 6.2.4 & 6.6
Polarization Feed Type – 6.6
Polarization Limit Is Interlock – 6.2.4

Polarization Pos Move Maximum PWM – 6.6
Polarization Pos Move Minimum PWM – 6.6
Polarization Pos Move PWM Factor – 6.6
Polarization RF Offset – 6.6
Polarization Stow Position – 6.6
Polarization Motor Abs Enc Offset – 6.6
Polarization Motor Abs Enc Scale Factor – 6.6
Polarization Motor Scale Factor – 6.6
Polarization Pot Offset – 6.6
Polarization Pot Scale Factor – 6.6
Polarization CW Limit – 6.6
Polarization CCW Limit – 6.6
User Polarization CCW Limit – 6.6
User Polarization CW Limit – 6.6

6.1.5 Optional

A number of system options are available for AvL products. These are listed at the end of the chapter and will contain a column for the category of configuration where they can be found.

Feed Slide – 6.8.2
NMEA Server – 6.8.1
Vector Compass – 6.8.3
Wings – 6.8.4
Wind Compensation – 6.8.5

See Appendices for the following internal options:

Appendix H - DvB Receiver
Appendix M - Step Track
Appendix N - Position Hold Lite
Appendix O – TLE Track
Appendix P - Step Track Hold
Appendix S – Predictive Track

6.2 Hardware Safety & Mechanical Limits - Core

Safe operation of the AvL antenna system is essential and it is critical that the AAQ software be configured appropriately. Many limits on motion of the antenna are set by physical switches that are monitored by the AAQ ACU. Others are set by software configuration parameter values that are compared to a particular system variable or sensor output. Most of these are set in the factory, not subject to change and require a high privilege level to view and modify. A small group is subject to change after the antenna leaves the AvL factory due to later mounting of CFE hardware on the antenna system and installation of the antenna onto the integrator's vehicle or base support. It is this small group of parameters that is addressed in this section.

6.2.1 Pedestal Limits

Long name	Level	Type	Value Range	Documentation
Elevation Up Stow Limit	4	Float	0.0 to 180.0 (deg)	The maximum elevation for the stow switch position.
Elevation Down Stow Limit	4	Float	-90.0 to 90.0 (deg)	The minimum elevation at the stow position.
Elevation Down Limit	4	Float	-45 to 45 (deg)	Down elevation limit (except stow position) when using a removable reflector and the reflector is mounted.
Safe Turn Maximum Elevation	4	Float	0 to 180 (deg)	Maximum elevation that is safe to turn in Azimuth
Safe Turn Maximum Elevation Reflector Mounted	4	Float	0 to 180 (deg)	Maximum elevation that is safe to turn in Azimuth when using a removable reflector & the reflector is mounted.
User Azimuth CCW Limit	4	Float	-220.0 to 0.0	The maximum counter clockwise pedestal azimuth position
User Azimuth CW Limit	4	Float	0.0 to 220.0	The maximum clockwise pedestal azimuth position
User Elevation Down Stow Limit	4	Float	-90.0 to 90.0	The minimum elevation at the stow position
User Elevation Up Limit	4	Float	0.0 to 180.0	The maximum elevation of the positioner

~IMPORTANT~

When the antenna is pointing at low look angles, the movable feed boom, along with any CFE BUC(s) that may be mounted on it, is located in close proximity to the stationary base support. Safe elevation angles must be determined for normal operation of the antenna. This includes movement while the antenna is deployed and when it reaches the stow position. All elevation angles associated with these parameters are Ped-EL values, which are referenced to the antenna mechanical interface and are not subject to adjustment due to tilt compensation. Special attention should be paid to the full range of antenna motion and any objects attached to the deck below the antenna that might not be stowed when the antenna in its normal operational position.

The **Elevation Up Stow Limit** is set to a value slightly (typically 0.5 degrees) above the target *El stow position (for antenna systems that stow in the up position)*. The target Elevation stow position is set by either a mechanical switch located on the antenna's elevation axis or, less frequently, by a sensor (usually a Resolver) when "Stow to Position" mode is employed. This parameter is a safety limit that is only tripped if the normal stow process fails to stop antenna elevation motion at the target stow position for any reason. This limit is only active when the antenna is at the Azimuth Stow Position angle, otherwise the appropriate Elevation UP Limit is in effect.

The **Elevation Down Stow Limit** is set to a value slightly (typically 0.5 degrees) below the target *Elevation stow position*. The target Elevation stow position is set by either a mechanical switch located on the antenna's elevation axis or, less frequently, by a sensor (usually a Resolver) when

“Stow to Position” mode is employed. This parameter is a safety limit that is only tripped if the normal stow process fails to stop antenna elevation motion at the target stow position for any reason. This limit is only active when the antenna is at the Azimuth Stow Position angle; otherwise the appropriate Elevation Down Limit is in effect.

Elevation Down Limit is also referred to as the “Safe Turn Limit”. This is the minimum elevation angle for deployed antenna motion. It should be set to insure that the antenna, CFE hardware and cables located on the moving platform (above the azimuth bearing ring) do not contact anything on the stationary base structure / vehicle.

“User” level limits are specifically designed for the user or integrator so that custom limits can be created without disabling safety limits built into the system.

6.2.2 Stow Position

Long name	Level	Type	Value Range	Documentation
Show Stow Warning	4	Choice	“No”, “Yes” Default: Yes	Flag indicating whether a user is prompted with a warning before stow.
Azimuth Stow Position (AzStowPosition)	4	Float	-180 to 180	The position in degrees for azimuth in the stow routine.
Elevation Stow Position	4	Float	-100 to 180	Elevation stow position in degrees if the stow type is 'Stow at Position'.
Polarization Stow Position	4	Float	-180 to 180	The position in degrees of the pol for the stow routine.
Auto Stow On Movement	4	Choice	“No”, “Yes”	Enables Auto Stow function when set speed is reached.
Auto Stow Speed	4	Integer	0 to 200	Speed from the GPS to trigger an auto stow.
Auto Stow Speed time	4	Integer	0 to 200	Time in seconds at the specified speed to trigger an auto stow.

Proper setting of the Stow Position is essential for all AvL antenna systems, as some models use non-standard type mounting designs. The manual provided with every AvL antenna system provides details on how the Stow Position should be determined for that antenna.

Once the antenna has been manually placed in the correct Stow Position, the *Azimuth, Elevation and Polarization Stow Position* parameter values with Type = Float should be set to match the appropriate Pedestal angle displayed at that position.

The **Azimuth Stow Position** parameter with Type = Float, tells the AAQ what position in degrees that the Stow Routine will be performed.

The **Auto Stow On Movement** parameter is reserved for vehicular mount antennas. If this is enabled, any information from the system GPS indicating vehicle motion above a set speed will activate the antenna stow routine. Speed indication units are determined by the GPS settings.

6.2.3 Reflector/Feed On/Off

Long name	Level	Type	Value Range	Documentation
Reflector Mount Azimuth Position	4	Float	- 180.0 to 180.0	Pedestal Azimuth position for reflector mount or dismount.
Reflector Mount Elevation Position	4	Float	- 180.0 to 180.0	Pedestal Elevation position for reflector mount or dismount.
Reflector Mount Elevation Switch Position	4	Choice	"No", "Yes"	Pedestal Elevation switch position for reflector mount or dismount.
Reflector Mount Switch Elevation Offset	4	Choice	"No", "Yes"	El position in degrees from the selected switch to mount the reflector.
Reflector Mount Polarization Position	4	Float	- 180.0 to 180.0	Pedestal Polarization position for reflector mount or dismount.
Elevation Down Limit Reflector Mounted	4	Float	-45 to 45	Down elevation limit except at the stow position when using a removable reflector and the reflector is mounted.
Safe Turn Maximum Elevation Reflector Mounted	4	Float	0 to 180	Maximum elevation that is safe to turn in azimuth when using a removable reflector and the reflector is mounted.

Many AvL antenna systems have removable reflectors and feed booms to minimize pack-up size and improve transportability of the product. These systems may have a Stow Position that is necessary for pack-up, but leaves no room for an attached reflector or feed boom. In that case, the AAQ will not completely Stow the positioner until the operator confirms that these items have been safely removed. Conversely, the antenna cannot operate as intended without these items installed, so the same confirmation process in reverse is required on antenna deployment.

These parameters are typically set by the operator's response to an appropriately timed prompt, offered by the AAQ in the appropriate GUI window.

6.2.4 Interlocks

Long name	Level	Type	Value Range	Documentation
Azimuth CCW limit switch Is Interlock	4	Choice	"No", "Yes"	The flag indicating that this digital input is an interlock (blocks other operations when set)

Azimuth CW Limit Switch Is Interlock	4	Choice	"No", "Yes"	The flag indicating that this digital input is an interlock (blocks other operations when set)
Azimuth Stow Is Interlock	4	Choice	"No", "Yes"	The flag indicating that this digital input is an interlock (blocks other operations when set)
Digital Input 0 (through 4) Is Interlock	4	Choice	"No", "Yes"	The flag indicating that this digital input is an interlock (blocks other operations when set)
Elevation Down Limit Switch Is Interlock	4	Choice	"No", "Yes"	The flag indicating that this digital input is an interlock (blocks other operations when set)
Elevation Stow Raw Is Interlock	4	Choice	"No", "Yes"	The flag indicating that this digital input is an interlock (blocks other operations when set)
Elevation Up Limit Switch Is Interlock	4	Choice	"No", "Yes"	The flag indicating that this digital input is an interlock (blocks other operations when set)
Digital Output 2 (or 3) Digital Out 1(through 6)	4	Integer	0 or 1	State of Digital Output. 1= Set output to on.
Wing Elevation Safety Switch is Interlock	4	Choice	"No", "Yes"	Flag indicating the digital input as an interlock
Wing Left/Right Deploy Switch is Interlock	4	Choice	"No", "Yes"	Flag indicating the digital input as an interlock
Wing Left/Right Stow Switch is Interlock	4	Choice	"No", "Yes"	Flag indicating the digital input as an interlock

Interlocks are digital inputs to the AAQ controller. Many of these inputs parallel existing switch and or sensor functions when needed. Optional systems often use interlocks for added safety or when functional redundancy is called for. Contact AvL customer support for additional information and before changing any interlock parameters which are part of your factory system configuration.

6.3 General System Set-Up - Core

The parameters discussed in this section are static and configure the AAQ for operation independent of the chosen Target Satellite or Signal Source(s). They typically affect basic behavior of the system or make a choice among multiple hardware sensor or device options that may be available for a particular function.

The General System Set-Up and previously discussed Hardware Safety parameters may be accessed through one of the four tabs, "Core", "Target", "Signal", and "Feed", in the Configuration window in the AAQRemote GUI. An example of that window is provided as Figure 6.3.

Path
Main Window → View → Configuration
Level 4

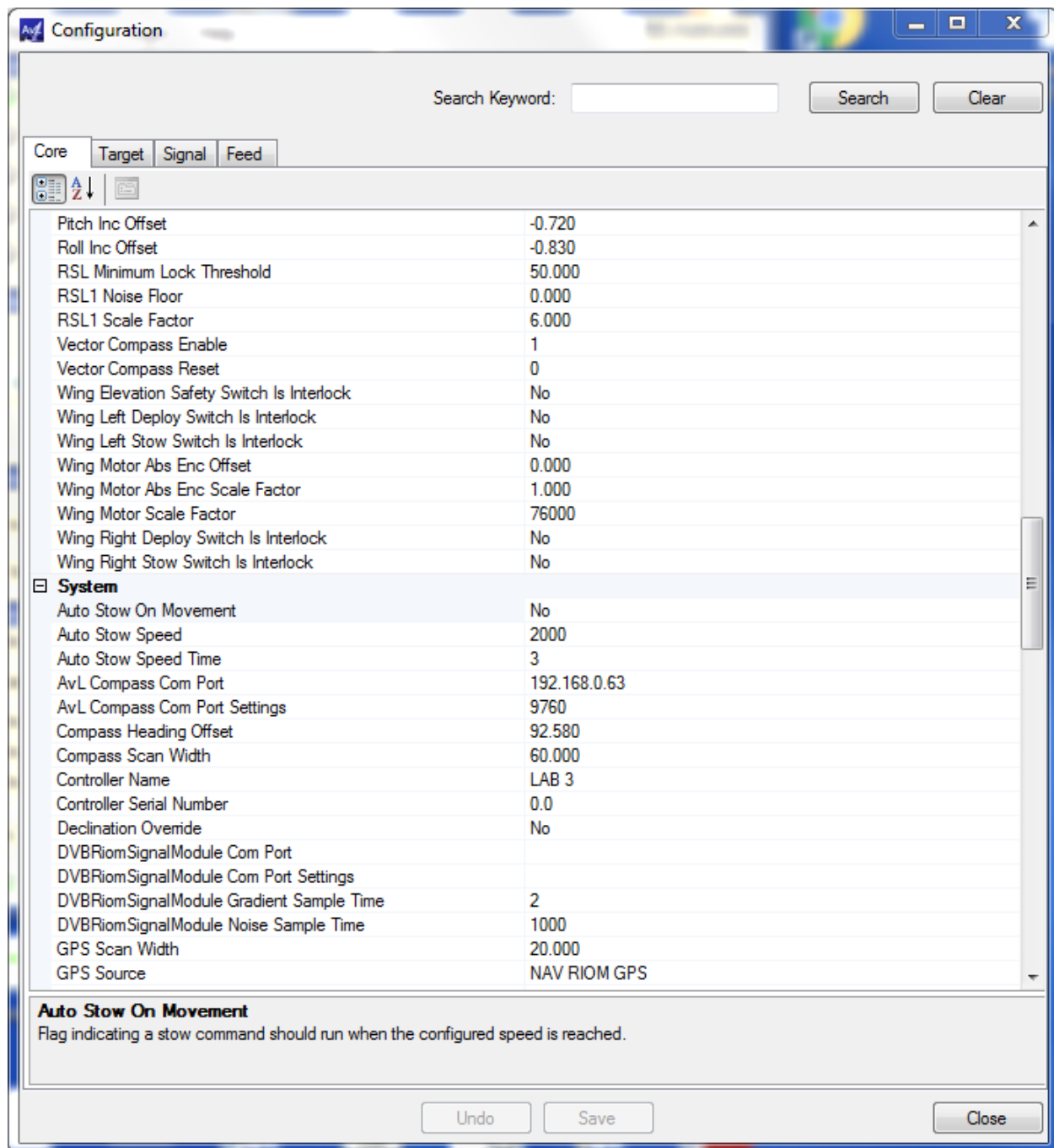


Figure 6.3 - AAQRemote Configuration Window

6.3.1 RSL Meter

Long name	Level	Type	Value Range	Documentation
RSL1 Noise Floor	4	Float	-100000 to 100000	Minimum value that indicates an RSL signal above noise
RSL Minimum Lock	4	Float	-100000.0 to 100000	Minimum value that indicates a lock with RSL

Threshold			Default value: 50	
RSL Gradient Sample Time	4	Integer	0 to 60	Sample time for detecting the signal gradient
RSL Noise Sample Time	4	Integer	0 to 60000	Sample time in MS for detecting signal noise
RSL Com Port	4	String	-	The computer filename for the communications port used
RSL Com Port Settings	4	String	-	The communications parameters for the com port, in the form of Baud, Data, Stop & Parity Bits (ie: 9600 8 1 0) where parity values are 0 for none and 1 for even.
RSL1 Scale Factor	4	Float	- 100000.0 to 100000 Default value: 1	Value to Divide the rad A/D value to produce a sensor value. The formula for producing a final value is: ((raw number*10000)/scale factor)

The RSL power meter is used for broadband signal level detection. Aside from the RSL 1 noise floor & lock threshold parameters, it is recommended that this device settings are changed only under the guidance of AvL technical staff.

The **RSL Minimum Lock Threshold** value determines the Minimum signal strength reported for detecting a lock signal from a satellite. When this level is reached during a modem scan, the system will scan at **the slow speed**.

The **RSL 1 Noise Floor** value determines the Minimum signal strength above which an RSL signal is indicated.

6.3.2 Navigation

Long name	Level	Type	Value Range	Documentation
Primary heading Source	4	Choice	"NoCompass", "GPS", "Compass", "Manual", "SatTant", "VectorCompass"	The device to use as the primary source of the heading.
Secondary Heading Source	1	Choice	"NoCompass", "GPS", "Compass", "Manual", "SatTant", "VectorCompass"	The device to use as the heading source if the primary source fails.
Heading Averaged	4	Choice	"No", "Yes"	This flag indicated if the heading will be averaged during the dwell time.
Compass Heading Offset	1	Float	-180.0 to 180.0	The offset in degrees of the compass device.
Elevation Compass Position	1	Float	-180.0 to 180.0	The Elevation position in degrees, to read the magnetic compass
GPS Source	1	Choice	"Manual GPS", "Compass GPS", "NAV RIOM GPS", "Vector Compass GPS"	The device to use as the source of the GPS location.
Coarse Peaking Source	4	Choice	"RSL Meter 1", "Modem Signal Data", "Beacon Rx", "None"	Signal strength source used for coarse peaking on alternate satellite.
Use Man. GPS on Fail	4	Choice	"No", "Yes"	Flag indicating that the manual GPS entry should be used on GPS failure.

Nav Operation Mode controls the operating mode of the compass located inside the NAV RIOM. It is typically set to "Normal." From time to time, it may be advisable to calibrate the Compass to compensate for vehicle mounting conditions or other similar consistent influences on compass readings. When the parameter is set to "Calibration," the AAQ automatically prompts the operator

through the Compass calibration process. Do not calibrate the compass without consulting AvL technical support.

Heading Source parameters set the primary and secondary sensors or methods that the AAQ will use to determine an initial compass heading for the antenna pedestal. These parameters can be viewed or modified in either the main AAQRemote GUI window or the Controller Config window. The standard choices for these parameters are:

- NoCompass – Instead of polling a sensor device for the Heading value, the AAQ will execute a user settable, AZ Line Scan to acquire.
- GPS – AAQ uses the heading provided by the GPS receiver in the NAV RIOM based on the most recent directional motion of the platform.
- Compass – AAQ uses the heading provided by the Compass in the NAV RIOM.
- Manual – AAQ uses the current value of the *Heading for Manual Compass* parameter.
- SatTant – The AAQ executes a SatTant based on the Compass heading to refine the pedestal heading at system initialization.
- VectorCompass – Optional Vector Compass is used at the Heading Source. (optional)

Heading Averaged – Averaging is performed during the compass read part of acquisition. The normal condition for this parameter is “Yes”.

Compass Heading Offset is the nominal difference between the Pedestal Heading and the Compass Heading. This parameter takes into account the difference between the orientation of the Compass device inside the NAV RIOM and the Pedestal. This value is calibrated in the factory, but must be made available at lower user login privilege levels to enable potential NAV RIOM replacement in the field. Do not change this value without the assistance of AvL technical staff.

Based on the *Magnetic Compass* parameter, the AAQ can make the necessary correction for magnetic declination whenever necessary to convert a Compass reading from Magnetic North to the required True North reference frame.

Coarse Peaking Source identifies the default Signal Source that will be used for the Target Satellite during the Coarse Peaking process.

Values for the **Signal Source 1 / 2 / 3** configuration parameters are selected on the left-hand side of the Profile System window (see Figure 6.4). All valid Signal Sources are available for each step in all three Acquisition attempts. As implied in the figure, up to three successive attempts will be made by the AAQ to acquire the Target Satellite based on entries made in the Primary, Secondary and Tertiary sections. This flexibility provides the Level 4 operator with the option of attempting the quickest, possibly least reliable, method first knowing that the system will automatically progress to more robust acquisition schemes. Parameter choices for the standard systems are:

- None – AAQ will skip that step in the Acquisition process.
- RSL – RSL Meter 1 (default)
- Modem (if installed)
- Beacon Receiver (if installed)
- DvB Receiver (if installed)

6.3.3 SATTANT

Long name	Level	Type	Value Range	Documentation
SatTant Heading Timeout	4	Integer	0 to 60000	Time in seconds to invalidate a SatTant based heading

The total validity time for a SatTant based heading is set by the **SatTant Heading Timeout** parameter. Setting the parameter value to “0” keeps the SatTant based heading valid indefinitely or until the next AAQ system reboot. A non-zero value may be selected to insure that a SatTant is repeated each time a new Target Satellite is selected that meets the criteria. However, care should be taken in setting the value such that the SatTant based heading remains valid through completion of the Acquisition process.

6.3.4 Manual Moves

Long name	Level	Type	Value Range	Documentation
Manual Control Azimuth Fast Speed	4	Float	0.1 - 100.0	Speed in degrees per second for manual control of the azimuth motor in fast mode.
Manual Control Azimuth Slow Speed	4	Float	0.1 - 100.0	Speed in degrees per second for manual control of the azimuth motor in slow mode.
Manual Control Elevation Fast Speed	4	Float	0.1 - 100.0	Speed in degrees per second for manual control of the elevation motor in fast mode.
Manual Control Elevation Slow Speed	4	Float	0.1 - 100.0	Speed in degrees per second for manual control of the elevation motor in slow mode.
Manual Control Polarization Fast Speed	4	Float	0.1 - 100.0	Speed in degrees per second for manual control of the pol motor in fast mode.
Manual Control Polarization Slow Speed	4	Float	0.1 - 100.0	Speed in degrees per second for manual control of the pol motor in slow mode.
Manual Control Allow Modem Tx.	4	Choice	"No", "Yes"	When set to “Yes”, does not disable Tx in Manual mode.

The speed at which the antenna moves when manually jogged is set by the *Manual _ Speed* parameters. Each of the three axes is set independently. Two speed settings are available; “Fast” and “Slow.”

The “Fast” setting is typically set to a value at or above the maximum speed that the antenna axis can move. Setting a value higher than the maximum actual speed has no effect, ill or otherwise. Common values are in the area of 1 to 6 degrees per second.

The “Slow” setting is typically set to a very low value. This allows very fine adjustments to be made such that accurate fine peaking on that axis can be easily verified or emulated. Common values are in the area of 0.1 to 2 degrees per second.

Manual Control Allow Modem Tx. makes transmitting from modem possible in manual mode. Typically this is not recommended, given the possibility of unintended interference and should be used with caution.

6.3.5 Acquisition

Long name	Level	Type	Value Range	Documentation
Satellite Inclination Threshold	4	Float	0.0 - 100.0 (deg)	The inclination threshold of the current satellite. Inclination status variable is set when this is exceeded.
Line Scan Polarization Adjust Flag	4	Choice	"No", "Yes"	Flag indicating that the Pol should be adjusted during a line scan. Usually set to Yes.
Compass Scan Width	1	Float	0.0 to 400.0 (deg)	Scan width to use during a SatTant or 0.0 to disable SatTant.
GPS Scan Width	1	Float	0.0 - 400.0 (deg)	Scan width to use during a SatTant or 0.0 to disable SatTant.
Manual Compass Scan Width	1	Float	0.0 to 360.0	Heading scan width in degrees to scan if override compass is selected.
NoCompass Scan Width	1	Float	0.0 - 400.0 (deg)	Scan width to use during a SatTant or 0.0 to disable SatTant.
Polarization Flip Amount	4	Float	-180 to 180	This will be added to pol when target is below CCW limit & subtracted when above CW limit.
Polarization Home Position	4	Float	-180 to 180	Position in degrees of the pol home switch
Pitch Inc Offset	4	Float	-180 to 180	Offset in degrees to add to the pitch inclinometer
Roll Inc Offset	4	Float	-180 to 180	Offset in degrees to add to the roll inclinometer
Azimuth Motor Scale Factor	4	Integer	-100000 to 100000	Unit factor to divide by to produce the actual value needed by code
Azimuth Motor Abs Enc Offset	4	Float	-600.0 to 600.0	The offset in degrees to be added to the read position of the absolute encoder
Azimuth Motor Abs Scale Factor	4	Float	-10000.0 to 10000.0	The factor that will be multiplied to the raw absolute encoder or resolver value
Elevation Motor Scale Factor	4	Integer	-100000 to 100000	Unit factor to divide by to produce the actual value needed by code
Elevation Motor Abs Enc Offset	4	Float	-600.0 to 600.0	The offset in degrees to be added to the read position of the absolute encoder
Elevation Motor Abs Enc Scale Factor	4	Float	-10000.0 to 10000.0	The factor that will be multiplied to the raw absolute encoder or resolver value
Azimuth Pot Scale Factor	4	Float	-10000 to 10000	Value to Divide the rad A/D value to produce a sensor value. The formula for producing a final value is: ((raw number*10000)/scale factor)
Azimuth Pot Offset	4	Float	-360 to 360	The offset added to the converter A/D value.
Signal Wait Time	4	Integer	0 - 1000	Number of seconds to wait for valid signal data from a signal device.

Cross Polarization Disable	4	Choice	"No", "Yes"	Flag indicating that automatic & manual cross pol should be disabled. This is usually set to no.
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The **Satellite Inclination Threshold** parameter sets the satellite inclination angle value that tells the AAQ to switch from standard to Inclined Satellite Acquisition process. In general, the Inclined Satellite Acquisition process takes longer than the standard Acquisition process when the satellite is located close to the equatorial plane. However, if the satellite is significantly inclined, then the Inclined Satellite Acquisition process must be used to assure a high probability of success. The optimal setting for a particular antenna and frequency band is best arrived at empirically. The Inclination of typical commercial satellites is kept within 0.15 degrees. "Inclined" satellite orbits may deviate to as much as 5 degrees or more.

Satellite Inclination should be set to the published value for the Target Satellite. If the Target Satellite is listed as "Geostationary" and no inclination value is provided, then a value of "0.0" is usually a good choice. If a successful acquisition is not consistently occurring on the first Acquisition AZ line scan, then this satellite property should be verified by other means.

The **Line Scan** parameters establish the overall height and number of lines used in the standard Acquisition raster scan. **Line Scan Pol Adjust Flag** – This indicates that the Pol should be adjusted during a line scan. Usually set to Yes.

The **Scan Width** parameter sets the width of the AZ Line Scan used for SatTant as well as Target Satellite Acquisition purposes. The scan width should be based primarily on the assumed accuracy of the Heading Source. The scan width for each valid *Heading source* (see Section 6.3.3) can be set independently using these parameters. If SatTant is selected as the *Heading source*, then the **Compass Scan Width** value **will be used for the SatTant scan and the Target Satellite will be acquired directly without scanning.**

Pitch Inc Offset & Roll Inc Offset are factory settings where access is reserved for field service requirements. Consult AvL technical staff before making changes.

Motor Offset - Because of variations in manufacturing tolerance, it occasionally becomes necessary to add a small angular value to correct for mechanical error in the axis. This should not be adjusted unless the system has been repaired. (includes **Abs Encoder Offset**)

Motor Scale Factor - Because of variations in manufacturing tolerance, it occasionally becomes necessary to change the scale factor to correct for mechanical error in the axis. This should not be adjusted unless the system has been repaired. (includes **Abs Encoder Scale Factor**)

Signal wait time – If signal device (modem, beacon receiver etc.) has not provided a valid signal and wait time has been exceeded, the controller will then proceed to the secondary, then tertiary acquisition method. Should these also fail to acquire, the controller will present the user with the message, "Acquisition Failed, Waiting for Beacon / Modem Signal"

6.3.6 Time

Long name	Level	Type	Value Range	Documentation
NTP Server IP Address	1	String	-	IP Address for the NTP (time) server. Leave blank to not use an NTP server.
NTP Server Port	1	Integer	0 - 65536	Port number used to communicate with the NTP server (123 is the default).
Time Source	1	Choice	"None", "NTP", "NAV RIOM GPS", "XML"	Time source used by the controller for time synchronization.
Time Service Maximum GPS Drift	4	Float	-	Time Service Max GPS Drift
AvL Compass Com Port	4	String	-	The computer device filename for the communications port used for serial and the IP address used for Ethernet
AvL Compass Com Port Settings	4	String	-	The communications parameters for the comm port in the form of BaudRate DataBits StopBits Parity for serial (ie 9600 8 1 0) where parity values are 0, and IP port used for Ethernet.

