AL-7203/4/5

Ku-Band
Maritime Stabilized TVRO
DUAL System

Installation and Operation Manual

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Orbit Communication Ltd. 8D Hatzoran St. P.O.B. 8657, Netanya 42504, Israel, Tel: +(972) 9 892 2777, Fax: +(972) 9 885 5944 www.orbit-cs.com

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Revision History & Control

Revision #	Date	Description
Rev: -	July 2010	Initial version
Rev: A	February 2012	Updated version

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SAFETY PRECAUTIONS

- Keep clear of the moving Antenna, at all times
- The Antenna Pedestal is equipped with high torque motors that develop considerable forces. These forces can be harmful
- Equipment contains potentially harmful voltages when connected to the designated power sources. Never remove equipment covers except for maintenance or internal adjustments
- Before removing the covers of any unit, verify that the POWER switch is in the OFF position

- Metal parts accessible to the operator are connected to the chassis' ground to prevent shock, and similar hazards. The chassis' ground conductor must not be removed. Ensure the enclosure is at ground potential
- only qualified and trained personnel should perform installation, operation and maintenance of this equipment
- Care should be taken when lifting the radome since it acts as a sail during windy conditions. At least two people should handle the Radome during installation
- To prevent shock or fire hazard, when sub-units are open or cables are disconnected, do not expose the equipment (with the exception of the Radome) to rain or moisture
- Avoid making unauthorized modifications to the circuitry. Any such changes to the system will void the warranty
- Do not disconnect cables from the equipment while the system is Powered-on

- Interfacing equipment requires the use of high quality connectors and cables
- Use only ORBIT authorized parts for repair

ACRONYMS AND ABBREVIATIONS

ACU.....Antenna Control Unit
ADE .....Above Deck Equipment
BDE.....Below Deck Equipment
CCU .....Central Control Unit
GND.....Ground
IMU.....Inertial Measurement Unit
LAN .....Local Area Network
LAT.....Latitude
LHCP .....Left Hand Circular Polarization
LONG .....Longitude
LOS .....Line of Sight
MMI .....Man-Machine Interface
RHCP .....Right Hand Circular Polarization
TVRO.....TV Receive Only

ABOUT THIS MANUAL

This Manual provides the shipboard system's operator with system description, and operation instructions. The Manual is divided into the following chapters:

Chapter 1. Dual System Description

Provides a general description of the dual system architecture, system units and theory of operation

Chapter 2. CCU Installation and Connections

Provides CCU installation information, of CCU cables connection instructions

Chapter 3. Dual System Operation

Provides detailed operation information and instructions

Chapter 4. Remote DaoLink Application

Provides short introduction to the 'Remote DaoLink Application'

1 DUAL SYSTEM

This manual is an addition to each of the AL-7203/4/5 SYSTEM INSTALLATION and OPERATION MANUAL

1.1 Description

1.1.1 Dual System Configuration

To overcome severe visibility angles limitations existing on some ships, dual system configuration is installed on a single ship.

The dual system constellation allows combining the clear view angles of two different locations on a single ship, by switching the Receive (Rx) and Transmit (Tx) signals from a blocked location to a clear one.

The dual system configuration includes two AL-7203/4/5 systems (ADE terminals only), controlled by a single 'Dual type' Central Control Unit (CCU).
The CCU is connected to the ACU in each of the BDE terminals via LAN cables. The L-Band signals from the two terminals are fed into an internal RF Switch inside the CCU, and the CCU controls the IF Tx/Rx signals, and switch simultaneously to connect the Modem to the "active" system, with the optimal (un-obstructed) signal, to the distribution system.

The dual system configuration is shown in the following Figure.

