Installation Guide

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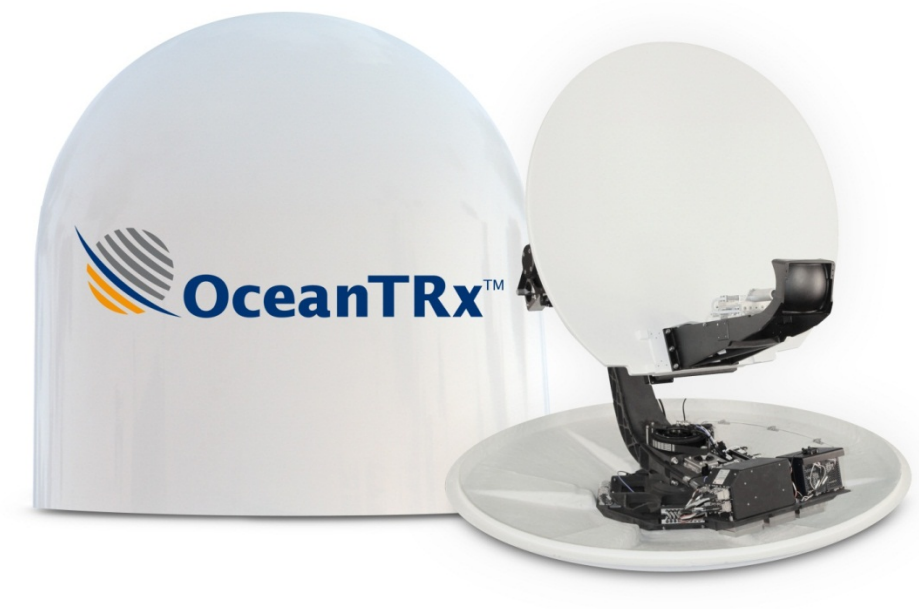
OceanTRx™ 4-500

1.15m (45”) Linear Ka-Band Maritime Stabilized VSAT System

For O3b System



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About this Manual

This guide is designed to guide you through the installation and operating procedures for the OceanTRx™4-500 for O3b topology.

It is recommended to review the information in the OceanTRx™4-500 User Manual in addition to following the instructions in the guide.

Table of Contents

1 Introduction

Orbit's O3b installation is based on OceanTRx™4-500 satellite antenna systems. The O3b installation is designed to ensure continuous coverage through handover between operating antennas, as well as robustness through redundancy of operating antennas and (optionally) a backup antenna and a backup communication room.

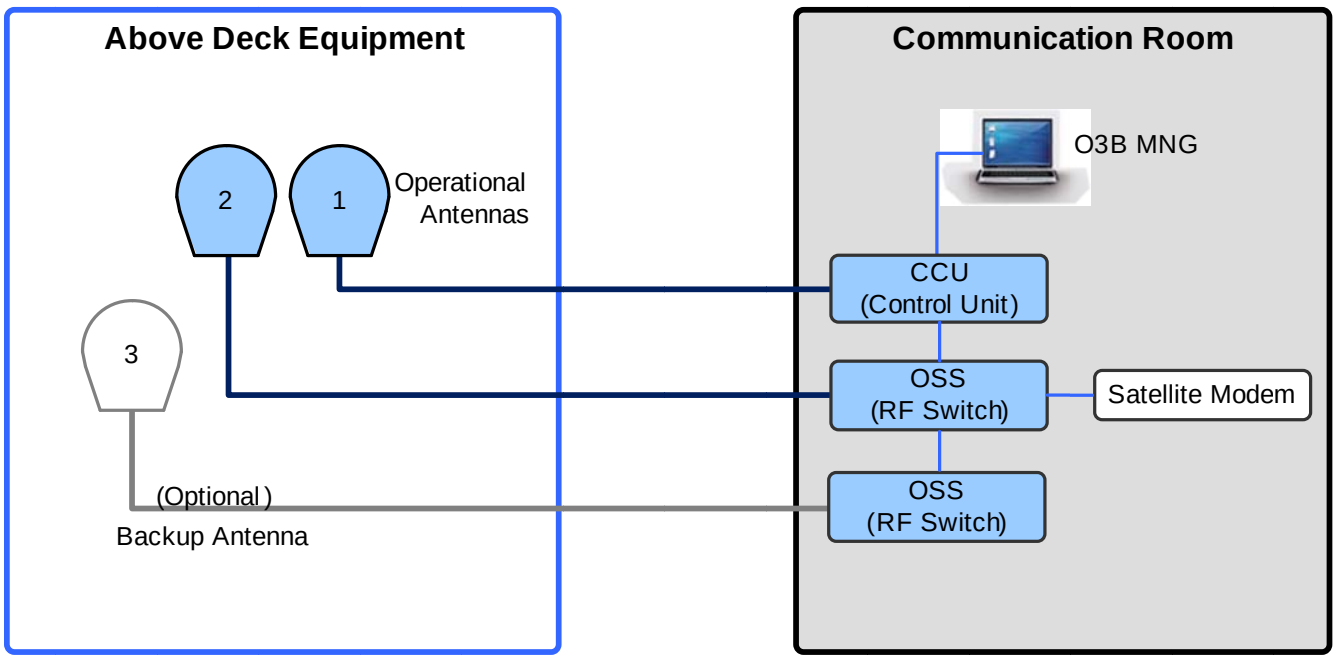
The O3b installation consists of either two or three antennas installed above deck, where usually only two of the antennas operate at any one time - tracking or preparing to track a satellite. A third (optional) antenna can serve as a backup antenna that (usually) tracks the satellites as well but only begins transmitting in the event one of the operational antennas is faulty.

Although antenna handover can be performed according to various, user defined criteria, it is (by default) performed automatically to provide continuous coverage over the changeover period of two satellites - one satellite descending and the other ascending, to compensate for defined blockage zones and for a faulty antenna.

The antennas can be installed at a distance of up to 140 meters from the communication room located below deck, where data between the antennas and communication room is transferred over coaxial cable.

The MtsVLink, antenna dedicated management application is used for antenna setup, management and troubleshooting operations. Once the system is installed and set up, the O3bLink management application is used for overall system monitoring and if necessary, for troubleshooting and re-configuration of the handover criteria.

The following figure illustrates the O3b system with three antennas (two operational and one backup).



1-1.O3b General System Description of a System Architecture

1.1 O3b Basic System Architecture

The OceanTRx™4-500 O3b system consists of the following main elements:

- **OceanTRx™4-500 Antenna** – either two or three antennas are installed. Two are operational and a third antenna (if installed) serves as backup.
- **OSS** (Orbit System Selector) – RF switch installed below deck. It is controlled by the CCU for switching up to 3 systems L-Band Signals.
- **CCU** (Control and Communication Unit) – installed below deck. Provides single source management and control of the system.

The following figure shows the RF and control signals path of a *single* Antenna.

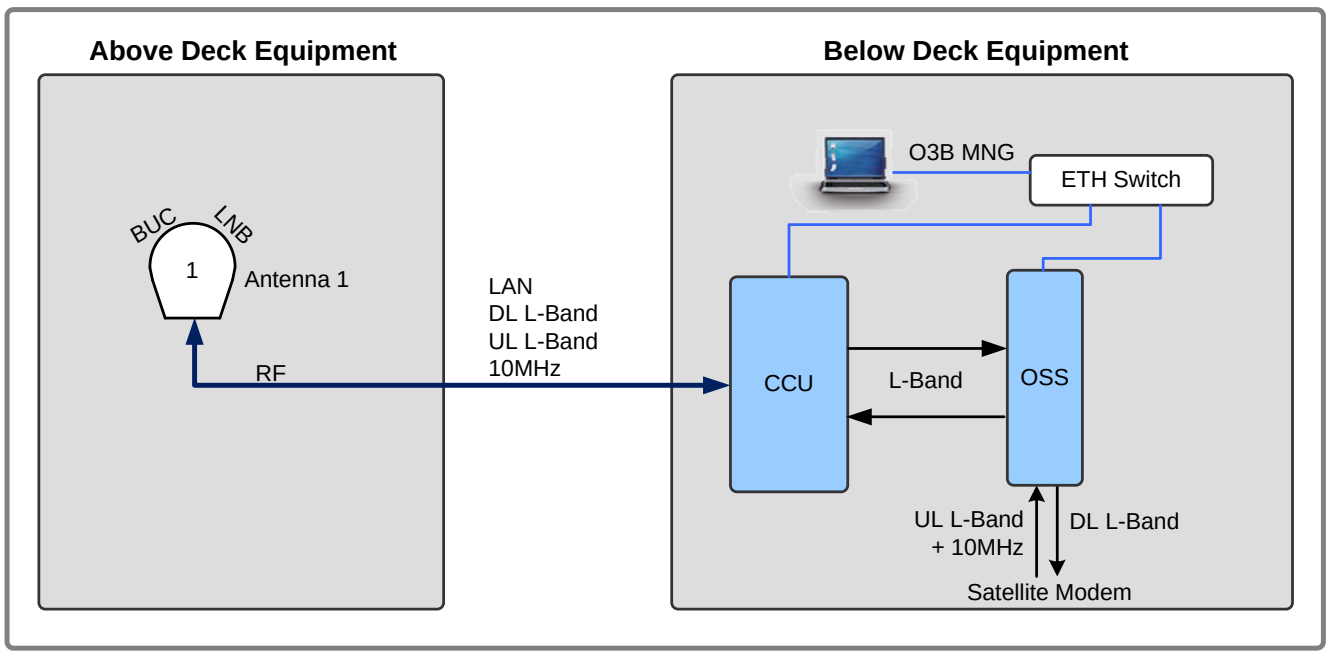


Figure 1-2: Basic System Architecture Showing Signal Path

Note the following:

- All four signals are routed via the LMR cable: LAN, L-Band UL, L-band DL and 10Mhz.
- Downlink (DL) signal – signal from LNB (Low Noise Block)
- Uplink (UL) signal – signal to BUC (Block Up Converter)

1.2 Antenna Handover

This section describes the default, most common antenna handover configuration and the options available for modifying the configuration for changing needs.

In most cases, two antennas alternatively transmit to the currently available satellite. In installations that include a third, backup antenna, the third antenna can either be in tracking mode (by default) or in stand-by mode - ready to take over in case coverage cannot be provided by either of the operational antennas.

The antennas track a satellite on its route and ensure continuous coverage by performing two types of handover:

- **Planned handover** - over the descending time of the current satellite and ascending time of the new satellite
- **Mid-pass (unexpected) handover** – either when the antenna direction causes the satellite to antenna path to approach a blockage zone, or if one of the antennas is identified as faulty and another antenna takes over.

The backup antenna (if installed) takes over only if the currently operating antennas cannot provide full coverage over existing blockage zones or one of the antennas is faulty.

The handover criteria and settings are defined by default on the O3b Link application and can be modified by the user.

1.2.1 Terminology

The following terminology is defined:

Term	Description
Physical names	Antenna-1, Antenna-2, Antenna-3
Primary/Active Antenna	Tracking Antenna which Transmits and Receives and is connected to the active Demod in the modem.
Secondary Antenna	Tracking Antenna which Receives but does not Transmits and is connected to the non-active Demod.
Switching	Primary and Secondary Antennas switch roles between them at the exact moment of Handover - Primary becoming Secondary and vice versa.
Backup Antenna	May be tracking mode or in standby mode. Antenna which does not transmit and is not connected to any one of the two Demods.
Stand-by Backup Antenna	Antenna which Does not transmit and is not connected to any of the Demods, but is forced (by CCU Configuration) to Stand-by mode.

1.2.2 Planned Handover

This section describes the tracking and handover flow of two operational antennas for ascending and descending satellites. The handover time is planned since the track of the satellites is known and programmed in the system.

For clarity, the backup antenna is shown as being in Standby mode; by default, in most configurations the backup antenna tracks the satellites as well.

A. Both antennas (primary and secondary), track the *same descending* satellite on its course.

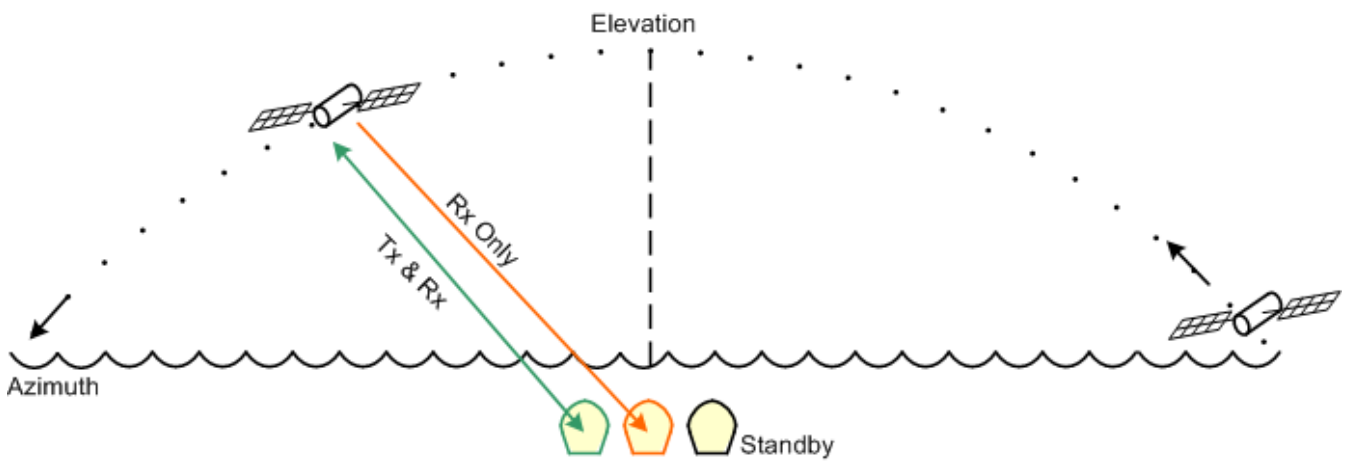


Figure 1-3: Two Antennas (primary and secondary) Tracking Descending Satellite

B. A set period of time *before* the *planned* handover time, the secondary antenna turns towards the *ascending* satellite, while the primary antenna continues to track the *descending* satellite.

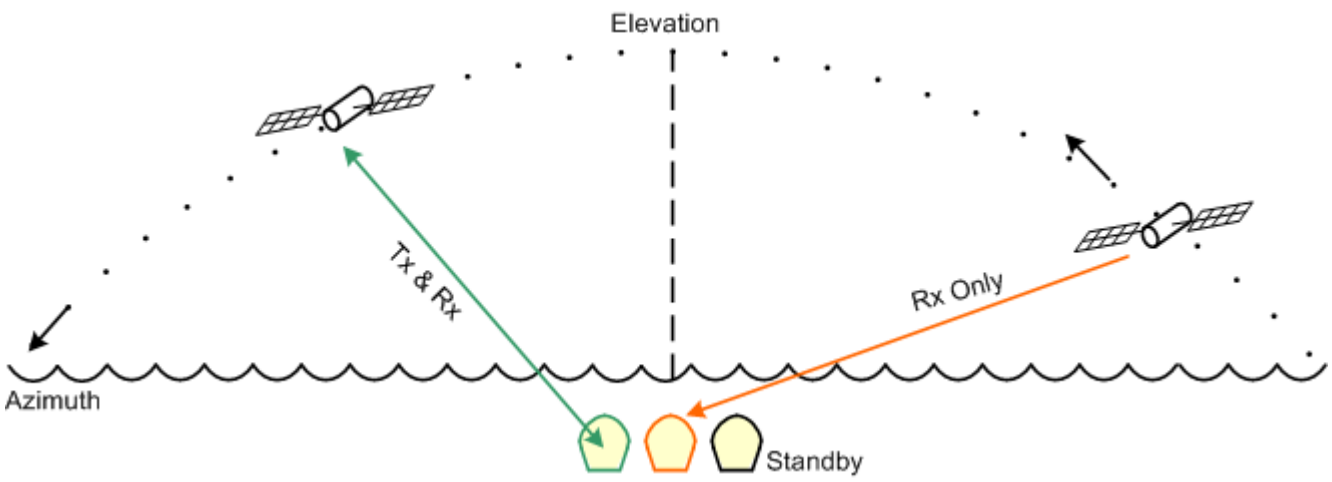


Figure 1-4: Before Handover, secondary Antenna Turns to Ascending Satellite

C. During handover, the secondary antenna (tracking the ascending satellite) begins receiving and transmitting the signal. The primary antenna (tracking the descending satellite) continues receiving and transmitting as well. (Each antenna receives and transmits to a different satellite).

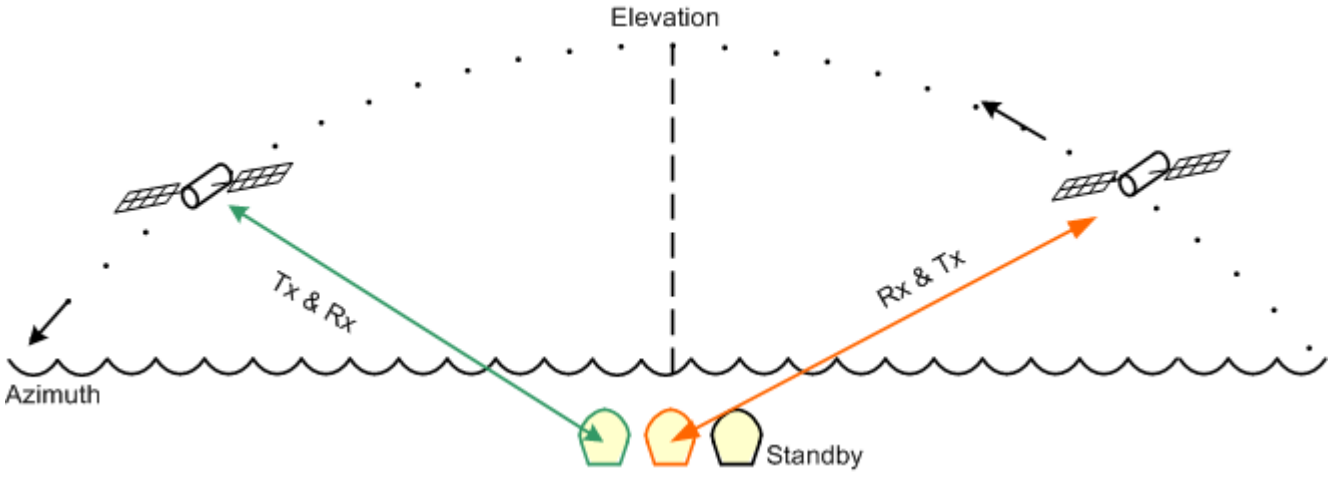


Figure 1-5: During Handover, both Antennas Rx and Tx to Different Satellites

D. After a set period of time (following Step-C), the antennas exchange roles:

- The primary antenna (tracking the descending satellite) stops Tx and assumes the role of secondary antenna and turns to the ascending satellite (Rx only).
- The secondary antenna (tracking the ascending satellite), assumes the role of the primary antenna.