NTP Server parameters define the IP address and port number for the NTP (Network Time Protocol) server the AAQ should use for time synchronization, assuming one is available for that purpose. If not, then the *IP Address* should be left blank.

The **Time Source** parameter defines the source used by the AAQ for time synchronization purposes. A description of the available choices follows. The default value for this parameter is "None."

- None – AAQ will use its internal time reference. Time stamps in AAQ system logs will reflect time since system start-up, with time zero equal to 0:00 AM on 1 January 2000.
- NTP – AAQ will use the NTP server with the IP address and port number specified by the *NTP Server* configuration parameters.
- NAV RIOM GPS – AAQ will synchronize its time with its own GPS receiver inside the NAV RIOM. Prior to receiving a valid GPS message from the receiver, the AAQ will use its own internal time reference.

The **Time Service Maximum GPS Drift** measures the differential in time between GPS time readings that compares to the time increment reported, if exceeded, a GPS time error is indicated.

The **AvL Compass** settings are needed when the system time source is set to GPS.

6.3.7 Other Core Parameters

Long name	Level	Type	Value Range	Documentation
Modem Tx Restore On Open	4	Choice	"No", "Yes"	Restore the modem Tx enable when modem is reopened after a failure.
Modem Tx Enable On Rx Lock	4	Choice	"No", "Yes"	Set modem Tx enabled if Rx Lock is received during idle processing.

Run Position Hold on Startup	4	Choice	"No", "Yes"	This flag indicates whether position hold should be run on startup if an Rx lock is detected
Position Hold Run Acquire on Peak Fail	1	Choice	"No", "Yes"	If set to yes then the acquire command will be run if peaking fails to find a lock during position hold.
Controller Name	4	String	-	Name of the controller
Controller Serial Number	4	String	-	Serial number of the controller
Panel Connect Blocks Others	1	Choice	"No", "Yes"	This flag indicates whether other clients are blocked when connected.
Rack Controller Field 0 - 9	1	String	-	Field Name for a single field to display in the rack controller. Blank will skip the field
Rack Controller Label 0 - 9	1	String	-	Label for a single field to display in the rack controller.
Repeak On Power On When Rx Locked	4	Choice	"No", "Yes"	This flag indicates that system should run re-peak on power up if the Rx lock is active.
Step Mode Sample Delay	4	Integer	0 to 1000	Delay in MS between testing and retrying the step jog mode move
Step Mode Wobble Correction	4	Choice	"No", "Yes"	Flag indicating that wobble correction should be performed when the Pol is changed
Circular Polarization Center Position	4	Float	-90 to 90	Center position, in degrees, Of the motorized circular pol
Feed Bit Override	4	Choice	"No", "Yes"	Flag indicating whether the feed bits are overridden with a manual value
Feed Bit Override Type	4	Choice	, "C-LP", "X-LP", "Ku-LP", "Ka-LP", "C-CP", "X-CP", "Ku-CP", "Ka-CP", "L", "S", "Q", "Ka (EXTENDED)", "C-CP (MOTORIZED)", "Ka-CP (MOTORIZED)", "C-LP-2"	Value to override the feed bits with
Manual Control Allows Modem Tx	4	Choice	"No", "Yes"	When set to yes, doesn't disable the tx when manual control is run

The **Modem** configuration parameters are only valid if the AAQ is optionally configured to communicate with the terminal's modem. If this option has been exercised, then these parameters specify the AAQ's response under the specific conditions as described above in the Documentation column. Also see the appendix documentation in accordance with the specific modem used.

The **Controller** parameters are set in the AvL factory and visible at all privilege levels for service and maintenance purposes.

Wobble Correction compensates for any mechanical offset which may occur during the movement of the feed assembly and its operation depends upon the specific feed type used.

The **Feed Bit Override** parameter, extends the choices available to the controller outside the information provided by the feed bit logic output which comes from the feed itself. This also allows proper use of feeds which do not have feed bit control.

6.4 Automatic Operation - Target

Configuration of the AAQ's automated features is made on a Target Satellite or Signal Source specific basis using the Profile System. The steps necessary to create and manage Profiles are described in Chapters 4 & 5 of this document. In this section, the configuration parameters contained in these Profiles are detailed.

The Signal Sources and Acquisition Geometry may be defined for each Target Satellite independently by setting up a Profile. In this way, reliable satellite detection and good signal quality for antenna peaking purposes can be assured for all satellites of interest.

Without this critical flexibility, antenna performance could be significantly compromised by satellites that vary widely in their signal characteristics. The parameters and sources that may be tailored for a specific satellite are accessible through the Profile System window of the AAQRemote GUI. An example is shown in Figure 6.4.

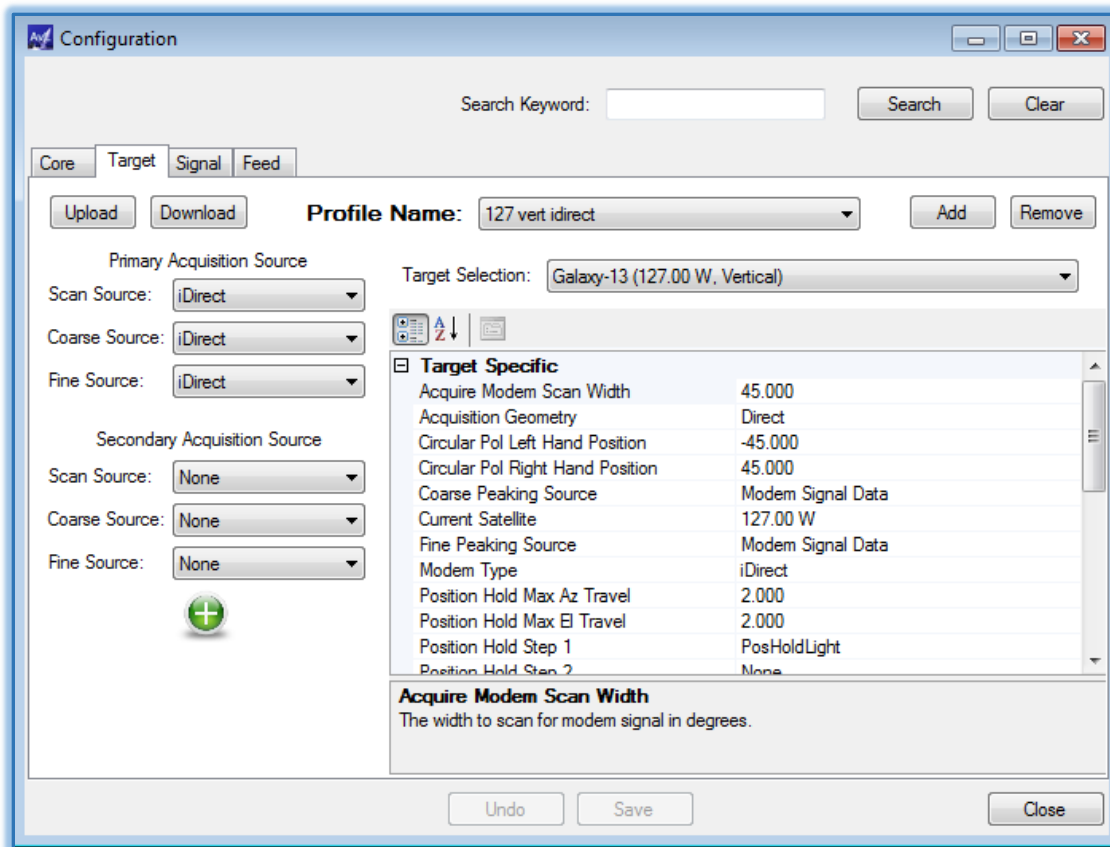


Figure 6.4 - AAQ Target and Profile System Window

6.4.1 Target Satellite

Long name	Level	Type	Value Range	Documentation
Current Satellite Inclination	1	Float	-100 to 100	The inclination of the current satellite. (degrees)
Current Satellite	1	String	-	The longitude of the satellite to target during acquire with the numeric portion in decimal degrees and the hemisphere as a single letter (ie 61.5 W).
Current Satellite Polarization	1	Choice	"Horizontal", "Vertical"	Feed orientation for the selected satellite (Horizontal/Vertical).
Reference Profile 1	1	Choice	All Listed	First reference profile used to perform a Ref Sat Acquisition
Reference Profile 2	1	Choice	All Listed	Second reference profile used to perform a Ref Sat Acquisition
Reference Satellite Mode	4	Choice	"No", "Yes"	Flag indicating that reference profiles should be used if a heading is needed.

Note – The three following parameters are entered automatically when a target satellite is selected. These may be changed from the Satellite List.

Satellite Inclination should be set to the published value for the Target Satellite. If the Target Satellite is listed as “Geostationary” and no inclination value is provided, then a value of “0.0” is usually a good choice. If a successful acquisition is not consistently occurring on the first Acquisition AZ line scan, then this satellite property should be verified by other means.

Current Satellite should be set to the Longitude value of the Target Satellite. Format is important for this parameter. It must be entered in decimal degrees followed by a space and a single letter indicating hemisphere (e.g. 61.5 W or 110.0 E).

Satellite Orientation is critical for linearly polarized satellite signals. It should be chosen to match the linear polarization of the Target Satellite’s downlink (receive) signal. This value is used by the AAQ to correctly position the Polarization Axis of the antenna. If the Target Satellite is circularly polarized, then the value of this parameter is ignored by the AAQ.

Reference Satellite Mode performs two checks to determine if either Reference Profile is valid for use in locating the Target Satellite. The first check looks to see if either Reference Satellite is within the SatTant Min Long dif (typically 20 degrees) Core Configuration setting available for reading and writing at level 7 and above. The second check looks to see that the elevation of the Reference Satellite is greater than zero degrees. If both Reference Satellites are valid, then the closest is used for reference. If both Reference Satellites fail, then the AAQ performs a SatTant to locate the Target Satellite.

6.4.2 Target Sources

Long name	Level	Type	Value Range	Documentation
Modem Type	4	Choice	"None", "RSL"	Type of modem installed.
RSL 1 Attenuation	4	Choice	"0 dB", "1 dB", "2 dB", "4 dB", "8 dB", "16 dB", "31.5 dB"	Specifies the attenuation of the built in RSL meter.
Satellite Signal Source	4	Choice	"None", "Modem", "Beacon"	Signal source of the 'modem' satellite.
Coarse Peak Signal Source 1 - 3	1	Choice	"None", "RSL", modem, beacon see description below	Type of modem, beacon if installed.
Fine Peak Signal Source 1 - 3	1	Choice	"	Type of modem installed.
Scan Signal Source 1 - 3	1	Choice	"	Type of modem installed.

The choice made for **Modem Type** tells the AAQ which device will be providing the Modem Data Signal. The drop-down menu will contain all valid choices for the AAQ as configured for that particular system, which might include multiple optional Modem makes and models and / or a Beacon Receiver. With no optional device Modules installed, the choices for this parameter are:

- None legacy?
- RSL – RSL Meter 1

The **RSL Attenuation** parameters set the input attenuator value for the broadband power meter to discrete values ranging from 0.0 to 31.5 dB. By properly adjusting this parameter value for each satellite, the RSL meter remains within its linear range at maximum received signal levels and dynamic range is also maximized. Good dynamic range and linear performance insures robust, more reliable Acquisition and optimal Fine Peaking on the satellite signal.

Sat Signal Source identifies the default Signal Source that will be used for the Target Satellite during the Acquisition (Scan) process. Choices for this parameter are:

- None - AAQ will skip that step in the Acquisition process.
- Modem – The modem signal is used provided the AAQ has been optionally configured to interface with the Modem. Otherwise, the AAQ will use RSL Meter 1.
- Beacon – The signal level reported by the Beacon Receiver is used provided the AAQ has been optionally configured to interface with that device. Otherwise, the AAQ will use RSL Meter 1.

Values for the **Signal Source 1 / 2 / 3** configuration parameters are selected on the left-hand side of the Profile System window (see Figure 6.4). All valid Signal Sources are available for each Acquisition and Peaking step in all three Acquisition attempts. As implied in the figure, up to three successive attempts will be made by the AAQ to acquire the Target Satellite based on entries made in the Primary, Secondary and Tertiary sections.

This flexibility provides the Level 4 operator with the option of attempting the quickest, possibly least reliable, method first knowing that the system will automatically progress to more robust acquisition schemes. Parameter choices for the standard systems are:

- None – AAQ will skip that step in the Acquisition process.
- RSL – RSL Meter 1
- Modem (if installed)
- Beacon Receiver (if installed)
- DvB Receiver (if installed)

6.4.3 Target Acquisition

Long name	Level	Type	Value Range	Documentation
Acquisition Geometry	4	Choice	*"Direct"	The acquisition geometry module to use during the acquisition process.
Acquire Modem Scan Width	1	Float	1.0 - 45.0	The width to scan for modem signal in degrees.
Satellite Polarization Offset	4	Float	-180 - 180 (deg)	The pol correction to be added to the calculated pol position during the targeting sequence.
Use Secant Correction	4	Choice	"Yes", "No"	Flag indicating whether to use a SECANT correction on azimuth scans
Disable Scans	4	Choice	"Yes", "No"	Flag indicating that a compass scan over the target should not be run (yes = do not run scans)

Acquisition Geometry selects the AZ and EL search pattern, or geometry, which will be used during the Acquisition process for the Target Satellite. The standard AvL antenna ships with a single Geometry Module that performs a Direct search referred to elsewhere in this document as a raster scan.

A single AZ Line Scan is performed centered at the predicted satellite location. If this initial scan is not successful, then the EL angle is changed by a user specified amount and the AZ Line Scan is repeated. *If optional Geometry Modules are included in the AAQ software, then they will also appear as choices in the drop-down menu list for this parameter.

Acquire Modem Scan Width defines the AZ and EL scan widths that are used to acquire the Target Satellite after the Heading has been refined by either a successful SATTANT satellite acquisition or previous acquisition of a Target Satellite. Under these conditions, the heading is known with higher precision and a much smaller scan angle is sufficient to locate the current Target Satellite. Smaller scan angles are particularly advantageous when the Signal Source is the RSL Meter, as this minimizes the chance that a stronger neighboring satellite will be detected and peaked upon.

Satellite Polarization Offset is used to include the published linear polarization offset, or skew, for the Target Satellite in the POL pointing solution. For example, Eutelsat's fleet of satellites employ a 3.5 degree skew in their linear polarization vector.

The use of **Secant Correction** is determined by the design of the antenna system. This parameter is generally not changed from the factory test setting.

The **Disable Scans** Flag indicates that a compass scan over the target will not be run. Choosing "Yes" will prevent scans from being run. This allows the controller to use the original heading source instead of performing a SatTant or in the case where TLE tracking is used. If signal sources with good satellite signal discrimination are going to be used and short acquisition times are essential, then the time required to complete a SatTant under normal conditions may always be avoided by choosing "Yes" for this parameter. Note: This will increase the probability of acquiring the wrong satellite if the RSL signal source plays any role in the systems Acquisition or Peaking processes defined later in this section.

6.4.4 Other Target Based Parameters

Long name	Level	Type	Value Range	Documentation
Tx Enable Before Fine Peak	4	Choice	"No", "Yes"	If enabled then Tx is enabled before fine peaking otherwise Tx is enabled after acquisition.

Circular Polarization Left Hand Position	1	Float	-90 to 90	Left hand position, in degrees, Of the motorized circular pol
Circular Polarization right Hand Position	1	Float	-90 to 90	Right hand position, in degrees, Of the motorized circular pol
Circular Polarization Position	1	Choice	"Center", "Left Hand", "Right Hand",	Polarization target for motorized circular pols
Run Position Hold After Acquire	1	Choice	"No", "Yes"	Flag indicating that Position Hold should run after a successful acquisition.
Run Position Hold After Peak Cmd	1	Choice	"No", "Yes"	Flag indicating that Position Hold should run after a successful peaking routine.
Position Hold Step 1 (through 4)	4	Choice	"No", "Yes"	Position Hold / Tracking module to use. Up to 4 can be called, each with a different configuration item
Skip Acquire Sat State	1	Choice	"No", "Yes"	Flag indicating whether the acquire state should be set performed before entering track mode.

If a Modem Module is present in the AvL antenna system and it supports a TX enable / disable command, then the ***Tx Enable Before Fine Peak*** parameter may be used to modify when the TX Enable command is sent to the Modem by the AAQ. This flag is typically not set (Value = "No") by default and the TX Enable command is sent after Fine Peaking is completed.

When set (Value = Yes), the ***Run Position Hold After Acquire*** (tracking option) instructs the AAQ to start the Position Hold process immediately after completion of the Acquisition process. Examples of the Position Hold process are Tracking and Wind Hold, which are optional AAQ features enabled by additional Software Modules.

Some optional modes of operation such as TLE and Predictive Track do not require a standard acquisition. For these, the ***Skip Acquire Sat State*** is enabled to allow these tracking modes to begin immediately.

6.5 Signal Source Based Parameters

Properly configuring the parameters in the previous section assures that a good signal will be made available to every Signal Source device. Since each device has its own characteristics, strengths and weaknesses, the AAQ software gives the Level 4 operator the opportunity to fine tune the Acquisition and Peaking processes for each Signal Source. Those parameters are available for viewing and modification in the AAQRemote's Profile Signal Source Window. An example of this window appears in Figure 6.5.

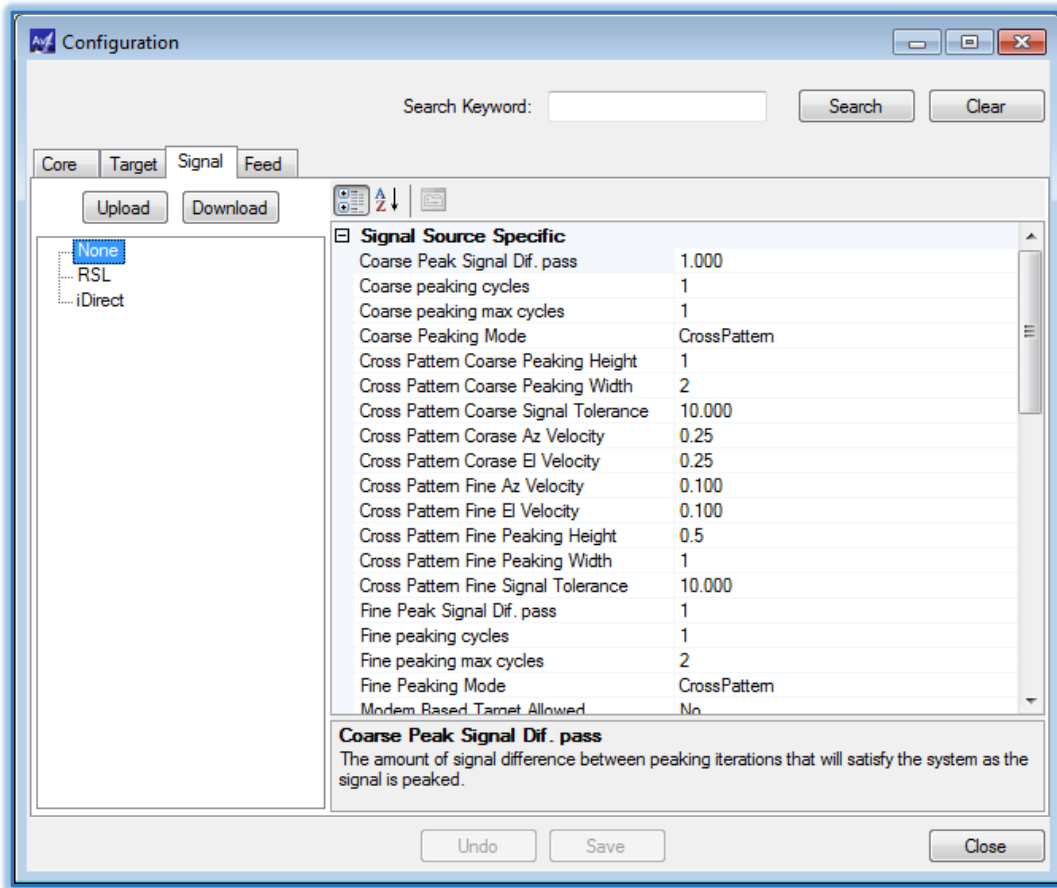


Figure 6.5 - AAQRemote Profile Signal Source Window

6.5.1 Acquisition

Long name	Level	Type	Value Range	Documentation
Scan Azimuth Velocity	4	Float	0.01 - 60.0 (deg/sec)	Azimuth scanning maximum velocity used in scanning movements.
Scan Elevation Velocity	4	Float	0.01 - 60.0 (deg/sec)	Elevation scanning maximum velocity used in scanning movements.
Scan Polarization Velocity	4	Float	0.01 - 60.0 (deg/sec)	Polarization scanning maximum velocity used in scanning movements.
Slow Scan Azimuth Velocity	4	Float	0.01 - 60.0 (deg/sec)	Azimuth slow scanning maximum velocity used in scanning movements.
Slow Scan Elevation Velocity	4	Float	0.01 - 60.0 (deg/sec)	Elevation slow scanning maximum velocity used in scanning movements.
Slow Scan Polarization Velocity	4	Float	0.01 - 60.0 (deg/sec)	Polarization slow scanning maximum velocity used in scanning movements.
Peaking Ignore Noise Level	4	Choice	"No", "Yes"	Select "Yes" to ignore calculated noise. Select "No" to only peak on signal changes greater than the noise.

These **Scan Velocity** parameters set the maximum speed that each axis is allowed to move when the indicated scan speed is used by the AAQ.

Speeds should be selected with the delay and response time of the device in mind. For example, if the device's signal output level is slow to respond to actual changes in signal level, then setting a relatively slow scan speed is advisable. If scan speed is set too slow, acquisition time will lengthen unnecessarily.

Note - Picking a value above the actual maximum speed of any axis will result in motion at the actual maximum speed and will have no detrimental effect to the system.

6.5.2 Coarse Peaking

Long name	Level	Type	Value Range	Documentation
Coarse Peaking Cycles	4	Unsigned	0 to 100	Number of cycles to complete for coarse peaking. (0=1 Az only, 1 = 1Az and 1 El only)
Coarse Peaking Maximum Cycles	4	Unsigned	0 to 100	Maximum number of cycles to complete before Coarse Peaking stops.
Coarse Peaking Mode	4	Choice	"None", "Cross Pattern", "Step Pattern", Plateau Peaking	The peaking method to use for Coarse Peaking routines
Coarse Peak Signal Difference Threshold	4	Float	0.1 to 100	The amount of signal difference between peaking iterations that will satisfy the system as the signal is peaked.

Coarse peaking cycles sets the minimum number of cycles that will be completed in the Coarse Peaking process regardless of any improvement made in antenna pointing (received signal level) at the completion of each cycle.

Coarse peaking Maximum Cycles sets the maximum number of Coarse Peaking cycles that may be completed before the process is terminated. This parameter insures that the antenna does not fall into an "infinite do loop" attempting to satisfy the *Coarse Peak Signal Dif. pass* parameter that may have been set too low for current conditions.

The Coarse Peak Signal Difference Threshold parameter establishes the success criteria for the cyclical Coarse Peaking process. At the completion of each Coarse Peaking cycle, the final signal level value achieved in the previous cycle is subtracted from the final signal value achieved in the latest cycle. If the magnitude of that difference is equal to or less than the value of this parameter, then the Coarse Peaking process is deemed to be complete. Else another Coarse Peaking cycle is performed.

6.5.3 Fine Peaking

Long name	Level	Type	Value Range	Documentation
Fine Peaking Cycles	4	Unsigned	0 to 100	Number of cycles to complete for fine peaking. (0 = 1 az only, 1=1 az and 1 el only)
Fine Peaking Mode	4	Choice	"None", "CrossPattern", "StepPattern", Plateau Peaking	The selection of the peaking method used for fine peaking routines.
Fine Peaking Maximum Cycles	4	Unsigned	1 to 100	Maximum number of cycles to complete for fine peaking stops.
Fine Peak Signal Difference Threshold	4	Float	0.1 to 100.0	The amount of signal difference between peaking iterations that will satisfy the system as the signal is peaked.

Fine Peaking Cycles sets the minimum number of cycles that will be completed in the Fine Peaking process regardless of any improvement made in antenna pointing (received signal level) at the completion of each cycle.

Fine Peaking Maximum Cycles sets the maximum number of Fine Peaking cycles that may be completed before the process is terminated. This parameter insures that the antenna does not fall into an "infinite do loop" attempting to satisfy the *Fine Peak Signal Dif. pass* parameter that may have been set too low for current conditions.

The *Fine Peak Signal Difference Threshold* parameter establishes the success criteria for the cyclical Fine Peaking process. At the completion of each Fine Peaking cycle, the final signal level value achieved in the previous cycle is subtracted from the final signal value achieved in the latest cycle. If the magnitude of that difference is equal to or less than the value of this parameter, then the Fine Peaking process is deemed to be complete. Else another Fine Peaking cycle is performed.

6.5.4 Cross Pattern - Coarse Peaking

Long name	Level	Type	Value Range	Documentation
Cross Pattern Coarse Peaking Width	4	Float	0.0 to 60.0	Width in degrees to scan during a coarse cross pattern peaking function.
Cross Pattern Coarse Peaking Height	4	Float	0.0 to 60.0	Height in degrees to scan during a coarse cross pattern peaking function.
Cross Pattern Coarse Azimuth Velocity	4	Float	0.02 to 30.0	Azimuth velocity in degrees/sec for coarse peaking.
Cross Pattern Coarse Elevation Velocity	4	Float	0.02 to 30.0	Elevation velocity in degrees/sec for coarse peaking.
Cross Pattern Coarse Signal Tolerance	1	Float	0.0 to 1000.0	Signal degradation amount before a scan stops.
Cross Pattern Fine Signal Tolerance	4	Float	0 to 1000	Signal degradation amount before a scan stops

Coarse Cross Peaking is the standard method used by the AAQ for Coarse Peaking on the received satellite signal.

The **Cross Pattern Coarse Peaking** parameters set the total AZ width and EL height of the “cross” that will be scanned. These parameters should be set sufficiently large enough to insure that Coarse Peaking is not performed in a side lobe of the antenna beam. However, making them overly large will add time to the overall Acquisition process and increase the chance that the signal from a stronger neighboring satellite will be used for Coarse Peaking.

The **Cross Pattern Coarse Velocity** parameters specify the speed that the antenna will move in each direction during the signal level measurement scans. As was true for the Scan Velocity parameters, the possibly sluggish response time of the Signal Source and the desire for short Acquisition times must be considered.

Cross Pattern Coarse Signal Tolerance sets a tolerance on acceptable signal drop between coarse peaking cycles. This is also used to set plateau levels when using Plateau Peaking.

Cross Pattern Fine Signal Tolerance sets a tolerance on acceptable signal drop between fine peaking cycles. This is also used to set plateau levels when using Plateau Peaking.

6.5.5 Cross Pattern - Fine Peaking

Long name	Level	Type	Value Range	Documentation
Cross Pattern Fine Azimuth Velocity	4	Float	0.02 - 30.0	Azimuth velocity in degrees/sec for fine peaking.
Cross Pattern Fine Elevation Velocity	4	Float	0.02 - 30.0	Elevation velocity in degrees/sec for fine peaking.
Cross Pattern Fine Peaking Width	4	Float	0.0 - 60.0	Width in degrees to scan during a fine cross pattern peaking function.
Cross Pattern Fine Peaking Height	4	Float	0.0 - 60.0	Height in degrees to scan during a fine cross pattern peaking function.
Cross Pattern Fine Signal Tolerance	1	Float	0.0 to 1000.0	Signal degradation amount before a scan stops.