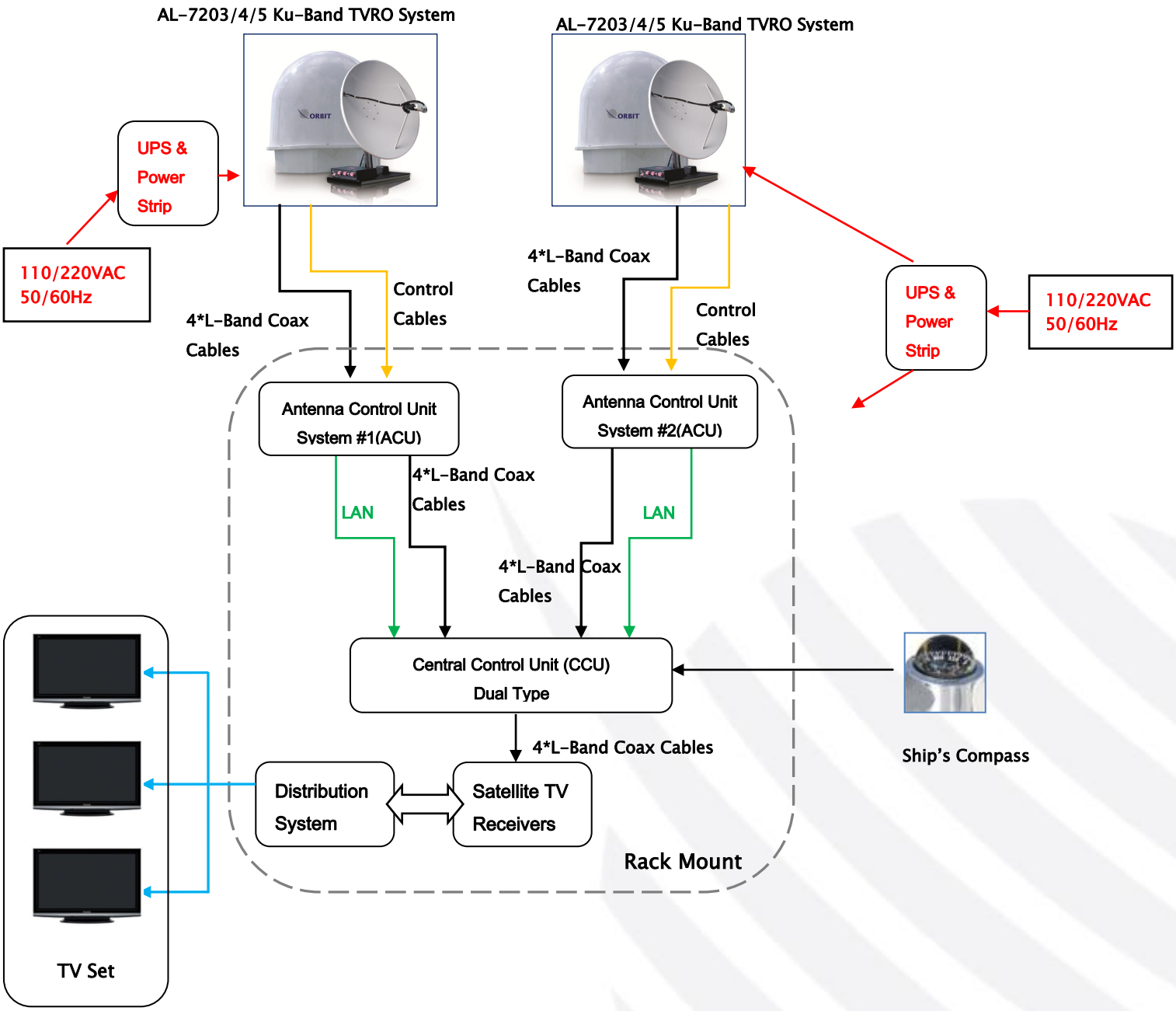


Figure 1 - AL-7203/4/5 Dual TVRO System – Block Diagram

- The power to the system must be supplied through a UPS unit.
- The following equipment is not supplied nor supported by Orbit: TV receivers, distribution systems, TV sets

1.1.2 Dual System Hand-Over Concept

This section describes the concept of hand-over between the two antenna systems that are installed on a ship.

Local Antenna Angles

For each antenna system, Local Antenna Angles are defined:

- Local Antenna Azimuth
- Local Antenna Elevation

These angles are needed for mapping the obstruction zones on the ship.