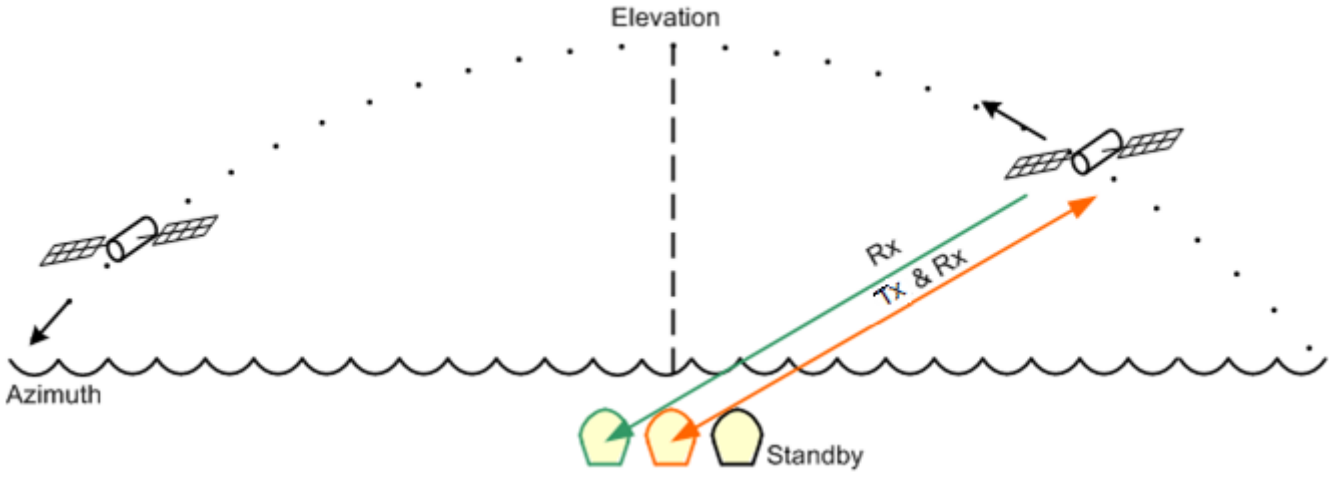


Figure 1-6: Both Antennas (primary and secondary) Tracking Ascending Satellite

1.2.3 Mid-pass Handover

This type of handover is unexpected and occurs under one of the following conditions:

- Antenna to satellite communication path nears a (defined) blockage zone
- One of the operating antennas is faulty

1.2.3.1 Handover Due to Blockage Zones

A blockage analysis based on the antenna location and position is performed. As the path of the transmitting antenna approaches within 30 minutes of the blockage zones, blockage warnings are displayed at five minute intervals (“Blockage expected in <30 min”, “Blockage expected in <25 min”, etc.). A short time before the anticipated blockage, handover will be performed to the secondary antenna; if the secondary antenna is within a blockage area as well, handover will be performed to the backup antenna.

Both antennas continue to alternate for continuous coverage. In installations with three antennas - if both antennas are expected to communicate over defined blockage zones, handover will be made to the backup antenna.

The system takes into account some angular extension for the defined Blockage Zones above the ship. This is used to cover for Blockage-Zone measurement inaccuracies as well as the predicted Satellite path deviations.

1.2.3.2 Handover Due to Faulty Antenna

If one of the active antennas is faulty, handover occurs to the other antenna. If both antennas are faulty, handover will be performed to the backup antenna (if available).

A fault condition can also be incurred by one of the following:

- LAN communication problems between the ADE and BDE equipment
- Incompatible ADE or BDE software version
- IMU not locked
- Manual modifications of some of the critical operational settings of the antenna
- Lock indication from the modem not received – optional and can be changed by the GUI

1.2.4 System with Only One Active Antenna

It is possible to use the system with only one active antenna, in this case:

- The antenna will not switch role when transferring to the next satellite – it will continue transmitting.
- The new satellite selection happens exactly at handover time.
- The system periodically checks if there is another antenna that can be used.

1.3 Management Applications

The system is setup and managed via two applications installed on the CCU:

- **MTSVLink** – used for antenna dedicated setup and management
- **O3b Link** – used for overall O3b System monitoring and management

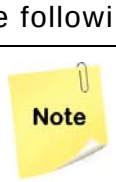
An additional application – MtsDock – is used for managing the system IP addresses, as well as for managing system configuration, operation and calibration files.

1.3.1 MTSVLink Application

MTSVLink is a dedicated antenna management application used to set up, configure and monitor individual antenna.

Each MTSVLink application is associated with a specific antenna: thus, for installations with two antennas - two MTSVLink Applications are run; for three antennas - three MTSVLink applications.

The following figure shows the MTSVLink application main window.



MTSVLink is described in detail in the **OceanTRx™4-500 User Manual**.

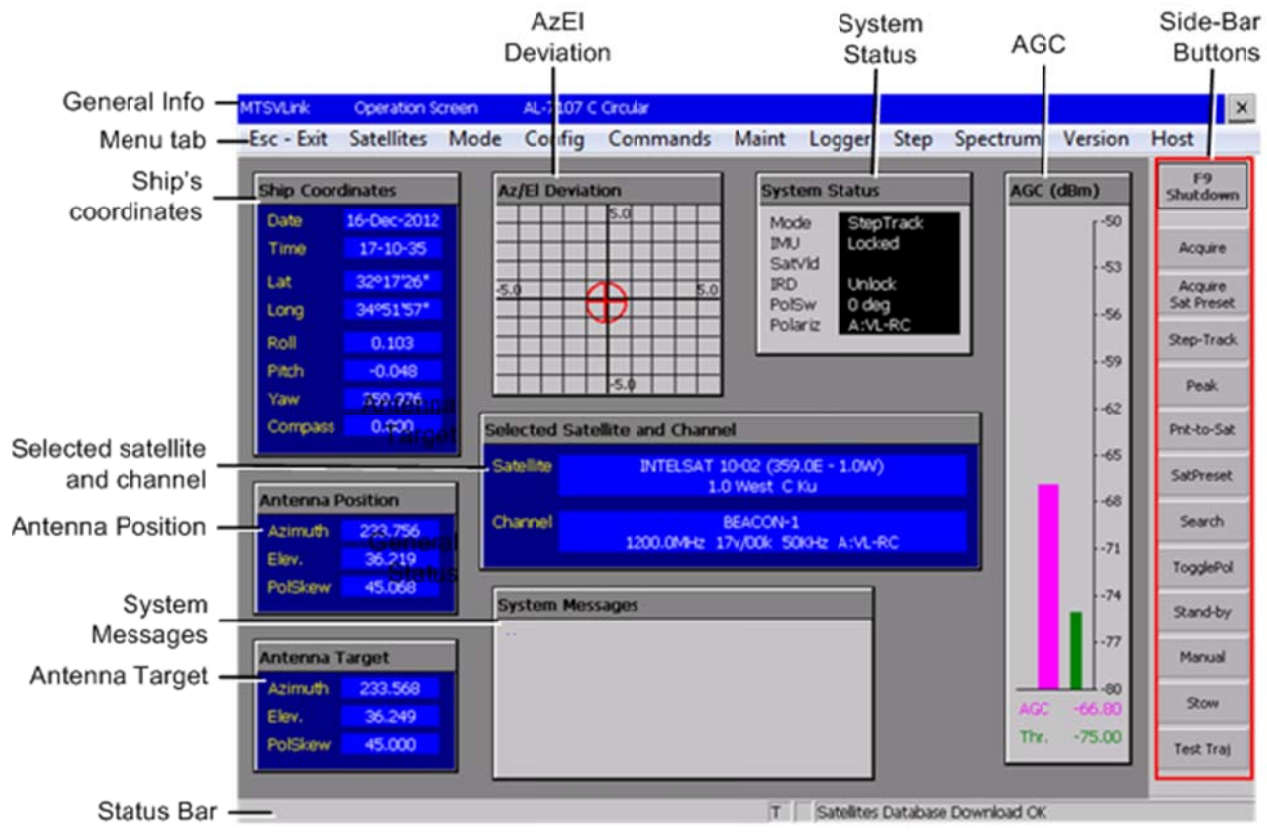


Figure 1-7: MTSVLink Main Screen

1.3.2 O3b Link Management Application

The O3bLink application is used to manage and monitor all the antennas in the O3b System.

By default, the system is already set up and the O3b Link application only used to monitor system operation.

Note The O3bLink application is described in detail in Chapter 1.

The following figure shows the System Monitor tab. This tab displays basic information on each of the antennas and provides a view of system status.

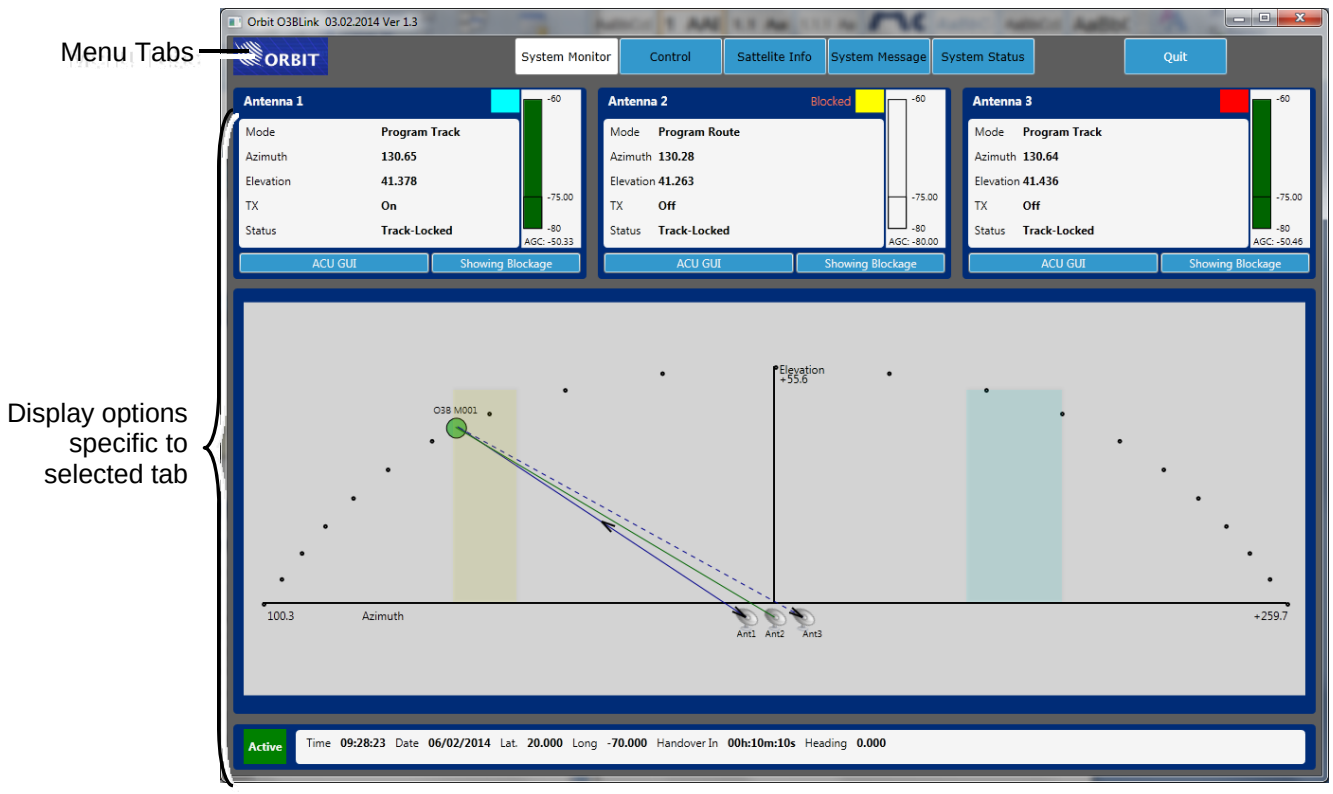


Figure 1-8: O3bLink Main Screen

1.3.3 MtsDock

This application is used to do the following:

- Modifying the IP Address for the CCUs, ACUs and updating the system with the modified CCU and ACU addresses and with the modem IP Addresses
- Saving and restoring system configuration, operation and calibration files

The MtsDock main window is shown below, where the ACU menu options are displayed as an example.

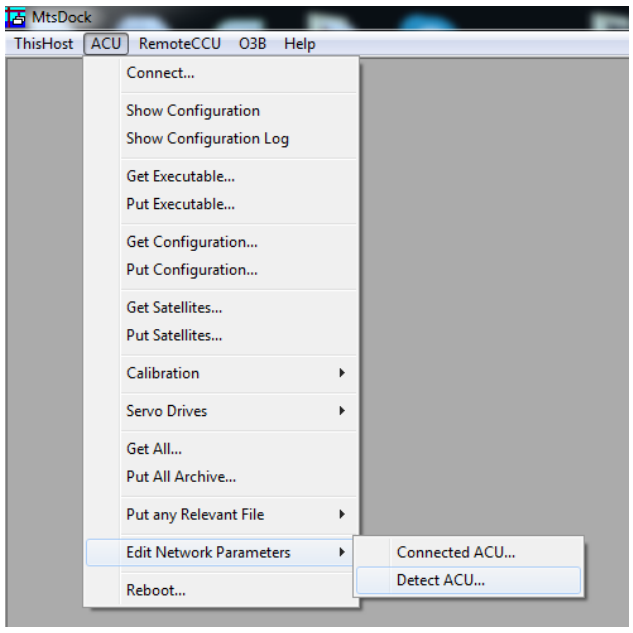


Figure 1-9: MtsDock Main window

2 Element Descriptions

This chapter provides the descriptions of the CCU and OSS.

2.1 CCU

The CCU provides single source local and remote management capabilities for the system. It is connected to the network and manages the OSS through an Auxiliary connection to the OSS.

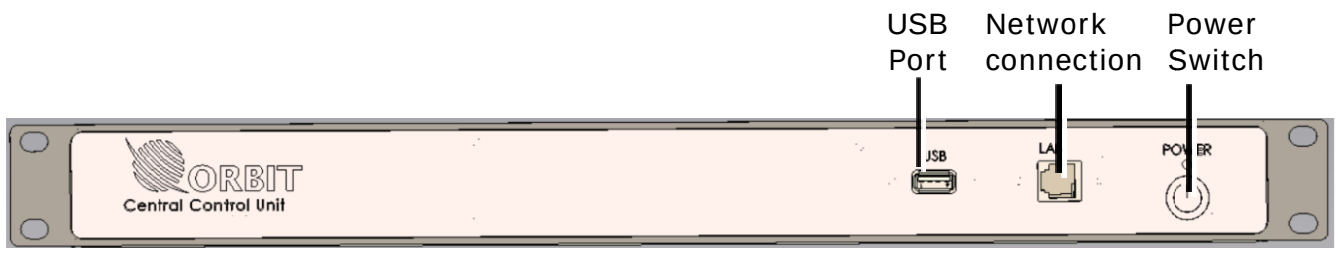


Figure 2-1: CCU Front Panel

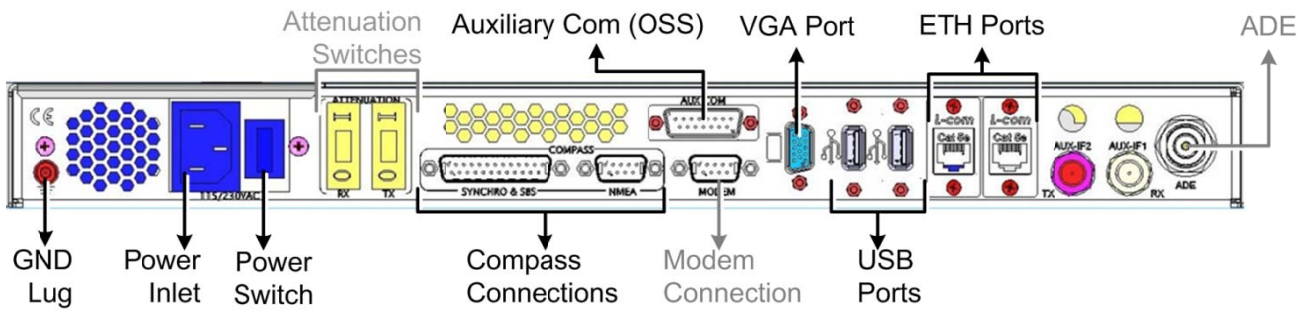


Figure 2-2: CCU Rear Panel

Table 2-1: Relevant CCU Rear Panel Interfaces

Interface	Function
COMPASS NMEA	D-type 9-pin interface to an NMEA type compass. NOTE: For compass type SYNCHRO or SBS, connect to the D-Type 25-pin connector.
LAN Com (2 ports)	Ethernet ports for connection to the ship's LAN
AUX COM	D-Type (15-pin). Dual-system, OSS connection.
USB (2 ports)	General purpose USB ports (e.g. can be used to connect a mouse)
VGA	HD15. External video monitor connection. Used in conjunction with keyboard and mouse (USB connections) for direct management connection to the CCU.
POWER (inlet)	Male connector to mains AC power 115/230VAC
POWER (switch)	Power ON/OFF
GND	Ground lug

2.2 OSS

The Orbit System Selector (OSS) is an RF switch controlled by the CCU. It supports a coax connection to a single antenna and (depending on the physical topology), can provide RF switching functions between two or three L-band simplex inputs to the satellite modem. The OSS operates in conjunction with the CCU. The OSS is connected to the network; however, it is *managed by the CCU*.

- Some tri-antenna system configurations require two OSS units.
- For installations in which the modem does not supply the 10 MHz signal in the UL, specific OSS models can generate the 10 MHz signal to be multiplexed and transmitted along with the L-band RF signal and the LAN (control) signal over a single coaxial cable between the Antenna and the OSS.

➢ OSS operation in the O3b system

When installed in the O3b system, the OSS provides RF switching for the L-band signals between the BDE units (**Terminal** Rx 1/2/3 and Tx 1/2/3) and the Modem (**Modem** (Tx and Rx-1/2).

In the UL, it splits the signal from the Modem (Modem Tx and 10 MHz) towards the Terminal Tx ports to which the BDE units are connected.

In the DL, the OSS routes Terminal Rx1/Rx2/Rx3 signals to the modem Rx1 and Rx2 ports according to system operation as controlled by the CCU.

Figure 2-3: OSS Front Panel

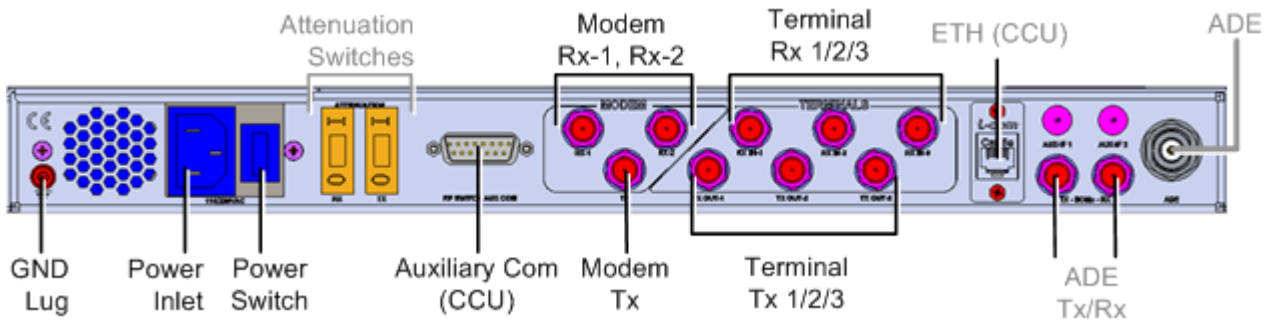


Figure 2-4: OSS Rear Panel

Table 2-2: Relevant OSS Rear panel Interfaces

Interface	Function
Terminals Rx1-3 (DL) **Terminals Tx1-3 (UL)**	F-type interface. Simplex RF L-band interfaces corresponding to each antenna.
Modem Rx 1/2 (DL) **Modem Tx (UL)**	F-type interfaces. Connect to **Modem Rx/Tx** ports: Rx 1/2 – receive signals from port Terminal Rx1/Rx2/Rx3 according to system operation as controlled by the CCU. Tx - splits signal *from* modem and distributes towards antennas via Terminal Tx1/Tx2/Tx3 ports.
AUX COM	D-Type (15-pin) – control line between the CCU and the OSS. Connect to the **CCU AUX COM** port
POWER connection	Connects to the mains 115/230VAC power
POWER switch	Power ON/OFF

3 Installations Instructions

3.1 O3b Pre-installation Requirements

3.1.1 Power Requirements

- All equipment: Antennas, OSS, CCU is classified and must be installed according to Over Voltage Category (OVC) II specifications.
- All equipment must be connected via single-pole or dual-pole circuit breaker - depending on the ship's electrical infrastructure.
- Power to all equipment must be wired according to the national wiring rules.
- All equipment must be connected via UPS (Uninterrupted Power Supply).
- When choosing power cables, take into account the electrical specifications according to Systems Power consumption.
- Equipment grounding:
  - ADE equipment: at least 16 AWG protective earthing conductor cable should be connected to the ship's earthing.
  - BDE equipment: at least 18 AWG protective earthing conductor cable should be connected to the rack's earthing.