“Fine Cross Peaking” is an alternate method used by the AAQ for Fine Peaking on the received satellite signal. As currently designed, this option must be requested by the customer before the antenna leaves AvL.

The **Cross Pattern Fine Velocity** parameters specify the speed that the antenna will move in each direction during the signal level measurement scans. As was true for the Scan Velocity parameters, the possibly sluggish response time of the Signal Source and the desire for short Acquisition times must be considered.

The **Cross Pattern Fine Peaking** parameters set the total AZ width and EL height of the “cross” that will be scanned. These parameters should be set sufficiently large enough to insure that the peak of the antenna’s Main Beam is included in the scan. However, making them overly large will add time to the overall Acquisition process.

Cross Pattern Fine Signal Tolerance sets a tolerance on acceptable signal drop between peaking cycles. If this parameter value is exceeded, then the AAQ assumes that the satellite signal is experiencing a Rain Fade and the peaking process is suspended.

6.5.6 Step Pattern Mode

Long name	Level	Type	Value Range	Documentation
Peaking Azimuth Travel Limit	4	Float	0.1 - 100.0 (deg)	The maximum amount of degrees that the azimuth axis can be moved during a single peaking cycle.
Peak Dwell Iterations	4	Unsigned	1 - 100	Number of peaking iterations to look for signal changes.
Peaking Elevation Travel Limit	4	Float	0.1 - 100.0 (deg)	The maximum amount of degrees that the elevation axis can be moved during a single peaking cycle.

Peaking Travel Limit parameters set a maximum limit on AZ and EL travel during the Step Peaking process. This way a reasonable search area can be defined that prevents the system from peaking on noise for an extended period of time should a weak satellite signal be lost during the Step Peaking process. When one of these limits is exceeded, Step Peaking is terminated and a message is displayed in the GUI.

Peak Dwell Iterations defines the number of signal measurements that will be averaged to determine the pointing metric for that particular step and hence the dwell time at the end of each step. An individual signal measurement takes 0.012 seconds (where 1 second = 50 samples). If a noisy signal environment is anticipated, then this parameter should be changed. As this parameter is Modem Specific, a general value of between 100 to 200 is used for the RSL Signal Source.

6.5.7 Step Pattern - Coarse Peaking

Long name	Level	Type	Value Range	Documentation
Step Pattern Coarse Azimuth Velocity	4	Float	0.02 to 30.0	Azimuth velocity in degrees/sec for coarse peaking.
Step Pattern Coarse Elevation Velocity	4	Float	0.02 to 30.0	Elevation velocity in degrees/sec for coarse peaking.
Step Pattern Coarse Peaking Azimuth Step	4	Float	0.0 to 60.0	Width in degrees to scan during a fine step pattern peaking function.
Step Pattern Coarse Peaking Elevation Step	4	Float	0.0 to 60.0	Height in degrees to scan during a fine step pattern peaking function.

The **Step Pattern Coarse Velocity** parameters specify the speed at which the antenna will move during each step. Higher speeds tend to make the process run quicker, at the expense of position accuracy. Setting the value too high may actually slow the process down as the AAQ is forced to correct for frequent over-shoot of the target position.

6.5.8 Step Pattern - Fine Peaking

Long name	Level	Type	Value Range	Documentation
Step Pattern Fine Peaking Azimuth Step	4	Float	0.0 to 60.0	Width in degrees to scan during a fine step pattern peaking function.
Step Pattern Fine Peaking Elevation Step	4	Float	0.0 to 60.0	Height in degrees to scan during a fine step pattern peaking function.
Step Pattern Fine Azimuth Velocity	4	Float	0.02 to 30.0	Azimuth velocity in degrees/sec for fine peaking.
Step Pattern Fine Elevation Velocity	4	Float	0.02 to 30.0	Elevation velocity in degrees/sec for fine peaking.

Fine Step Peaking is the standard method used by the AAQ for Fine Peaking on the received satellite signal.

Step Pattern Fine Peaking Step parameters dictate the size of the steps made along each axis during Fine Step Peaking. This parameter should be set consistent with the user's tolerance for beam pointing error. Smaller step sizes generally lead to smaller final pointing errors at the expense of a longer overall peaking time. There is a limit to how small a step size should be used. This is based on the position control accuracy of the antenna system and is feed / aperture specific.

The **Step Pattern Fine Velocity** parameters specify the speed at which the antenna will move during each step. Higher speeds tend to make the process run quicker, at the expense of position accuracy which leads to pointing inaccuracies. Setting the value too high may actually slow the process down as the AAQ is forced to correct for frequent over-shoot of the target position.

6.5.9 Plateau Peaking

Long name	Level	Type	Value Range	Documentation
Plateau Peaking Coarse Azimuth Velocity	4	Float	0.02 to 30.0	Azimuth velocity in degrees/sec for coarse peaking.
Plateau Peaking Coarse Elevation Velocity	4	Float	0.02 to 30.0	Elevation velocity in degrees/sec for coarse peaking.
Plateau Peaking Fine Azimuth Velocity	4	Float	0.02 to 30.0	Azimuth velocity in degrees/sec for fine peaking.
Plateau Peaking Fine Elevation Velocity	4	Float	0.02 to 30.0	Elevation velocity in degrees/sec for fine peaking.

Plateau Peaking is a function used only with certain types of modem systems, where the signal feedback reaches a limit over the course of a scanning sequence. The differential in degrees is measured during this limit and a pointing “center” is calculated for the acquisition solution.

6.5.10 Polarization Peaking

Long name	Level	Type	Value Range	Documentation
Peaking Polarization Travel Limit	4	Float	0.1 to 100.0 (deg)	The maximum amount of travel the pol can be moved during a single peaking cycle.
Polarization Peak Coarse Azimuth Velocity	4	Float	0.02 to 30.0	Azimuth velocity in degrees/sec for coarse peaking.
Polarization Peak Coarse Elevation Velocity	4	Float	0.02 to 30.0	Elevation velocity in degrees/sec for coarse peaking.
Polarization Peak Fine Azimuth Velocity	4	Float	0.02 to 30.0	Azimuth velocity in degrees/sec for fine peaking.
Polarization Peak Fine Elevation Velocity	4	Float	0.02 to 30.0	Elevation velocity in degrees/sec for fine peaking.
Polarization Dwell Iterations	4	Unsigned	1 to 100	Number of peaking iterations to pause for look for signal changes.
Polarization Peaking Step	4	Float	0.0 to 60.0	Width in degrees to scan during a pol peaking function.
Scan Polarization Velocity	4	Float	0.01 to 60.0 (deg/sec)	Pol scanning maximum velocity used in scanning movements.
Polarization Peaking Enabled	4	Choice	"No", "Yes"	If set to “Yes”, then the pol will be peaked after fine peaking

Polarization Peaking is an automated process that may be employed only on specially equipped and supported linearly polarized AvL antenna systems. This new AAQ feature is currently implemented only on satellite systems that utilize a feedback signal metric generated by the NOC and provided to the AAQ via the forward satellite link and the terminal’s Modem (Hughes HX).

6.5.11 Other Signal Based Parameters

Long name	Level	Type	Value Range	Documentation
Modem Based Target Allowed	4	Choice	"No", "Yes"	Allows a modem device to set the azimuth and elevation targets if supported by the modem.
Skip Coarse Peak If Tx Enabled	4	Choice	"No", "Yes"	If set to yes then coarse peaking will be skipped if the modem transmitter is enabled.
Modem Minimum Wait Time	4	Integer	0 - 1000	Minimum seconds to wait for a modem signal during acquire.
Modem Maximum Wait Time	4	Integer	0 - 1000	Maximum seconds to wait for a modem signal during acquire.
Line Scan Maximum Elevation Steps	4	Integer	1 - 100	Initial scan plus the number of el steps to make when an az scan fails.

Line Scan Failure Elevation Step Size	4	Float	0.0 - 45.0 (deg)	The amount of each el step to make when an az scan fails.
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These “Modem specific parameters” are considered common to several types of Modems and are included in the standard set of parameters to avoid issue with duplication in multiple Software Modules. If no Modem module is present, then these parameter values have no influence on the behavior of the AAQ and the AvL antenna system.

Modem Minimum Wait Time – During acquisition, the controller will wait this amount of seconds before attempting to read the modem signal level.

Modem Maximum Wait Time – If the AAQ controller has acquired but modem has not acquired and wait time has been exceeded, the controller will then proceed to the secondary, then tertiary acquisition method. Should these also fail to acquire, the controller will present the user with the message, “Acquisition Failed, all signal sources tried”.

The **Line Scan** parameters establish the overall height and number of lines used in the standard Acquisition raster scan. **Elevation Step Size** should be set as large as possible, while at the same time insuring that a satellite located midway in between the lines is easily detected. The number of **Max Elevation Steps** should be selected to set a reasonable overall height for the raster scan. Typical number of 3 is used for default.

6.6 Feed Based Parameters

Long name	Level	Type	Value Range	Documentation
Polarization Feed Type	4	Choice	"XPOL", "COPOL"	Specifies the type of feed the pol used (XPOL/COPOL).
Manual Polarization	1	Choice	"No", "Yes"	Flag indicating whether the pol should be set manually during the acquire sequence.
Polarization RF Offset	4	Float	-10 to 10	Offset in degrees, added to Pol angular value to correct for mechanical error
Elevation Inc Offset	4	Float	-180 to 180	Offset in degrees to add to the elevation inclinometer.
Polarization Pot Offset	4	Float	-360.0 to 360.0	The offset added to the converted A/D value
Polarization Pot Scale Factor	4	Float	- 100000.0 to 100000.0	Value to divide the raw A/D value by to produce a sensor value. The formula for producing a final value is ((raw number*10000)/ scale factor)
Line Scan Polarization Adjust Flag	4	Choice	"No", "Yes"	This flag indicates that the Pol should be adjusted during a line scan. Usually set to Yes.
Polarization Motor Abs Enc Offset	4	Float	-600 to 600	The offset in degrees to be added to the read position of the absolute encoder
Polarization Motor Abs Scale Factor	4	Float	-10000 to 10000	The scale factor that will be multiplied to the raw encoder or resolver value
Polarization Motor Scale Factor	4	Integer	-10000 to 10000	Scale factor to divide by to produce the actual value

Polarization Stow Position	4	Float	-180 to 180	The position in degrees of the pol for the stow routine
Polarization Position Move Max PWM	4	Integer	0 to 1000	Maximum PWM power used in a position move for pol when no encoders are present
Polarization Position Move Min PWM	4	Integer	0 to 1000	Minimum PWM power used in a position move for pol when no encoders are present
Polarization Pos Move PWM Factor	4	Integer	1 to 1000	Pol proportional multiplier to produce a PWM value when no encoders are present.
User Polarization CCW Limit	4	Float	-180.0 to 0.0	The maximum pol position for counter clockwise travel
User Polarization CW Limit	4	Float	0.0 to 180.0	The maximum pol position for clockwise travel
Polarization Center Switch Is Interlock	4	Choice	"No", "Yes"	Flag indicating the digital input as an interlock (blocks other operations when set)
Polarization Motor Abs Enc Scale Factor	4	Float	-999999 to 999999	The scale factor that will be multiplied to the raw absolute encoder or resolver value
Polarization RF Offset	4	Float	-10 to 10	The pol correction can be added to the calculated pol position during the targeting sequence

Many AvL antennas are multiple frequency band capable and employ an interchangeable feed design. This allows the antenna to be easily reconfigured in the field from one polarization and frequency band to another. These two parameters allow the AAQ to operate correctly given these multiple feed configurations.

When expressing the polarization of the antenna, AvL employs a received satellite signal convention. When the polarization of a standard cross-polarized linear Ku-band antenna is designated "Horizontal", this means the Receive signal polarization vector is Horizontal and the Transmit signal polarization vector is Vertical. On those rare occasions when the antenna's linearly polarized feed is co-polarized (Transmit and Receive signals share the same linear polarization), there is the potential for polarization mislabeling by the AAQ GUI. A proper setting of *Pol Feed Type* prevents that from happening.

Most of AvL's linearly polarized feeds include an automatic polarization adjustment feature, but not all. All of AvL's circularly polarized feeds employ a quick and easy *Manual Pol* change feature. When this flag is set and the AAQ detects that it is being configured for a change in the polarization value, the operator of the antenna will be prompted to perform a manual change of polarization by the GUI. The AAQ will not proceed past this step until the operator acknowledges that the change has been completed.

Polarization RF Offset - Because of variations in manufacturing tolerance, it occasionally becomes necessary to add a small angular value to correct for mechanical error in Polarization. This should not be adjusted unless the feed has been replaced or repaired. (includes **Abs Encoder Offset**)

Polarization Motor Scale Factor - Because of variations in manufacturing tolerance, it occasionally becomes necessary to change the scale factor to correct for mechanical error in Polarization. This should not be adjusted unless the feed has been replaced or repaired. (includes **Abs Encoder Scale Factor**)

Polarization Pos Move Min PWM and **Pol Pos Move PWM Factor** are factory settings where access is reserved for field service requirements. Consult AvL technical staff before making changes.

“**User**” level limits are specifically designed for the user or integrator so that custom limits can be created without disabling safety limits built into the system.

6.7 Sensor Override

In the unlikely event that the on-board navigation or tilt sensors in the AvL antenna system become unreliable, the operator may override them with values manually entered into the control system through the AAQRemote GUI. The configuration parameters that hold the manually entered values and the flags that trigger their use are detailed in the following sections.

6.7.1 Compass

Long name	Level	Type	Value Range	Documentation
Magnetic Manual Compass	1	Choice	"No", "Yes"	Flag indicating that the manually entered compass heading is magnetic rather than a true heading.
Heading for Manual Compass	1	Float	0.0 - 360.0	Heading in degrees to use as the frame heading if override compass is selected.
Declination Override	4	Choice	"No", "Yes"	Flag indicating that the compass declination should be ignored.

6.7.2 GPS

Long name	Level	Type	Value Range	Documentation
Manual Latitude	1	String	-	The latitude of the antenna to use if manual override for the GPS is selected in decimal degrees and direction (ie: 109.2 N).
Manual Longitude	1	String	-	The longitude of the antennae to use if manual override for the GPS is selected in decimal degrees and hemisphere (ie: 99.2 E).

6.7.3 Tilt

Long name	Level	Type	Value Range	Documentation
Manual Pitch	4	Float	-180 - 180	Manually entered pitch angle in degrees used in tilt override.

Manual Roll	4	Float	-180 - 180	Manually entered roll angle in degrees used in tilt override.
Use Manual Tilt	4	Choice	"No", "Yes"	Flag indicating whether manual tilt values are used.

6.8 System Options

The following section addresses specific equipment and optionally installed AvL modules. Any changes to parameters on systems where options are not installed will have no effect on operation.

6.8.1 NMEA Server

Long name	Level	Type	Category	Value Range	Documentation
NMEA Server Enable	4	Choice	Core	"No", "Yes"	Enables or disables the NMEA Server on the controller.
NMEA Echo Input Com Port	4	String	Core	-	The computer device filename for the communications port used.
NMEA Server Com Port	4	String	Core	-	Com port name (blank for IP address) to use for NMEA server on the controller.
NMEA Server Enable	4	Choice	Core	"No", "Yes"	Enables or disables the NMEA server on the controller
NMEA Server Interval	1	Integer	Core	0 to 65536	NMEA server broadcast interval in seconds
NMEA Server Message Source	4	Choice	Core	"Controller", "Echoed"	The source of the NMEA messages sent to the configured port. "Echoed" indicates a message echoed from a GPS device
NMEA Server Com Port Settings	4	String	Core	-	Com port setting or TCP-IP port number to use for NMEA server on the controller

6.8.2 Slide Motor Feed System

Note – Many of these options are found under the "Core" tab.

Long name	Level	Type	Category	Value Range	Documentation
SlideMotor Abs Enc Offset	4	Float	Sensor	-600.0 to 600.0	The offset in degrees to be added to the read position of the absolute encoder.
SlideMotor Abs Enc Scale Factor	4	Float	Sensor	-10000.0 to 10000.0	The scale factor that will be multiplied to the raw absolute encoder or resolver value.
Slide Motor Enable	4	Choice	Feed	"No", "Yes"	Slide Position Enable (No = slide is disabled)
Slide Motor Stow Position	4	Choice	Positioner	"None", "1", "2", "3"	Slide position to move to before a stow completes
SlideMotor Scale Factor	4	Float	Sensor	-10000.0 to 10000.0	The scale factor to divide by to produce the actual value.
SlideMotor Switch 1 (through 3) is Interlock	4	Choice	Sensor	"No", "Yes"	Flag indicating the digital input as an interlock (blocks other operations when set)

Slide Position 1	4	Float	Modules	-100.0 to 100.0	Numeric slide position representing the left slide position
Slide Position 2	4	Float	Modules	-100.0 to 100.0	Numeric slide position representing the center slide position
Slide Position 3	4	Float	Modules	-100.0 to 100.0	Numeric slide position representing the right slide position

6.8.3 Vector Compass

Long name	Level	Type	Category	Value Range	Documentation
Vector Compass Enable	1	Integer	Core, Sensor	0 or 1	Flag indicating that the compass should be used and powered (1 = powered)
Vector Compass Heading Offset	4	Float	System	-180.0 to 180.0	The offset in degrees of the device
Vector Compass Com Port	4	String	System	-	The filename for the com port used
Vector Compass Com Port Settings	4	Choice	System	"No", "Yes"	The computer settings for the com port, in the form of Baud, Data, Stop & Parity Bits (ie: 9600 8 1 0) where parity values are 0 for none and 1 for even.
Vector Compass Reset	1	Integer	Sensors	0 or 1	Flag indicating that the compass should be reset. (1 = reset now)
Vector Compass Scan Width	1	Float	Modules	0.0 to 400.0	Scan width used during a SatTant or 0.0 to disable SatTant
Vector Compass Separation	4	Float	Modules	0.0001 to 10.0	Separation parameter used to initialize the vector compass

Vector Compass parameters are included to configure and manage the optional high-precision Vector Compass offered on some AvL antenna systems. The **Enable** parameter is persistent and when set insures that the Vector Compass is always powered on and available to the system. When set and Saved, the **Reset** parameter causes the Vector Compass to be re-initialized. The parameter clears automatically (to value = 0) after a successful reset.

6.8.4 Wing System

Long name	Level	Type	Category	Value Range	Documentation
Wing Elevation Safety Switch is Interlock	4	Choice	Sensor	"No", "Yes"	Flag indicating the digital input as an interlock (blocks other operations when set)
Wing Left Stow Switch is Interlock	4	Choice	Sensor	"No", "Yes"	Flag indicating the digital input as an interlock (blocks other operations when set)
Wing Motor Abs Enc Offset	4	Float	Sensor	-600.0 to 600.0	The offset in degrees to be added to the absolute encoder
Wing Motor Abs Enc Scale Factor	4	Float	Sensor	-10000.0 to 10000.0	The scale factor that will be multiplied to the raw absolute encoder or resolver value
Wing Motor Scale Factor	4	Integer	Sensor	-10000.0 to 10000.0	The scale factor to divide by to produce the actual value
Wing Right Deploy Switch is Interlock	4	Choice	Sensor	"No", "Yes"	Flag indicating the digital input as an interlock (blocks other operations when set)
Wing Right Stow Switch is Interlock	4	Choice	Sensor	"No", "Yes"	Flag indicating the digital input as an interlock (blocks other operations when set)

Chapter 7 - Theory of Operation

7.1 Introduction

AvL antenna systems combine the AvL Cable Drive positioning system with a completely automatic satellite acquisition Antenna Control Unit (ACU) to provide ease of operation without needing a satellite technician and the ultimate in reliability under even the most demanding environmental conditions.

Our latest line of antenna systems features our AAQ ACU. The AAQ ACU is a robust system offering a variety of software control functions, high speed sensors, and High-Level integration between hardware and software. This new system is designed for complete integration into new or existing AvL antenna systems.

Key Features of the AvL Cable Drive system:

- Utilizes highly reliable aircraft control cables in a redundant configuration to achieve zero backlash
- Light-weight, very stiff drive system, suitable for high stability requirements such as Ka Band
- Method used to wrap the capstan results in a minimum free length of cable
- The load in the cable on the main drum is exponentially reduced as it is wrapped around the drum, minimizing elongation of the cable under load
- The AvL cable drive system results in stiffness of up to 10 times that of comparable gear or harmonic drive systems.
- The cables are pre-tensioned and spring loaded at the main drum attachment point which eliminates backlash at installation and backlash from any cable stretch in the future

Key features of the AAQ ACU:

- Supports multiple users with unique passwords and levels of access
- Provides an extensive set of configuration items
- All internal measurement and status variables are accessible
- Capability to remotely log any system variables
- Has the ability to run multiple levels of calibration
- Allows remote software upgrading and system diagnostics
- Allows remote and local setting of basic runtime acquisition parameters
- Allows remote and local execution of various position commands
- Provides the ability to monitor system logs and status in real time
- Supports SNMP communication protocol

The ACU is designed to handle all of the antenna operations in a standalone fashion – no external M&C connection is required. It also permits all configuring, operating and monitoring functions remotely through various methods to externally connected computers and other devices. While the system is designed to operate in a standalone fashion, all of the operational aspects can also be performed remotely by a connected device or computer.

7.1.1 Auto-Point Antenna Basics

All AvL transportable satellite antennas employ a parabolic main reflector with a single feed providing optimal RF illumination. The vast majority of our designs are front-fed full offset parabolic reflector antennas that provide exceptional antenna gain efficiency and very low side-lobe radiation characteristics. These antennas produce a very narrow “pencil shaped” beam that must be accurately pointed at a geostationary communications satellite located at a great distance (over 22,000 miles away). Antenna pointing is achieved by an elevation-over-azimuth positioner, or pedestal, that employs high-stiffness, low-backlash cable drive technology. For operation with linearly polarized satellite communication signals, an additional polarization positioner is included that typically rotates only the feed assembly.

All three of the axes are motorized and equipped with position feedback sensors that quantify positioner / antenna pointing in the pedestal coordinate system. Additional sensors on the antenna system such as GPS, magnetic compass and tilt sensors provide critical information that determines the antenna pedestal’s location and orientation relative to the Earth and its geosynchronous communication satellites. This motorized system and all of its sensors are managed by an ACU function that is completely hosted on the antenna system.

When properly equipped, deployed and operated, the antenna system is capable of automatically locating and acquiring the downlink signal of any visible geosynchronous communications satellite within its range of motion based solely on the satellite’s longitude.

7.2 Antenna Drive System

The Drive systems for Azimuth, Elevation and Polarization along with their respective sensor components are described below.

7.2.1 Azimuth Cable Drive

The AvL cable drive system produces a drive system with zero backlash, high stiffness, no wear, no lubrication, and maximum reliability. The system consists of stainless steel aircraft control cables reverse wrapped twice around the grooved capstan, and once around the drum, with solid connections on one end and high force Belleville springs on the other end. The additional cables are

used to provide increased stiffness and drive redundancy. The Azimuth drive components are described in this section.

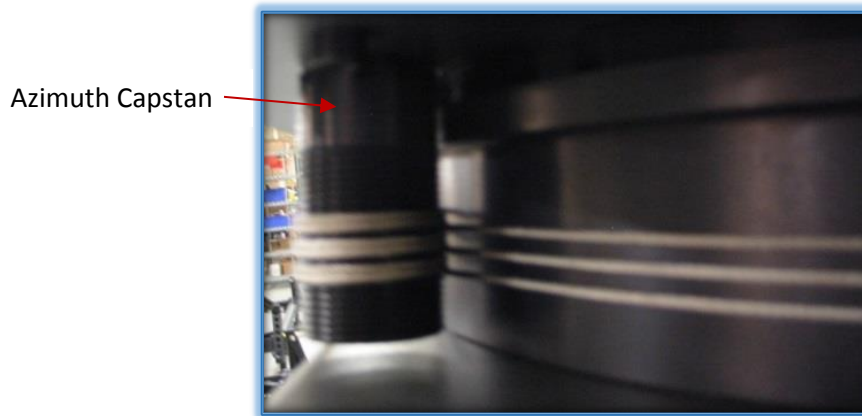


Figure 7.2.1a - Azimuth Capstan

If a cable becomes damaged during usage, remove the cable and continue to use the positioner. The positioner is designed to operate using a single cable if necessary. When time permits the damaged cable should be repaired by an authorized service facility.

The cables are sized to last the life of the positioner. No replacement from wear is expected. The spring packages at one end will automatically compensate for any elongation of the cables. Cable position and stiffness should be checked as per a periodic maintenance schedule.



Azimuth Cable Anchors

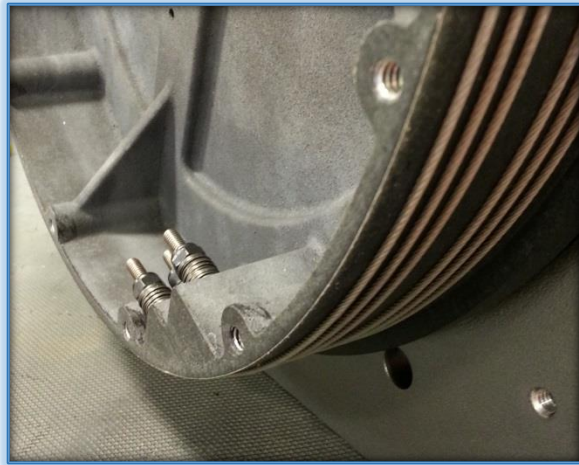


Figure 7.2.1b - Az Cable Drive Assy.

7.2.1.1 ***Azimuth Gear Box***

The azimuth gearbox is a low backlash worm gear type. The worm gear drive isolates any backlash in the motor drive from the system. In addition, the gear box eliminates back-drive, eliminating any need for a brake on the drive train.

The motor drives the input worm via a quill/female hole and square key. The worm shaft is extended with a hex shape installed for the hand crank. The hand crank is utilized to manually manipulate the positioner in the event the controller fails. The azimuth capstan is secured to the output shaft to eliminate any backlash between the capstan and gearbox.

The low backlash is achieved by the selective fit of the worm and worm gear. The gearbox contains synthetic grease to help prevent wear in the gears. Because of the design capacity of the gearbox and low rpm, no maintenance is required.

7.2.1.2 ***Azimuth Position Feedback***

The directional sense of azimuth movement is defined as clockwise (CW) or counter-clockwise (CCW), as viewed by an observer located above the antenna (aerial view or “bird’s eye”).

7.2.1.3 ***Azimuth Potentiometer (POT)***

The azimuth position feedback is produced in part, by a potentiometer. The pot acts as an adjustable voltage divider using a three-terminal resistor with a sliding contact. The pot is driven by the output shaft of the worm gear box. Since the AvL cable drive has no backlash, the position feedback is as accurate as the resolution and accuracy of the potentiometer along with its gear drive interface. The potentiometer is mechanically centered at the travel position when the Az platform is in the Az stow position or its physical center position. Limits are controlled by using inputs from the potentiometer and optical encoder together and are set in, and controlled by, the AAQ controller.