The following figures present the physical definition of the Local Azimuth and Elevation angles.

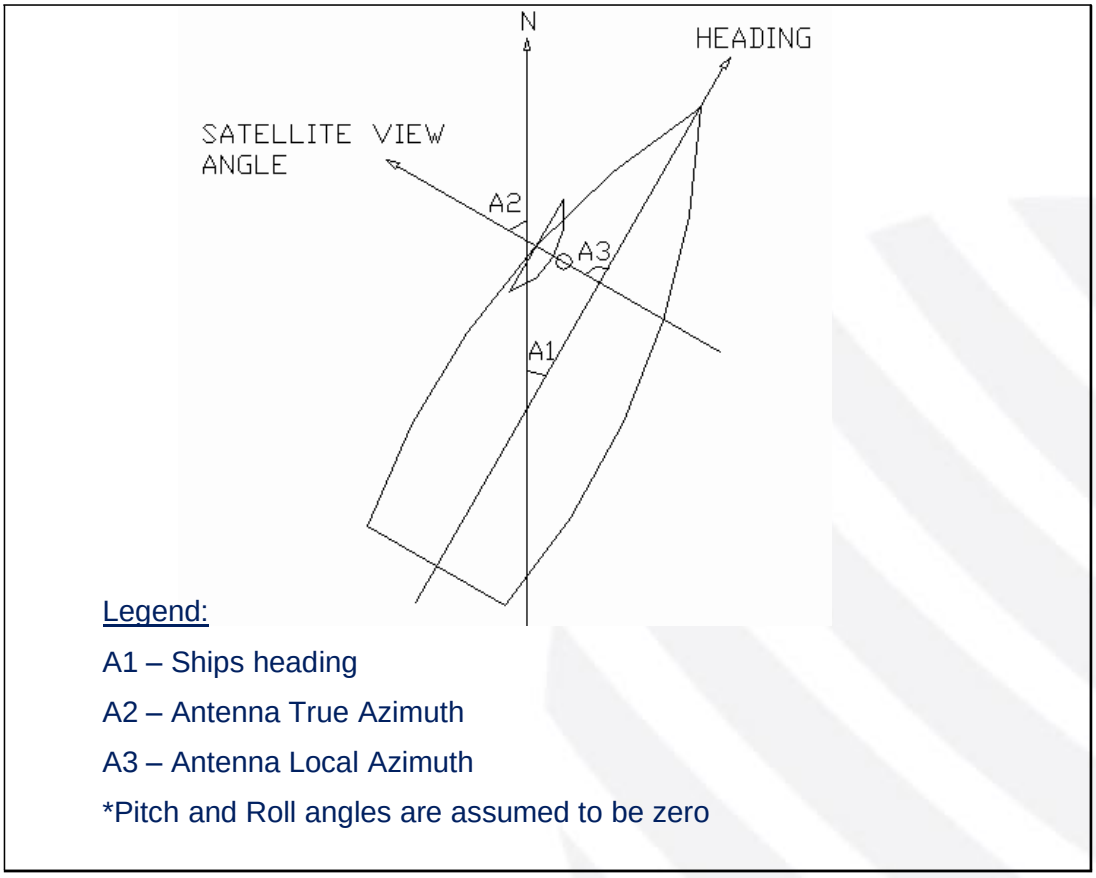
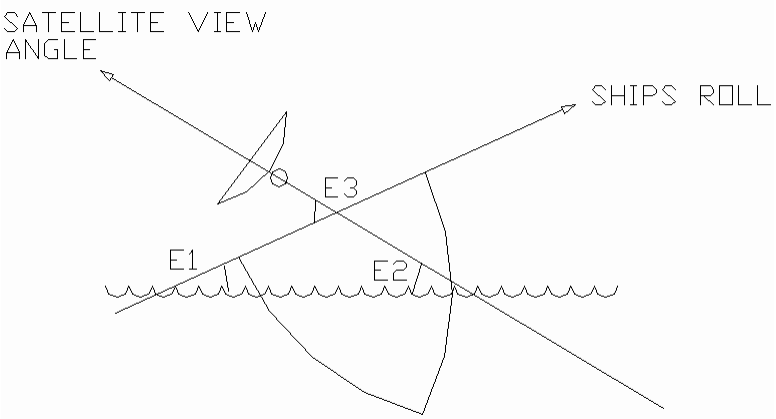