3.1.2 System Physical and Electrical Specifications

Table 3-1: System Physical and Electrical Specifications

Unit	Weight	Dimensions	Power Source
Antenna/Radom Assembly	~200 Kg (440 lbs)	Diameter = 1.55m (61") Height = 1.70m (67”)	115/230 VAC, 60/50 Hz 10.0 / 5.0 A (max)
CCU	-----	1U x 48.26 x 47.4 cm (HxWxD)	115/230 VAC, 60/50 Hz 6.0 / 3.0 A (max)
OSS	-----	1U x 48.26 x 47.4 cm (HxWxD)	115/230 VAC, 60/50 Hz 6.0 / 3.0 A (max)

3.2 Antenna GND and Power Connection

WARNING!! DO NOT SWITCH ON POWER AT THIS POINT. Verify that all power is OFF. All installation must be performed by qualified service personnel. All power must be fed via single or dual pole circuit breaker according to regulations and the electrical infrastructure on your vessel.

3.2.1 GND Connection

Connect an 16 AWG (at least) protective earthing conductor cable between the antenna power box GND lug and the support structure.

3.2.2 Power Cable Connection

Connect the power cable to the antenna power box POWER IN terminal**.**

3.2.3 Power-cable Disconnection

Before disconnecting the power cable from the antenna:

- Verify the mains power supply is DISCONNECTED from the CIRCUIT BREAKER.
- Verify the mains power supply is DISCONNECTED from the UPS.

3.3 BDE Installation

3.3.1 BDE Rack Installation

Recommended installation of BDE equipment in rack:

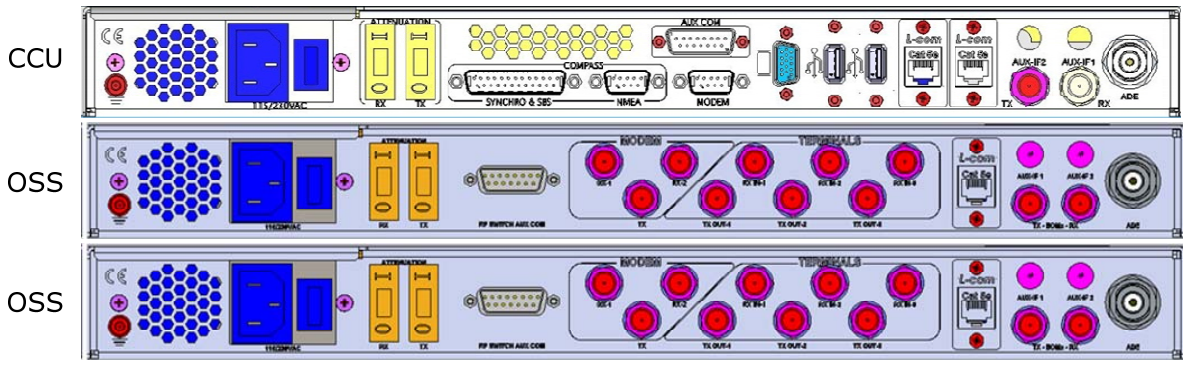


Figure 3-1: O3b Module Installation (Rear View)

Note	For dual Antennas installation, the second OSS (the lowest one) does not exist.

3.3.1.1 Overview of the Connections

Dual Antennas Connections:

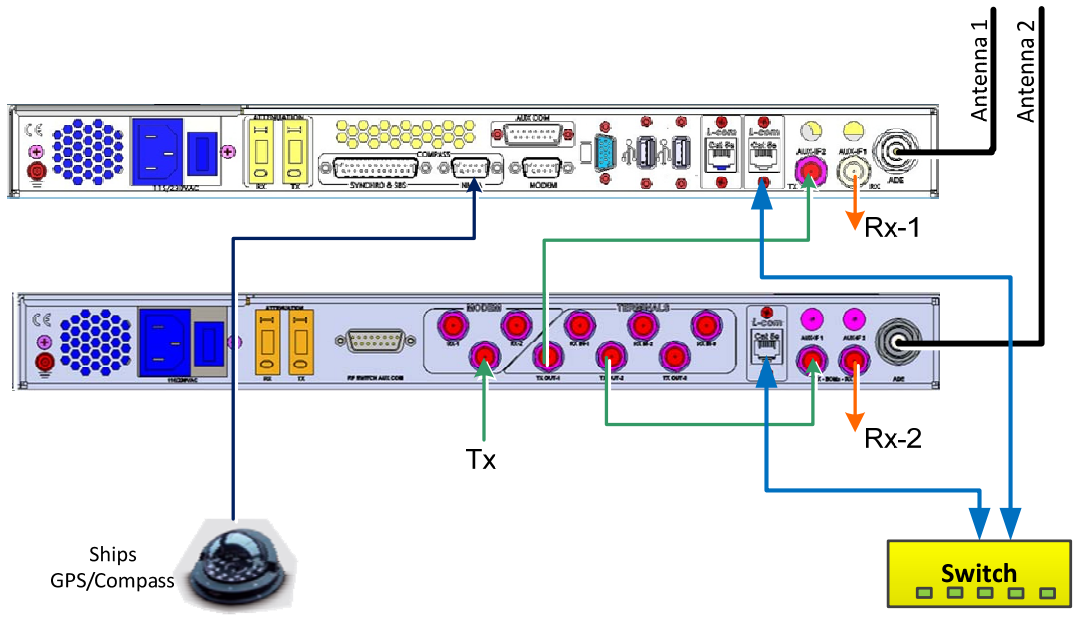


Figure 3-2: O3b Dual Antennas Connections

Triple Antennas Connections:

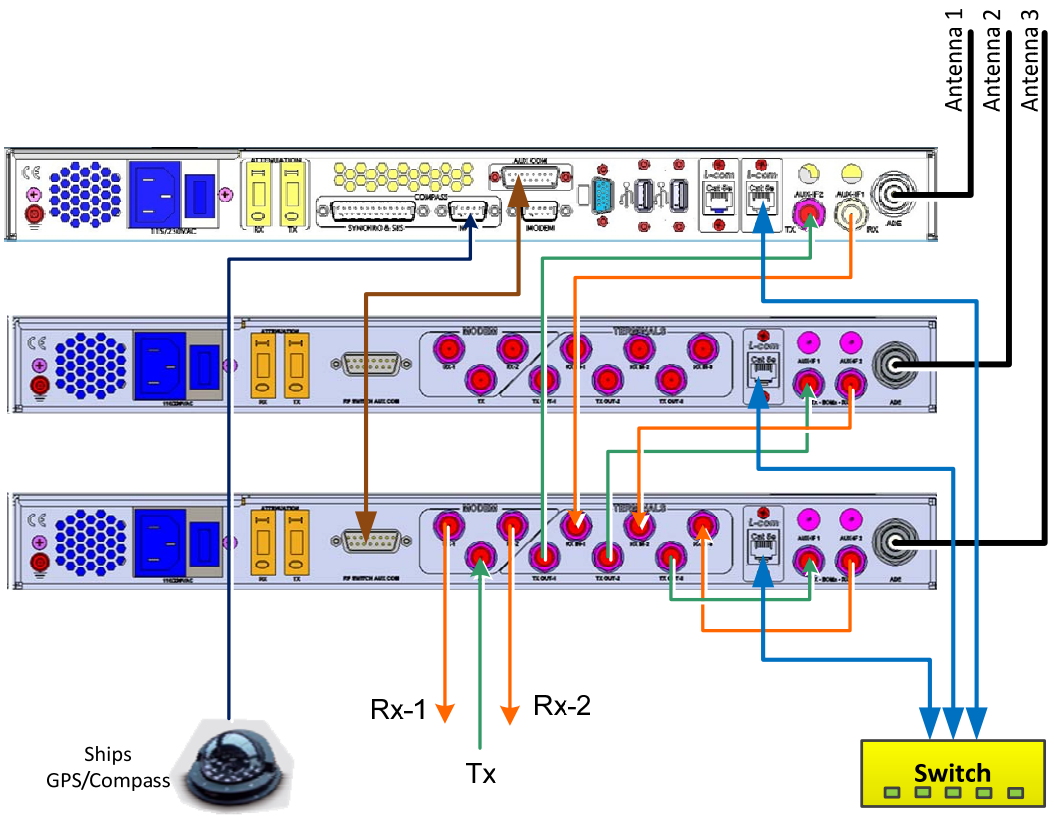


Figure 3-6: O3b Triple Antennas Connections

3.3.1.2 Ship's Compass to CCU

Connect the **CCU COMPASS-NMEA** rear panel D-type (9-pin) connector to the ship's **NMEA compass**.

The CCU COMPASS-NMEA connector pinout is given below.

- RS-422 (D-Type 9 pin) Cable:

Table 3-2: NMEA Connector Pin-out

Pin	Signal
1	Reserved
2	RX -
3	Reserved
4	RX +
5	GND
6	NC
7	NC
8	NC
9	GND

Note Pins 1 and 3 are reserved for internal use only and must be left open.

The following figure shows the mating connector wiring diagram for the RS-422 NMEA-0183 compass signal. The recommended interconnecting wiring is a shielded twisted pair, with grounded shield.

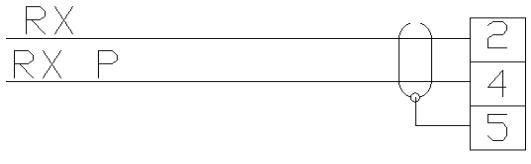


Figure 3-3: RS-422 NMEA-0183 Mating Connector Wiring Diagram

3.3.1.3 CCU to OSS AUX COM

- The OSS is supplied with a D-type (15-pin) flat cable.
- Connect supplied cable to the **CCU AUX-COM** rear panel D-type (15-pin) connector to the **OSS RF SWITCH AUX-COM**.

Note This cable is used for Triple Antenna Installation Only.

3.3.1.4 Modem Rx and Tx Connections

For Dual Antenna Installation:

- Connect the cable between the CCU **Rx** connector to Modem **Rx Demod-A** port.
- Connect the cables between the OSS **Tx** connector to Modem **Tx** (UL including 10MHz) and the **Rx** connector to the Modem **Rx Demod-B** port.

For Triple Antenna Installation:

- Connect the cables between the OSS **MODEM Tx, Rx-1** and **Rx-2** to the Modem **Tx** (UL including 10MHz), **Rx Demod-A** and **Rx Demod-B** ports.

3.3.1.5 LAN Connection

Each BDE unit is connected to the Ethernet switch.

A summary of the LAN connections is illustrated in Figure 3-4.

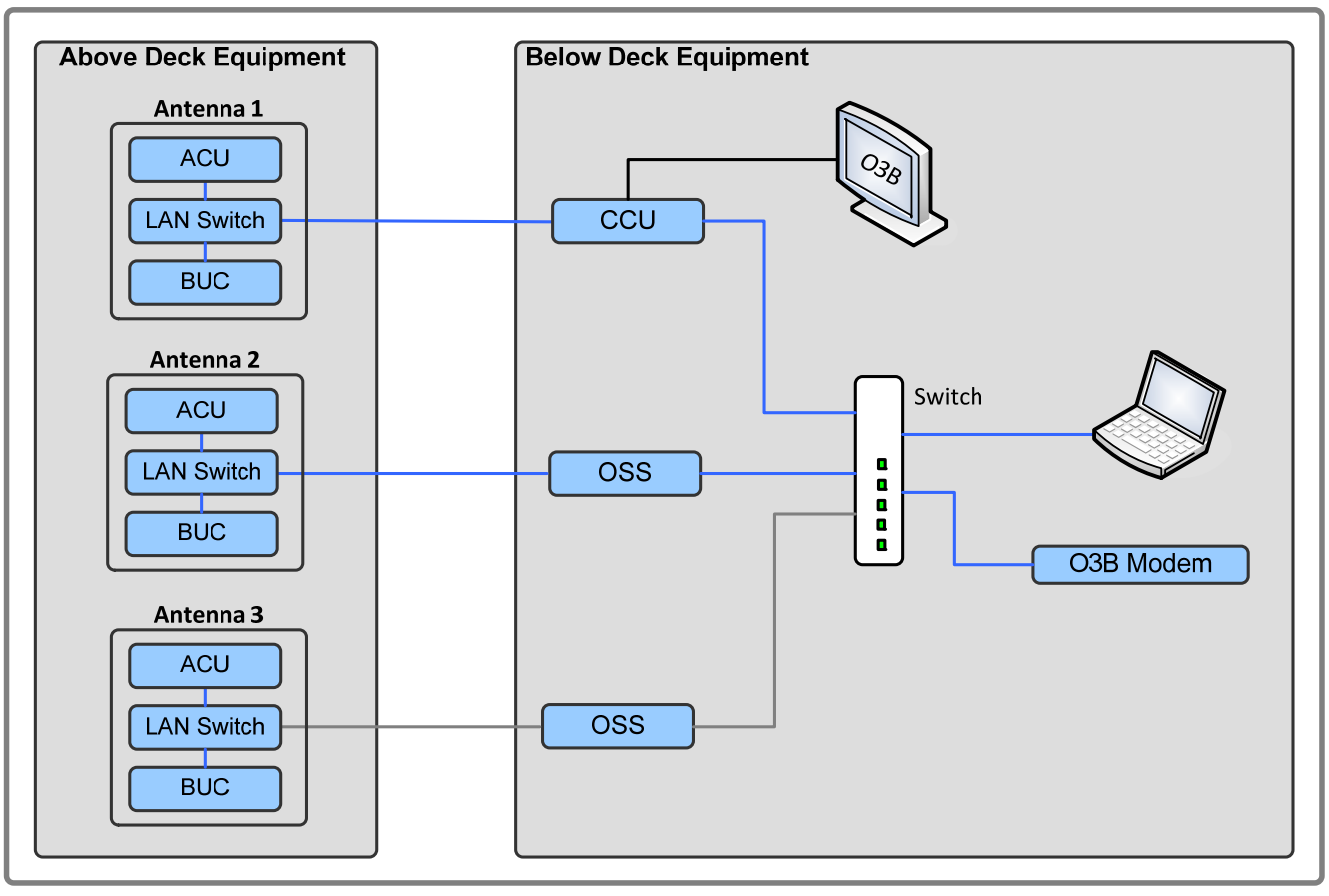


Figure 3-4: O3b LAN Connections

Note For dual Antennas installation, the second OSS (the lowest one) and the ‘Antenna 3’ does not exist.

4 System Commissioning

This chapter describes the procedures required for initially setting up *each of the O3b* OceanTRx4-500 antennas as well as the complete system. The procedures are described in the order in which it is recommended that they be performed.

- The OceanTRx™4-500 Maritime Satellite Communication System is preconfigured and tested before it is shipped. Tampering with any of the system settings that are not explicitly mentioned in this manual can impair the functioning of the system.
- For MTSVLink setup procedures, make sure to save the changes by pressing [V] on the keyboard (when accessing the Main Operations screen).

➢ **The commissioning procedure consists of the following steps**

1. Power-on
2. CCU Management Applications Initialization
3. LAN Connection Verification
4. Compass configuration - Compass Interface and Offset
5. Blockage zones configuration
6. Verify O3b files Availability.
7. O3b Constellation and Parameters Configuration
8. Run O3b System

4.1 Power-On

It is assumed that all previous installation procedures have been properly performed.

4.1.1 Verifying Cable Connections

Verify the following:

- All power cables and ground cables are routed and connected securely.
- Verify that the power and LMR cables inside the Radome are routed properly and secured - otherwise, they may be pulled and damaged as the antenna continuously repositions itself.

4.1.2 Power-on

Power-on the following (recommended order):

- Verify that the UPS and circuit-breakers for the ADE and BDE are powered ON.
- Power ON the BDE: CCU and OSS - this allows monitoring the ADE as the ADE is powered-on. Verify the power LED for *each* unit is ON.
- Power ON each antenna

Reach into the Radome through the BOTTOM HATCH and set the power switch located on the antenna POWER BOX to ON.

- Verify the antenna completes the initialization procedure for all three axes; at the completion of the initialization procedure, each axis is set to its zero position.

4.2 CCU Management Applications Initialization

After powering on the CCU, verify that the following Management Applications run on the CCU Task Bar:

- O3bLink
- MTSVLink - one instance per antenna

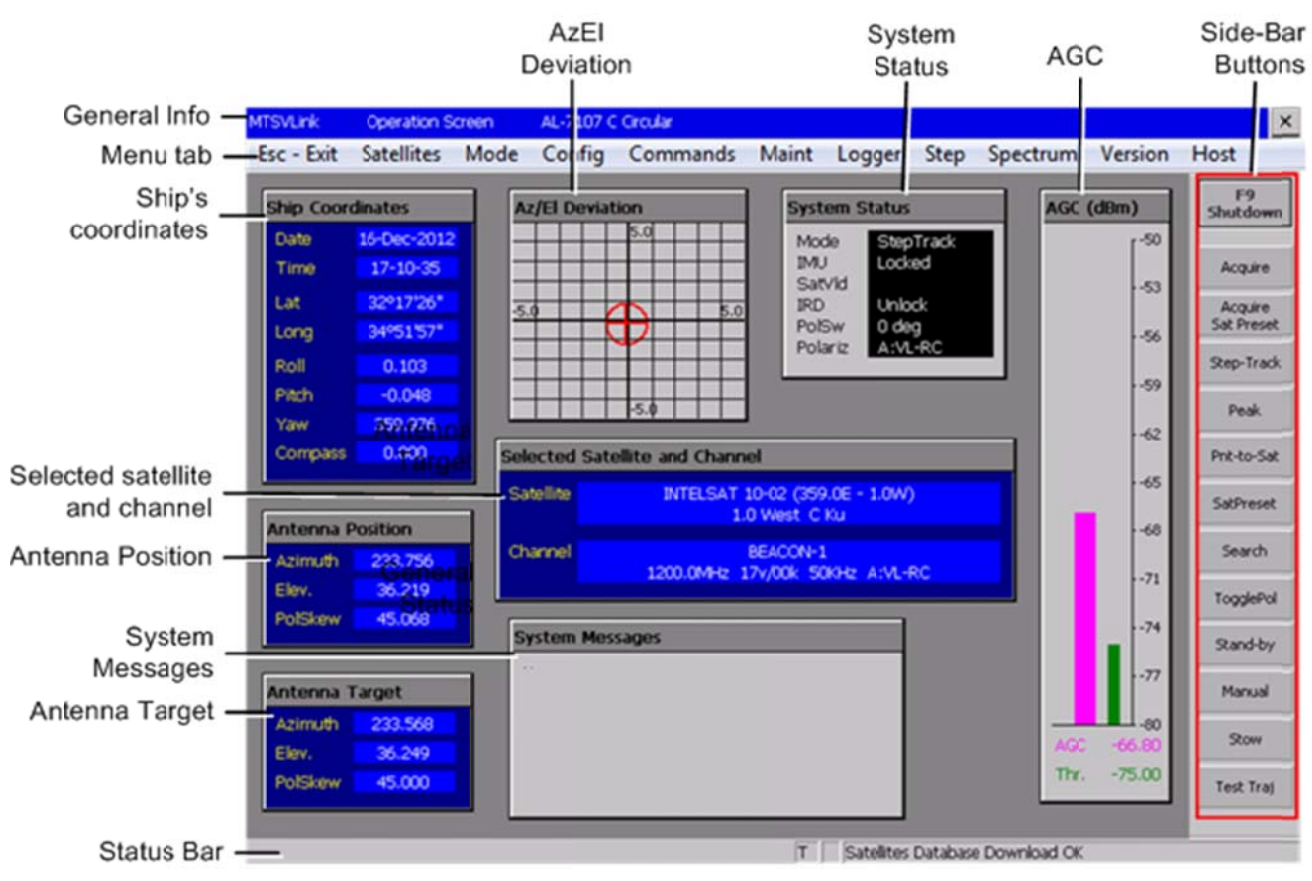
In addition, verify that following application are running (background)

- CCU Manager
- Modem Bridge

Other applications may be running in the background as well. Do not close any application - they may be required for system operation.