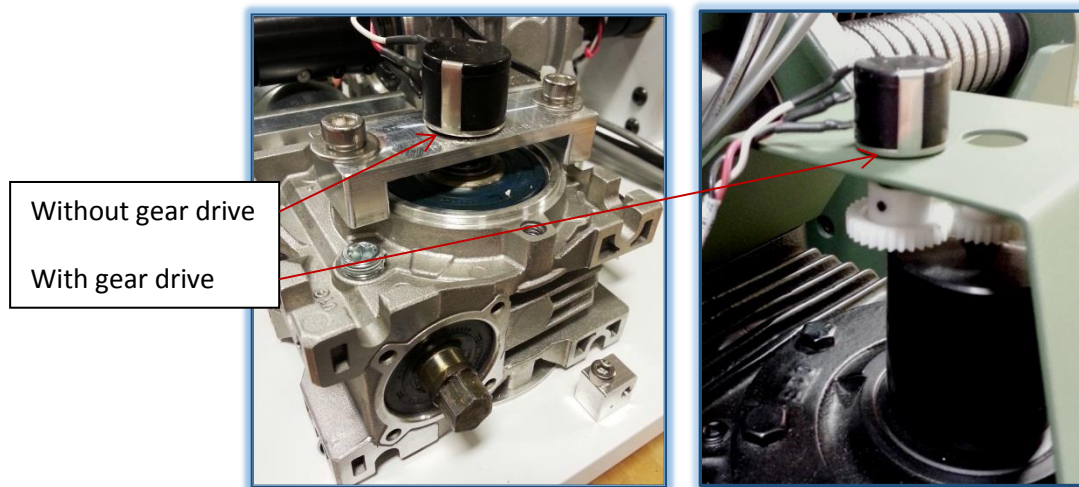


Figure 7.2.1.3 – Az. Potentiometer Examples

7.2.1.4 *Motor Shaft Encoders*

The shaft encoder mounts to the output shaft of the motor, providing a more precise feedback on Azimuth position. The controller uses the output of the azimuth encoder to determine the range of motion from axis point A to point B. The information is then processed by the AAQ and displayed as distance and angular position.

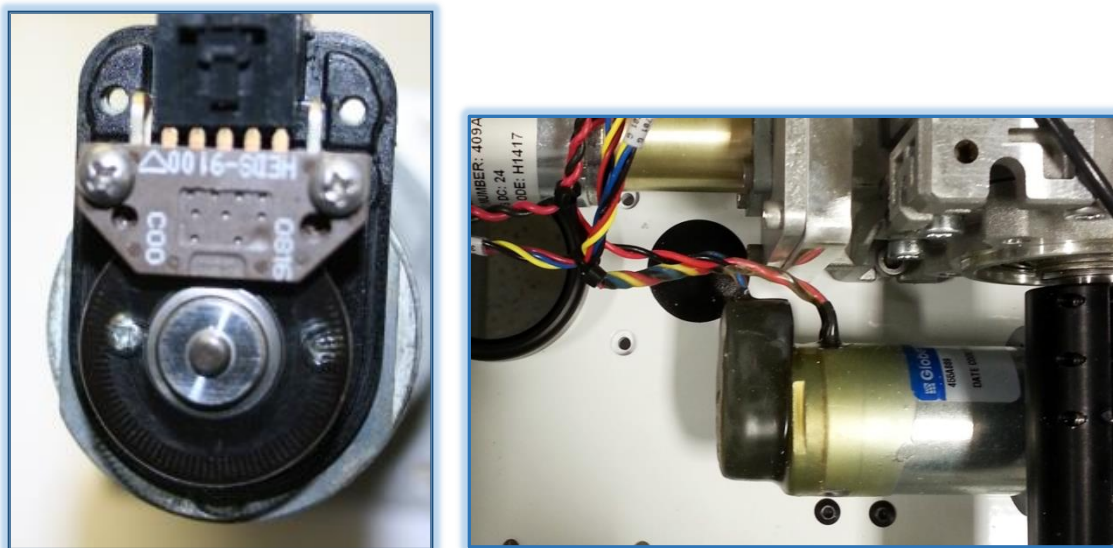


Figure 7.2.1.4 – Motor Encoder

7.2.1.5 *Azimuth Resolver (optional)*

The on axis resolver may be used for more precise motion control. Resolvers are generally used for the elevation and azimuth axis. The resolver is an on-axis sensor and is generally located on the pivot points of the unit to provide highly accurate angular data. This sensor is primarily used in precision movements such as peaking.



Figure 7.2.1.5 – Azimuth Resolver

7.2.1.6 *Azimuth Stow switch*

The controller uses the Az. potentiometer voltage to determine limits. Therefore, the AvL positioner is equipped with only an azimuth stow position switch to determine the stow position. The azimuth stow switch should trigger magnetically at the azimuth physical zero position.

The azimuth stow switch is mounted on the azimuth platform and is accessible under the Az/EI cover. The switch is fixed relative to the mounting surface and is actuated by a permanent magnet located on the azimuth bearing drum.

The logic of “Stowing” and “Acquire” requires that all axes be centered to physical zero for the antenna to complete its cycles.

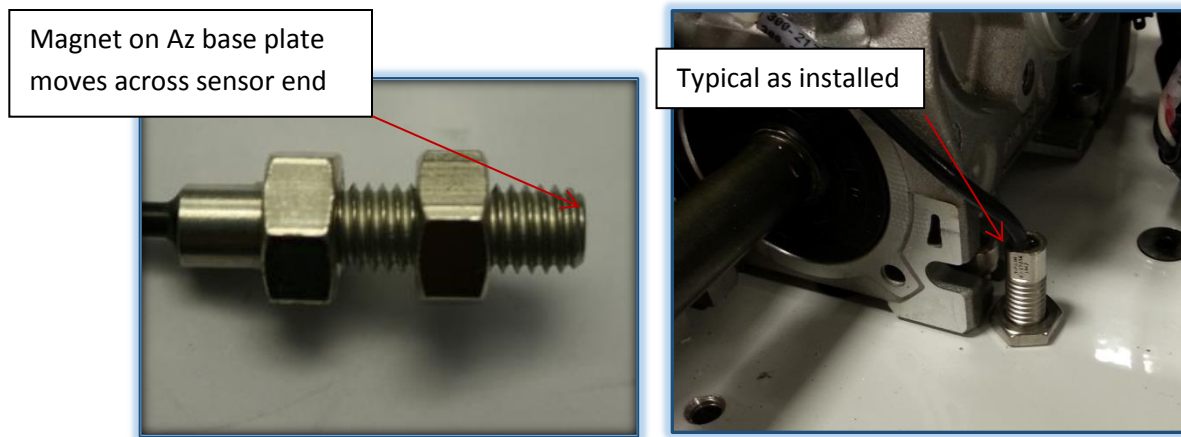


Figure 7.2.1.6 – Azimuth Stow Switch

7.2.1.7 *Notes on Azimuth Settings*

- The limits should be set after the potentiometer has been centered. Anytime the potentiometer is moved or repositioned, the limits should be reset.
- The Az angle displayed by the ACU is affected by several parameters in the ACU. (These include Az Scale Factor, Az Reference Position, etc.).
- While setting the limits, watch the Az capstan to make sure it does not run to the physical end of the cables. This could result in one or more of the cables breaking.
- After integration (external equipment, location, etc.), limits should be checked and set for safe travel.

7.2.2 Elevation Positioning

The elevation cable drive produces a drive system with zero backlash, high stiffness, no wear, no lubrication, and maximum reliability. The system consists of stainless steel aircraft control cables reverse wrapped twice around the grooved capstan, and once around the drum, with solid connections on one end and high force Belleville springs on the other end. The additional cables are used to provide increased stiffness and drive redundancy.

If a cable becomes damaged during usage, remove the cable and continue to use the positioner. The positioner is design to operate using a single cable if necessary. When time permits the damaged cable should be repaired by an authorized service facility.

The cables are sized to last the life of the positioner. No replacement from wear is expected. The spring packages at one end will automatically compensate for any elongation of the cables. Cable position and stiffness should be checked as per a periodic maintenance schedule. The Elevation drive components are described in this section.

7.2.2.1 *Elevation Pivot Assembly*

The elevation pivot assembly consists of two elevation drum assemblies pivoting between two clevis blade assemblies. The drum shafts pivot in hi-tech plastic (Delrin) bushings.

7.2.2.2 *Elevation Gear Box*

The elevation gearbox is a low backlash worm gear box. The worm gear drive isolates any backlash in the motor drive from the system. In addition, the gear box eliminates back-drive, eliminating any need for a brake on the drive train.

The motor drives the input worm via a quill/female hole and square key. The worm shaft is extended with a hex shape installed for the hand crank. The hand crank is utilized to manually manipulate the positioner in the event the controller fails. The elevation capstan is secured to the output shaft with a clam shell coupling to eliminate any backlash between the capstan and gearbox.

The low backlash is achieved by the selective fit of the worm and worm gear. The gearbox contains synthetic grease to help prevent wear in the gears. Because of the design capacity of the gearbox and low rpm, no maintenance is required.

7.2.2.4 *Elevation Motor*

The elevation drive motor is typically a DC motor with an optical encoder mounted to the motor output shaft, to provide real time positional information to ACU.

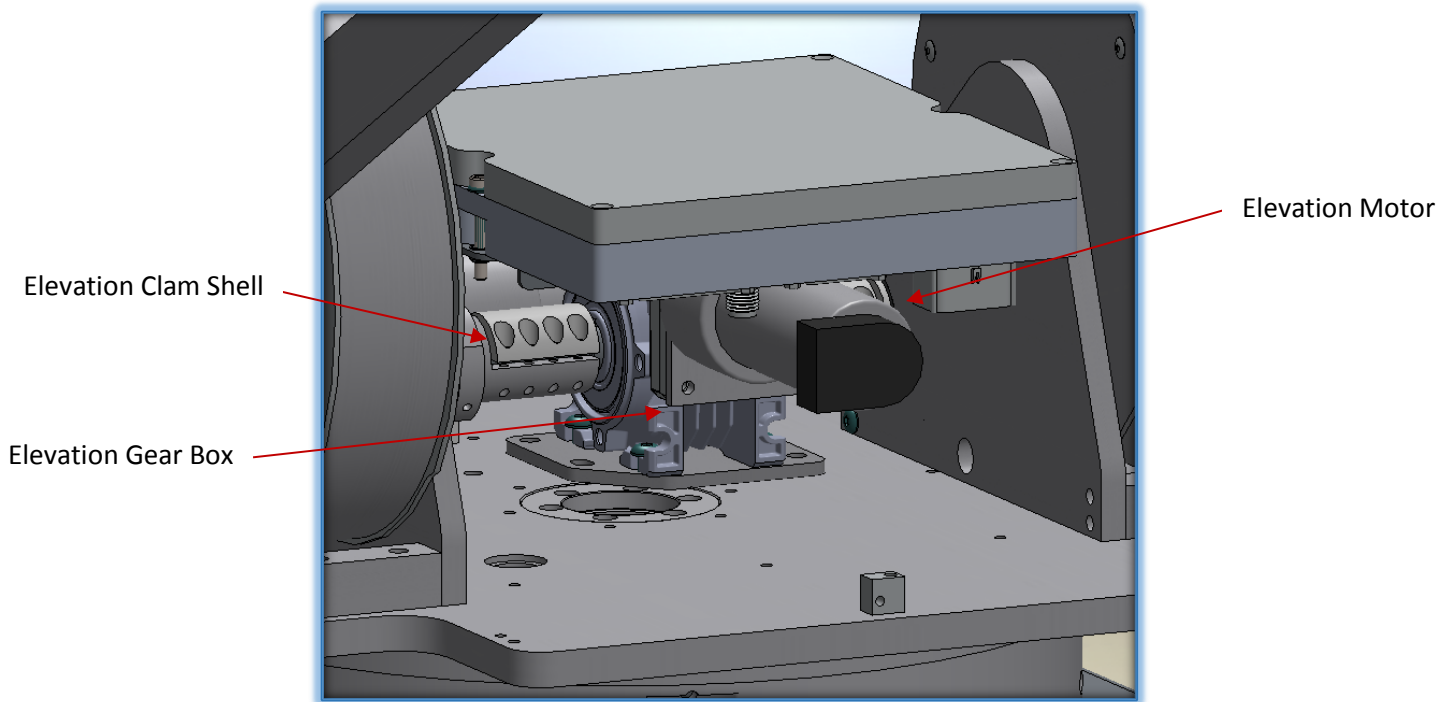


Figure 7.2.2.4 - Elevation Gear Box and Motor

Since the low backlash worm gear drive isolates the backlash from the motor, any backlash between the shaft adapter, coupler, or motor gear train will not be seen by the reflector bore sight. The motor is mounted to an adapter plate that is bolted to gearbox. No maintenance of the elevation motor is required.

7.2.2.5 *Elevation Cable Drive*

The elevation cable drive system provides zero backlash, high stiffness, no wear, no lubrication, and maximum reliability. The system consists of stainless steel aircraft control cables reverse wrapped twice around the grooved capstan, and once around the drum, with solid connections on one end and high force Belleville springs on the other end. The additional cables are used to provide increased stiffness and drive redundancy.

If a cable becomes damaged during usage, remove the cable and continue to use the positioner. The positioner is designed to operate using a single cable if necessary. When time permits the damaged cable should be repaired by an authorized service facility.

The cables are sized to last the life of the positioner. No replacement from wear is expected. The spring packages at one end will automatically compensate for any elongation of the cables. Cable position and stiffness should be checked as per a periodic maintenance schedule.

7.2.2.6 *Elevation Position Feedback (inclinometer)*

The elevation position feedback is typically produced by an electronic inclinometer within the AvL NAV RIOM (see 7.4.1.1). The NAV RIOM will most likely be located at the top of the reflector while the optional EL RIOM will generally be located in either elevation arm.

7.2.2.7 *Motor Shaft Encoders*

The shaft encoder mounts to the output shaft of the motor, providing a more precise feedback on Elevation position. The controller uses the output of the elevation encoder to determine the range of motion from axis point A to point B. The information is then processed by the AAQ and displayed as distance and angular position.

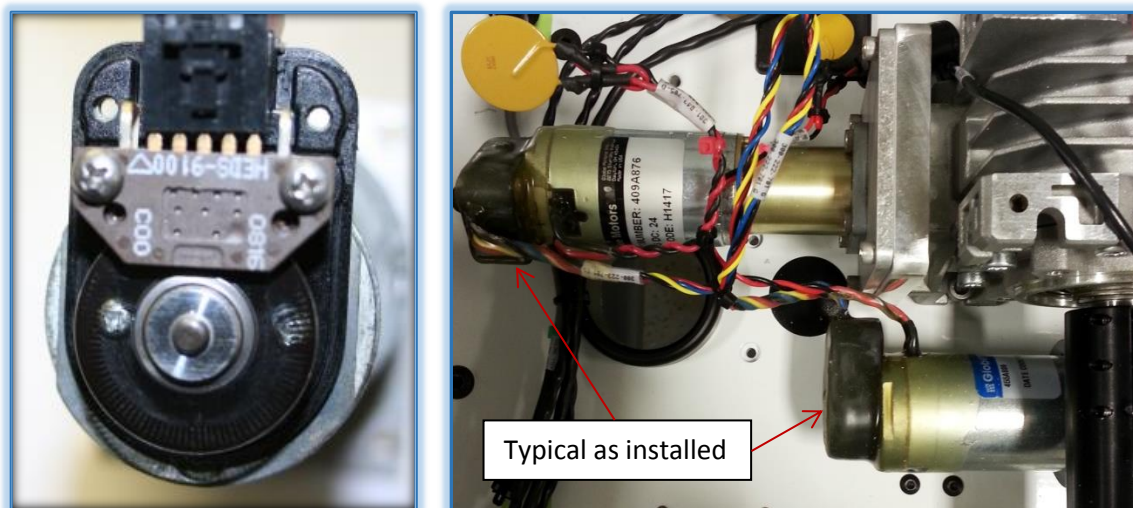


Figure 7.2.2.7 – Shaft Encoder Examples

7.2.2.8 *Elevation Resolver (optional)*

The on axis resolver may be used for more precise motion control. Resolvers are generally used for the elevation and azimuth axis. The resolver is an on-axis sensor and is generally located on the pivot points of the unit to provide highly accurate angular data. This sensor is primarily used in precision movements such as peaking.

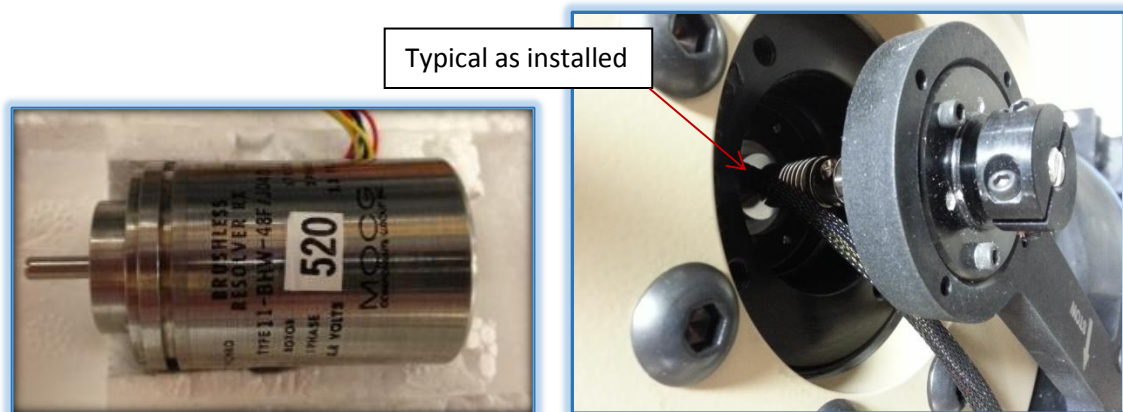


Figure 7.2.2.8 – Elevation Resolver

7.2.2.9 *Elevation Limit Switches*

The elevation limit or stow switch is actuated by a cam on the “elevation capstan” or the on “axis pivot drum”. The location of the switch(s) will vary depending on model.

The elevation Up and Down switches can also be actuated by a cam on the elevation capstan or the on axis pivot drum. The location of the switches will vary depending on model.

Elevation physical switches are generally used in conjunction with the soft (software created) switches. These are predetermined by the controller and may not always be present depending on model.



Figure 7.2.2.9a – Elevation Limit (or Stow) Switch

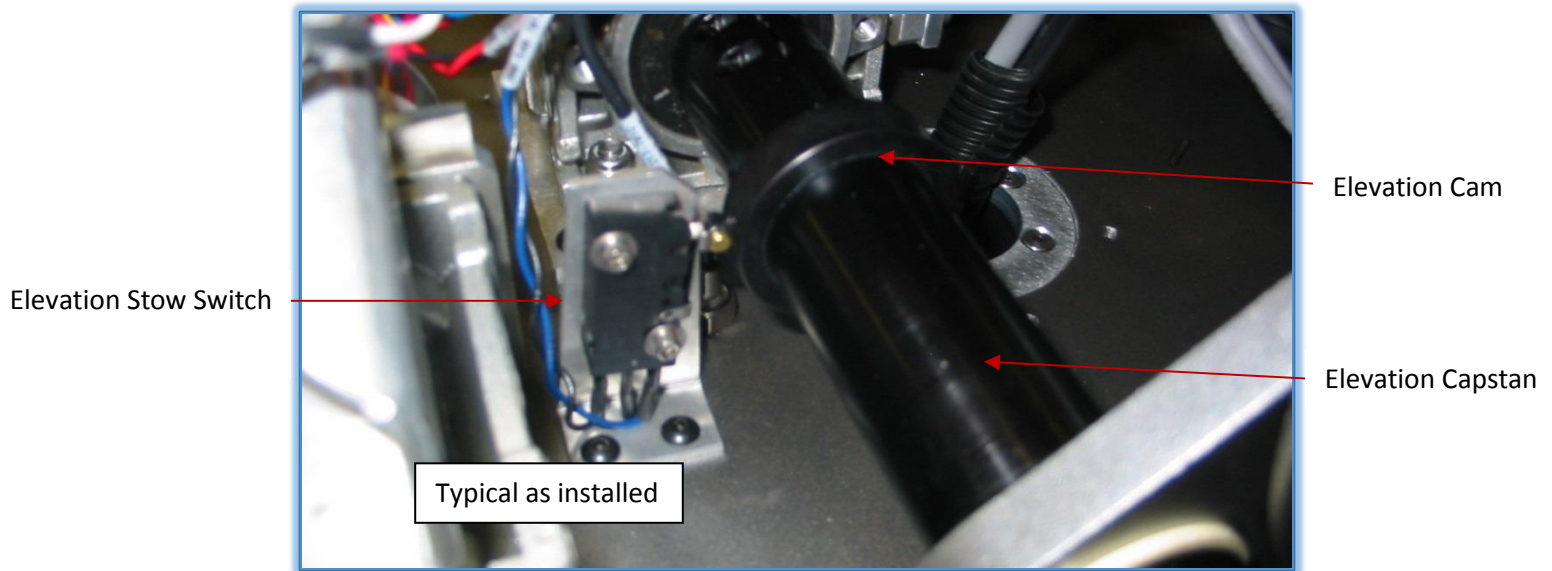


Figure 7.2.2.9b - Elevation Stow Switch

7.2.3 Feed and Polarization Positioning

Polarization movement is defined, in the directional sense as CW or CCW, as seen by an observer standing behind the reflector looking at the satellite.

Feed assemblies consist of a feed boom, a feed, RF components, feed sensing bits (optional) and a polarization drive assembly. Some models have a pivot connection at the end of the feed and use Delrin bushings and shoulder bolts as pivot fasteners. Position feedback is generated with similar sensors as used on the Az and El axis.

7.2.3.1 *Polarization Drive*

The feed/polarization drive can be found underneath the pol mounting plate. The actual arrangement is model dependent. The worm gear on the feed horn extends through a slot and mates with the drive worm gear. The polarization drive gear is adjusted to allow minimal backlash to the worm gear mounted on the feed horn. The polarization drive motor is a DC type with shaft encoder. A hex adaptor on the worm shaft provides manual polarization of the feed assembly using the hand crank in the case of a drive failure.

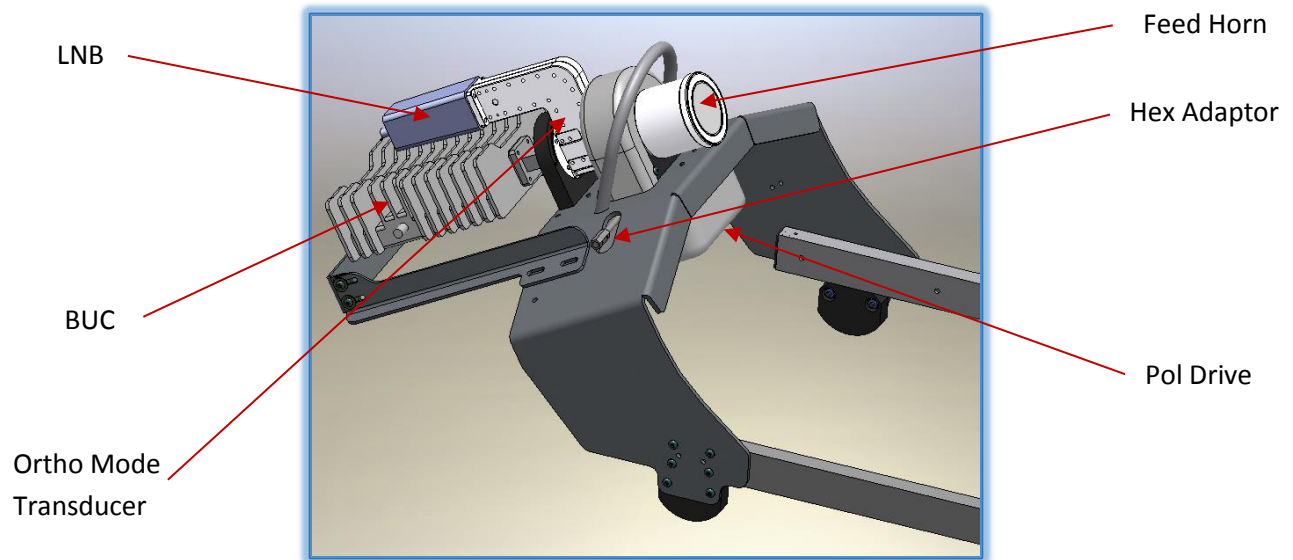


Figure 7.2.3.1 - Feed and Polarization Drive

Since the low backlash worm gear drive isolates the feed from the motor, no brake is required. No maintenance of the polarization motor/assembly is required.

7.2.3.2 *Potentiometer (POT)*

The polarization position feedback is typically produced by a potentiometer. The pot is an adjustable voltage divider using a three-terminal resistor with a sliding contact. The pot is driven by the output shaft of the worm gear drive. The potentiometer is sealed and rated for IP 65 environment - wind, rain, dust, etc. The potentiometer is mechanically centered at the travel position when the Pol platform is in the physical center position. Limits are controlled by using inputs from the potentiometer and / or encoder together and are set in, and controlled by, the AAQ controller.

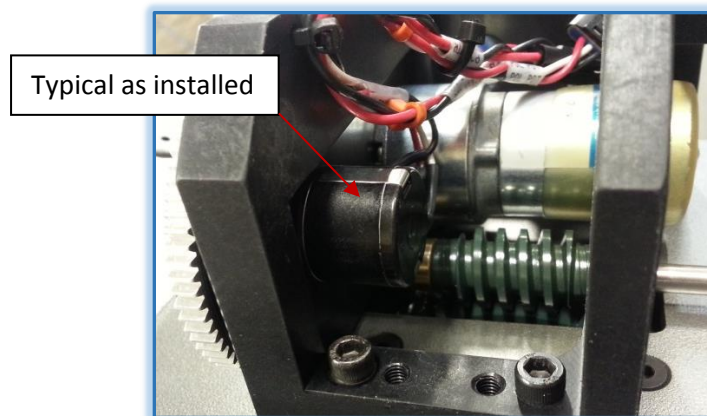


Figure 7.2.3.2 – Pol Potentiometer

7.2.3.3 *Polarization Encoder*

The Polarization encoder, when installed, is mounted to the output shaft of the motor providing a more precise feedback on Pol position. The controller uses the output of the encoder to determine the range of motion from axis point A to point B. The information is then processed by the AAQ and displayed as angular position.



Figure 7.2.3.3 – Pol Motor Encoder

7.2.3.4 *Polarization Limits*

The controller uses the polarization potentiometer voltage and motor encoders to determine limits. Most units have the mechanical capability of +/- 95 degrees.

7.2.3.5 *Feed Assembly*

The feed assembly consists of the feed, the polarization drive and position sensors. The feed is mechanically accurate to within 1/8" of the theoretical focal point of the reflector. This assures the RF System functions In Accordance With FCC compliance as stated in the specifications.