Figure 2 - Antenna's Local Azimuth Angles



Legend:

E1 – Ships Roll

E2 – Antenna True Elevation

E3 – Antenna Local Elevation

*Pitch and Heading angles are assumed to be zero

Figure 3 - Antenna's Local Elevation Angles

As shown in the above Figures, it is visible that the Antenna Local Azimuth is the Antenna Azimuth with respect to the ships' Bow-to-Stern line, rather than the North direction, whereas the Antenna Local Elevation is the Antenna Elevation with respect to the ships' deck rather than the horizon level.

The local angles depicted on the figures above are only for illustration. The actual mathematical definition of those angles is a bit more complex and takes into consideration ships Pitch, Roll and Heading at all times.

1.1.3 Mapping the Obstruction Zones

The local angles are used to define and map the antenna obstructions on the ship's deck, by surveying each antenna location and noting the corner angles of each obstruction in Local Azimuth and Elevation terms.

The two-dimensional obstruction definition of each of the two antenna locations is then being entered into the CCU, which in turn will control its internal RF switch, switching the signal coming from the preferable unit.

1.1.4 Hand-Over/Switching Logic

The CCU continuously monitors the Local Azimuth and Elevation of both antennas, and switches the RF signals from the two antennas using the following switching logic:

- If Antenna 1 is clear, and Antenna 2 is blocked, Antenna 1 signal is selected
- If Antenna 2 is clear, and Antenna 1 is blocked, Antenna 2 signal is selected
- If both antennas are clear, no switching is activated
- If both antennas are blocked, no switching is activated

The above hand-over logic offers two advantages:

1. Natural hysteresis by overlapping zones.
2. Future support for systems with more than two antennas.

1.2 Theory of Operation - Block Diagram Description

The dual system comprises of two AL-7203/4/5 Systems and a Single ‘Dual-type’ Central Control Unit (CCU).

The systems’ ‘Above-Deck-Equipment’ (ADE) is installed on the ship’s deck, while the ACU of each system and the ‘Dual-Type’ CCU are Below-Deck-Equipment (BDE), placed either in an environmentally controlled indoor compartment, or in a control room.

From each ADE run:

- 4 L-Band Coax cables towards a DiSEqC switch
- 1 or 2 control cables towards the ACU (AL-7203 we have 2 control cables, AL-7204/5 we have 1 control cable)

Between each DiSEqC switch and its related ACU there is 1 control cable.

From each DiSEqC switch run down 4 L-Band Coax cables towards CCU’s Internal RF switch. Each ACU is connected to CCU via coaxial cables, implementing CCU to ACU LAN connection for monitoring and control (M&C) and standard Ethernet LAN link featuring the TCP/IP protocol, which provides the following benefits:

- High data rates with hardly noticeable on-screen delay
- Error checking and correction
- Standard, available hardware

The CCU constantly monitors both antenna systems. It calculates their Local Azimuth and Elevation angles while comparing those against a preset obstruction zones mask, to produce an appropriate control command to the external L-Band RF Switch, which in turn will interconnect the ship’s Modem to the non-obstructed system.

2 CCU INSTALLATION AND CONNECTIONS

2.1 CCU INSTALLATION

The CCU is a 5U height unit, typically installed on a dedicated 19-inch rack, located in the ship's equipment room.