Each MTSVLink instance should display:

- Data values of the relevant parameters - indicating communication with the corresponding antenna.
- Connected status in the MTSVLink status bar.



4.3 LAN Connections

The CCU and each antenna (i.e. each antenna's ACU – Antenna Controller Unit) are supplied with the following factory defined default IP addresses:

- **CCU =** 192.9.200.22, 192.9.200.23
- **ACU =** 192.9.200.10, 192.9.200.11, 192.9.200.12

However, if necessary, the IP Addresses for the CCU and for the ACUs can be modified using the **MtsDock** application (installed on the CCU).

To modify the CCU and ACU IP Addresses:

- Detect IP Addresses of ACUs and configure the ACUs IP Addresses.
- Detect IP Addresses of the CCU and configure the CCU IP Address.
- Configure external hardware IP address.

***Always* do this, in order to set up the system LAN connections:**

- Configure O3b IP system configuration

4.3.1 Detect and Configure the IP Addresses of the ACUs

Warning! During this process, the antenna whose IP Address is modified will stop tracking the satellite and may automatically undergo an initialization process.

➢ **To detect and configure the IP Address of the ACU**

1. Launch the **MtsDock** application on the CCU (**Start / Programs / MtsDock**) and choose the **ACU** menu. The following window appears.

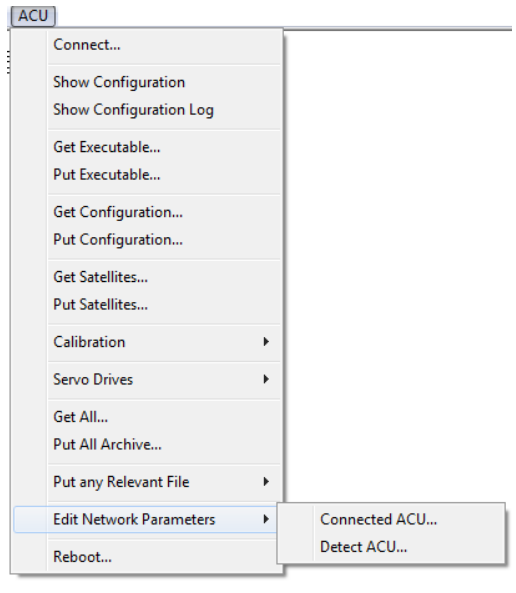


Figure 4-1: Modifying ACU IP Address

2. Select **Edit Network Parameters** and choose **Detect ACU**. The Detect ACU dialog appears, listing the IP Addresses of all ACUs connected to the CCU.

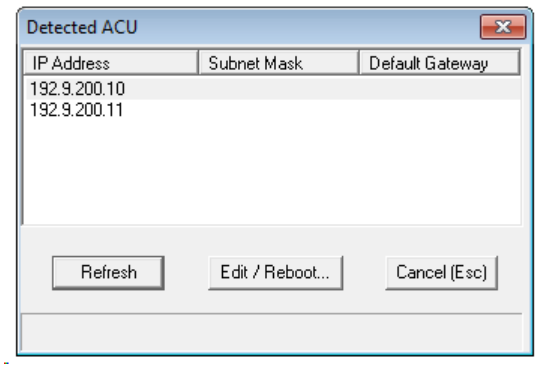


Figure 4-2: List of detect ACU IP Addresses

3. Click the **Edit / Reboot** button.
4. In the displayed dialog, enter New Settings parameters and click **Update**.

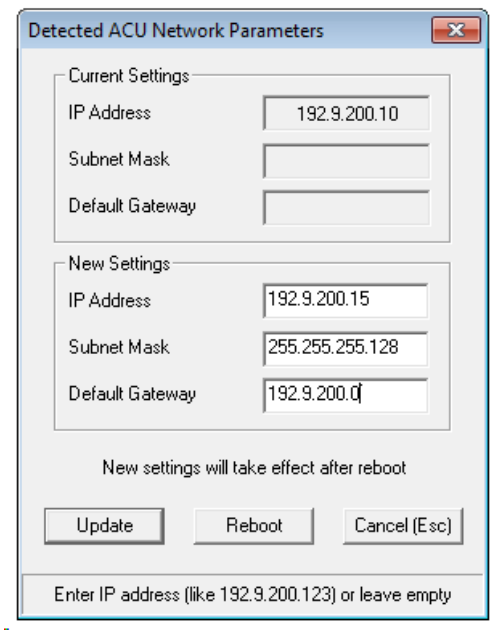
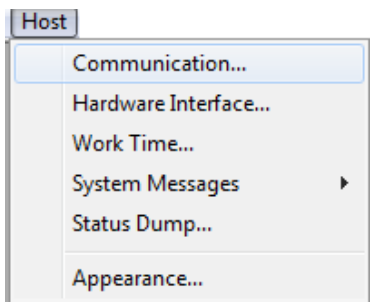


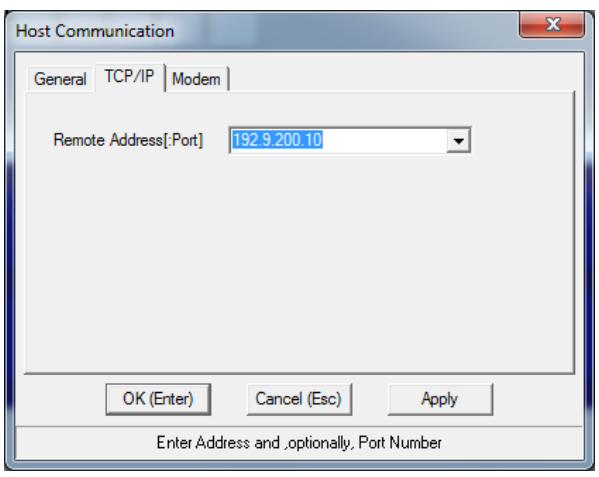
Figure 4-3: Modifying ACU IP Address

5. Click **Reboot.** Confirm reboot command by selecting OK. The *selected* antenna ACU (whose address was modified) will reboot. This address will now be associated with this antenna.

6. Associate the new Antenna (ACU) IP Address with the relevant MTSVLink instance:
   - Open the MTSVLink application, select the **Host** drop-menu, and choose **Communication.**



The following dialog appears.



7. To configure the IP address of the relevant ACU:
   - Click the **TCP / IP** tab.
   - Enter the IP Address (previously defined via the MtsDock).
   - Click **OK.**

This MTSVLink instance is now associated with the specific antenna. This procedure should be repeated for each antenna ACU.

4.3.2 Detect and Configure the IP Addresses of the CCU

This operation is performed using the MtsDock application.

➢ **To detect configure the IP address of the CCU**

1. Launch the **MtsDock** application on the CCU (**Start/Programs/MtsDock**) and choose the **RemoteCCU** menu.

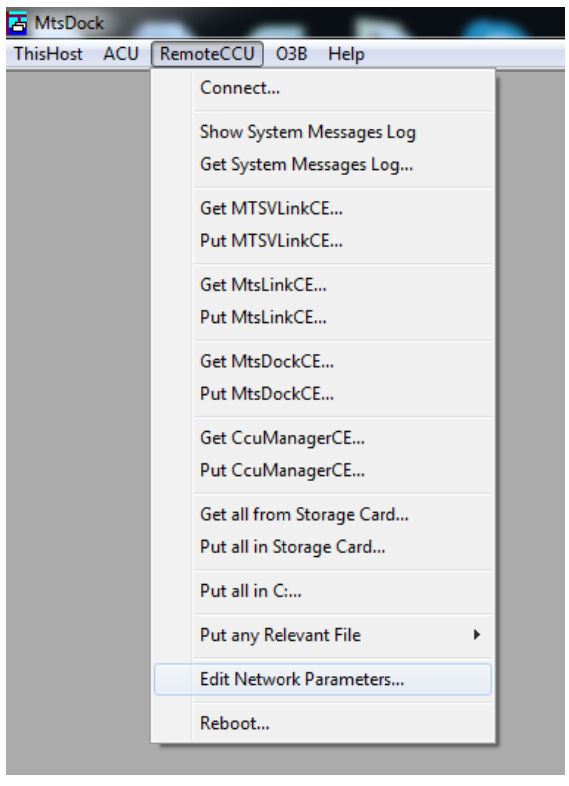


Figure 4-4: Modifying CCU IP Address

2. From the **RemoteCCU** menu:
   - Select **Connect**.
   - In the displayed dialog, enter the *current* IP Address of the CCU (default CCU IP Address = 192.9.200.22) and click **OK.**

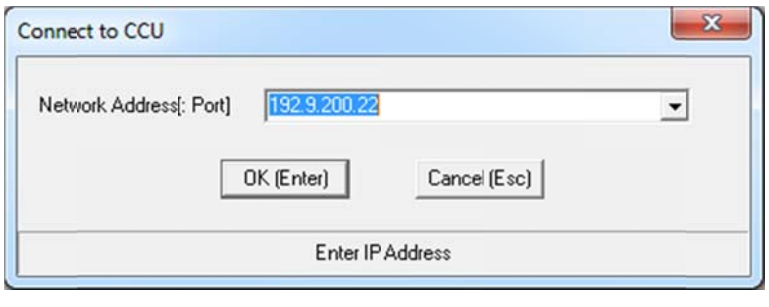


Figure 4-5: Connect to Current CCU

3. From the **RemoteCCU** menu:
   - Select Edit Network Parameters.

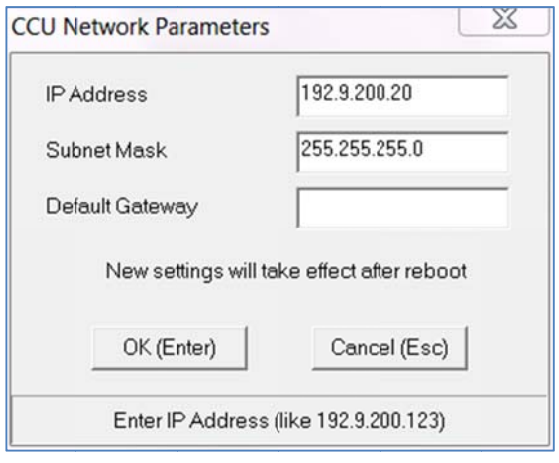


Figure 4-6: Modify CCU IP Address

   - Configure the required network parameters and click OK.
4. Select the **RemoteCCU** menu (again) and click **Reboot.** The CCU will reboot to the new IP Address.

4.3.3 Configure the External Hardware IP Address

This operation is performed using the MTSVLink application.

It is required to update the ACUs with the modified IP Address of the CCU.

➢ **To associate each ACU with the modified address of the CCU**

1. Select the **Config** menu and choose **External Hardware IP**.
2. Enter the CCU and the Modem IP addresses - separated by a semi-colon (;) and click **OK**.

Figure 4-7: External Hardware IP Address Configuration

4.3.4 O3b IP System Configuration

Verify that the relevant IP addresses are configured on the O3B system.

➢ **To configure the O3B system with the IP Addresses**

1. Launch the **MtsDock** application on the CCU (**Start/Programs/MtsDock**) and choose the **O3b** menu. The O3b System Configuration dialog appears.

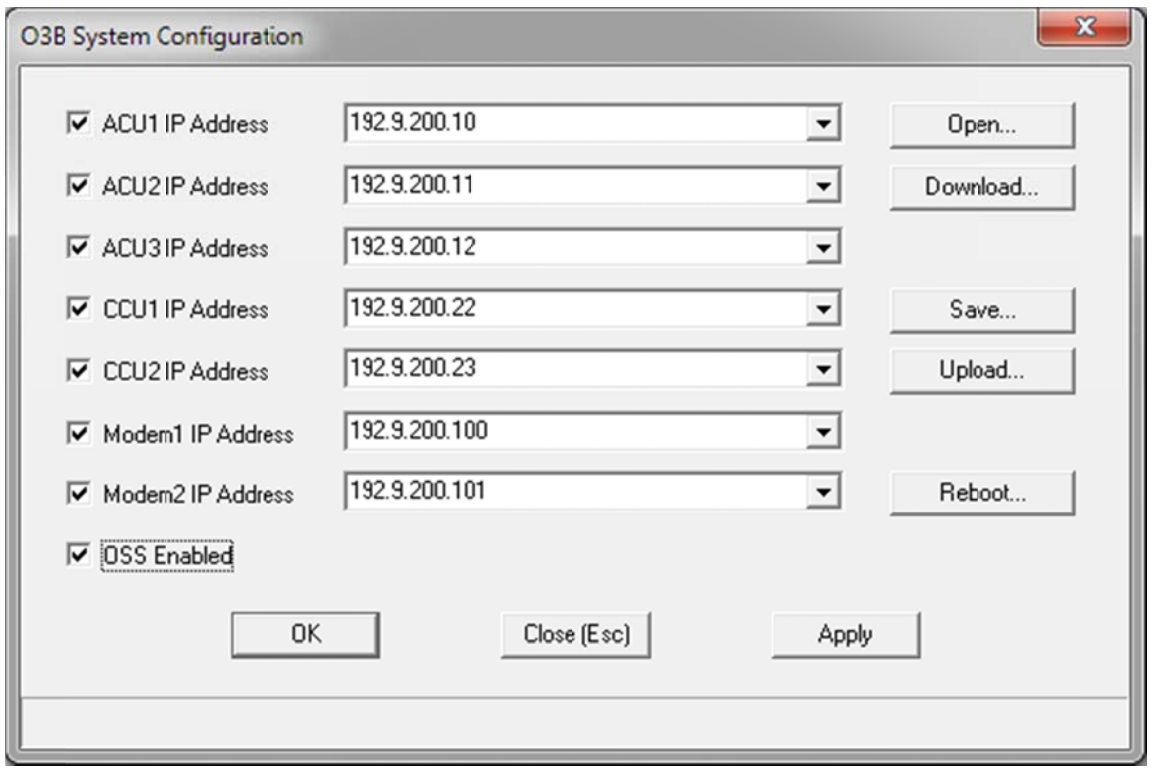


Figure 4-8: O3B IP System Configuration

2. For each element, relevant to the system:
   - Verify that the **checkbox** is selected
   - The relevant **IP address** is updated.
   - Verify **OSS Enabled** is selected.
3. Click **Upload** to upload the O3b system configuration to all the elements.
4. Click **Apply** and then **OK.**
5. Click **Reboot** and select Reboot All Units.

4.4 Compass Configuration

4.4.1 Compass Interface Configuration

4.4.1.1 Setting Compass Interface

➢ **To configure the compass interface**

1. Using the MTSVLink, From the **Config** menu, select **Compass**:

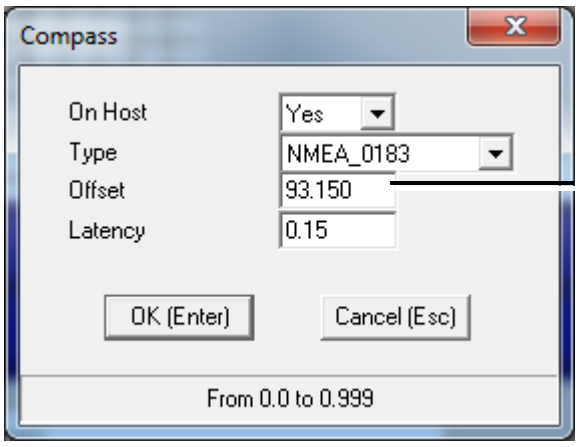


Figure 4-9: Compass Dialog Box

2. Perform the following operations and click **OK**:
   - Verify **On Host** field is set to **Yes**.
   - Verify compass **Type** is set to NMEA_0183.
   - Verify **Latency** = **0.15** seconds. Do not modify unless specific compass data latency (in seconds) is known.

3. Make a 'naked-eye' rough estimate of the offset angle between the ship's **bow-to-stern axis** and the **system's azimuth zero mark**. Use the following syntax:
   - Clockwise rotation from the ship's bow-to-stern = positive (+) values
   - Counter-clockwise from the ship's bow-to-stern = negative (-) values

   For example, in the following figure, an appropriate estimate would be (-30°).

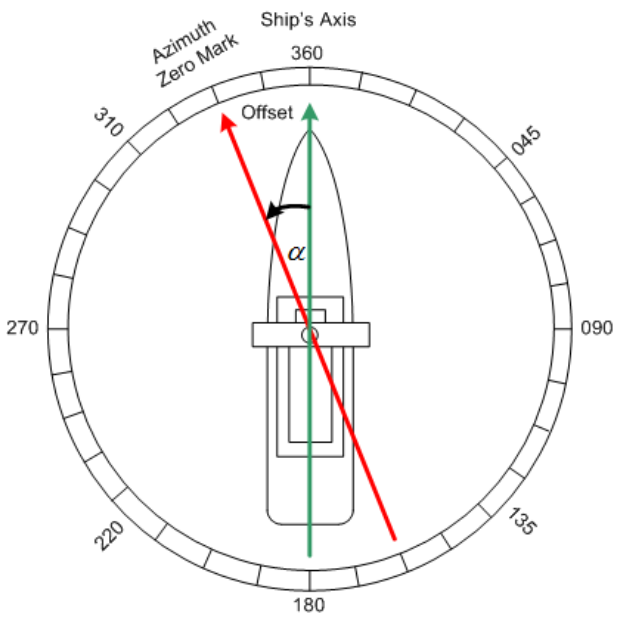


Figure 4-10: Compass Offset Variables

4. Enter a preliminary compass **Offset** value. (This will be updated during the Compass Offset procedure.)

Note	Compass offset is the angle between the OceanTRx™4-500 System Azimuth Zero mark and the Ship's Bow-to-Stern axis Since the system installation does not call for any specific Azimuth direction, the Compass Offset must be introduced and saved in the System ACU. The Azimuth Zero mark is physically shown by the arrow on the IMU unit, located on the antenna (inside the Radome) as well on the Radome base. For the preliminary compass offset value, perform a naked-eye estimation of the compass offset value

4.4.1.2 Configuring the Compass Hardware Interface

Set the communication parameters that allow communication between the NMEA compass and the CCU.