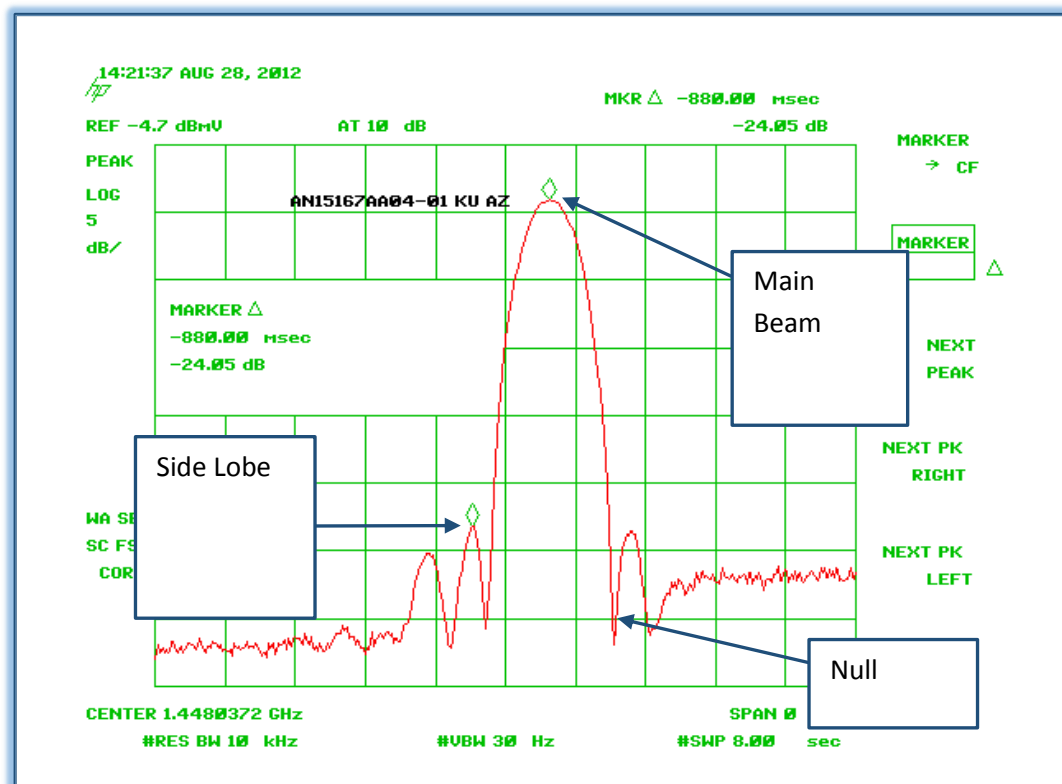


Figure 7.2.3.5 – Antenna Test Receive Pattern Example

7.2.3.6 Feed Bits (Band Sensing)

The AAQ is capable of multiband operation. When using a multi-feed system, the feed bits are utilized in recognizing the feed selected. Generally the feed connection is located on the interchangeable feed platform.

7.3 AAQ Controller System Detailed Description

AvL produces a wide variety of transportable antenna products with a vast array of capabilities tailored for different customers and market segments. Aperture sizes range from a fraction of a meter up to many meters. Operating frequencies range from L-band (1.5 GHz) up to Ka-band (30 GHz). The AAQ antenna controller must be able to interface with a wide variety of equipment for position sensing and signal monitoring purposes. It must also be able to perform a large number of specialized functions in addition to performing the standard Acquire and Stow commands. Historically, the ACU in our antennas required many different current versions of antenna control software running on a single hardware platform with all the work being done by a single processor. As a result, the flexibility and scalability of the critical ACU function in our antennas was limited.

The AAQ ACU employs a superior approach. Unlike our legacy systems, the AAQ software is not monolithic, instead is modular and parametric by design.

7.3.1 Modular / Parametric Software

AAQ software is segregated into a single ROM (Read Only Memory) code, several PIC (Programmable Integrated Circuit) codes and many device modules. The ROM code is common to every antenna system and is responsible for the basic control and communication functions necessary for any of our auto-point antenna systems. It runs on a state-of-the-art ARM (Advanced RISC Machine) processor where RISC stands for (Reduced Instruction Set Computer), with ample memory available for program execution and storage. The PIC code runs on distributed processors that are tasked with critical, lower-level processes such as positioner axis motion control and sensor suite control & digital Input /Output. Many of the software modules add enhanced capabilities to the AAQ ACU such as Step Track and Inclined Orbit Satellite Acquisition. Other modules act as software “drivers” that open interfaces to AvL optional and customer provided equipment such as modems, beacon receivers, and spectrum analyzers. This modular software architecture provides the ultimate in flexibility and responsiveness while minimizing the risk associated with the inevitable software changes typical of a continuously evolving / improving product by isolating new software and code changes at the module level.

An extensive set of user defined configuration parameters are used to enable one version of AAQ software to function as expected across a wide range of antenna hardware platforms. Through these parameter settings, the controller is made aware of the sensors that are present on a system and the role that each of them plays in providing critical information and feedback to the antenna control process. Control loops are properly managed and the appropriate software module connections made.

These configuration parameters also play a critical role, determining precisely how higher level functions like acquisition and tracking behave and how they may be optimized for a particular satellite and frequency band. The parametric aspect of our AAQ software design provides the flexibility necessary to optimally control any AvL antenna model and tailor its behavior to best meet the needs of a particular application or even an individual satellite.

7.3.2 Operator Access Levels

The operator of an AvL antenna system equipped with the AAQ ACU will interface with the controller through a Graphical User Interface (GUI) or the Red & Green (stow & deploy) buttons located on the antenna positioner cover. There are several GUI options that the operator might use,

including the PC-based AAQRemote .Net application, AAQ Webserver (see Appendix A), AAQ Controller Interface Panel (CIP) on the 1RU power supply (see Appendix B), AAQ Hand-Held Controller, and customer furnished custom GUIs. All AvL GUIs offer the operator an opportunity to log-in with a username and password that is associated with an access level.

The AAQ employs four (4) access levels based on a user's log-in credentials. The operator's access to all AAQ functions and configuration parameters is dictated by the level associated with their log in username and password. Those privilege levels are:

- Level 9 – AvL Engineering
- Level 7 – AvL Production and Service
- Level 4 – AvL Customer (System Integrator)
- Level 1 – End-User of the Antenna System

Every system leaves the AvL factory configured with default user log-in credentials for AvL internal and customer use. AvL's immediate customer is provided with a single Level 4 (Integrator) user account. With this account, our customer can create any number of Level 4 and Level 1 user accounts for their engineering, production, and service personnel; as well as the end-user of the satellite antenna system / terminal.

The AvL antenna system may be operated without logging in through any GUI. Under these circumstances, the operator is afforded access to only the basic commands and a pre-defined list of target satellites. He is able to view status variables and parameters, but unable to modify any configuration parameters.

The lowest privilege level (Level 1) is typically assigned to a knowledgeable terminal operator or end-user. At this level, the operator is allowed access to a limited set of functions that allow him to select from or modify a pre-defined list of satellites, execute all available commands, view antenna system status variables, and modify a small set of AAQ configuration parameters.

At Level 4, the satellite terminal integrator has access to all of the features and functions necessary to configure service and maintain the AvL AAQ antenna system.

Note - Privilege Levels 7 and 9 are reserved for AvL Service, Production and Engineering purposes, only. AAQ functions and configuration parameters restricted to these levels are only needed when the system is being assembled and or serviced in the factory or serviced by AvL personnel in the field.

7.3.3 AAQ Configuration Items

As mentioned previously, the AAQ ACU makes extensive use of user settable configuration parameters. These many parameters are segregated into three categories; hardware, calibration, and operation. Hardware configuration parameters are determined by the design of the antenna system and are common to all antennas with the same AvL master part number. Calibration parameters are unique to each antenna and are used to compensate for small variations seen from part to part and the inevitable assembly tolerances present in any complex antenna assembly. Those configuration parameters that do not fall into the previous two categories are generally useful in fine tuning the electromechanical operation and behavior of the antenna system.

7.3.3.1 *Hardware Parameters*

Hardware parameters specify the types of motors, gear ratios, and sensors present on the antenna system. There is one motor per positioner axis, usually three in all. There are a large number of sensors on each system that include those used to determine antenna geographic location and base heading, axis position feedback and satellite signal level received. These parameters also provide critical details about how the controller establishes communication with each of these devices (IP addresses, serial interface parameters, etc.). In summary, these parameters define the control system for the AAQ ACU and they are set at the factory via a Master Configuration File that is specific to the antenna's Master Part Number. These parameters can only be accessed at the highest privilege level and are not subject to change after the antenna system leaves AvL.

7.3.3.2 *Calibration Parameters*

Calibration parameters apply primarily to the sensors present on the antenna system. They typically take the form of scale factors and offsets that translate sensor readings into values that the AAQ ROM code can use. For example, a potentiometer voltage level reading is translated into an accurate estimate of Pedestal Azimuth angle by these parameters. All of these parameters are determined during the manufacture of the antenna system and verified during final system test.

Many of the sensors in the antenna system are either a Line Replaceable Unit (LRU) or part of one. By definition, an LRU is a customer serviceable item. For that reason, most of these parameters are changeable at the AvL customer's Level 4 privilege level.

7.3.3.3 *Operation Parameters*

Critical aspects of the antenna's operation are controlled by an extensive set of user settable parameters. These parameters set things like antenna azimuth axis scan speed, the satellite signal level sensor/device used for acquisition purposes, and the fine peaking method. AvL sets all of these parameters to default values in the factory based on information and Customer Furnished Equipment provided by our system integrator customer. Acceptable performance of every antenna system is verified to the extent possible before that system leaves our factory.

Most of these parameters are accessible at lower log-in privilege levels to provide the system integrator and the knowledgeable end user the ability to fine-tune the performance of the AvL antenna system for their specific application, satellite, frequency band, and even terminal location. This is a very powerful feature of the AvL AAQ design and should be exercised with some care and due diligence. Advice on how to set these parameters and their effect on antenna performance is included in Chapters 5 & 6 of this manual.

7.3.4 **Antenna System Calibration**

Every antenna must be accurately calibrated to insure safe, reliable acquisition, and tracking of the desired communications satellite. Almost every sensor has critical characteristics that will vary unit to unit. The orientation and placement of these sensors will vary within a range of tolerances allowed by their design and our assembly processes. The calibration process we have developed at AvL virtually eliminates these inconsistencies and allows us to provide a cost-effective auto-acquisition antenna system solution.

7.3.5 **Factory Test**

All model based calibration parameters are set in the AvL factory Engineering test lab. All customer based parameters are set before final test by the AvL Service group. The Service group test procedure includes steps that verify that every calibration parameter is set correctly. Upon successful completion of testing at AvL, all of the configuration parameters and files for every antenna system are recorded and stored by the Service group for future reference.

7.3.6 **Power-On Calibration**

Calibration is not a process that occurs only once during the factory assembly and test of AvL antenna systems. It is an important automatic step that is performed every time the antenna is powered on for normal operation. This calibration step is referred to as the "Home" process. It is also a system command that figures prominently on all of the AAQ GUIs. The main purpose of the Home process is to calibrate the primary position feedback devices used on most of AvL's antenna

systems. The optical encoders mounted on the AZ and EL motors and the potentiometer mounted on the POL motor would be an example of this.

These devices are high resolution and very precise, but they provide only relative angular position measurements with no reliable absolute reference point. For this reason, when the antenna system powers on it does not know with certainty where the antenna is pointing or where the positioner's axes are relative to hardware safety limits. Executing the Home command/process moves the antenna to known reference points using inclinometer and potentiometer feedback and a magnetic reed switch that together allow the AAQ to assign a reliable absolute position value to the readings provided by the encoders.

7.3.7 Product Lifetime

AvL designs antennas for a long service lifetime with minimal maintenance required. However, it may become necessary at some point to re-calibrate the antenna system due to replacement of a sensor or some other critical component of the antenna system. AAQ software includes several automated calibration (Auto-Cal) routines to assist the user in many of these situations. When necessary, step-by-step instructions may be provided to address special cases. A properly trained System Integrator technician or end-user, with sufficient log-in privileges, is able to safely and accurately execute all the calibration steps necessary to maintain the antenna system in good working order.

7.4 AAQ Controller Functional Description

7.4.1 Pedestal Base Heading

Every AvL antenna system ships with an Electronic Compass that is used to determine an initial heading for the antenna system's base platform. This information, along with the antenna's geographic location (latitude and longitude), is essential to determine a pointing solution (antenna pedestal azimuth, elevation, and polarization angles) for the target satellite.

This estimate of the antenna's heading value is approximate and subject to significant variation due to the possible presence of ferrous material, such as a metal framed building or vehicle, in the vicinity of the antenna system. For this reason, the default value for the azimuth line scan angle employed during acquisition is set to a value of +/- 20 degrees. In AvL's extensive experience supporting users of our transportable antenna systems, this value has proven to be very reliable in the vast majority of applications.

Both the Electronic Compass and GPS are built into the AAQ's NAV RIOM.

7.4.1.1 *Navigation Remote Input Output Module (RIOM)*

The NAV RIOM contains a GPS receiver and a 3 axis Electronic Compass and is the primary positional sensor of the AAQ Controller. A 2-axis inclinometer also resides within the NAV RIOM. The NAV RIOM is plugged into the AAQ's J2 harness and it is typically mounted on the back of the reflector at the topmost point when deployed. At this location, the GPS antenna is afforded a good view of the sky.

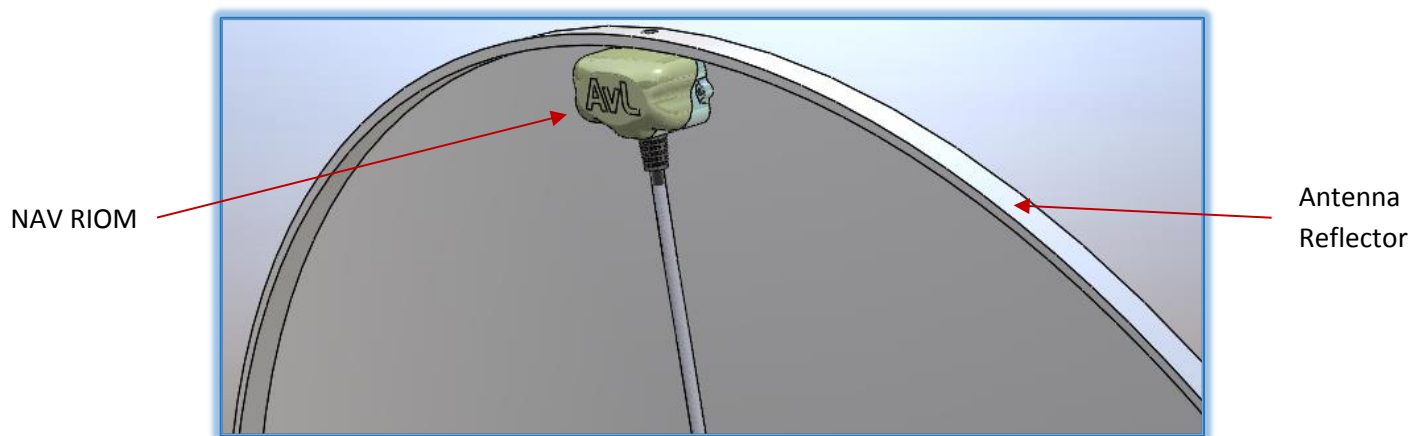


Figure 7.4.1.1 - NAV RIOM on Reflector

7.4.2 SATTANT

SATTANT is the name AvL has assigned to a novel approach developed to refine the antenna base heading provided by the electronic compass using satellite received signal power, only. Unlike methods employed by other antenna controllers to refine the compass heading, SATTANT does not require a DVB receiver or an extensive, up-to-date satellite location database. A simple and inexpensive broadband power detector (RSL) is all that is required. This method provides an accurate estimate of antenna heading immediately out-of-the-box anywhere the antenna system is deployed.

This approach depends only on accurate knowledge of the antenna's location and the elevation angle of the antenna's bore-sight. The GPS antenna and receiver included in every AvL antenna system provides location information to accuracy much higher than the SATTANT process needs. A carefully calibrated elevation inclinometer provides an accurate estimate of the antenna's elevation angle relative to the local gravity vector.

Based on the antenna's location and heading, the imaginary line in the sky traced by the geostationary satellite arc can be calculated. The two points at which a line of constant elevation angle intersects that geostationary satellite arc can also be calculated with precision and expressed in terms of elevation angle and azimuth angle relative to true North. These intersecting lines are illustrated in Figure 7.4.2. Successfully acquiring and peaking on any geostationary satellite provides the information (pedestal elevation and azimuth angles) necessary to substantially improve the antenna heading estimate and allow the antenna to zero in on the target satellite's location.

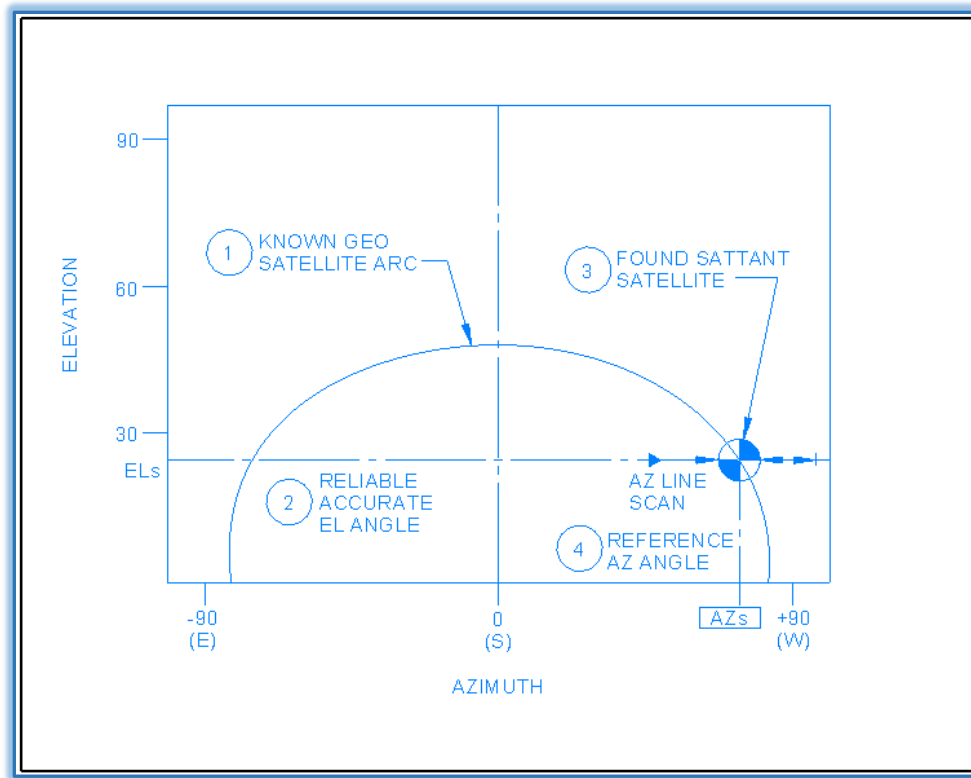


Figure 7.4.2 – SATTANT Process

AvL's SATTANT algorithm takes several factors into consideration when it selects the elevation angle for its satellite acquisition scan and the east / west intercept point. Every effort is made to insure that a reliable heading update is made at the end of this process.

It should be emphasized here that the SATTANT process used to improve your heading accuracy is a mathematical process as opposed to the Reference satellite method which takes advantage of knowledge of location and or carrier information to provide more reliable data for acquisition.

7.4.3 Reference satellite function

Reference satellites are generally of two types. Those of the first "Direct Broadcast" type have broad, high power carriers in the high band section of their transmitted signal. Once found, these carriers can be used to fine tune the heading of the antenna to a considerable degree, while reducing any error in the Target acquisition process. The spacing of these satellites (in CONUS) makes it very unlikely that an adjacent satellite will be acquired. DBS type satellites are often used as their high carrier power simplifies acquisition in poor weather conditions as well.

The second type of reference satellite uses a “DvB” carrier on a known satellite location and of a known frequency, bandwidth etc. While this offers a generally lower power carrier than the DBS type, the specifics of the carrier make it very unlikely that an adjacent satellite will be acquired.

Use of a Reference Satellite requires the creation of a separate profile for each Reference chosen. The Reference is then set to use the signaling device and carrier information available. An example of a reference profile created to use the AvL DvB receiver can be found in section 5.9.9 of this manual as well as section 9.6 of the DvB receiver appendix.

7.4.4 Pedestal Tilt Compensation

In order to calculate an accurate satellite pointing solution, the tilt (pitch and roll) of the antenna platform must be known to a relatively high degree of accuracy. This information also plays an important part in aligning the antenna’s linear polarization vector with that of the target satellite to insure optimal co-polarized signal transmission / reception and to minimize cross-polarized interference on the forward and return links.

Tilt of the antenna platform is measured by precision inclinometers that are usually located inside the AAQ ACU main module. The ACU module is typically mounted directly on the Azimuth positioner base plate above the Azimuth Bearing Assembly. Mounted in this location, the sensors are always on a surface that is nominally level during antenna operation, which insures the actual tilt of the system will be well within the accurate / linear range of these devices.

During normal operation, pitch and roll sensor values are recorded during the Home process (for calculation of the pointing solution) and immediately after peaking is completed on the target satellite (for polarization optimization).

7.4.5 Satellite Pointing Solution

The AAQ calculates the current pointing vector of the reflector boresight in Pedestal Coordinates and World (Local Tangent Plane) Coordinates. These are displayed on the AAQRemote GUI main window and output as Sensor Outputs if desired.

World Coordinates - These are the AZ/EL spherical coordinates in the Local Tangent Plane reference system. AZ is measured clockwise (when looking down on the antenna) from true north. EL is measured up from the local tangent plane (horizon). These are the coordinates most common in the satellite industry.

Pedestal Coordinates - These are the AZ/EL spherical coordinates of the pointing vector, in the pedestal reference system. AZ is measured clockwise (when looking down on the antenna) from the AZ Home Position. The antenna boresight will be parallel to the frame of the antenna at the Home Position. EL is measured up from a boresight of 0 degrees.

The AAQ calculates the pointing solutions in Pedestal Coordinates. These are the Pedestal Coordinates that will point the antenna boresight at the Target Satellite if the Pitch and Roll are 0.0 and the Heading is exactly equal to the current heading. These are displayed in the “Target Selection” section of the AAQRemote GUI main window as “Actual” values and are output as Sensor Outputs.

The AAQ calculates Tilt Corrections that must be made to the pointing solution. These tilt corrections are calculated by a “3 rotation tilt transform” using Yaw (Heading) followed by Pitch and then Roll. The Yaw, Pitch, and Roll values used in this transform are measured during a Home routine at power up. When these corrections are added to the “Actual” values, they become the Pedestal Coordinates that will point the antenna boresight at the Target Satellite assuming the Pitch, Roll, and Heading values last reported by those sensors.

This process is performed whenever the AvL antenna system is powered up or a new target satellite/profile is selected in any AAQ GUI (AAQRemote .Net, Web Server, CIP or Handheld).

7.4.6 Acquiring the Satellite Signal

The AAQ usually acquires the Target Satellite by executing a single Azimuth (AZ) Line Scan (Azimuth angle varied while the Elevation angle is held constant) centered on the best current Ped-AZ / Ped-EL pointing solution. If this initial AZ Line Scan is not successful, then a raster scan is performed automatically. This raster consists of several back-and-forth Azimuth line scans at different Elevation angles. The AZ width, EL height, and EL step size of this scan volume are all based on user settable configuration parameters. The AAQ acquisition scan is illustrated in Figure 7.4.5.

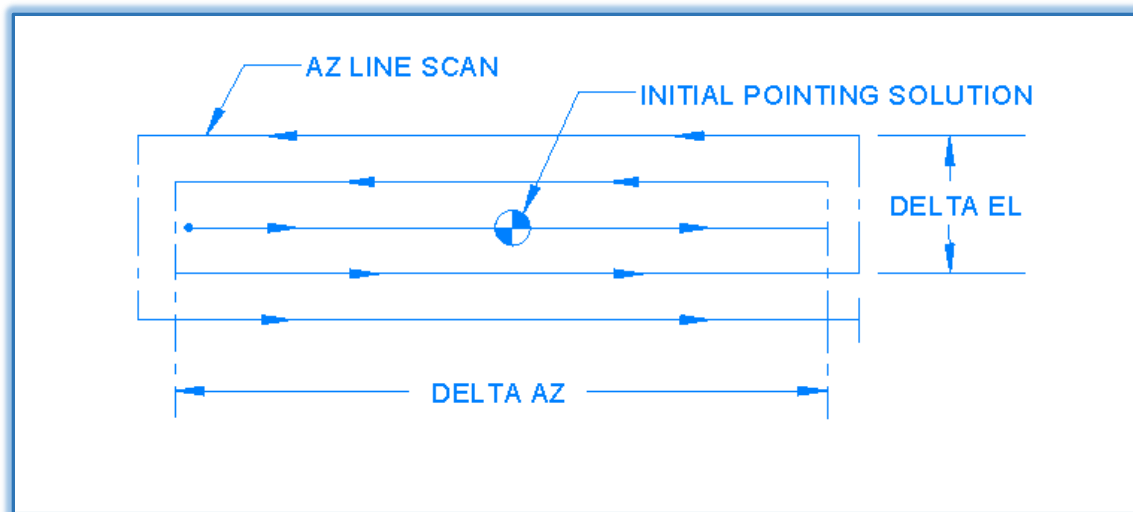


Figure 7.4.6 - AAQ Acquisition Scan

The required AZ width parameter is substantially influenced by the accuracy of the pedestal heading source used for acquisition purposes. The standard magnetic compass included with all AvL antenna systems is a moderately accurate device. However, like any magnetic compass, its reading is subject to significant errors when the antenna system is located close to large ferrous objects like metal framed buildings and large commercial vehicles or the electromagnetic fields generated by underground utility cables. For this reason, the AAQ's raster scan is typically rectangular in shape, with an AZ width that is many times larger than the EL height.

As mentioned previously, the AAQ typically acquires the target satellite on the first AZ scan. This high success rate is due in large part to a feature called continuous tilt compensation. This standard AAQ feature enables the antenna system to perform acquisition AZ scans at a constant World-EL value instead of a constant Ped-EL value. In this way, potentially significant World-EL angle errors due to pedestal tilt are eliminated near the beginning and end of the AZ scan. With this feature in place, multiple AZ scans (additional acquisition time) and increased probability of acquiring the wrong satellite is avoided.

The steps employed by the AAQ during satellite acquisition vary depending on the type of acquisition signal source being used and the satellite's position relative to the terminal's location. These dependencies are described in the following sections.

7.4.7 Signal Source = RSL

A Received Signal Level (RSL) broadband power detector comes standard on all AAQ equipped AvL antennas. It is designed to detect power in the standard L-band used by most satellite terminals, specifically 950 – 2150 MHz. AvL antennas are typically wired to provide the RSL with a sample of the satellite signal available on the cable running from the customer provided LNB to the modem via an AvL provided in-line signal splitter or coupling device. Based on the nature of its design, the RSL is a great detector of satellite signals, but it cannot reliably confirm that the detected signal is originating from the target satellite. For this reason, extra steps are sometimes required to increase the probability that the antenna acquires and peaks on the correct satellite.

As mentioned previously in this chapter, prior to acquisition of a satellite the AAQ is typically operating with a very good knowledge of the EL angle and a relatively poor estimate of the AZ angle for the antenna beam. Consequently, the AAQ searches for the target satellite using relatively wide AZ line scans as illustrated in Figure 7.4.6a. While performing an AZ line scan, the AAQ records RSL output. Upon completion of each scan, the AAQ reviews data taken on that pass and compares it against a user defined threshold value. If the threshold value is met or exceeded, then the AAQ will return the antenna to the location corresponding to the highest level detected and begin peaking on the signal. Otherwise, the AAQ will continue with its raster scan routine. A successful acquisition of Satellite A after a single AZ line scan is illustrated in Figure 7.4.6b.