Data Sharing parameter configuration is required for O3b system installations

➢ **To set compass communication parameters**

1. Using the MTSVLink, From the Host menu, select **Hardware Interface**, click the **Enable** tab and verify **Enable Hardware** is set to **Yes.** Click **Apply.**

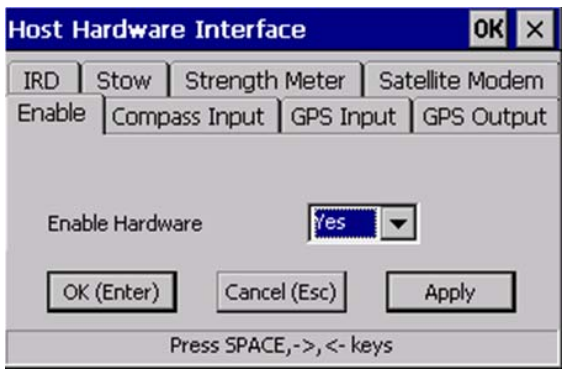


Figure 4-11: Host Hardware Interface Enable Tab

2. Click the **Compass Input** tab.

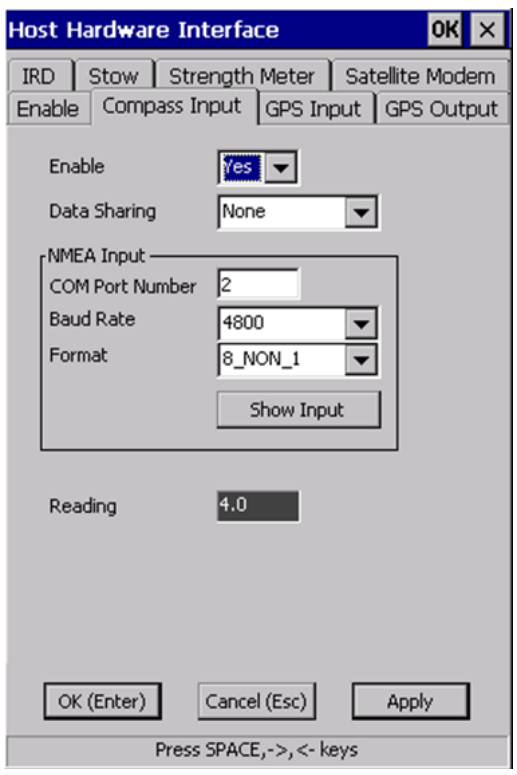


Figure 4-12: Host Hardware Interface Compass Input Tab

3. Configure as follows:
   - Verify that Enable is set to **Yes.**
   - Under **Data Sharing**, set the following values:
     - o For one of the MTSVLink (ACU), set as **Server**.
     - o For the other MTSVLinks (ACU), set as **Client**.
   - Set Enable to **Yes**.
   - Set **COM Port Number** = 2 (RS422)
   - Set **Baud Rate –** according to compass baud rate (default 4800 bps).
   - Set **Format –** according to compass communication format (default = 8_NON_1).
   - Click **Apply**, verify Reading field displays a value and click **OK**.

4.4.1.3 Configuring the NMEA-0183 Compass Defaults

➢ **To configure to NMEA-0183 Compass Defaults**

1. Using the MTSVLink, Open the **Config** menu and select Compass NMEA. The following dialog appears.

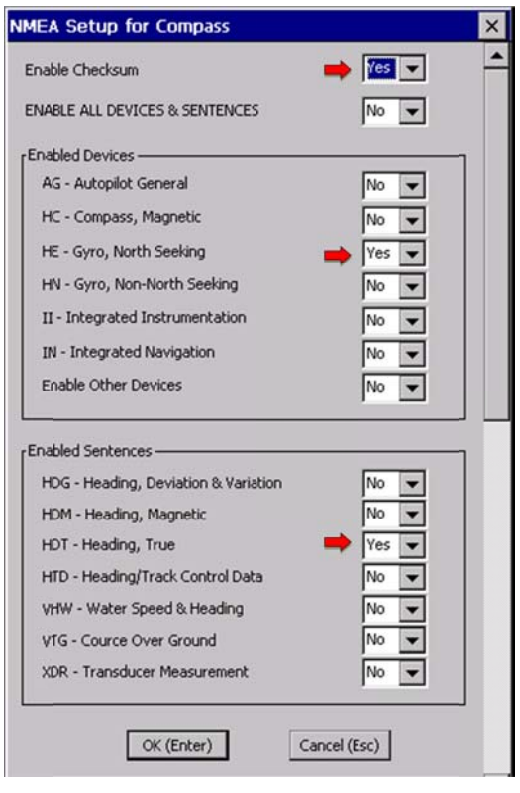


Figure 4-13: NMEA-0183 Compass Defaults

2. Verify the following parameters are set accordingly:
   - Enable Checksum = **Yes**
   - Under Enabled Devices, HE - Gyro, North Seeking = **Yes**
   - Under Enabled Sentences, HDT - Heading, True = **Yes**

These values are preconfigured and should only be changed if the ship's compass is using a different NMEA telegram.

4.4.2 Compass Offset Configuration

➢ **To calibrate the compass offset (Antenna Azimuth)**

1. Point the antenna to the desired satellite.

In case a satellite is not available, the **Sun Program Track** mode can be used.

For using the Sun Program Track:

- The **System Type Constellation** should be set to **GEO.**
- The **Program Route** configuration should be set to **Sun**.
- After the offset procedure has been completed, set the Program Route configuration back to **Satellite**. Failure to do so will cause the Solar Outage protection to be de-activated.

2. Write down the antenna's azimuth as it appears in the **Antenna Target** window of the **Operation Screen**. This will serve as your nominal azimuth. (See the following figure).

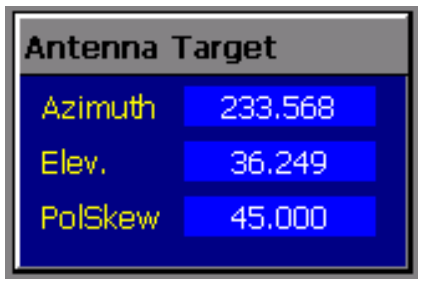


Figure 4-14: Antenna Target Window

3. Using **Manual Mode**, increment or decrement the antenna's azimuth orientation until it points to the satellite (or sun).
4. The required amount of movement depends on the accuracy of your initial estimate (a typical estimate will fall within ±10°).
5. Once the satellite is acquired, set the antenna to **Step-Track Mode**.

6. Determine the azimuth deviation, using one of the following methods:
   - Observing the graphical Tracking Error using **Az/El Deviation** window on the **Operation Screen** (scale up to ±5°).

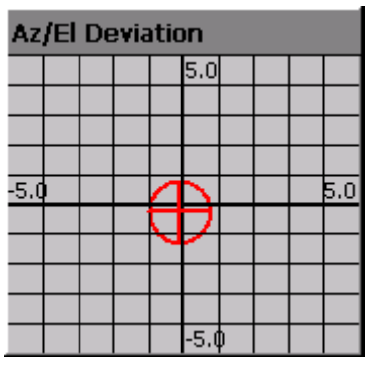


Figure 4-15: Az/El Deviation Window

   - Running the **Graphic Data Logger**, which records azimuth deviation as a parameter of the Antenna Step Track subgroup.
   - Setting the antenna to **Peak Mode** and calculating the difference between the resulting azimuth and the nominal azimuth (previously recorded).
7. Calculate the degree to which the original 'naked-eye' estimation of the compass offset angle must be corrected in order to reach the accurate zero setting.
8. Configure the accurate offset value:
   - From the **Config** menu, select **Compass**.
   - Enter the correct compass offset in the **Offset** field.
   - Click **OK** and then click **[V]** on the keyboard and press **Enter** to save.

4.5 Blockage Zones Configuration

OceanTRx™4-500 allows inserting up to four blockage zone angles (per antenna). Each zone is defined by the azimuth and elevation angles. In addition, the LNB power supply (LNBV) can be turned ON or OFF globally for all defined zones.

For additional information on blockage zones configuration and antenna behavior, refer to the OceanTRx™4-500 User Manual.

➢ To configure the Blockage Zones

1. Using the MTSVLink, From the **Config** menu, select **Antenna Blockage**.

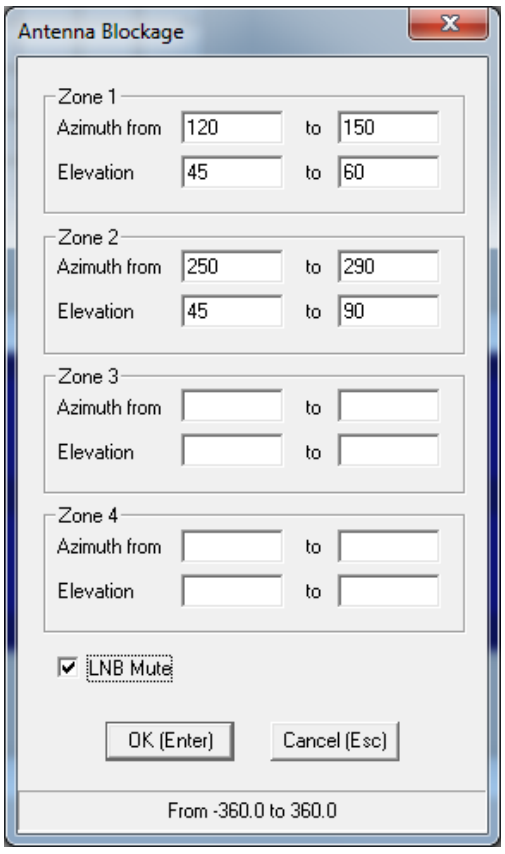


Figure 4-16: Blockage Zones configuration

2. For each blockage zone define the following:
   - **Azimuth** (horizontal blockage range) - Azimuth angles relative to the ship's bow-to-stern axis.
   - **Elevation** (vertical blockage range) - Elevation angles relative to the ship's deck level.
3. To disable LNB power supply when the antenna path comes across a blockage zones, check **LNB Mute**.
4. Click **OK (Enter)** to close dialog.
5. Save by pressing **[V]** and **Enter** on the keyboard.

4.6 Verifying O3b Files Availability

Verify that up-to-date Schedule, Channel and TLE files are available on the O3b server.

These files are required by the CCU. The CCU extracts the necessary information from the Schedule, Channel and TLE files supplied by the O3b server and, based on this information, automatically configures the O3b Constellation.

The satellite constellation files folder is location in the folder:

C:\CCU\o3bdata\gw_sat

4.7 O3b Constellation and Parameters Configuration

Verify that the O3b files are uploaded correctly into the O3bLink application.

To verify the O3b files are uploaded correctly, click the O3bLink application **Info** tab and view the parameters.

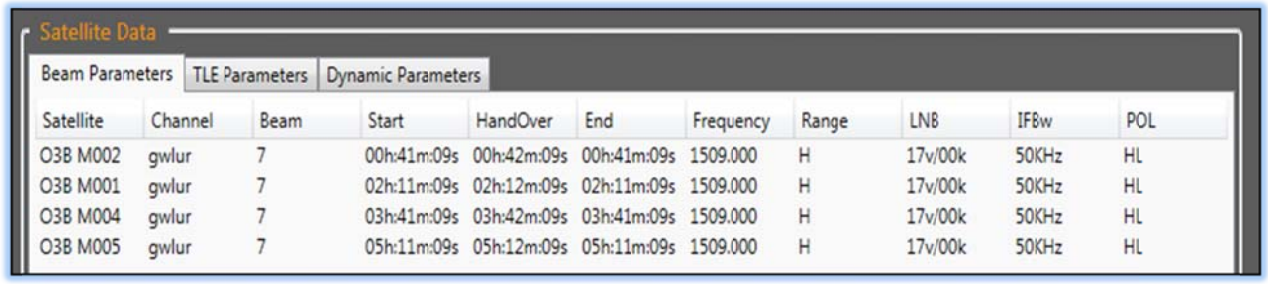


Figure 4-17: Partial Satellite Info Tab – Satellite Data

Verify that the O3bLink Control window parameters are configured as displayed in the following window.

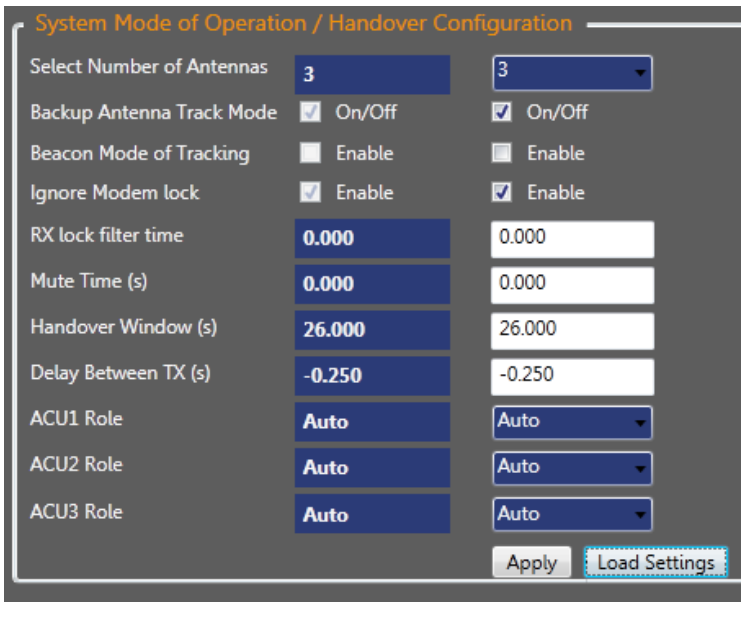


Figure 4-18: Partial Control Tab – Operation/Handover Configuration

Note

For dual Antennas installation, the selected number of Antennas shall be 2.

4.8 Run the O3b System

After completing the configuration procedure, run the O3b system and verify system operation.

➢ **To run the system**

Select the **Control** tab and click **Run** in the **Control** window.

5 About O3b Link

The O3b management application is used for routine monitoring of the O3b system.

Using O3b Link, various status data on all three antennas can be simultaneously viewed. In addition, the system operation mode can be changed and operation of specific antennas controlled: for example, the roles of the active and standby antennas can be interchanged, etc.

For more antenna specific control, configuration and monitoring options, the MTSVLink antenna dedicated application can be accessed for each antenna from the O3b Link.

The program can run on the CCU itself or on an external computer connected via Ethernet to the CCU.

5.1 O3bLink Navigation

The application consists of the following main window areas:

- Menu tabs – dedicated screens for various types of monitoring information, where the System Monitor tab is displayed by default.
- Header – shows application version
- Display area – varies according to the selected tab

For dual Antennas installation, only two Antennas will be shown on the GUI.

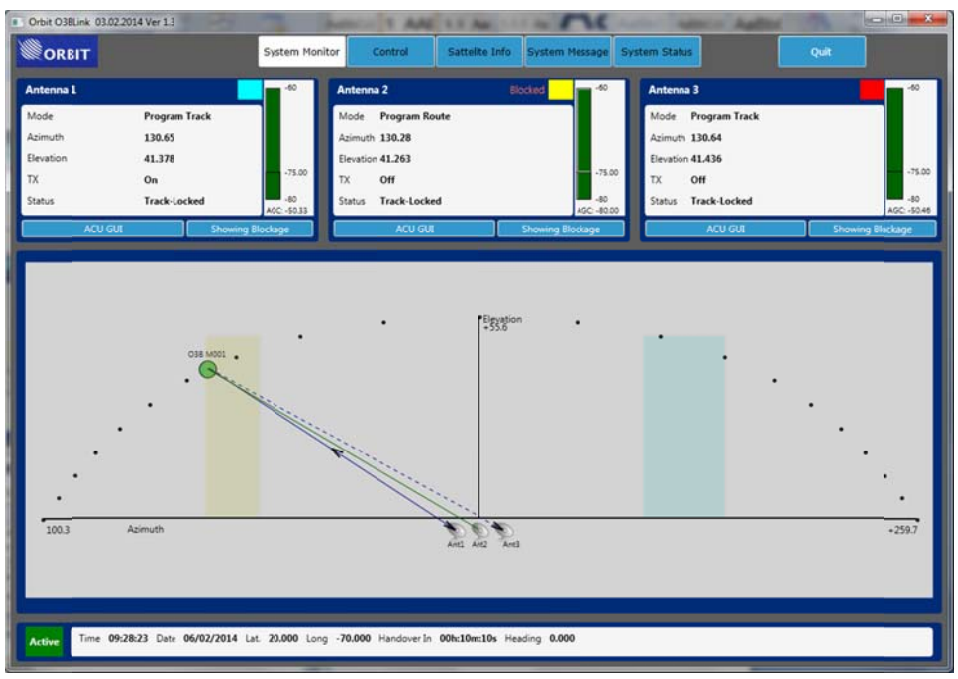


Figure 5-1: O3bLink Window

The following Menu options are available:

Tab Option	Description
System Monitor	**Default Tab.** Shows antenna specific parameters such as position, mode and status, as well as graphical display of currently active antennas and approximate satellite position
Control	Used to change/control operation modes and configure antenna handover.
Satellite Info	Displays satellite constellation general parameters and additional info.
System Message	Lists time-stamped system messages and warnings.
System Status	Used for debug purposes, shows real-time parameters for each ACU and antenna handover.
Quit	Exits **O3bLink** application.

5.2 Overview of system Monitor (overview)

The **System Monitor** tab is provides an overview of system operation. This includes basic status and position for each of the three antennas and a graphical view of the satellite position relative to the antennas and the coverage and blockage zones.

The tab is divided into the following areas:

- Antenna1-3 – show position and status of each antenna
- Real time graphical system view – graphical view of satellite position and operation modes of the antennas
- Status bar – current status of system, including GPS coordinates active antenna, etc.

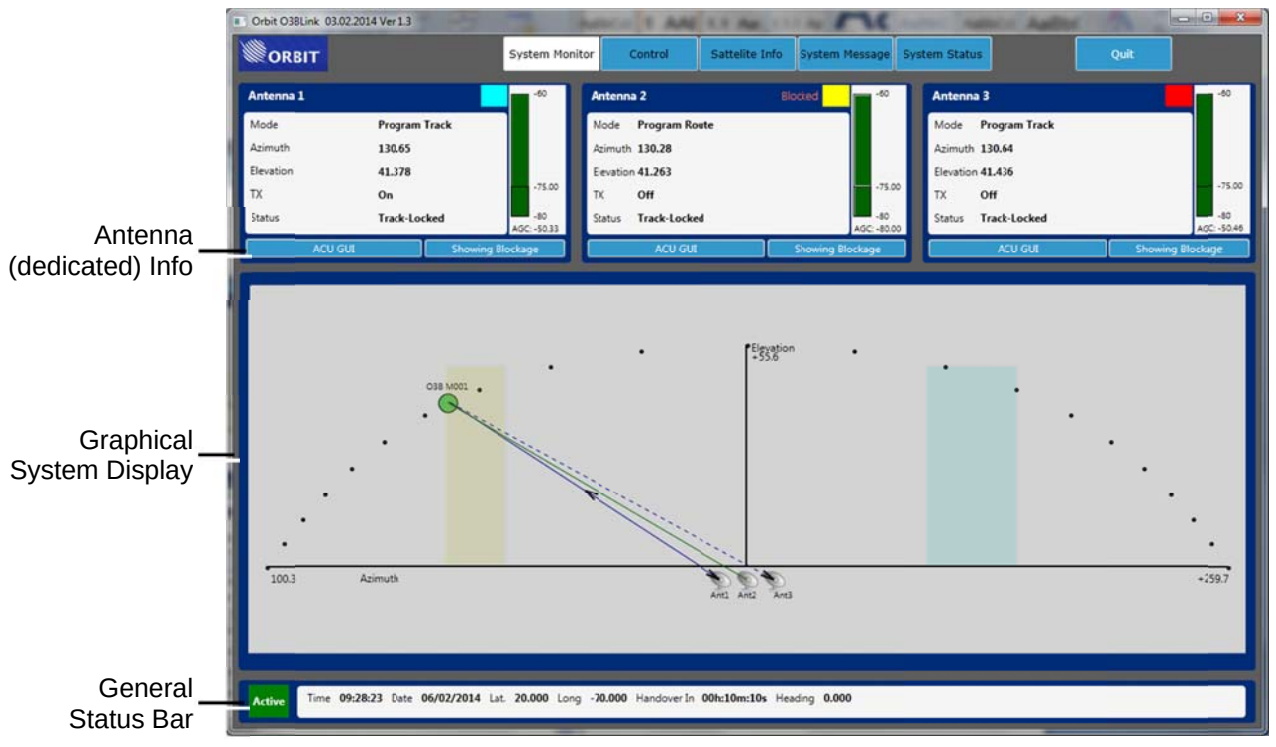


Figure 5-2: System Monitor Tab

5.2.1 Status of Each Antenna

The antenna-specific window areas provide general information on each antenna and access to the antenna's MTSVLink application. The figure below shows *one* of the areas.