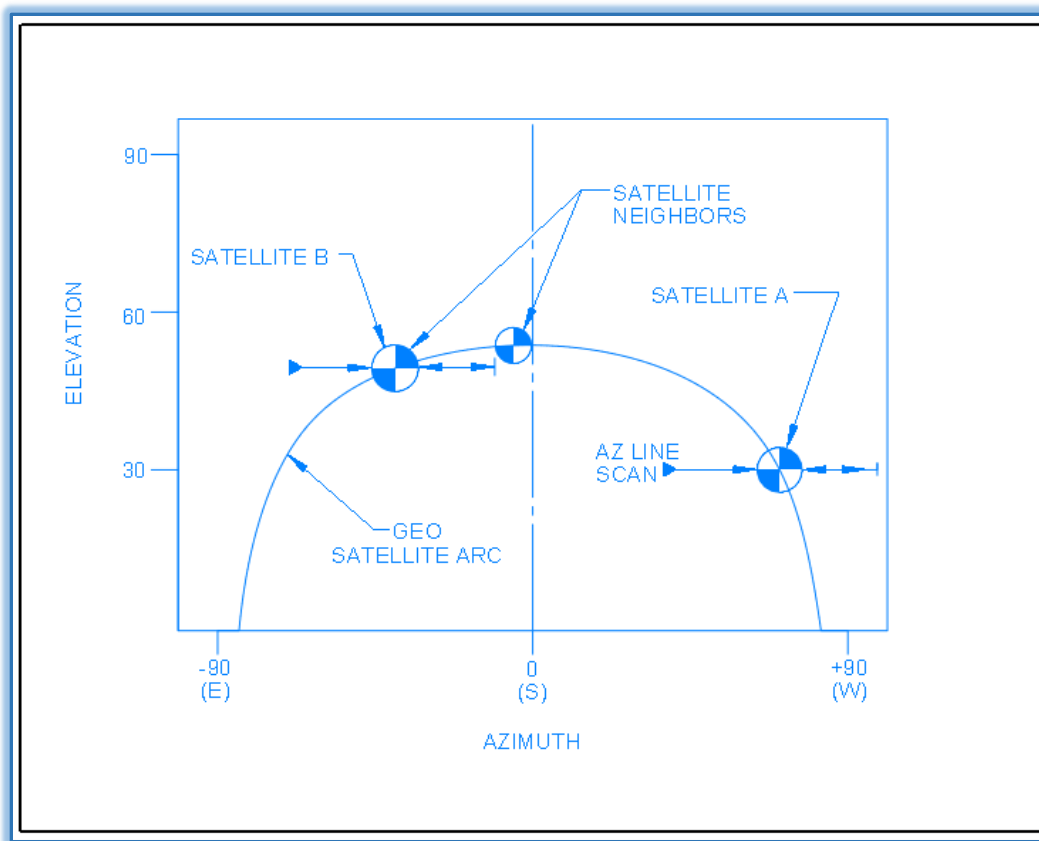


Figure 7.4.7a – Wide Az. Line Scan Example

When the difference between the longitude of the target satellite and the terminal is small, the target satellite will appear near the top of the geosynchronous satellite arc when viewed from the terminal's location (Satellite B in Figure 7.4.7a). As shown in the figure, the AZ line scan for Satellite B passes very close to several other GSO satellites. If the EL angle is off by even a small amount and/or any of those other satellites is transmitting higher broadband power than the target satellite, then the AAQ could easily select and peak on the wrong satellite's signal. In order to minimize the probability of making the wrong choice under these circumstances, a SATTANT is automatically performed by the AAQ before target satellite acquisition (peaking only) is attempted. This process is illustrated in Figure 7.4.7b. The longitude difference between satellite and terminal that triggers the automatic SATTANT is user configurable and typically set to a value of 20 degrees.

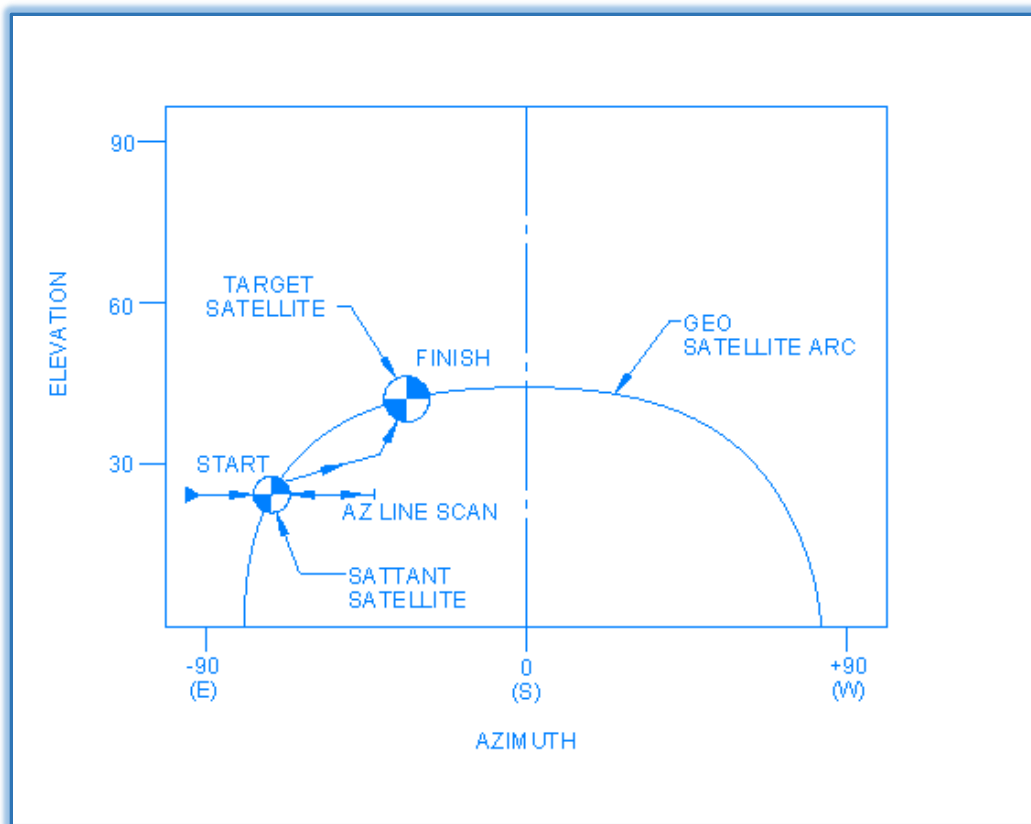


Figure 7.4.7b – Narrow Az. Line Scan Example

Even with these extra precautions, it is difficult to successfully acquire a target satellite with a relatively weak broadband signal when it is located next to a newer, higher power satellite. In this case, it is desirable to use a more selective satellite signal source such as a modem, DvB or beacon receiver.

7.4.8 Signal Source, Modem or Beacon Receiver

AvL offers an optional Satellite Beacon Receiver with almost every antenna system, but Satellite Modems are typically supplied by our system integrator customers. The AAQ is compatible with a large number of Satellite Modems and Beacon Receivers and they are the Signal Source of choice for robust and reliable satellite acquisition. Their preference is based primarily on their ability to confirm that the signal detected is originating from the target satellite and not one of its neighbors. Modems usually lock exclusively on only the carrier associated with their particular network. Narrowband satellite beacon signal frequencies, while not completely unique to each satellite, are usually assigned in a way that helps differentiate close neighbors so when the receiver locks, the antenna is pointing at the correct satellite. Modems that are designed to work with the AAQ controller have an associated Appendix to be used with this manual.

When one of these signal sources is selected for acquisition, the AAQ will move directly to the “AZ Line Scan” starting point based on the pointing solution for the target satellite and initiate a raster scan. The AZ line scan is stopped immediately upon target satellite signal detection (modem/receiver lock indication) and the AAQ shifts directly into peaking mode. The AAQ does not normally execute a SATTANT when the Signal Source is Modem or Beacon Receiver since neighboring satellites that lie on or close to the AZ line scan will be ignored by these signal sources.

7.4.9 Peaking on the Signal

After acquisition is complete, the AAQ peaks on the satellite signal in two stages; referred to as Coarse Peaking and Fine Peaking. The objectives for Coarse Peaking are to (1) insure that the system is peaking on the main beam of the antenna’s pattern and not a “side lobe” and (2) position the antenna such that the peak of the main beam is closely aligned with the satellite. The objective for Fine Peaking is to precisely align the antenna with the target satellite.

The following Sections, describe the default (recommended) mode for Coarse and Fine Peaking on the Target Satellite signal. In reality, either of the modes described here (Cross Peaking and Step Peaking) may be used. Additionally, Coarse and/or Fine Peaking may be skipped entirely if that is the Integrator’s choice. All of these options are configurable via the AAQ Profile System parameter settings described in Chapters 4 & 5.

7.4.10 Coarse Peaking

At the completion of the acquisition process, the antenna is aligned close enough to the satellite’s location to receive a signal that meets or exceeds the user settable minimum detection threshold. The next step involves reliably moving the center of the antenna’s main beam (boresight) to an angle that aligns closely with the target satellite. This is usually accomplished by executing cross scans as illustrated in Figure 7.4.9.

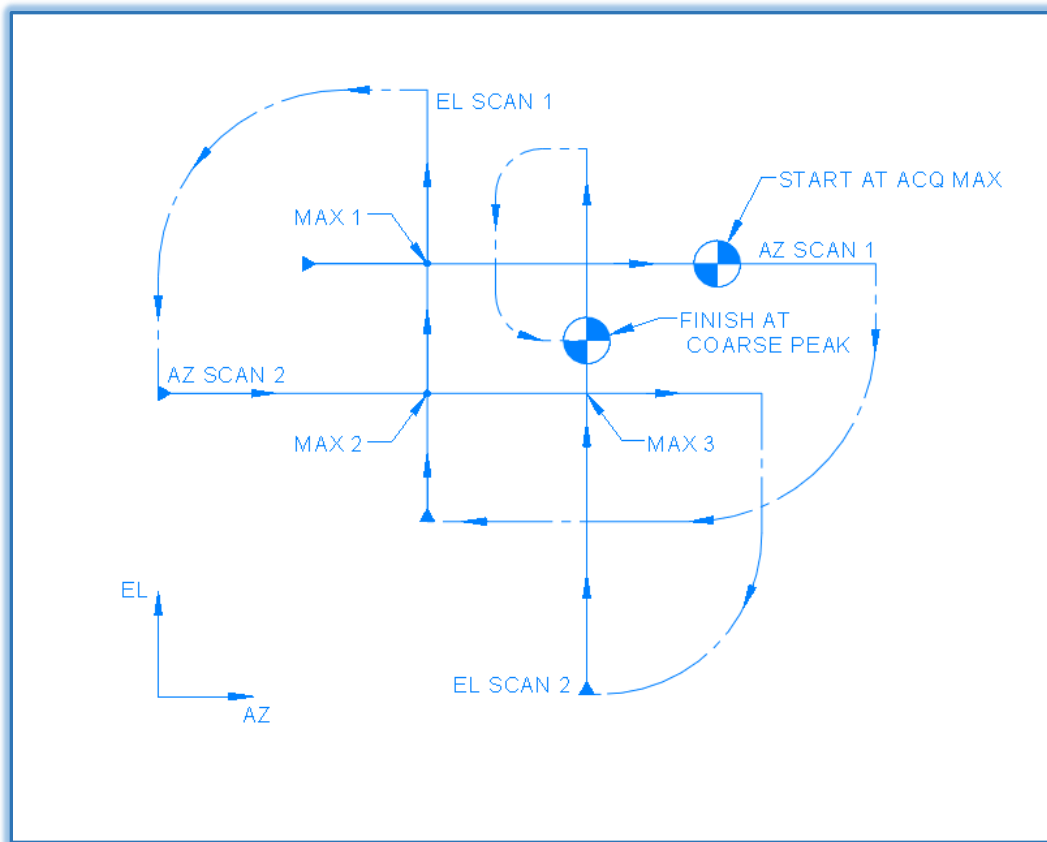


Figure 7.4.10 – Cross Scan Example

As noted in the figure, the axes of the cross scan (two orthogonal line scans) align with the antenna's Ped-AZ and Ped-EL axes. After the first line scan is completed, the AAQ commands the antenna to the scan angle corresponding to maximum received signal level. The next line scan is made in the orthogonal direction and passes through the previous scan's maximum signal point. Again, the AAQ commands the antenna to the scan angle corresponding to maximum received signal level seen during the second scan. This process is repeated until Coarse Peaking success criteria are met. Those criteria may be a predetermined number of cycles or some minimum peak signal difference between cycles.

The length of the cross scans in AZ and EL are selected to insure that the peak of the main beam will be scanned even if the target satellite is initially acquired in a "side lobe" of the antenna. This assures that the Fine Peaking process will be initiated when the target satellite is well within the main lobe of the antenna's beam.

7.4.11 Fine Peaking

Optimal pointing of the antenna at the target satellite is usually achieved by a Ped-AZ and Ped-EL step scan technique. A series of small, equal changes in antenna pointing are made in one direction (Ped-AZ). After each small step, the received satellite signal is measured and compared to the level recorded at the end of the previous step. If the new signal reading is higher than the previous reading, then an additional small step is made in the same direction and the signal is measured at the new position. Else, the AAQ commands a backwards step and begins a step scan in the orthogonal direction (Ped-EL). This step scan process is illustrated in Figure 7.8.2.

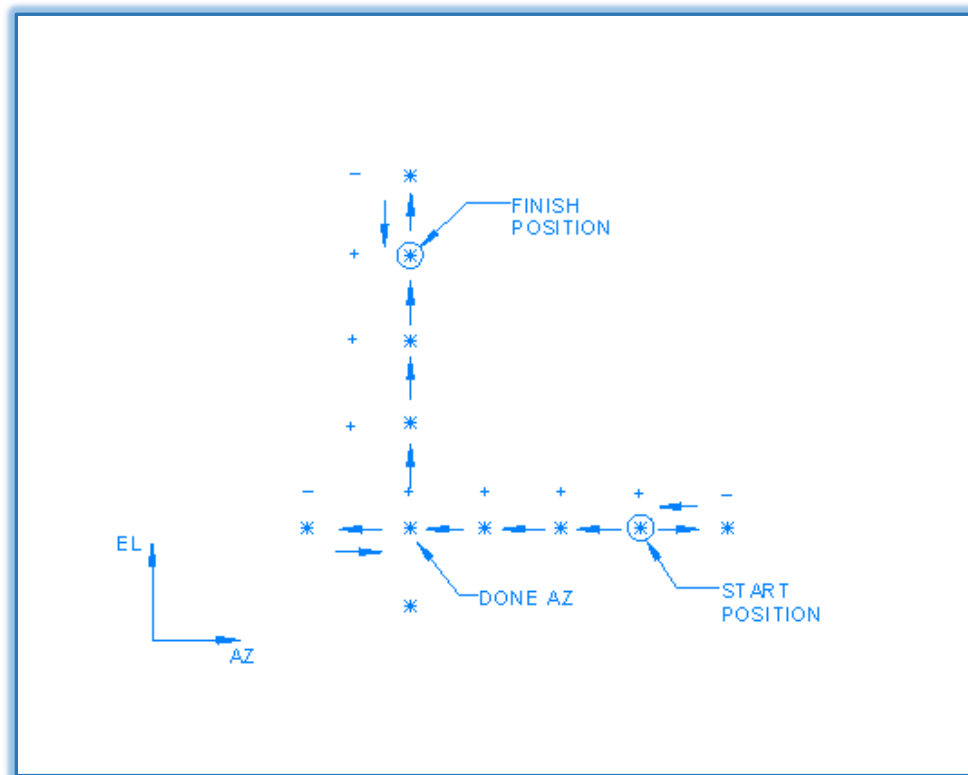


Figure 7.4.11 – Fine Peaking Example

At the end of each Ped-AZ / Ped-EL step scan cycle, the signal level achieved at the end of the current cycle is compared to the signal level recorded at the end of the previous cycle. If the difference is positive and exceeds a user defined limit, then the Fine Peaking process continues and another step scan cycle is performed. Fine Peaking is considered complete when no further meaningful improvement in received satellite signal level can be made.

7.4.12 Linear Polarization Optimization

It is critical that the linearly polarized satellite ground antenna align its polarization vector closely with that of the satellite. Any mismatch between satellite and terminal antennas will reduce signal power on the forward and return links. Even a small misalignment of the polarization vector will significantly increase cross-polarized interference and further degrade the communications link between satellite and terminal. Both of these potential performance shortfalls are addressed and minimized by the AAQ.

The satellite pointing solution implemented by the AAQ and described earlier, address the angle of the satellite's linear polarization vector in addition to Azimuth and Elevation pointing angles. All three of these angles depend on the same factors, including the pitch and roll of the antenna's pedestal. Prior to acquisition of the satellite, all of the satellite pointing and polarization angles are calculated based on the initial, relatively inaccurate estimate of pedestal heading. The antenna's linear polarization is configured based on this initial value, which is more than adequate for acquisition and peaking purposes.

Once the AAQ has successfully acquired and peaked on the target satellite (or the SATTANT satellite), the pedestal heading is updated with an extremely accurate value. Without this final adjustment, the satellite terminal's performance would be degraded and the resulting cross-polarized interference on the return link could be a significant issue for the satellite operator and other users of the system.

7.4.13 Tracking on the Signal (Optional)

The vast majority of communications satellites in geosynchronous orbit are essentially stationary relative to any point on the Earth's surface. Occasional station keeping maneuvers keep these satellites within a very small "box" centered on their assigned orbital location. In most applications, there is no reason for the AvL antenna system to move (change antenna pointing) once the satellite has been acquired and the peaking process is complete.

There are exceptions to this general rule and the AAQ is equipped to deal effectively with them. One exception involves large aperture antennas (≥ 2.4 meters) operating at Ka-band. Antennas of this size have very narrow "beam widths" at 30 GHz and they suffer a measurable loss in antenna gain due to pointing error as the geostationary satellite drifts around in its small box. Since these antennas are typically used in small gateways for many remote terminals, the entire network suffers when the gateway antenna is not performing optimally. In this case, the gateway antenna is usually required to track the small motion of the satellite and maintain the antenna gain very close to peak level.

The popularity of satellite services using inclined geosynchronous satellites is growing and becoming a more frequent exception to the stationary rule. These satellites typically start their service lives in stationary orbits. As their station keeping fuel supply dwindles, the satellite operator decides to extend the life of the satellite by moving the satellite into an inclined orbit that requires much less fuel to maintain.

The new orbit is still geosynchronous (orbit period = 1 day), but the satellite no longer appears stationary when viewed from the Earth's surface. Instead, it moves in a predictable, narrow "figure 8" path that aligns North to South. The price charged for bandwidth on these inclined / drifting satellites is much lower than that charged for stationary satellites, hence their growing popularity.

The AAQ may be optionally configured with satellite tracking capabilities through the addition of software modules. Two tracking modes are currently available, with more to follow. They are Step Track and TLE Track.

7.4.14 Step Track

Step Track mode is designed to address the first exception to the stationary satellite rule described above. It is also very useful when an AvL transportable antenna might be inadvertently deployed on an unstable surface, such as sand or loose soil. Any gradual, permanent changes in antenna pointing due to the frequent vibration of passing vehicles or induced by gusty winds on the antenna's reflector are automatically corrected.

Step Track is best described as periodic Fine Peaking of the antenna system. The periodic peaking process is the same as described in Section 7.4.10. Small step scans are performed in Ped-AZ and Ped-EL until the Fine Peaking criteria is met. The AAQ then waits a specified time period (Level 4 user settable) and repeats the process. This method insures that the antenna beam remains peaked on the target satellite and temporary antenna gain loss due to "step off" is minimized by choosing an appropriately small angular step size, which is also Level 4 user settable. See appendix M for the Step Track option.

7.4.15 Two-Line Element (TLE) Track

TLE Track mode is the preferred approach for tracking inclined geosynchronous satellites. As mentioned above, the track that these satellites make in the sky is predictable and a standard method for efficiently and accurately calculating the time varying antenna pointing solution has been developed. This standard method uses a set of orbital elements in a standard format called Two-Line Elements (TLE) that describe the orbit of Earth-orbiting satellites. These TLE sets are widely distributed on the Internet. A computer program called a model or propagator uses the TLE set to calculate the pointing solution for the target satellite at a particular time.

The AAQ's TLE Track software module includes a TLE propagator program that takes a user provided TLE set and calculates the antenna Ped-AZ and Ped-EL angles versus time necessary to reliably acquire and accurately track the target satellite. The TLE set for a particular satellite will be updated from time to time based on NORAD tracking data and infrequent maneuvers performed by the satellite operator to maintain the satellite's inclined orbit. The operator of the terminal is responsible for keeping the TLE set current. See appendix O for the TLE Tracking option.

7.4.16 Position Hold

The AAQ has a Position Hold mode that makes it tolerant of power outages. While in this mode, if the power should fail and return without any detectable movement of the antenna system, then the AAQ will continue to hold its position provided that the Modem reports a lock on the Target Satellite's signal.

7.4.17 Satellite Signal Properties

The AAQ requires a metric that it can use to discern a successful satellite acquisition and optimize for antenna peaking purposes. That metric is some representation of the signal received by the antenna from the target satellite. The signal itself is subject to significant perturbation by the atmosphere through which the electromagnetic waves travel. For the AAQ, the satellite signal is represented by the output of a device called a "Signal Source". The AAQ is designed to work with several types of signal sources, each with its own advantages and disadvantages that must be accommodated by AAQ software.

7.4.18 Scintillation Effect

Scintillation is a term for rapid variation in apparent brightness or position of a distant object when viewed through a medium such as the Earth's atmosphere. Scintillation's effect on a satellite signal causes rapid changes in received signal level that can reach several decibels (dB) in magnitude. The effect is caused by anomalous refraction of the satellite's RF signal due to small fluctuations in air density. The effect varies significantly in intensity with time as atmospheric conditions are constantly changing.

In order to optimally peak the antenna system on the target satellite, the AAQ must be able to make Fine Peaking decisions based on changes of only a fraction of a dB in received satellite signal level from one step to the next. This becomes problematic when scintillation effects reach several dB. Under nominal conditions, when the received satellite signal is reasonably stable, the AAQ will

command the antenna to dwell for some time at the end of each step and average several short duration measurements to filter out the always present scintillation “noise.”

7.4.19 Rain Fade

Rain Fade refers to the absorption of an RF signal by atmospheric rain, snow, or ice. It is most prevalent at frequencies above 11 GHz. A heavy rain storm can reduce the satellite signal level received by a Ku-band or Ka-band antenna system to essentially zero in a matter of seconds. Lesser storms, which are much more common, can still have significant effects long before they arrive at the antenna’s location, especially when the antenna is operating at low look (elevation) angles. Any significant signal changes not related to the pointing of the antenna system can have a detrimental effect on the performance of an auto-pointing antenna system.

Rain fades are usually short duration events, so the antenna typically returns to normal operation very quickly.

7.4.20 Signal Sources

The AAQ is designed to interface with four different types of signal sources; RSL (broadband power meter), Beacon Receiver, the AvL DvB receiver and a variety of Modems. Each of these devices falls short of being the ideal signal measurement device for an auto-point antenna system. That ideal device would have the following key characteristics:

1. Reliable confirmation that the signal originates from the target satellite
2. High sensitivity and dynamic range
3. Near instantaneous response time
4. Frequent ($> \sim 10$ Hz) and accurate signal level estimates
5. Affordable incremental system price

A device that excels in all of these areas would assure very fast and reliable satellite acquisition and peaking while minimizing complexity in the AAQ software. Modems tend to do very well on characteristics (1) and (5), but fall short on the others. The RSL scores well on items (3) – (5). The best Beacon Receivers meets most of the above criteria, but they struggle with the important characteristic (5). See appendix listing for Beacon receivers and other signal source options.

With no clear winner, the AAQ is designed to work with all three. Special provisions are made in the design of the AAQ software and available configuration parameter settings to compensate for their short-comings. Scan speeds can be varied to account for variation in response time and the rate at which new measurements are provided. Averaging times can be modified to deal with different sensitivity levels. The SATTANT process reduces the necessity for satellite signal identification at the expense of additional acquisition time. Finally, if more than one type of signal source is present in the system, then the AAQ allows each source to be assigned the task that they are best suited to perform.

The AAQ ACU is compatible with a long list of popular Modem types. Four of these Modem Types are addressed in detail in Appendices D, E, F and G of this document.

7.4.21 Profile System

The AAQ Profile System is a powerful tool that is available in the AAQRemote .Net GUI. It is described in detail in Chapters 4 & 5 as well as in the DvB receiver appendix H. For the average operator, it provides the means to create a selectable target without having to adjust simple parameters for longitude, polarization or signaling devices each time. For the knowledgeable operator or integrator, it provides the ability to optimize the AAQ's acquisition and peaking processes for each satellite placed on the Target Satellite list. Additionally, profiles can be created where different carriers on the same satellite have individual requirements. It also allows the operator to optimize the appropriate AAQ configuration parameters, such as scan speeds, dwell times and carrier thresholds for each of the signal sources present in that particular antenna system.

When the profile is complete, it becomes a selection in the Target Profile drop-down menu on the main screen of all AAQ GUIs. The operator of the antenna in the field can select that profile and immediately benefit from all of the careful system optimization work done by others without ever logging in to the AAQ system and changing a single parameter. Through Profiles, the end-user experience is simultaneously simplified and optimized.

7.5 The Acquisition process

This section describes the normal operations of the AAQ controller from power on to acquisition of the target. For each step, the “command response” indicated on the GUI will also be included.

7.5.1 Power on and Boot

The AAQ controller is a Linux based operating system. When power is applied to the controller, the system begins a boot process that loads the file system and application programs into RAM. This boot process requires 30-60 seconds to complete. Once the controller is booted, it is in an operational state and ready to accept commands. For this example we will use a system equipped with a modem for our signal source.

All external equipment modules are initialized during the boot process. During this process the modules are allowed to initialize specific devices or functions outside the normal AAQ operations.

When booted the controller awaits a command request. Commands recognized by the AAQ controller are:

- Stop: Stops the current running command.
- Manual Control: Enables the manual jog commands to be accepted.
- Home: Positions the antenna upright and initializes axis based sensors.
- Stow: Stows the antenna to the specified values based on the configuration.
- X Pol: Moves the polarization 90 degrees from its current position.
- Acquire: Automatically points the antenna to the specified satellite.
- Move To: Moves to the requested pedestal coordinates.
- Peak: Performs peaking using the current signal source.
- Track: Performs the current tracking sequence.
- Repeat: Performs fine peaking sequence if signal is above a set threshold.
- SatTant: Automatically points the antenna to the specified Target satellite utilizing a SatTant based pointing solution.

7.5.2 Home Sequence

The “Home” command determines tilt and initializes the motor feedback sensors (i.e. encoders and resolvers) needed for precision movements. The acquire command will initiate a “home” sequence before completing the sequence.

7.5.2.1 *Setting the Azimuth Axis*

Once the elevation axis has reached its home position, the azimuth axis will begin searching for the magnetic reed switch located in the center of the azimuth axis on the baseplate. The azimuth will begin moving to the defined value based on the azimuth potentiometer position sensor. Once detected, the azimuth will follow the logic below to derive the center of the azimuth magnetic switch. After the position sensors (i.e. Magnetic reed switch and/or potentiometer) have found the physical center, the precision feedback sensors are initialized (i.e. encodes).

- Move to the Counter-Clockwise side of the magnetic switch.
- Move through the magnetic switch to the Clockwise side. Record the values of the transitions on and off the switch.
- Move through the magnetic switch to the Counter-Clockwise side. Record the values of the transitions on and off the switch.
- Calculate the center of the switch, removing hysteresis effect. Move to the calculated center of the switch.