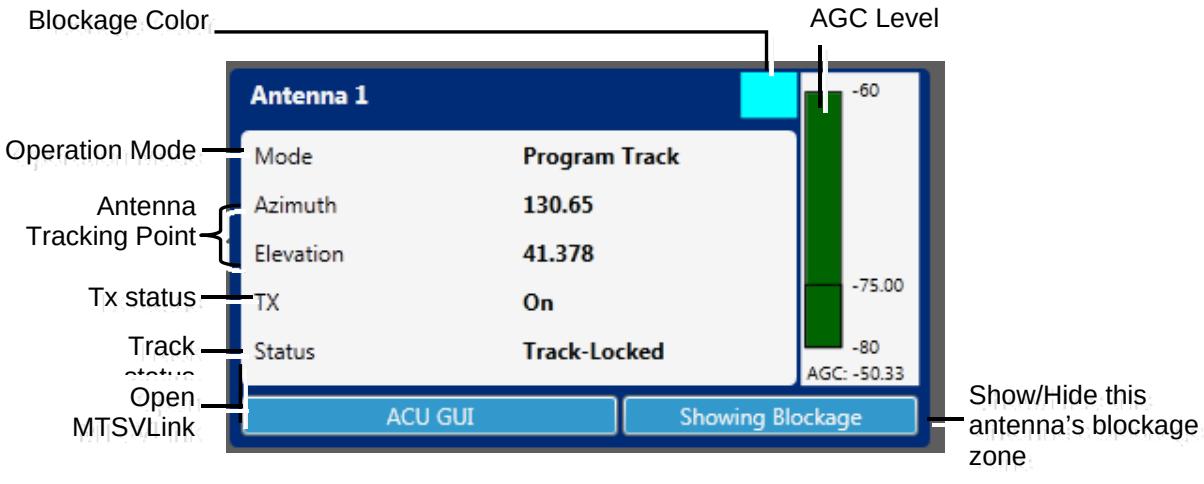


Figure 5-3: Single Antenna General Parameters

Item	Description
Blockage color	System assigned color for the blockage area represented in the System Graphical Display
Mode	Mode of operation: Standby – Antenna is not active. Program Route – calculated route followed by antenna Program Track – satellite signal used for tracking
Antenna Tracking point	Position of antenna. Azimuth and Elevation angles of this antenna.
Tx status	Tx status (BUC mode) of this antenna: ON – antenna is currently transmitting. OFF – antenna is not transmitting.
Track Status	Shows if antenna is tracking or not and if the modem is locked or unlocked.
AGC	Minimum, maximum and threshold AGC values. Default range: -80 to -60 *NOTE: The available displayed range can be modified according to section 7.4.*
ACU GUI	Click to access antenna dedicated MTSVLink. The MTSVLink is used to perform all antenna configuration, management and troubleshooting operations. The application is fully described in the OceanTRx™ User Manuals.
Show/Hide Blockage Zone	Shows or hides antenna specific blockage zone in the graphical display.

5.2.2 Graphical System Display

The following area shows the blockage map of the system, the current satellite position relative to the antennas and the operation modes of the antennas.

The following display reflects a configuration in which:

- Ant1 and Ant2 are active
- Ant1 is transmitting (UL) and receiving (DL) - bi-directional arrow between Ant1 and satellite
- Ant2 is only in receiving mode (DL) – directional arrow towards Ant2. However, a signal will not be received since Ant2 is now attempting to receive in its defined blockage zone (yellow area)
- Ant1 is transmitting and receiving; but Ant2 is open to receive currently blocked (within yellow blockage zone)

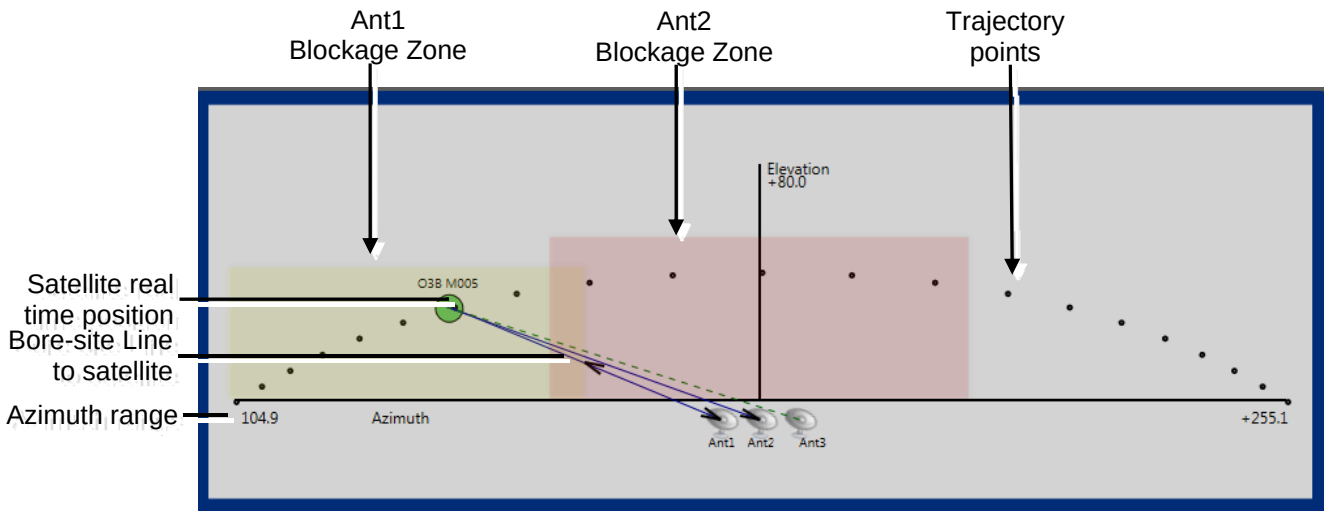


Figure 5-4: Antennas and Satellite Display

Item	Description
Satellite real-time position	Satellite position relative to blockage zones of antennas
Trajectory points	Representation of satellites calculated Route (NOTE) over the Earth horizon.
Blockage Zones	Shows the blockage zone for each antenna, where the colors correspond to the blockage colors associated with each antenna.
Bore-site Line to satellite	Shows transmission path between the antenna and the satellite. *NOTE: For terminology description of various antennas described below, refer to section 1.2.1.* Primary Antenna – A solid Bore-site line with arrows pointing in both UL and DL directions Secondary Antenna – A solid Bore-site line with a single arrow pointing in DL direction. When in Blockage or Solar Outage, the Secondary Antenna reverts to Program Route. This is graphically marked by removing the arrow

Item	Description
	off its solid Bore-site line. Tracking Back-Up Antenna – A dotted Bore-site line with a single arrow pointing in DL direction. When in Blockage or Solar Outage, the Tracking Back-up Antenna reverts to Program Route. This is graphically marked by removing the arrow off its dotted Bore-site line. Stand-by Back-Up Antenna – No Bore-sight line is associated with the Antenna

5.2.3 Status Bar

The Status Bar provides information on the currently transmitting system.

Figure 5-5: Status Bar

Item	Description
Active	Control Unit Active state – may be inactive for systems with two CCUs: Active (green) - the active CCU is in control of the system. (The other CCU should be inactive.) Inactive (red) – the other CCU should be in control of the system.
GPS	GPS Coordinates (longitude and latitude).
Date and Time	System clock. Used for time-stamping events.
Handover countdown	Count-down in seconds, to handover of operation to the next antenna defined in the configuration criteria. For example, handover between Ant1 and Ant2.
Heading	Compass heading

5.2.4 Controlling System Operation

This tab is usually used if one of the antennas is faulty. You may then perform various operations through this screen in order to allow troubleshooting, replacing the antenna or reconfiguration of the system to support two antennas (or one as the situation requires).

Use the **Control** tab to perform the following operations:

- Stop operation of ALL antennas - either freeze positions or move all to standby (usually used for troubleshooting or maintenance).
- Perform manual switch of the Rx switch (and stops the O3b system control) between antennas – override configured switching criteria.
- Modify system configuration (antenna role and several parameters of the switching algorithm) – usually system operation is factory set.
- View the IP Addresses of each system management element (ACUs and CCUs)

The Control panel is shown below.

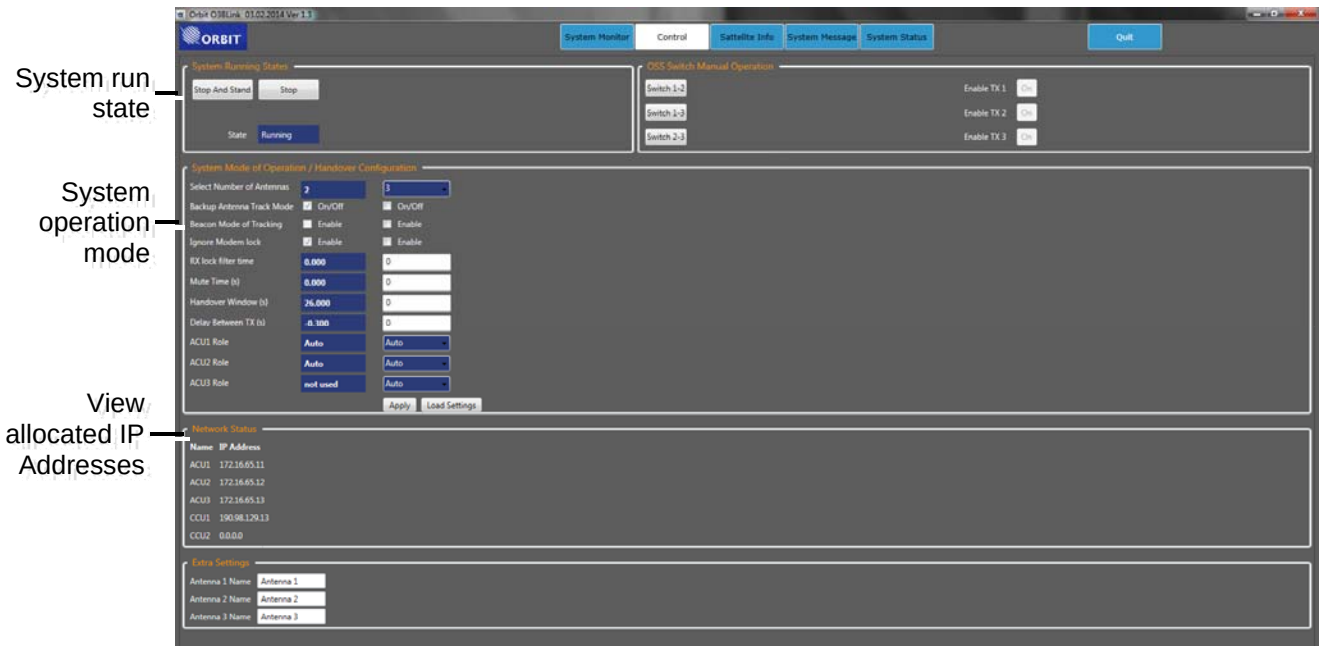


Figure 5-6: Control Tab

5.2.4.1 Antenna Role Definition - Background

Antenna roles assigned in O3bLink have meaning only on O3bLink “Run” start command when roles are assigned to antennas for the first time.

Then roles are changed automatically according to End-pass Handover, Mid-pass Blockage and Fault Switch-over conditions.

Four possible roles may be assigned to each of the Antennas: Auto, Primary, Secondary or Backup.

If “Auto” is selected, CCU is free to assign initial Antenna Role as per its internal logic. For Normal operation, “Auto” should be assigned for all three Antennas.

1. Practical Examples

Roles set in O3bLink: ACU1-Secondary, ACU2-Primary, ACU3-Backup:

- If on handover start all 3 antennas are Ready, their roles will be the same as set in O3bLink: ACU1-Secondary, ACU2-Primary, ACU3-Backup
- However if for example ACU2 is Not Ready during 20 sec after start the assigned roles will be: ACU1-Primary, ACU2-Backup, ACU3-Secondary
- Another case: ACU1 is Not Ready. The roles will be: ACU1-Backup, ACU2-Primary, ACU3-Secondary

Roles set in O3bLink: All roles in O3bLink are Auto

- If all 3 antennas are Ready on start, their roles will be: ACU1-Primary, ACU2-Secondary, ACU3-Backup
- If for example ACU1 is Not Ready, the roles will be: ACU1-Backup, ACU2-Primary, ACU3-Secondary

2. "Impractical" Examples

Since the software does not prevent senseless settings such as defining all three Antennas roles as "Primary" or setting two of the Antennas (1 and 2) to "Back-up" and the third to "Auto", the following response logic is implemented:

Antenna with higher role in O3bLink gets higher initial role on start.

Primary role is higher than Secondary, Secondary is higher than Auto, Auto is higher than Backup.

If roles of 2 antennas in O3bLink are equal, antenna with smaller ID gets higher role.

So, if all antennas are in normal state, in case of Antennas (1 and 2) are set to "Back-up" while Antenna 3 set to "Auto", the actual role assignment will be: Ant1-Secondary, Ant2-Backup, Ant3-Primary;

In case of all three Antennas set to "Primary", the actual role assignment will be: Ant1-Primary, Ant2-Secondary, and Ant3-Backup

3. Back-up Antenna

Back-up Antenna may be of two types:

- "Stand-by" – Back-up antenna is held still in Stand-by mode
- "Tracking" – Back-up antenna is copying the motion of the Primary Antenna

To select "Tracking", the operator must check the "Tracking Back Up Enable" check box.

5.2.4.2 Controlling System Operation

Control system operation from the **Control** tab, **System Running States** area.

Note

Refer to the following section for more information on antenna roles.

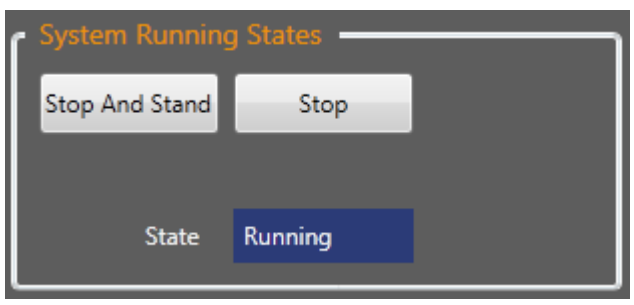


Figure 5-7: Partial Control Tab - System Start Stop

Perform the following Operations from the **Control** tab.

To	Do this….
Allow antenna operation to continue; but, disable CCU control.	Click **Stop.** Antenna operation is not affected; but CCU control is disabled. (The button toggles to **Run**).
Re-enable CCU control	Click **Run** Antennas continue operation; but can now be controlled via the CCU. (The button toggles to **Stop).**
Stop running state of antennas and set antennas to *Standby mode.*	Click **Stop And Stand.** All antennas stop operating/Tx. And their mode set to standby. (If the Antenna Mode is set to Stand-by it cannot track any satellite)
To Manually re-define the two antennas that will be Active.	This option is relevant ONLY if ALL antennas are still operational. For example, Antennas 1 and 2 are defined as active and antenna 3 is backup; Antenna 2 shows sporadic problems but is still functional. We would want to redefine Antenna 2 role as the backup mode (n*o other operation is needed*); the overall system setup and operation criteria has not been modified. To change the roles of the antenna, press on load settings then change the parameters on the left and apply the new settings.
Stop antenna transmit	Future option. Click **Tx1 / 2 / 3** to stop transmission of the corresponding antenna.

5.2.4.3 Modifying Operation Parameters

System operation parameters can be modified from the **Control** tab, by doing one of the following:

- Modifying the parameters
- Loading settings from a pre-defined file

Note Be sure to click Apply after changing parameters

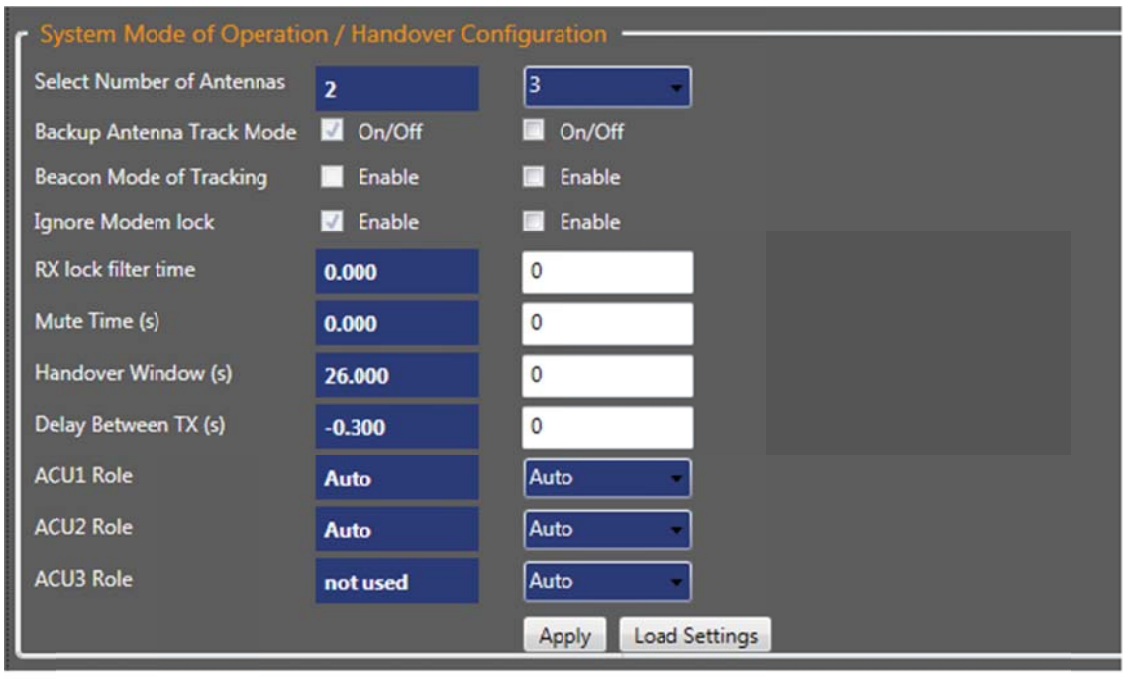


Figure 5-8: Partial Control Tab - Modifying System Operation Mode

Option	Description
Select Number of Antennas	By default, two or three antennas are defined (according to installation): two are operational and one is on standby. Use this parameter to redefine the configuration if one of the antennas is faulty.
Backup Antenna Track Mode	Define the operation mode of the backup antenna currently defined as standby. If checked, backup antenna will track the satellite (along with the other antenna(s))
Beacon mode	Check the Beacon Mode Of Tracking checkbox. The antennas track the data Beacon of the satellite (rather than the satellite itself).

Ignore Modem Lock	The system will not replace the antenna when the Modem loses lock.
Rx Lock Filter Time	If ignore modem lock is not checked this filters the system response to lock or not lock events from the modem.
Mute Time	Time to start transmitting before handover time
Handover window (s)	The time interval in which two antennas are transmitting to two different satellites.
Delay Between Tx(s)	When mid pass handover accrue, the antenna will start transmitting only after this time interval.
ACU-X Role	Refer to section 5.2.4.1.
Control Buttons	• Load Settings - Load the current settings from the CCU, must be applied at least once before updating the settings. • Apply - Update the settings to the CCU

5.2.4.4 Viewing Antenna Names and IP Settings

The antenna names and system (ACUs and CCU(s)) IP Addresses can be viewed from the **Control** tab, under the lower window areas as shown below.

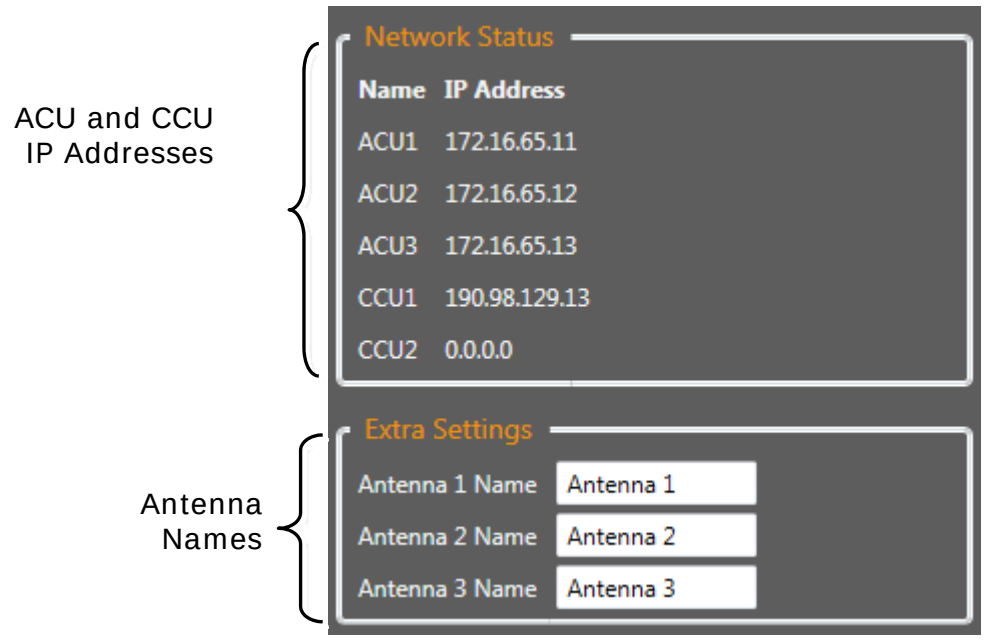


Figure 5-9: Partial Control Tab – System IP and Antenna Names

Option	Description
Select Number of Antennas	By default, three antennas are defined: two are operational and one is on standby. Use this parameter to redefine the configuration if one of the antennas is faulty.
Backup Antenna Track Mode	Define the operation mode of the backup antenna currently defined as standby. If checked, backup antenna will track the satellite (along with the other antenna(s))

5.3 Satellite General Info And Parameters

The Satellite Info tab displays information on the satellite(s) that this O3b system tracks. The dialog provides the following type of information:

- Satellite constellation parameters
- Detailed information on the satellite beam
- TLE parameters – used to calculate satellite route
- Real time information on satellite position, handover time and other paraemters

5.3.1 Constellation Parameters

The Satellite Info tab shows various constellation parameters:

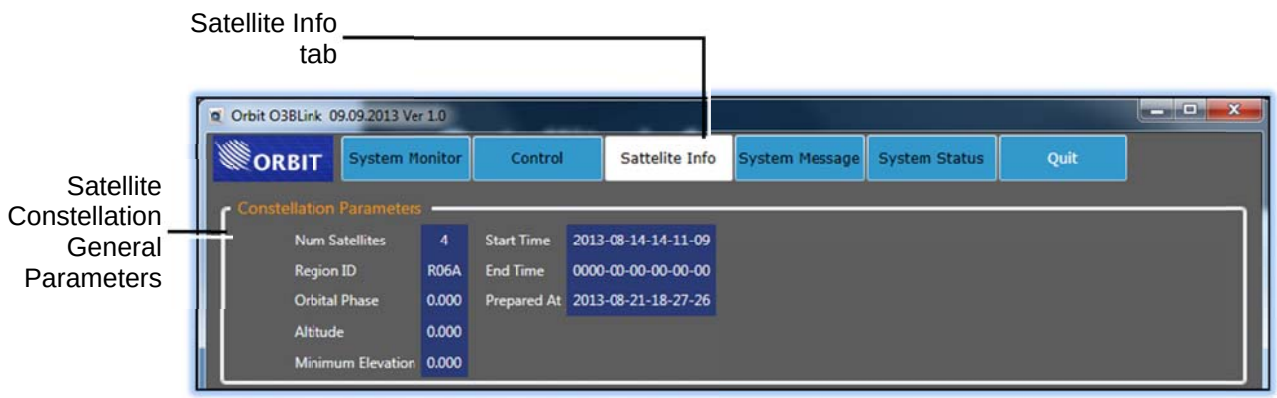


Figure 5-10: Partial Satellite Info Tab – Constellation Parameters

The following constellation parameters are available:

- Number of available satellites
- Region ID – the region in which the ship is located , different region my result in different beams being used.
- Orbital phase
- Altitude – satellite altitude.
- Minimum elevation – the minimum (antenna) elevation in which a signal can be received from the satellite.

5.3.2 Satellite Date

The following types of Satellite data are provided:

- Beam Parameters
- TLE Parameters
- Dynamic Parameters

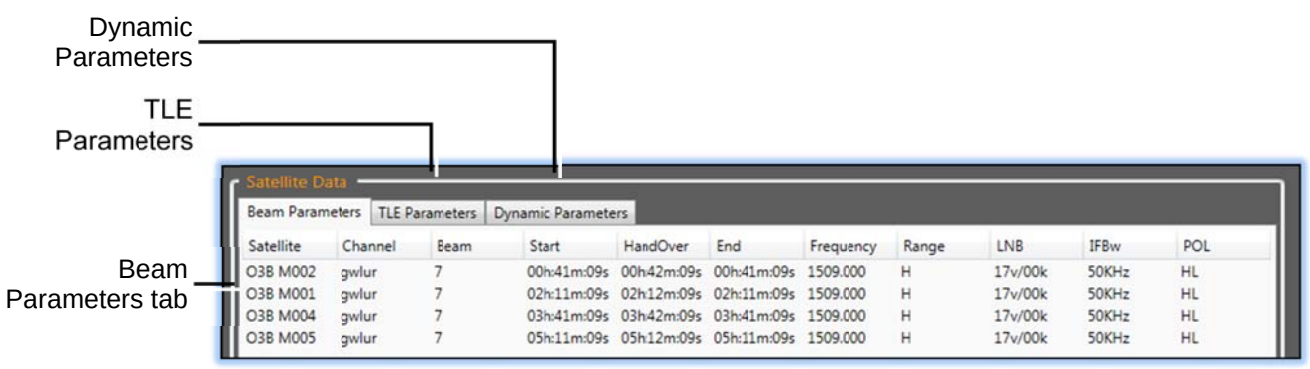


Figure 5-11: Partial Satellite Info Tab – Satellite Data

5.3.2.1 Satellite Data – Beam Parameters

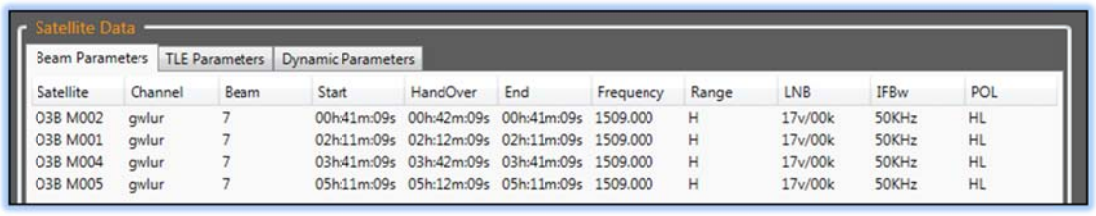
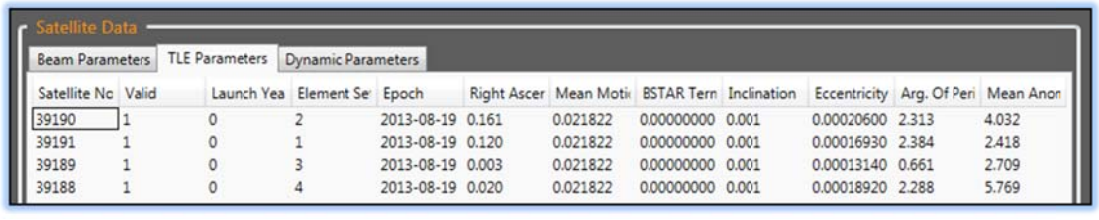


Figure 5-12: Partial Satellite Data Tab – Beam Parameters

The following Satellite Data – Beam Parameters are provided.

- Satellite name
- Channel name
- Beam number
- Start time – the next time the ascending satellite will be available.
- Handover – time to begin transmitting to the ascending satellite.
- End time – time to switch the second antenna off the descending satellite.
- Frequency – Beam frequency.
- Range – (H/L) high or low frequency BUC.
- LNB
- IFBW
- POL – signal polarization

5.3.3 Satellite Data – TLE Parameters



Satellite No	Valid	Launch Yea	Element Se	Epoch	Right Ascer	Mean Moti	BSTAR Tern	Inclination	Eccentricity	Arg. Of Peri	Mean Anon
39190	1	0	2	2013-08-19	0.161	0.021822	0.00000000	0.001	0.00020600	2.313	4.032
39191	1	0	1	2013-08-19	0.120	0.021822	0.00000000	0.001	0.00016930	2.384	2.418
39189	1	0	3	2013-08-19	0.003	0.021822	0.00000000	0.001	0.00013140	0.661	2.709
39188	1	0	4	2013-08-19	0.020	0.021822	0.00000000	0.001	0.00018920	2.288	5.769

Figure 5-13: Partial Satellite Data Tab – TLE Parameters

The following Satellite Data – TLE Parameters are provided:

- Satellite number
- Valid – is the data for the satellite valid or outdated.
- Launch year
- Element set
- Epoch
- Right ascension - the angle measured eastward from the Vernal Equinox to the ascending node.
- Mean motion - the reciprocal of the period.
- BSTAR term
- Inclination - orbital plane's tilt angle with respect to the equator.
- Eccentricity - the distance from the center of the ellipse to the center of the Earth divided by the semi major axis.
- Arg. Of Perig - the angle measured in the direction of satellite motion from the ascending node to perigee
- Mean Anomaly - describes what the satellite's true anomaly would be if it were in a circular orbit.

5.3.4 Satellite Data – Dynamic Parameters

This tab shows the live, currently measured and updated parameters.

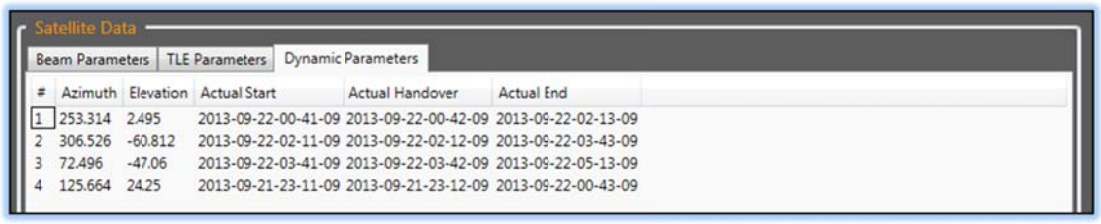


Figure 5-14: Partial Satellite Data Tab – Dynamic Parameters

The following Satellite Data – Dynamic Parameters are provided:

- Satellite azimuth angle.
- Satellite elevation angle.
- Actual start time. – calculated time when one of the antennas should start tracking the next ascending satellite. This occurs about four times per day for each satellite.

  The time is determined by a file that is continuously received continuously from the O3b system to Orbit's system.

The calculation is necessary because O3b provides only a single time of day for each satellite while each satellite requires about four switchovers per day

- Actual handover – actual time to start transmitting to the ascending satellite.
- Actual End time – actual time to stop tracking the descending satellite and rewind the second antenna to the ascending satellite.

5.4 System Messaging

This tab shows warnings and errors of the system operation, the errors are divided into 4 groups: ACU1, ACU2, ACU3 and CCU.

For example:

ACU1: communication error.

CCU: No GPS data.

(warning) ACU2 : Blockage Zone excepted in 25 min.

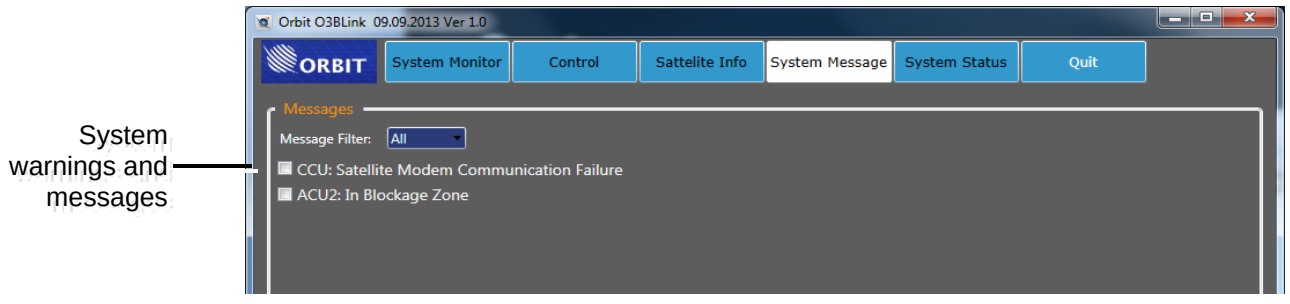


Figure 5-15: System Messages Tab

5.5 General System Status Review – Advanced Debug

This screen is used for debugging purposes it presents the some groups of parameters , if a parameter is preceded by an asterisk than there is an error with that parameter.

In addition to the many debug parameters some of the important parameters are :

- Handover run condition – system operation OK
- Handover Configuration Status – corresponds to the parameters configured in the Control screen
- Configuration and status of each ACU -

Handover state - Indicates if the system is running in O3b mode.

CCU active state - indicates if the current CCU is the active one.

ACU 1/2/3 Status.

Ready for handover – if the value of this parameter is “no” or preceded by an asterisk there is some error that prevents the ACU to work in O3b mode.

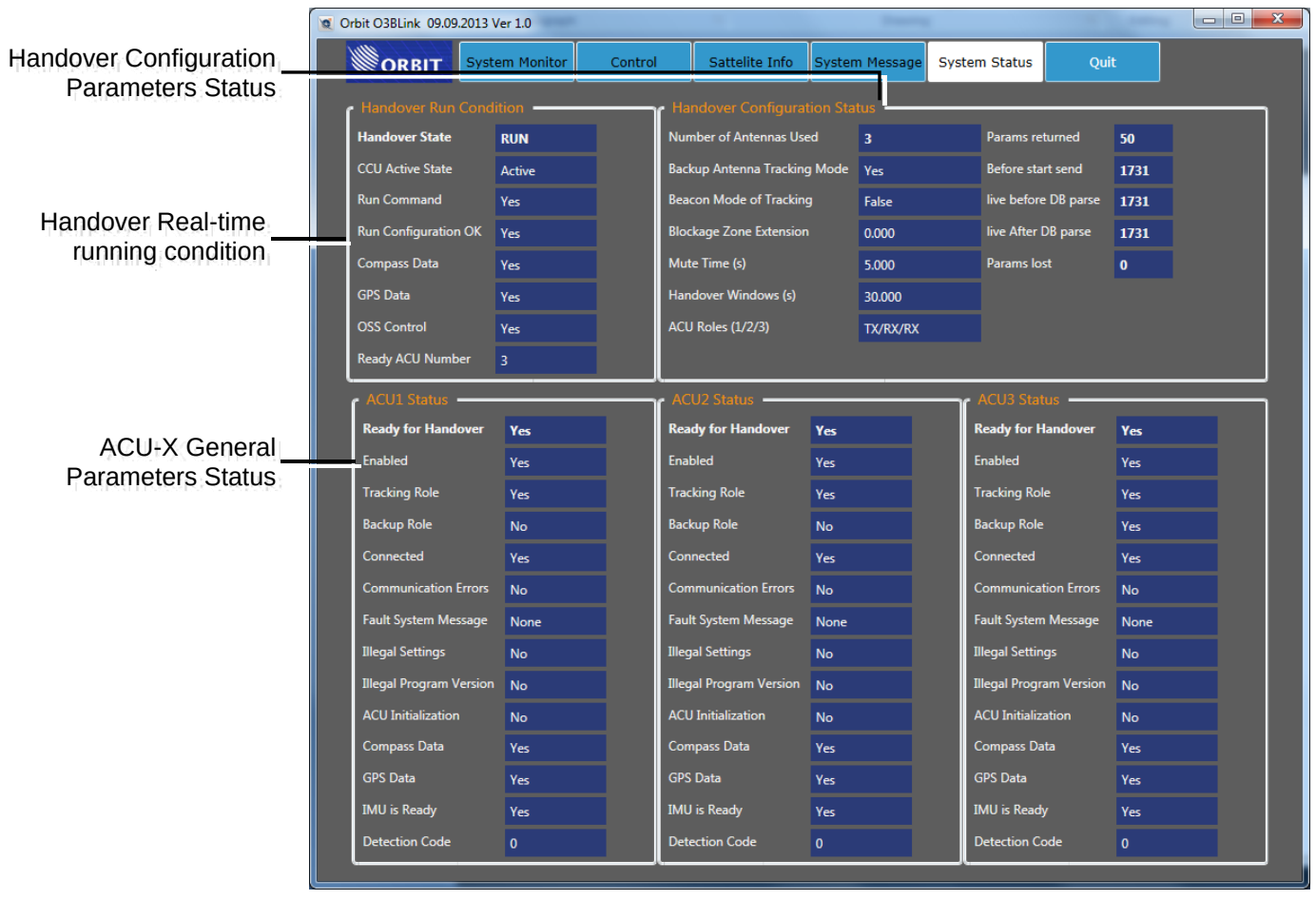


Figure 5-16: System Messages Tab

6 O3b Operation and Maintenance from MtsVLink (ACU)

The O3b system supports two groups of operation modes:

- TLE Based Modes - operational modes.
- Trigonometry based modes - mainly used for maintenance and debug. The modes use basic trigonometry with O3b Constellation Altitude (8069km), Period (6 hours) and Orbital Phase.

All operation modes (except "Stand-by") are stabilized: even if the antenna is pointing to a specific point, there is continuous motion to compensate for any ship displacements in Yaw, Pitch and Roll.