Command Response: Initializing Azimuth Encoder

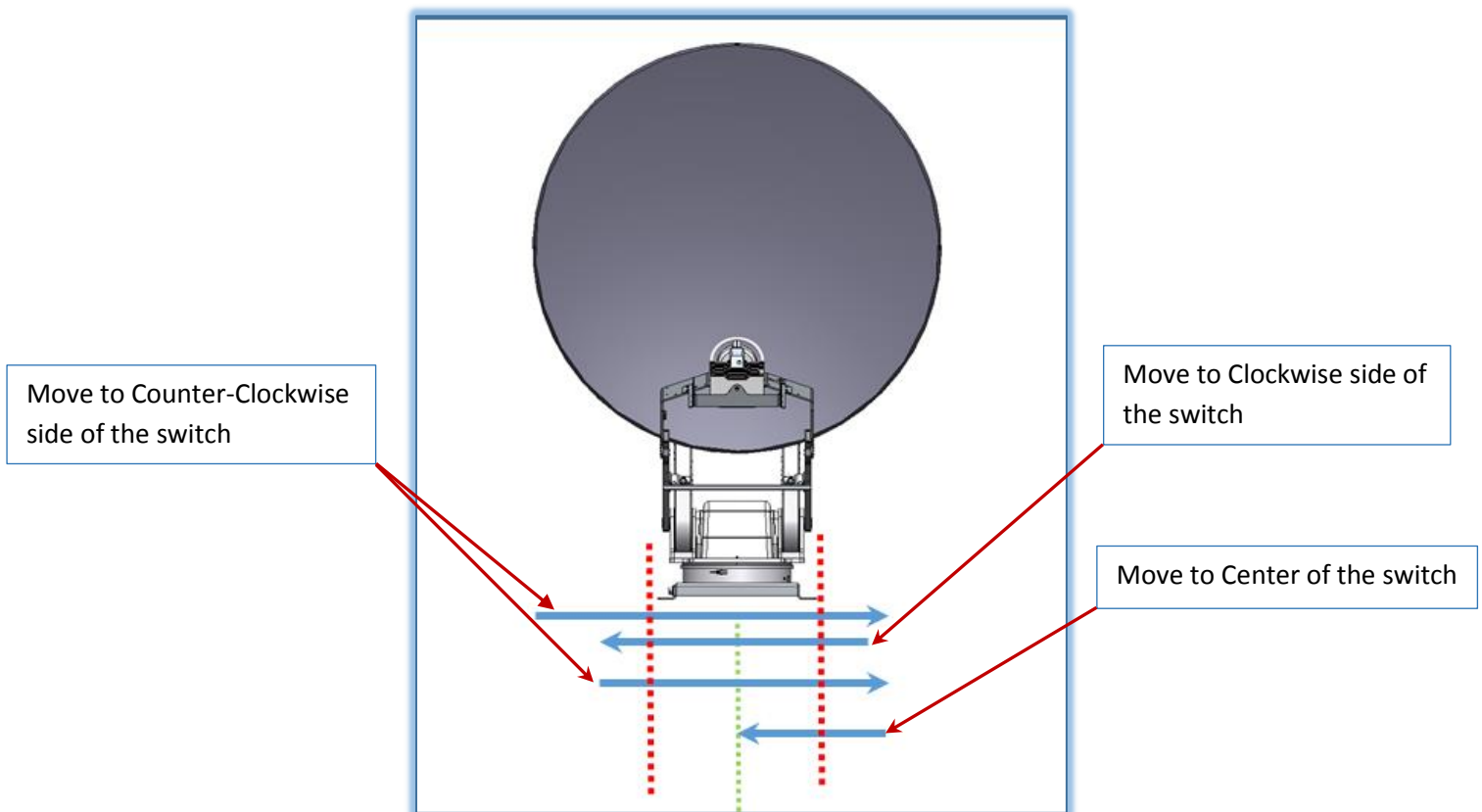


Figure 7.5.2.1 – Setting Azimuth Axis

7.5.2.2 Setting the Elevation Axis

When performing the “Home” command for the first time, the system will first move to a defined position using the elevation position sensors (i.e. switches and/or inclinometers). This action moves the antenna from the stowed position to a point where azimuth movements are allowed. Once in the home position the elevation precision feedback sensors can be initialized (i.e. encoders). After setting the Az. Encoders, the antenna moves elevation to within a valid range (core config) to then set El encoders

Command Response: initializing elevation encoder

7.5.2.3 Elevation down Limit

Only elevation axis movements are permitted below the *Down Limit with the azimuth centered*, this is to avoid collateral damage that could result from moving the azimuth or polarization axis prematurely. The following warning will show on the GUI main window:

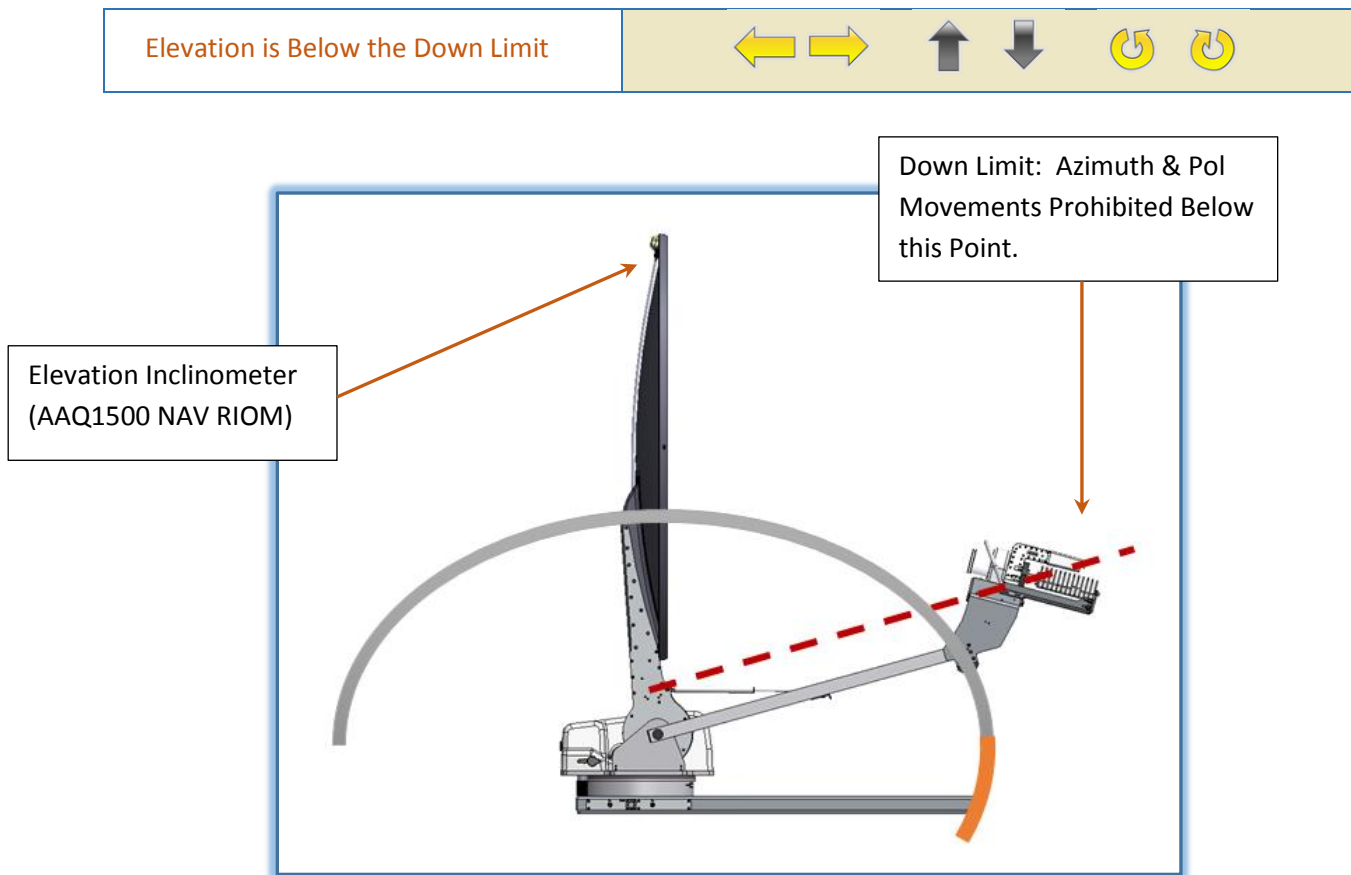


Figure 7.5.2.3 – Elevation Down Limit Example

7.5.2.4 *Initializing Sensors*

Now that the azimuth and elevation are in the proper homed position, the precision feedback encoders are initialized based on the analog sensor position. From this point forward, axis movements are based on the motor encoders and analog inputs are used to signal an alarm in the event a sensor fails or the readout is incorrect.

7.5.3 Acquisition Sequence

Any Acquisition command will use parameters selected in the active profile for the current target. The following steps are common for all types of Acquisition.

7.5.3.1 *Compass Read*

If a home has not been performed prior to the compass routine, the unit will automatically home first before taking a compass reading. The system will then move to the predefined azimuth/elevation compass read positions. Typically this is where the Electronic compass is level. This reading is a coarse heading the system will use to reduce time searching for the target satellite. Once the system is in the correct orientation for data collection from the compass, the system reads the value from the compass and generates a heading based on the reading. Once the heading is generated, the system creates a series of azimuth and elevation points that are tilt compensated according to the pitch and roll values taken during the 'Home' command. The points are based on a compass scan width where the width is set to compensate for any compass error.

Command Response Message: Read Compass

7.5.3.2 *Move to Initial Scan Point*

The positioner now moves to the initial scan point (first point of the tilt compensated azimuth and elevation values). The polarization is moved to a calculated value based on the electronic compass heading.

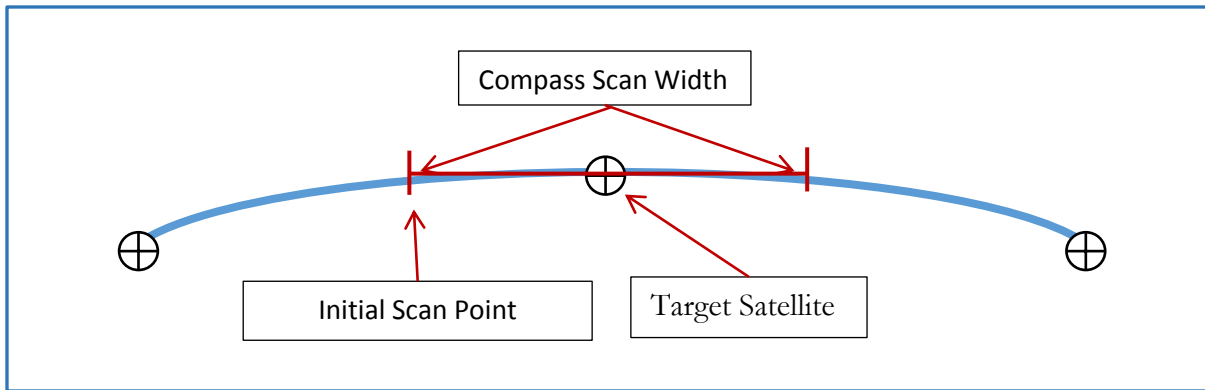


Figure 7.5.3.2 - Satellite Arc

Command Response Message: Moving to begin scanning in Az for Target Sat Signal

7.5.3.2 *Move to Second Scan Point*

The positioner now moves through the scan width searching for data satellite. Once the system or external signaling device (i.e. modems, beacon receiver, etc.) declares a lock. The system will discontinue the scan and move into the peaking sequence. This may vary with signaling device used.

Command Response Message: Scanning Az. For Target Sat Signal, Pass 1

7.5.4 Peaking Sequence

In general, the acquisition process attempts to locate and lock onto the strongest signal detected from the desired satellite using the signal levels and reported by the Modem, beacon receiver, RSL etc. This operation consists of the following steps:

Note - Setting values referred to below are part of the parameter settings for a particular profile. See chapters 4 & 5 for more information on the Profile system.

7.5.4.1 *Coarse peaking*

Coarse Peaking is the typical method used to automatically coarse peak on a satellite. This method sweeps in Azimuth based on the "*Coarse Peaking Width*" setting. Upon completion of the sweep, it will return to the highest signal level position where it then will move elevation based on the "*Peaking Height*" setting. Upon completion of the elevation movement, it will once again return to the highest signal level position.

At this point, it will compare the current signal level to the previous signal level. If the signal level difference is greater than the *“Coarse Peak Signal Dif. Pass”* setting value and meets the minimum number of peaking cycles specified by the *“Coarse peaking cycles”* setting, then “Cross Pattern, Coarse Peaking” has completed. If the value is not greater, it will continue Cross Pattern Coarse Peaking for a maximum number of tries based on the *“Coarse Peaking Max Cycles”* setting.

Command Response Message: Coarse Peaking

7.5.4.2 *Fine peaking*

This is the typical method used to automatically fine peak on a satellite. This method steps in Azimuth based on the *“Fine Peaking Az Step”* setting. Upon completion of each step, it compares the current signal level to the previous signal level. The *“Peak Dwell Iterations”* is set accordingly to allow for the signal level to stabilize before the comparison between steps is calculated. If the current signal level is greater than the previous signal level, it will step again. This process will continue until the previous signal level is greater than the current signal level. At this point, it will return to the previous signal level’s position. It will then step in Elevation based on the *“Step Pattern Fine Peaking El Step”* setting.

This process will once again continue until the previous signal level is greater than the current signal level. At this point, it will once again return to the previous signal level’s position. If the signal level difference is greater than the *“Fine Peak Signal Dif. Pass”* value and meets the minimum number of peaking cycles specified by the *“Fine peaking cycles”* setting, then Step Pattern Fine Peaking has completed. If the value is not greater, then it will continue Step Pattern Fine Peaking for a maximum number of tries based on the *“Fine peaking max cycles”* value. At this point, the antenna acquisition is considered to be complete.

Command Response Message: Fine Peaking

Chapter 8 - Troubleshooting

There are many interfaces between the AAQ and positioner including sensors, limit switches, the mechanical components of the antenna and ancillary satellite equipment, etc. Some issues are due to interactions that are not always readily apparent. A review of symptoms and faults will be given in this section.

8.1 Alarms & Messages

Numerous alarms, cautions, prompts and running messages are presented by the AAQ GUI depending upon situation as well as the equipment supplied with each type of system. This section will list and describe those found within the current revision.

8.1.1 Alarms

The following table lists alarm messages and their descriptions as shown on the AAQ GUI:

Alarm Name	Description
AzPot	The azimuth potentiometer cannot be read. The azimuth RIOM reports this error. This does not indicate an azimuth potentiometer is broken, it indicates the A/D interface cannot be read by the RIOM.
EIPot	The elevation potentiometer cannot be read. The elevation RIOM reports this error. This does not indicate an elevation potentiometer is broken, it indicates the A/D interface cannot be read by the RIOM.
PolPot	The polarization potentiometer cannot be read. The polarization RIOM reports this error. This does not indicate a polarization potentiometer is broken, it indicates the A/D interface cannot be read by the RIOM.
RSL1	Indicates an RSL read issue
AzStow	The azimuth stow magnetic switch cannot be read. The azimuth RIOM reports this error. This does not indicate the magnetic switch is broken, it indicates the digital input cannot be read by the RIOM.
PolLimit	The polarization limit switch cannot be read. The polarization RIOM reports this error. This does not indicate the limit switch is broken, it indicates the digital input cannot be read by the RIOM.
PolCenterSwitch	The polarization center switch cannot be read. The polarization RIOM reports this error. This does not indicate the center switch is broken, it indicates the digital input cannot be read by the RIOM.
EIUpLimitSwitch	The elevation up limit switch cannot be read. The elevation RIOM reports this error. This does not indicate the up limit switch is broken, it indicates the digital input cannot be read by the RIOM.
ElDownLimitSwitch	The elevation down limit switch cannot be read. The elevation RIOM reports this error. This does not indicate the down limit switch is broken, it indicates the digital input cannot be read by the RIOM.
AzCWLimitSwitch	The azimuth clockwise limit switch cannot be read. The azimuth RIOM reports this error. This does not indicate the clockwise limit switch is broken, it indicates the digital input cannot be read by the RIOM.

AzCCWLimitSwitch	The azimuth counter-clockwise limit switch cannot be read. The azimuth RIOM reports this error. This does not indicate the counter-clockwise limit switch is broken, it indicates the digital input cannot be read by the RIOM.
AzMotor	The azimuth motor had entered an error state. The azimuth RIOM reports this error. This indicates the azimuth motor can no longer move due to a physical problem.
EIMotor	The elevation motor had entered an error state. The elevation RIOM reports this error. This indicates the elevation motor can no longer move due to a physical problem.
PolMotor	The polarization motor had entered an error state. The Polarization RIOM reports this error. This indicates the polarization motor can no longer move due to a physical problem.
navDevice	The navigation RIOM cannot be communicated with.
WingMotor	The wing motor had entered an error state. The wing RIOM reports this error. This indicates the wing motor can no longer move due to a physical problem.
WingLeftDeploySwitch	The wing left deploy switch cannot be read. The wing RIOM reports this error. This does not indicate the left deploy switch is broken; it indicates the digital input cannot be read by the RIOM.
WingRightDeploySwitch	The wing right deploy switch cannot be read. The wing RIOM reports this error. This does not indicate the right deploy switch is broken; it indicates the digital input cannot be read by the RIOM.
WingLeftStowSwitch	The wing left stow switch cannot be read. The wing RIOM reports this error. This does not indicate the left stow switch is broken; it indicates the digital input cannot be read by the RIOM.
WingRightStowSwitch	The wing right stow switch cannot be read. The wing RIOM reports this error. This does not indicate the right stow switch is broken; it indicates the digital input cannot be read by the RIOM.
WingEISafetySwitch	The wing elevation safety switch cannot be read. The wing RIOM reports this error. This does not indicate the elevation safety switch is broken, it indicates the digital input cannot be read by the RIOM.
DigIn0 through 4	The RIOM configured as the Digital Input 0 through 4 register cannot be communicated with.
ElevationInc	The elevation inclinometer cannot be read or the inclinometer device is not functioning.
PitchRollInc	The pitch and roll (tilt) inclinometer cannot be read or the inclinometer device is not functioning.
FeedType	The feed bit digital inputs cannot be read.
GreenRed	The Green and Red digital inputs cannot be read.
RackController	The Legacy 1RU Rack Controller cannot be communicated to.
DigitalOut	The RIOM configured as the Digital Output 0 register cannot be communicated with. AAQ 1500 hardware is configured to use Digital Output 0 as the LNB control.
DigitalOut1 through 3	The RIOM configured as the Digital Output 1 through 3 register cannot be communicated with.
LocationService	The controller has not received a valid GPS location.

GPS	The GPS device on the NAV RIOM cannot be read or the GPS device is not functioning.
Compass	The compass device on the NAV RIOM cannot be read or the compass device is not functioning.
VectorCompass	The vector compass device cannot be communicated to.
AvLCompass	The heading device configured as the AvL Compass cannot be communicated with.
Az Limit	The azimuth axis is in a limit condition.
El Limit	The elevation axis is in a limit condition.
Pol Limit	The polarization axis is in a limit condition.
User Manager	The internal user manager has encountered an issue.

8.1.2 Error Messages

The following table lists error messages and comments as shown on the AAQ GUI:

Message	Comment
Cannot execute command while alarm is active.	Clear alarm and retry
GPS Coordinates are not valid.	Check GPS or manually entered coordinates
GPS or compass is in Alarm state.	Clear alarm and retry
Modem has not sent a target.	Check device and retry
All signal sources tried with no valid signal detected.	Possible RF or signal threshold issue
Scanning will exceed Az Limits - Rotate Base and try again	Rotate Base and try again
Heading calibration failed. No signal found during arc scan.	Check heading source and retry
Command failed. Home must be run first.	Home command needed to initialize resolvers
Elevation inclinometer failure.	Check inclinometer or El RIOM may be incorrect
Azimuth must be on stow switch	
Invalid target for this location.	Target may not be visible from present location
Invalid signal for peaking.	Possible signal threshold issue or peaking on incorrect satellite
Heading Cal Failed	Unable to Calculate Heading
Invalid target for this location.	Target may not be visible from present location
Could not transform world coordinates.	
Acquire failed waiting for modem/beacon signal.	Possible signal threshold issue or peaking on incorrect satellite
Elevation deploy failed.	Check cabling or interference
Elevation stow failed.	Check cabling or interference
Heading calibration Failed. No signal found during scan for a reference satellite.	Possible compass calibration needed

The crosspol command cannot be performed with this feed.	Check hardware or “feedbit” read issue.
Invalid operation	Invalid operation for the current hardware

8.1.3 Prompts

The following table lists user prompts and their descriptions as shown on the AAQ GUI:

Message	Comment
Mount reflector and select OK to continue	For use on systems with removable antennas only. At this point in the deploy process, the antenna should be mounted.
Unmount reflector and select OK to continue	For use on systems with removable antennas only. At this point in the stow process, the antenna should be unmounted.
Warning stow may cause elevation to move to the deploy range. Press OK to continue.	The stow process may require that the antenna elevation is moved past the elevation limit. Caution is advised to avoid potential damage.
Connect all RIOMs and select OK to continue	A RIOM may have been unintentionally disconnected or may need to be connected during deployment.
Disconnect all removable RIOMs and select OK to continue	This message is typically used during the stow process for the antenna.

8.1.4 Running Messages with Associated Hex Code

The following table lists running messages and their descriptions as shown on the AAQ GUI. Depending on the message location, either the short or long message will be displayed:

Function Code (Hex)	Short Message	Long message
0x0001	"Scanning in Az 1"	"Scanning in Az for Target Sat Signal, Pass 1"
0x0002	"Moving back to Peak "	"Moving back to Peak signal"
0x0003	"No Signal-Rescanning"	"No Signal found on first pass"
0x0004	"Scanning in Az 2"	"Scanning for Target Signal, Pass 2"
0x0005	"No Sig Return Home"	"No Signal found returning to Home Position"
0x0006	"Adjusting Pol"	"Adjusting Pol during Az Scan"
0x0007	"Acquiring"	"Acquiring"
0x0008	"Moving to Home"	"Moving to Home Position"
0x0009	"Read GPS"	"Read GPS"
0x000A	"Read Compass"	"Read Compass"
0x000B	"Acquiring"	"Waiting for target from modem."

0x000C	"Waiting"	"Waiting on modem to allow move."
0x000D	"Performing Move To"	"Moving to commanded position"
0x000E	"Moving to Home"	"Moving to Home Position"
0x000F	"Stowing"	"Stowing"
0x0010	"Compass Cal"	"Performing compass calibration."
0x0011	"X-Pol (H/V) moving"	"Cross Pol (H/V) moving Pol"
0x0012	"Initializing Sensors"	"Initializing EI Encoder"
0x0013	"In Manual Control"	"In Manual Control and Jog mode"
0x0014	"Moving"	"Moving"
0x0015	"Coarse Peaking"	"Coarse Peaking"
0x0016	"Coarse Peaking done"	"Coarse Peaking Complete"
0x0017	"Fine Peaking"	"Fine Peaking"
0x0018	"Fine Peaking Done"	"Fine Peaking Complete"
0x0019	"Fine Peaking Pol"	"Fine Peaking POL"
0x001A	"Peaking"	"Peaking"
0x001B	"Idle"	"Idle"
0x001C	"Tracking for signal"	"Moving to maintain signal"
0x001D	"Position Hold Active"	"Moving to maintain signal"
0x001E	"Opening wings"	"Opening wings."
0x001F	"Closing wings"	"Closing wings."
0x0100	"Mount Reflector"	"Moving to reflector mount position"
0x0101	"Dismount reflector"	"Moving to reflector dismount position"
0x0102	"Acquire Complete"	"Locked and Acquired continuing pos/wind hold and track ops"
0x0103	"Tilt Compensating"	"Calculating Tilt compensation"
0x0104	"Moving to Target"	"Moving to begin Scanning in Az for Target Sat Signal"
0x0105	"Moving back to Peak "	"Moving back to Peak signal"
0x0106	"Calibration"	"Performing Calibration"
0x0107	"Initializing Sensors"	"Initializing Az Encoder"
0x0108	"Initializing Sensors"	"Initializing POL Encoder"
0x0109	"Intializing sensors"	"Intializing sensors"
0x0110	"Acquiring"	"Paused"
0x010A	"Waiting for signal"	"Acquiring, waiting for modem/beacon signal."
0x010B	"Wait. Cal Heading"	"Please wait. Calibrating heading."
0x010C	"Elevation Deploy"	"Moving in elevation to deploy range"
0x010D	"Elevation Stow"	"Moving in elevation to the stow position"
0x010E	"Wait. Cal Heading"	"Please wait. Calibrating heading."
0x010F	"Mod Cmd Running"	"Please wait. Module command running."
0x0111	"No Ref., Calibrating "	"Invalid Ref. Satellites, Calibrating Heading "
0x0112	"Adj. using Ref #1 "	"Adjusting Heading using Reference Sat. #1"
0x0113	"Adj. using Ref #2 "	"Adjusting Heading using Reference Sat. #2"
0x0114	"Ref 1 Fail use Ref 2 "	"Ref. Satellite #1 Failed, using Ref. Satellite #2"
0x0115	"Ref 2 Fail use Ref 1"	"Ref. Satellite #2 Failed, using Ref. Satellite #1"

0x0116	"Ref Fail Calibrating"	"Ref. Satellites Failed, Calibrating Heading"
0x0117	"Moving to target"	"Moving to target satellite"
0x1001	"Has Alarm"	"Cannot execute command while alarm is active."
0x1002	"Invalid GPS"	"GPS Coordinates are not valid."
0x1003	"Location Alarm"	"GPS or compass is in Alarm state."
0x1004	"No modem target"	"Modem has not sent a target."
0x1005	"Acquire Failed"	"All signal sources tried with no valid signal detected."
0x1006	"Acquire Failed"	"Scanning will exceed Az Limits - Rotate Base and try again"
0x1007	"Heading Cal Failed"	"Heading calibration failed. No signal found during arc scan."
0x1008	"Needs Home"	"Command failed. Home must be run first."
0x1009	"Sensor failure"	"Elevation inclinometer failure."
0x100A	"Operation failure"	"Azimuth must be on stow switch"
0x100B	"Invalid operation"	"Invalid operation for the current hardware."
0x100C	"Invalid signal"	"Invalid signal for peaking."
0x100E	"Move failed"	"Geometry move failed."
0x100F	"Invalid Target"	"Invalid target for this location."
0x1010	"World calc failed"	"Could not transform world coordinates."
0x1012	"Signal wait failed"	"Acquire failed waiting for modem/beacon signal."
0x1013	"El Deploy failed"	"Elevation deploy failed."
0x1014	"El Stow failed"	"Elevation stow failed."
0x1015	"Heading Cal Failed"	"Heading calibration Failed. No signal found during scan for a reference satellite."
0x1016	"XPol not valid"	"The crosspol command cannot be performed with this feed."
0x1017	"Heading Cal Failed"	"Unable to Calculate Heading"
0x2000	"Aborted"	"Command aborted"
0x2001	"Acquire Complete"	"Locked and Acquired"
0x2002	"Heading Cal. Comp."	"Heading calibration completed"
0x2003	"X-Pol (H/V) complete"	"Cross Pol (H/V) POL move complete"
0x2004	"Home Completed"	"Home Completed"
0x2005	"Command completed"	"Command completed."
0x2006	"Command completed"	"Position hold completed."
0x2007	"Command skipped"	"Command skipped due to hardware configuration."
0x2008	"Stowed"	"Stowed"
0x2009	"Idle"	"Idle waiting for next command"
0x200A	"El deploy completed"	"Elevation deploy completed"
0x200B	"El stow completed"	"Elevation stow completed"
0x200C	"Ref Sat Completed"	"Scan for reference satellite completed"
0x200D	"Mod Cmd Completed"	"Module command completed"
0x3000	"Mount Reflector"	"Mount reflector and select OK to continue"
0x3001	"Unmount Reflector"	"Unmount reflector and select OK to continue"

0x3002	"Stow Confirm"	"Warning stow may cause elevation to move to the deploy range. Press OK to continue."
0x3003	"Connect RIOMs"	"Connect all RIOMs and select OK to continue"
0x3004	"Remove RIOMs"	"Disconnect all removable RIOMs and select OK to continue"

8.2 Communicating with the GUI

Should the AAQ Graphical User Interface (GUI) application not show a connection to the Antenna Control Unit (ACU), follow the steps below.