TLE Based Modes (Operational)	Trigonometry Based Modes (Maintenance)
Program Route	Point-to-Satellite
Program Track (and Peak)	Manual
Acquire Program Tack	Satellite Preset
Re-Acquire	O3b Hunt
	Step-Track (and Peak)
	Acquire Satellite Preset
	Acquire Satellite
	Search

6.1 Operational (TLE Based) Modes

6.1.1 Program Route

- Load the TLE of the selected Satellite.
- Move the Antenna according to the continuously calculated Azimuth and Elevation angles of the selected Satellite, as per TLE mathematics (ephemeris).
- If the current calculated Elevation is below the Minimal Elevation, the antenna will hold at Minimal Elevation, until the Satellite is in view.
- The Antenna will track the Satellite until its Elevation descends at below the Minimal Elevation point.

6.1.2 Program Track (and Peak)

- Periodically re-peak the Antenna on signal maxima with respect to O3b Satellite Arc with the Azimuth-Elevation Satellite view angles constantly recalculated using selected Satellite TLE.
- If the signal times out below the threshold level or Antenna view is blocked, **Re-Acquire (Program Search)** mode is automatically invoked.
- If the signal is re-acquired (exceeds the threshold by a predefined "epsilon"), the Antenna reverts back to **Program Track**
- If **Re-Acquire** mode times out, the Antenna reverts to **Program Route**, but still if the signal re-appears, the Antenna will automatically resort to **Program Track**
- Note that the **Re-Acquire** Timeout may be set to 0.0, thus causing the Antenna to revert straight to **Program Route** in case of signal loss.
- Note that “Program Track” cannot be activated from the Operational screen as a stand-alone mode. It is used as a sub-mode in “Acquire Program Track” batch below.

6.1.3 Acquire Program Track

- This is the nominal operation mode for O3b project. It operates according to the O3b Constellation screen parameters as well as the parameters in its configuration menu:
- Acquire Program Track automatically points the Antenna to the Scheduled O3b Satellites using their TLE data. Furthermore it controls the weather to transmit onto a Satellite or not, in order to achieve correct Dual-Antenna Tracking and Handover.
- The differentiation for the ACU roles when paired together, is according to "Tx Permission" parameter: one ACU would normally be set-up "For Even Satellites" whereas the other "For Odd Satellites"
- Note that if the CCU Monitoring is checked, the ACU will automatically disable its Tx, if the communications with CCU is stopped for over the Timeout defined seconds.

In any case, the Acquire Program Track mode implements the following time states:

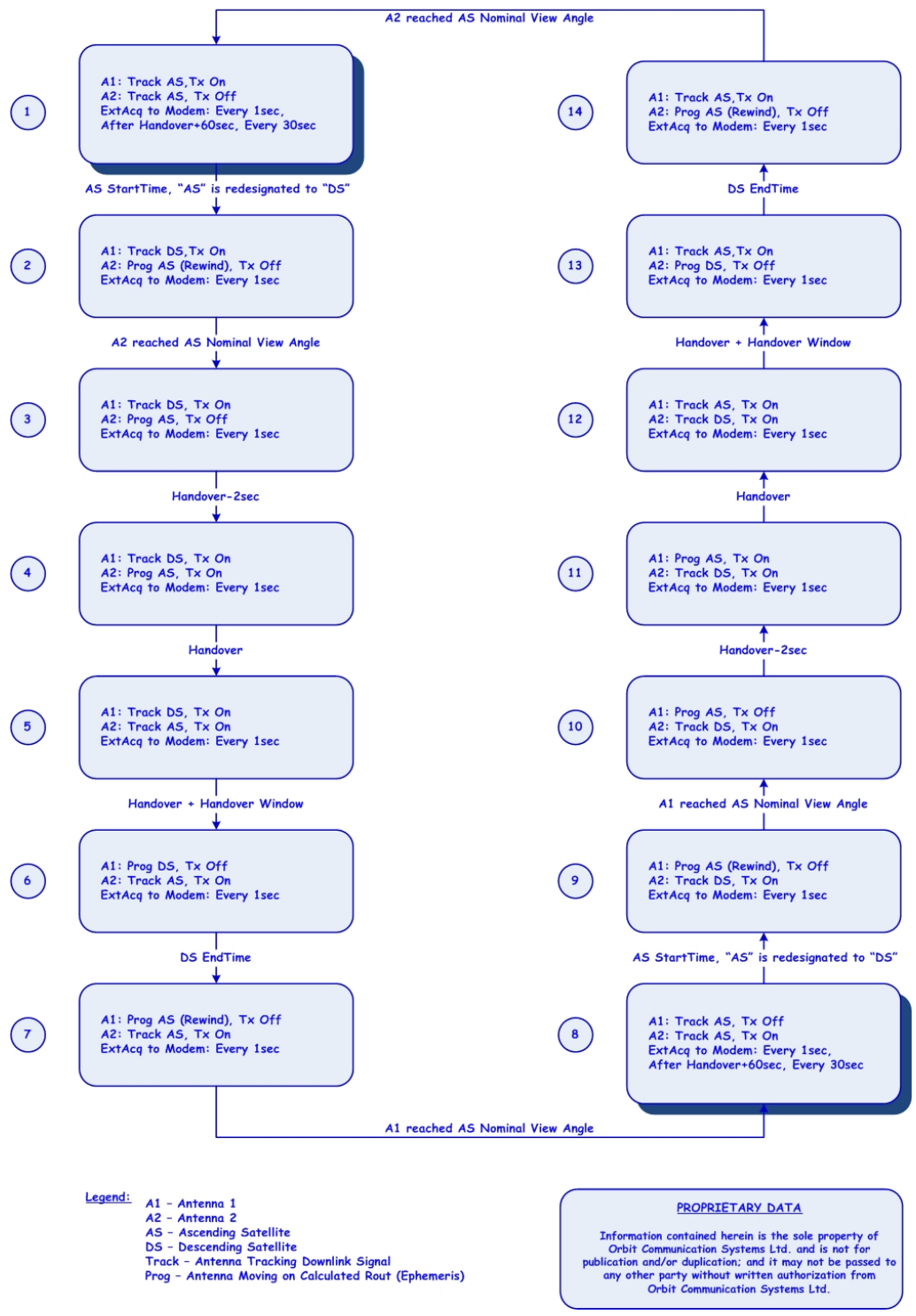


Figure 6-1: Handover Flow for Two Antennas

6.1.4 Re-Acquire (Program Search)

- Move Antenna in increasing Longitude swings, back and forth along the O3b Arc, around last selected view angle location
- Combine the Search swings with movement of the antenna on the O3b Arc, calculated using last selected Satellite TLE
- When Signal raises above threshold activate **Program-Track**
- If timed-out – activate **Program-Route**

6.2 Maintenance Modes

6.2.1 Point to selected Satellite

- Point to selected O3b Satellite Arch location. If below the Horizon, move to the point of expected ascend at Minimal Elevation defined in Program Track configuration (default of 0.0 degrees). To select an O3b Satellite – use the O3b Constellation screen
- Move the antenna on the O3b Arch, until the point of descend below Minimal Elevation. The movement is calculated as per simple trigonometric trajectory based on the parameters fed in the General Parameters of the O3b Constellation screen: Orbital Phase, Altitude, Constellation period.
- Note that this mode does not use TLE information and will point to a Satellite only if Orbital Phase, Altitude, Constellation period parameters are set to correct values.

6.2.2 Manual

The Antenna is pointed towards the last commanded Orbital Longitude. A control screen allowing manual incremental corrections is provided. If Manual mode is configured to "Sat Arc", the "Azimuth" increments will move the Antenna onto the O3b Satellites sky Arc

6.2.3 Satellite Preset

- Ask for Orbital Longitude (numeric float value in the range of -180.00 to 180.00 degrees)
- Calculate Az/El view angles towards the O3b Arc
- Point to O3b Arc location
- Note that this mode does not use TLE information and will point to the commanded Orbital Longitude only if Altitude and Constellation period parameters are set to correct values.

6.2.4 O3b Hunt

- This is a batch activating Satellite Preset towards the "O3b Hunt" point, then waiting for the Signal to appear (cross the Threshold level), then invoke Step-Track
- The "O3b Hunt" is a Longitude point on the O3b Satellite Arc calculated as follows: Antenna GPS Longitude – 180/Number_of_O3b_Satellites
- The **O3b Hunt** mode is presented in the Mode List menu only when O3b Constellation is selected.

6.2.5 Step-Track

- Periodically re-peak the Antenna on signal maxima with respect to O3b Satellite Arc with the Azimuth-Elevation Satellite view angles constantly trigonometrically recalculated using Altitude and Constellation Period parameters.
- If the signal times out below threshold, or Antenna view is blocked, **Search** mode is automatically invoked.
- If the signal is re-acquired (exceeds the threshold by a predefined "epsilon"), the Antenna reverts back to **Step-track**

6.2.6 Peak

- Point the Antenna to the Point of maximal reception as found by the last Step-Track or Program-Track iteration.
- Keep Antenna moving on the O3b Satellite Arc. If invoked during Step-Track, calculate Antenna movement using trigonometry of O3b Trajectory Altitude and Period. If invoked during Program Track, calculate Antenna movement using TLE math.

6.2.7 Acquired Satellite Preset

- This is a batch, activating Satellite Preset and then Step-track modes one after the other:
  - Ask for Orbital Longitude (numeric float value in the range of -180.00 to 180.00 degrees)
  - Calculate Az/El view angles towards the O3b Arc
  - Point to O3b Arc location
  - Periodically re-peak the Antenna on signal maxima with respect to O3b Satellite Arc with the Azimuth-Elevation Satellite view angles constantly trigonometrically recalculated using Altitude and Constellation Period parameters.
  - If the signal times out below threshold, **Search** mode is automatically invoked.
  - If the signal is re-acquired (exceeds the threshold by a predefined "epsilon"), the Antenna reverts back to **Step-track**

6.2.8 Acquire Satellite

- This is a batch, activating Point-to-Satellite and then Step-track modes one after the other:
  - Point to selected O3b Satellite Arch location. If below the Horizon, move to the point of expected ascend at Minimal Elevation defined in Program Track configuration (default of 0.0 degrees). To select an O3b Satellite – use the O3b Constellation screen
  - Move the antenna on the O3b Arch, until the point of descend below Minimal Elevation. The movement is calculated as per simple trigonometric trajectory based on the parameters fed in the General Parameters of the O3b Constellation screen: Orbital Phase, Altitude, Constellation period.
  - Periodically re-peak the Antenna on signal maxima with respect to O3b Satellite Arc with the Azimuth-Elevation Satellite view angles constantly trigonometrically recalculated using Altitude and Constellation Period parameters.
  - If the signal times out below threshold, **Search** mode is automatically invoked.
  - If the signal is re-acquired (exceeds the threshold by a predefined "epsilon"), the Antenna reverts back to **Step-track**
  - Note that this mode does not use TLE information and will point to a Satellite only if Orbital Phase, Altitude, Constellation period parameters are set to correct values

6.2.9 Search

- Move Antenna in increasing Longitude swings, back and forth along the O3b Arc, around last selected view angle location
- Combine the Search swings with movement of the antenna on the O3b Arc, calculated trigonometrically using O3b Constellation Period and Altitude
- When Signal raises above threshold activate **Step-Track**
- If timed-out – activate selected revert mode

7 MtsVLink O3b Files

7.1 CCU Events Logger

If the CCU Monitoring option is enabled in the O3b Acquire Program Track Dialog, the event logger is activated.

Events log is created c:\ccu\o3blog folder files.

The file names are O3bEventLog0.txt, O3bEventLog1.txt, … O3vEventLog9.txt.

O3bEventLog0.txt contains latest events, O3bEventLog9.txt – earliest event.

Each file size is up to 5MB.

The sequence of records in each file – from earliest one at the file starts to latest ones at the file end.

The log files are updated once per hour or on exit CCU Manager from menu.

The files may be downloaded via RSync and double-clicked in File Explorer to open them in text editor to view on the CCU Screen.

7.2 O3b CCU Flash Disk Contents

Folder	Contents
C:\Ccu\CcuManager	CcuManager utility components. CcuManager.exe - executable file. CcuManager.lnk - shortcut to run the program not in O3b mode. O3b_CcuManager.lnk - shortcut to run the program in O3b mode
C:\Ccu\Desktop	Backup of shortcuts that should appear on CCU Windows desktop. Shortcuts are located in: C:\Documents and Settings\Administrator\Desktop
C:\Ccu\Lib	Common library files used by different utilities. CcuBase.dll enables to fulfill same basic CCU-related operations.
C:\Ccu\LinkModifier	Components of LinkModifier utility, which is used for debugging purposes only
C:\Ccu\ModemBridge	Components of the utility providing communication bridge between ACU and Satellite Modem in O3b system. TcpBridgeControl.exe - executable file. TcpBridgeControl.exe.config - configuration
C:\Ccu\MtsDock	Contains components of MtsDock utility, which is used for setup operations fulfilled from CCU itself.
C:\Ccu\Mtslink	MTSVLink utility components and shortcuts for communication with ACU of Antenna1-3 in O3b system
C:\Ccu\O3b	Contains O3b system configuration files.

Folder	Contents
	O3bcns.xml - current satellites constellation data. O3bncns.xml - next constellation data. O3bncns.xml file, according to defined in it time value, replaces O3bCNs.xml. The file is produced by CcuManager as combination of necessary data of received from remote client Channel, Schedule and Ephemeris files. O3bpcns.xml - the copy of O3bcns.xml file, created before its replacement by O3bncns.xml; the file may be used just for debugging purposes. O3bFault.xml - ACU fault condition file. O3bWork.xml - handover configuration parameters
C:\Ccu\O3bData	Contains initial satellites data received from remote client. Remote client, for example O3b gateway, sends Channels, Ephemeris and Schedule files. They are placed C:\Ccu\O3bData\gw_sat folder. To detect that new files are placed in gw_sat folder, CcuManager keeps the files times in C:\Ccu\O3bData\gw_check\GwStamp.xml file. CcuManager once per 30 sec, checks if gw_sat files changed. If the files change is detected CcuManager checks once per 30 sec that there is no additional change, i.e. new files set is completely received. CcuManager reads gw_sat files and combines then in O3bNcns.xml (next constellation data) file in C:\Ccu\O3b folder.
C:\Ccu\O3bLink	The folder contains O3bLink utility component. O3bLink.exe - executable file. O3bLink.exe.config - configuration.
C:\Ccu\O3bLog	The folder contains CCU events log files. The files names are O3bEventLog0.txt, O3bEventLog1.txt…O3vEventLog9.txt. O3bEventLog0.txt contains latest events, O3bEventLog9.txt contains earliest events. Each file size is up to 5MB. The sequence of records in each file is from earliest one at the file start to latest ones at the file end. The log files are updated once per hour.
C:\Ccu\RsyncInit	The folder contains files used to establish connection with remote client via RSYNC protocol. Rsyncd.conf – RSYNC daemon configuration file. RsyncStart.bat – launch of RSYNC daemon after reboot. Secrets.txt - RSYNC user name and password pairs. Rsyncd.conf file contains definition of RSYNC modules with the set of attributes: module name, corresponding disk folder, if the module is read-only or the files update operations are enabled, user name. 2 modules are defined for O3b purposes: "system-data" and "o3b-logs". "system-data" modules corresponds to C:\Ccu\O3bData\gw_sat

Folder	Contents
	folder with satellites data files. The module may be accessed only with pointed in rsyncd.conf user name and pointed in secrets.txt password. "o3b-logs" module corresponds to C:\Ccu\O3bLog folder with log files. The module is read-only.
C:\Ccu\Start	CCU operations fulfilled after reboot. CcuStart.exe fulfills 2 operations: to move files from C:\Ccu\Update folder to any other place on disk; to modify CCU network parameters (IP address, mask, gateway IP). Start.bat file launches all necessary utilities after reboot. The shortcut start.lnk to start.bat file must be in Windows menu All Programs\Startup folder.
C:\Ccu\SwitchCcu	Components of utility which fulfills active CCU selection. It should be used only in debugging purposes. SwitchCcu.exe - executable file. SwitchCcu.exe.config - configuration.
C:\Ccu\Update	Folder is used for software update operations. The files placed in this folder are deleted after the update end. Files in C:\Ccu\Update\Move folder are just moved after reboot, with preservation their relative path, in the disk root folder C:\. File C:\Ccu\Update\SysConfig.i modifies CCU network parameters.
C:\Ccu\Utilities	Miscellaneous utilities for debugging and other auxiliary purposes. AddIp.exe - addition of dynamic IP address. DebServer0.exe - execution of miscellaneous commands sent from remote console. FtpServer.exe - FTP server; the access is possible with any user name and password. Msocudp.exe - UDP protocol link test. WinCap32.exe - screen areas capture.

7.3 Replacing Satellites Constellation Data

This section describes how to replace the Current satellites constellation data by the constellation data of the next satellite.

O3bncns.xml file should be replaced according to its start time O3bCns.xml.

➢ **To replace the data**

1) New constellation data Start Time is taken as minimum of all satellites Start Time values in Schedule file.
2) Replacement of O3bCns data by O3bNCns is fulfilled in ACU and CCU, and it may be in different times. The time of replacement depends on specified in Schedule file Action field, which may be ADD or PURGE. CCU makes the replacement after all ACU did it.
3) Case: ACU, Action ADD
   If loaded O3bNcns Start time is less than current UTC, the replacement is fulfilled immediately.
   Otherwise the replacement is fulfilled on switch to new satellite if its Start time not less than O3bNCns Start time.
4) Case: ACU, Action Purge
   If O3bNcns Start time is less than current UTC, the replacement is fulfilled immediately.
5) Case: CCU, Action Add
   If O3bNcns Start time is less than current UTC, the replacement is fulfilled immediately.
   Otherwise, the replacement is fulfilled after handover end: at a satellite End time if this End time more than O3bNCns Start time and the previous satellite Start time is less than O3bNCns Start time.
6) Case CCU: Action Purge
   If O3bNcns Start time is less than current UTC, the replacement is fulfilled immediately.

7.4 Modifying Displayed AGC Range

- This can be done in the following section in the file by changing the values:
  - **<add key="AGCMIN" value="-80"/>**
  - **<add key="AGCMAX" value="-60"/>**

Appendix A – Antenna Fault conditions

This section lists the conditions that will set the fault state of the antenna. The antenna will not be available for tracking the satellite until the fault is cleared.

The fault conditions are stored in an XML file on the CCU (in addition to warning and info messages displayed on O3bLink).

• Missing Configuration File • No Satellites Database File • No Valid IMU Calibration File • Satellite File Read Error • Restart timed out (REBOOTING) • CPU power out of tolerance • CPU Temp out of tolerance • System Reboots, Axes Jammed • Azimuth Stuck • Elevation Stuck • PolSkew Stuck • Tilt Stuck • Azimuth Initialization Failed • Elevation Initialization Failed • PolSkew Initialization Failed • Tilt Initialization Failed • Azimuth Encoder Fault • Elevation Encoder Fault • PolSkew Encoder fault detected • Tilt Encoder Fault	• Azimuth Overcurrent on 96V • Elevation Overcurrent on 96V • PolSkew Overcurrent on 96V Bus • Tilt Overcurrent on 96V • Azimuth Overcurrent on 5V • Elevation Overcurrent on 5V • PolSkew Overcurrent on 5V • Tilt Overcurrent on 5V • Servo Azimuth Config Init Error • Servo Elev Config Init Error • Servo PolSkew ConfigInit Error • Servo Tilt Config Init Error • USB Ports not Detected; Reboot