8.2.1 Comms. LED Indicator

Communication between the GUI and ACU is indicated by an LED located in the bottom left corner of the GUI. Green indicates communication is present, while gray indicates no communications are present.



Figure 8.2.1 – GUI Communication Indicator

8.2.2 Remote IP Address

View the Remote IP address in the AAQRemote Settings window located in FILE>SETTINGS tab. Verify that the IP address on the Client Computer is correct.

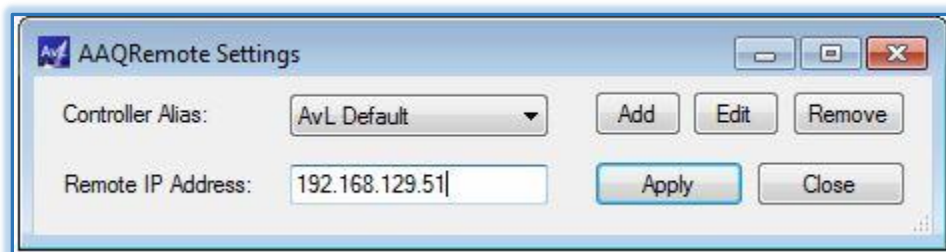
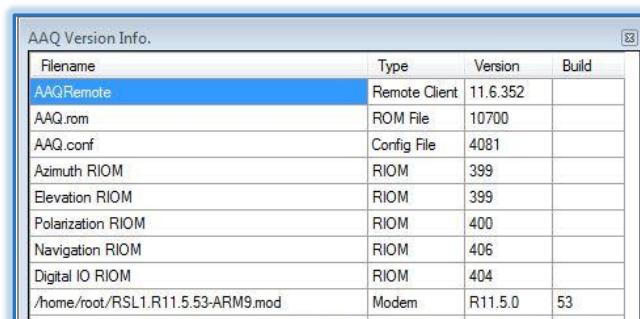


Figure 8.2.2 – Remote Settings Address

8.2.3 Verifying Connections

If the Addressing appears to be correct, continue with the following steps:

1. Verify the Ethernet cable from the pedestal to the PC is present.
2. Open the client computers command prompt (cmd).
3. Ping the ACU, i.e. (ping 192.168.129.51. , Service IP)
4. If ping responds with replies. Contact AvL to ensure the correct GUI is installed in the AAQ Version Info found in HELP>VERSION tab.
5. Contact AvL support to assist in reinstalling ROM software if necessary.
6. If ping does not respond, ensure power is present by checking power supply and re-checking control cable connections.



Filename	Type	Version	Build
AAQRemote	Remote Client	11.6.352	
AAQ.rom	ROM File	10700	
AAQ.conf	Config File	4081	
Azimuth RIOM	RIOM	399	
Elevation RIOM	RIOM	399	
Polarization RIOM	RIOM	400	
Navigation RIOM	RIOM	406	
Digital IO RIOM	RIOM	404	
/home/root/RSL1.R11.5.53-ARM9.mod	Modem	R11.5.0	53

Figure 8.2.3 – Version Info Example

8.2.4 ACU communication to RIOMs

Communication between the GUI and RIOM's are indicated by a series of LED's located in the bottom of the GUI. Green indicates communication is present, while gray indicates no communications are present.

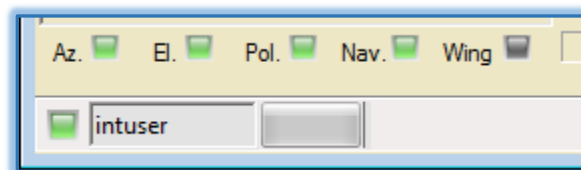


Figure 8.2.4 – RIOM Comms. LEDs

If system has external RIOM modules, Verify connections from ACU to external RIOM (i.e. Tyco connections) are secure. If all connections appear to be correct, contact AvL Customer Support to verify correct RIOM software is installed.

8.3 Modem Signal Source not found on scan

When during the initial acquisition scan, a signal was not detected by the ACU's external device (i.e. modem, beacon receiver, etc.), follow steps below

8.3.1 Verify Communication

Verify communication between the ACU and modem are present by viewing the "Current Device Stats" window found in the VIEW>DEVICE WINDOW tab.

If communications is present the window will populate with the device's information, if communications is not present the window will be blank for the device in use. The unit will fail to acquire if communication is not present between the ACU and the external device.

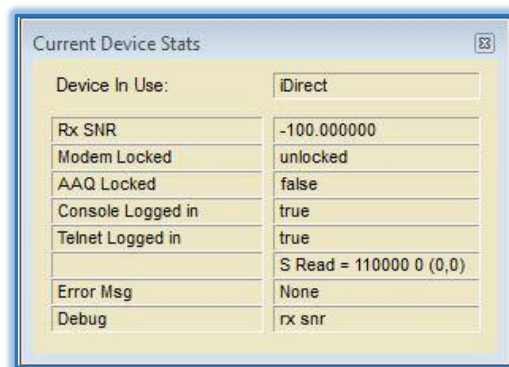


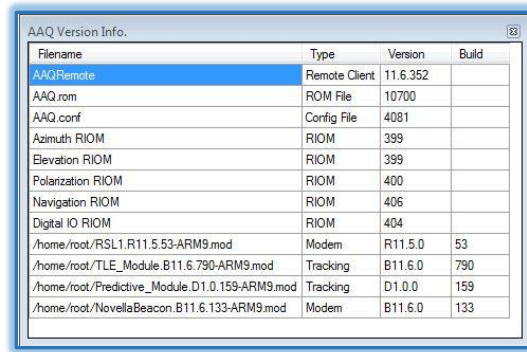
Figure 8.3.1 – Current Device Stats Example

8.3.2 IP Addressing

Verify the Configuration port and IP addresses are set to match the external device settings. (i.e. 192.168.100.1, port settings: 80 for Viasat modem).

Verify that Ethernet and/or serial connection is present between the ACU and external device. If the "Device in use" box shown in figure 8.2.1, shows blank, then the external device is still not recognized by the ACU.

Contact AvL Customer Support to verify the correct module is installed in the AAQ Version Info found in Help > Version tab.



Filename	Type	Version	Build
AAQRemote	Remote Client	11.6.352	
AAQ_rom	ROM File	10700	
AAQ_conf	Config File	4081	
Azimuth RIOM	RIOM	399	
Elevation RIOM	RIOM	399	
Polarization RIOM	RIOM	400	
Navigation RIOM	RIOM	406	
Digital IO RIOM	RIOM	404	
/home/root/RSL1.R11.5.53-ARM9.mod	Modem	R11.5.0	53
/home/root/TLE_Module.B11.6.790-ARM9.mod	Tracking	B11.6.0	790
/home/root/Predictive_Module.D1.0.159-ARM9.mod	Tracking	D1.0.0	159
/home/root/NovellaBeacon.B11.6.133-ARM9.mod	Modem	B11.6.0	133

Figure 8.3.2 – Version Info

If the external device is recognized in the Device Window, manually point the antenna to verify the external device can recognize the intended signal. Should the signal then be recognized, verify the Azimuth and Elevation alignment are correct for the intended Target Satellite.

8.4 Elevation and Azimuth alignment

Incorrect offsets in both azimuth and elevation are the most common inaccuracies when acquiring a satellite. Offsets may be introduced due to mechanical tolerances, slight inaccuracies in installation, etc.

8.4.1 Elevation Offset

Once a known satellite is identified, the elevation can be verified. If the actual and the predicted are noticeably different, an elevation offset may need to be applied in the system calibration window. The “Eline Offset” configuration item is located the “System Configuration” window located in the VIEW>CONTROLLER CONFIGURATION tab.

Note - The pedestal must be level before the elevation can be set. It is also necessary that the “roll” reading be as close to zero as practical before entering a new Elevation offset.

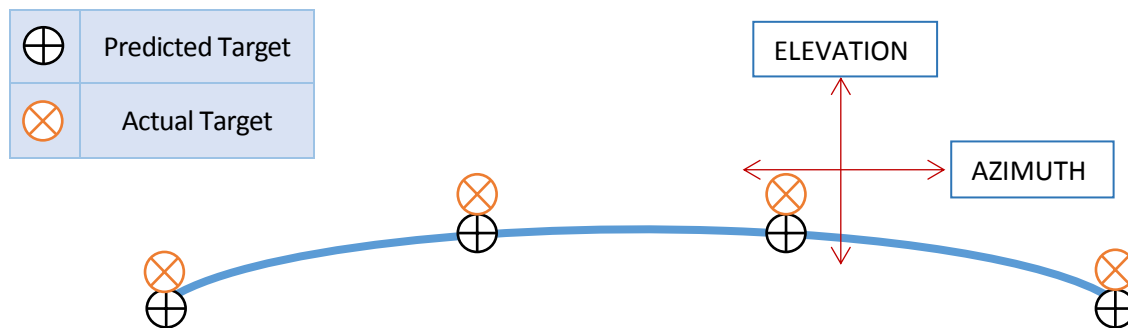


Figure 8.4 - Errors in the Elevation Calibration (El Offset)

WARNING - Anytime the “elevation offset” value is changed, the elevation limit switches (UP, DN, and STOW) should be checked.

8.4.2 Azimuth Offset

If a consistent error in actual vs. predicted azimuth is observed, an offset in the compass may need to be applied. The “Compass Heading” configuration item is located the “System Configuration” window located in the View>Controller Configuration tab. Compass test and calibration tools are located in File > Calibration.

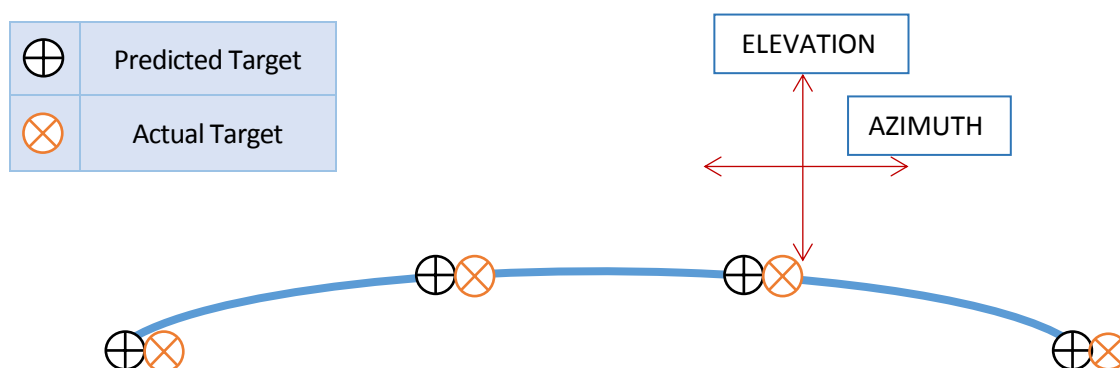


Figure 8.4.2 - Errors in Azimuth (Compass) Calibration

8.4.3 Recognizing a Failed Compass

Manual Compass is required when the compass module fails and the readout does not change from default (zero), regardless of the true heading. The compass readout will remain zero during the compass routine and continue the acquiring process. The ACU assumes the compass heading of zero is correct and continues the acquiring process. See Figure 8.3.3.

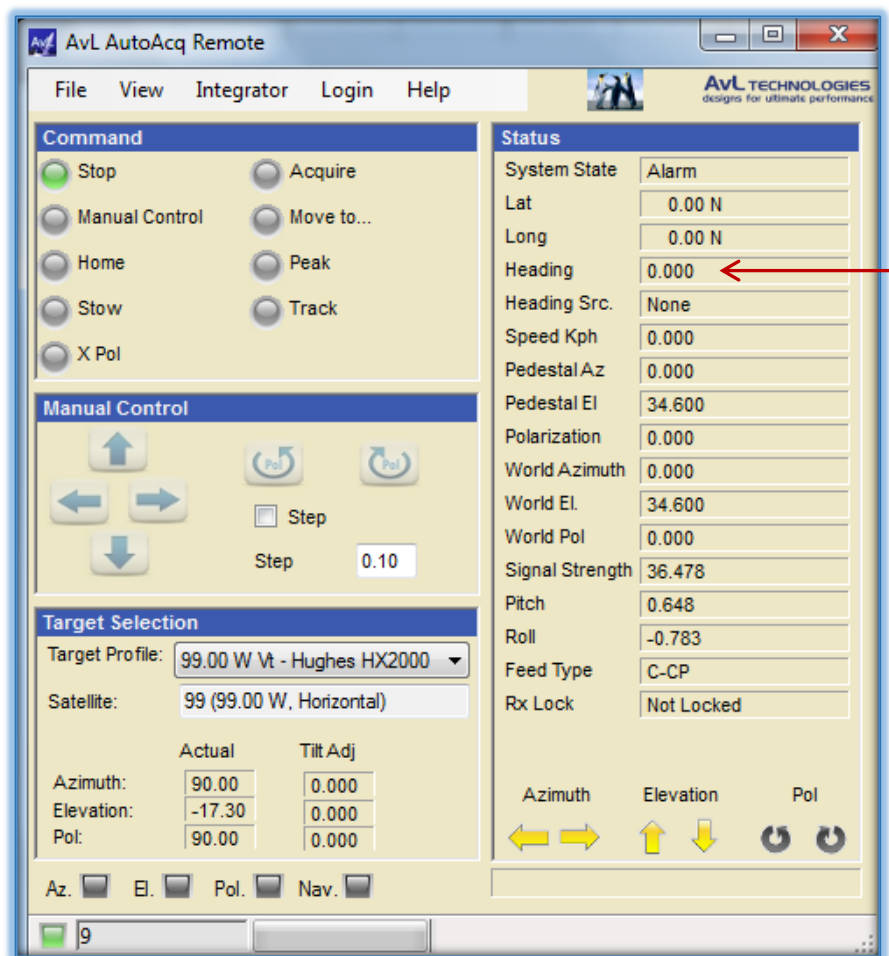


Figure 8.4.3 - Main GUI, Heading Indicates Zero

Note - A compass fault will not be indicated in the event the compass fails to produce a heading.

8.4.4 Changing the Compass Heading Sources

The “Heading Source” configuration item is located in the “Configuration” window VIEW>CONFIGURATION, Core tab. Keyword search was used to find heading related items.

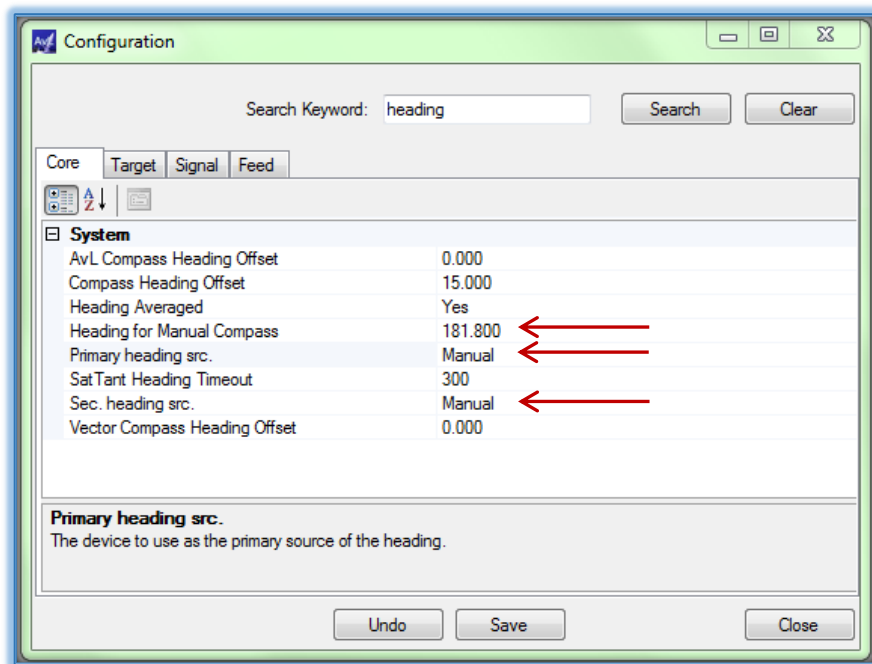


Figure 8.4.4 – Heading Sources to Manual

Selecting “Manual” from the pull downs for both primary and secondary heading sources, will direct the AAQ controller to use the value listed under “Heading for Manual Compass” for the heading source. This parameter is listed under the “Configuration” window VIEW>CONFIGURATION, Core tab as shown in Figure 8.3.4b.

Note - Searching for the “Keyword(s)” simplifies the process as indicated.

The ACU is now set to recognize this value as the position of the Antenna frame when beginning the acquisition process. Typically, the pedestal is pointed due south (north when operating below the equator) and the Manual heading is set to 180.00.

In the case of a vehicular mount, the operator will make a best estimate of the antenna’s pointing direction while stowed, with a hand compass. This value then becomes the “Manual Heading”.

Remember to save the changes when finished.

8.5 Recognizing a Failed GPS

A “GPS Coordinates are not valid” error will occur when “zero” values are displayed in the “Lat” and “Long” readout positions.

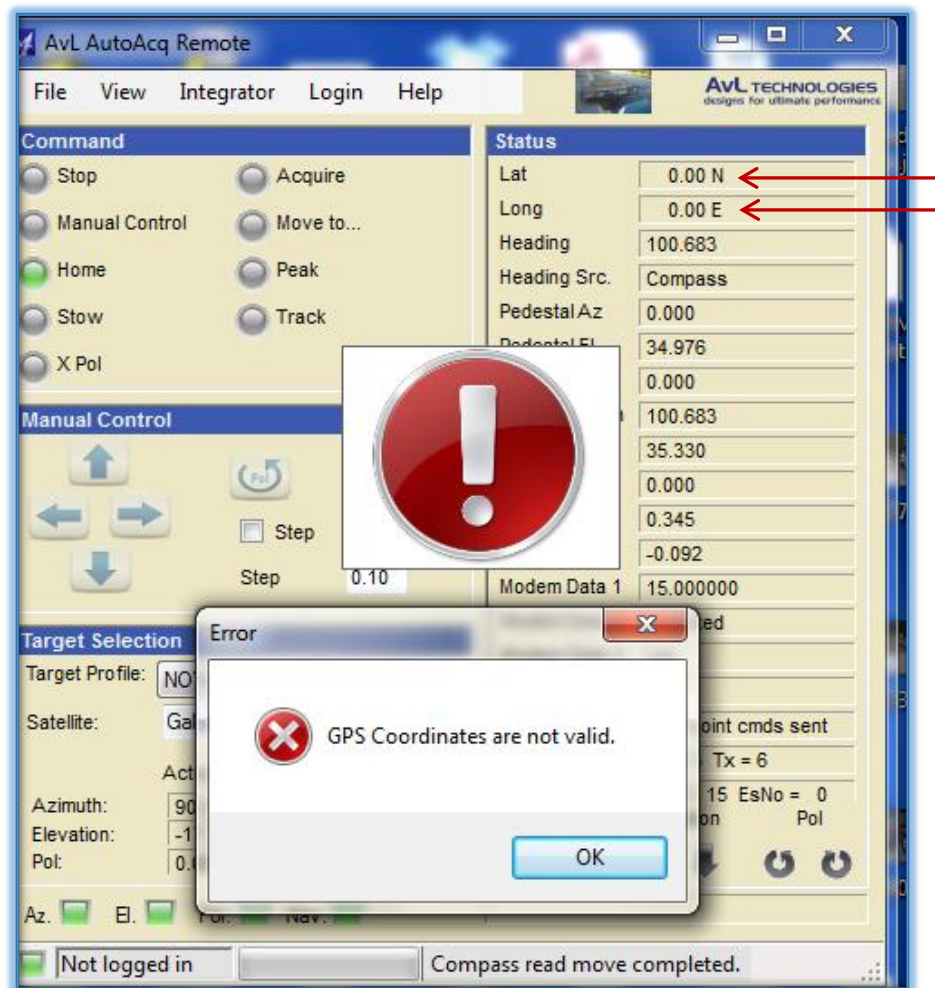


Figure 8.5 - Main GUI, GPS Coordinates

8.5.1 Changing to Manual GPS

The “GPS Source” configuration item is located in the “Configuration” window under, VIEW> CONFIGURATION>Core Tab.

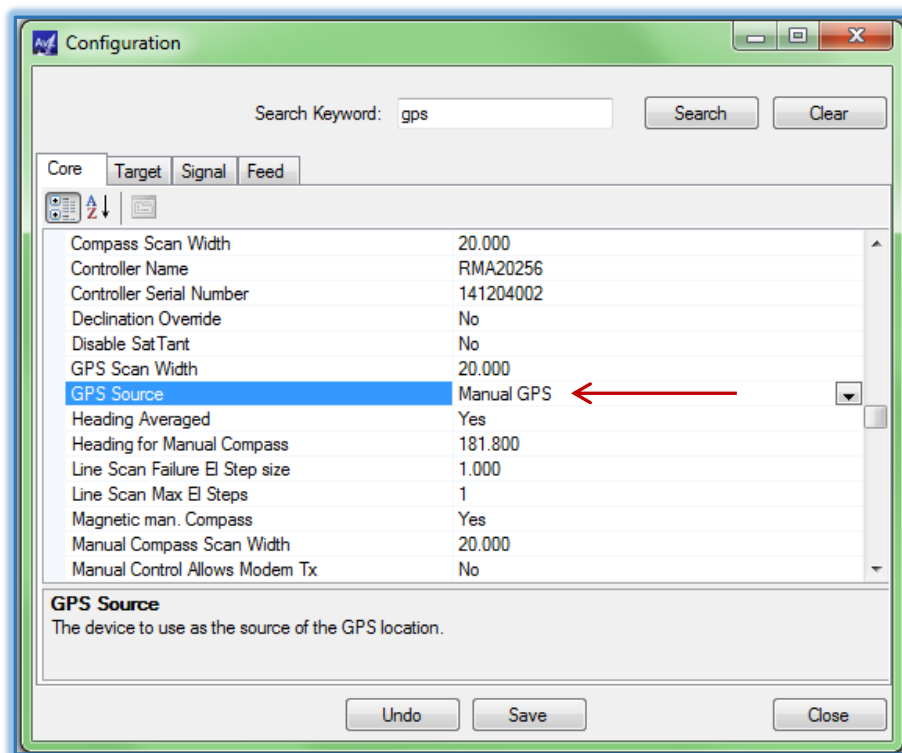


Figure 8.5.1 – GPS Source to Manual

Selecting “Manual” from the “GPS Source” pull down menu will direct the AAQ controller to use the values listed under “Manual Latitude” and “Manual Longitude” for the GPS source. These values are also listed under the “Configuration” window, VIEW>CONTROLLER CONFIGURATION> Core tab.

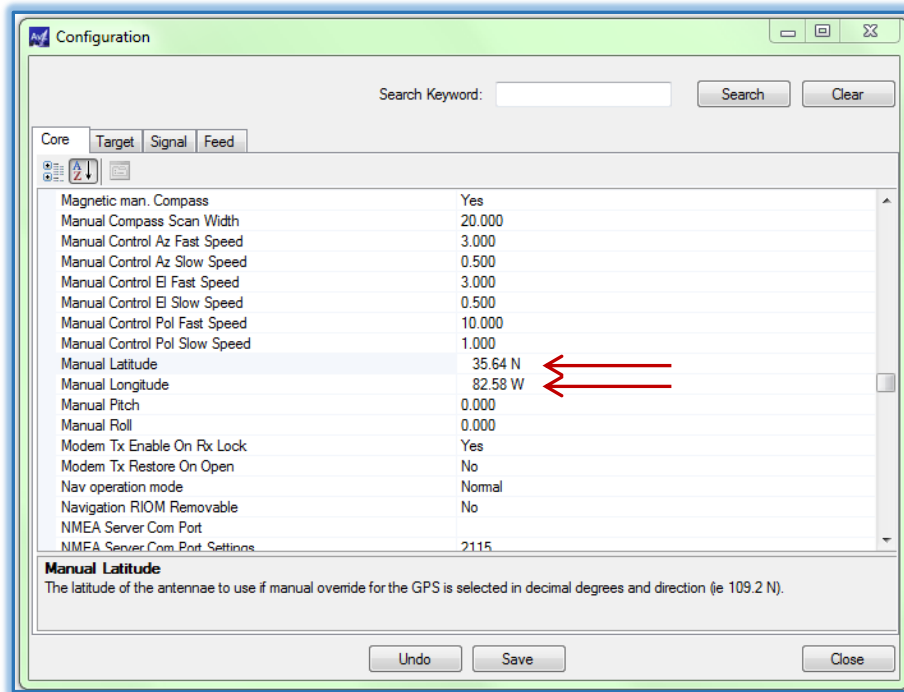


Figure 8.5.1b - Manual Lat and Long entry

8.6 Maintenance

AvL Antenna systems are designed such that any wear should never degrade performance below specifications and essentially no maintenance should ever be required. However, since it is impossible to ascertain or test for all possible environments, the following checkup is recommended each year. If any problems are observed, refer to section 8.6 in order to contact Customer Service.

8.6.1 Annual Inspection

Azimuth

- Check for unusual noise in the azimuth bearing, the azimuth gearbox and the azimuth motor.
- Run in azimuth and check for unusual noise in the azimuth motor.
- Check the position of the azimuth drive cables on capstan at 0° Azimuth.
- Check the drive cables for damage.
- Run both Az. limits and observe cable tracking.
- Check for excessive backlash in the gearbox.
- Inspect cable connections and tensions.
- Inspect the Azimuth potentiometer for looseness, damage or dirt.

Elevation

- Hand crank in elevation - the unit should hand crank easily.
- Unit should hand crank with approximately 50-75 in-lbs. torque depending on model.
- Check for unusual noise in the elevation pivot bearings and the elevation gearbox.
- Run in elevation and check for unusual noise in the elevation motor. (Run to limits)
- Check the position and tracking of the elevation drive cables.
- Check the drive cables for damage.
- Check the oil level in the gearbox, where accessible.
- Inspect the elevation limit switches.

Polarization

- Run in polarization and check for unusual noise in the polarization gearing or motor.
- Inspect the polarization potentiometer.
- Inspect the wave-guide for any damage, dents, or cracks.

8.7 Contacting Customer Service

AvL Customer service is available 24 hours a day, seven days a week for your inquiries. We strive to assist our customers in any way they need, providing as much information, training, and assistance as is necessary. AvL customer support is committed to solving our customer problems. We are a team of dedicated professionals working to continually improve all aspects of our products and the service we provide. We want to take the time to understand your technical and operational requirements.

When contacting customer support please ensure the following information is available, this information can be found on the AvL serial tag located between the elevation arms or on the azimuth base plate.

- AvL antenna type
- serial number
- Manufacturing Date
- Customer the unit was originally purchased from (optional).

8.7.1 Email Support

General email support is available to all AvL customers at support@avltech.com.

We encourage making primary contact for routine requests through email in order for our technical staff to organize and evaluate needs in a timely manner.

8.7.2 Priority Telephone & Fax Support

In case of an emergency or relating to matters of a more pressing nature, telephone and fax support is available per incident to AvL customers throughout the world.

General telephone support - (Monday - Friday 8am - 5pm EST):
1-828-250-9950

After hours/emergency customer service (Weekends and Holidays):
1-828-250-9140, then follow prompts to page Custom