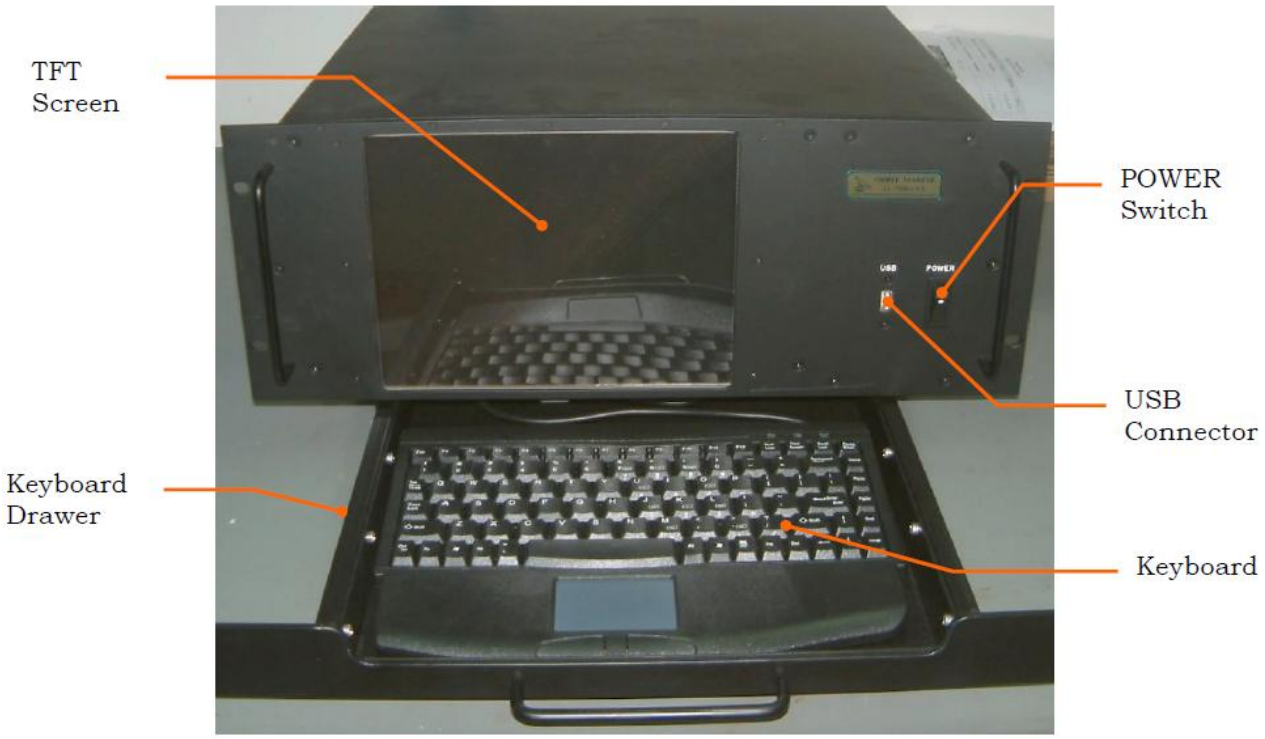


Figure 4 - Dual CCU Front Panel

CCU must be installed at a distance of at least 5 meters from the vessel's compass.

The following figure depicts the CCU (with the keyboard drawer) external views:

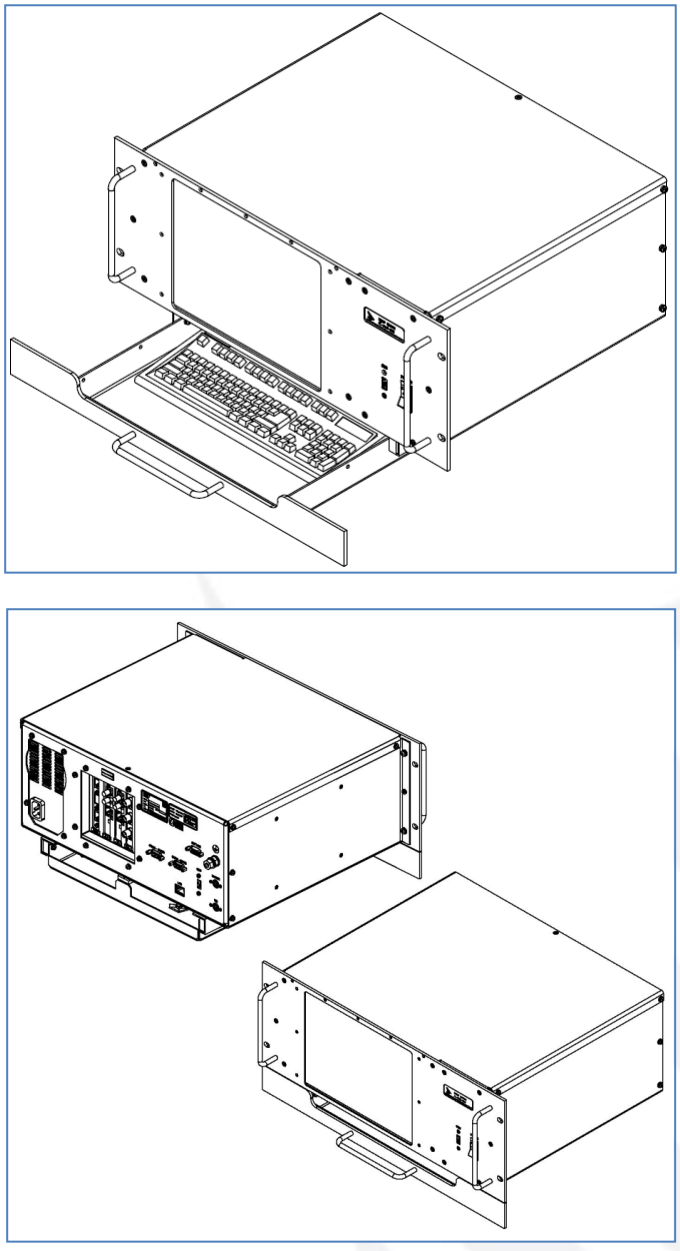


Figure 5 - CCU General View

2.2 CONNECTING CCU CABLES

2.2.1 CCU Rear-Panel Connectors Overview

The following Figure shows the CCU rear-panel connectors, and the subsequent table specifies the type and function of each connector.

Figure 6 - CCU Rear Panel Connectors (with LAN)

2.2.2 Table 1 - CCU Rear Panel Connectors

Connector	Connector Type	Function
Power Supply Inlet	Integrated plug	Mains power connection (power cord from ship's power source).
COM1	DB9 male	Serial communication connector (RS-422)
COM2	DB9 male	Serial communication connector (RS-232)
CPU Board Connectors		
LAN	RJ-45	Connects to the HUB connector via a jumper cable.
VGA	DB 15-Pin HD	Connects to an external VGA monitor.
KB / MOUSE	MINI-DIN	Connects the CCU to the keyboard located at the CCU drawer.

SW-1 Board Connectors		
N.C.	F-type	Normally Close
OUT	F-type	Out
N.O.	F-type	Normally Open
SW-2 Board Connectors		
N.C.	F-type	Normally Close
OUT	F-type	Out
N.O.	F-type	Normally Open
SW-3 Board Connectors		
N.C.	F-type	Normally Close
OUT	F-type	Out
N.O.	F-type	Normally Open
SW-4 Board Connectors		
N.C.	F-type	Normally Close
OUT	F-type	Out
N.O.	F-type	Normally Open

2.2.3 General-Purpose Connections (Power, LAN, USB, KB, Mouse)

The following Figure depicts the general-purpose cables that should be connected to the CCU:

- Power cable
- LAN Jumper cables between the Hub and CCU LAN connector
- USB Connector
- Keyboard and Mouse

Figure 7 - CCU Rear Panel – General Purpose Connections

2.2.4 ADE-BDE LAN Cables Connection

Each of the two ADE SBCs is connected to a CCU Hub port by a LAN cable.

Figure 8 - CCU Rear Panel – Hub LAN Connectors

Important Note:

The Dual CCU, integrated in AL-7203/4/5 Dual TVRO system, can support the full 4 channels using 4 switches for dual function.

2.2.5 IF Switch Connection

The external IF Switch is connected to the CCU via the SW-1/SW-2/SW-3/SW-4 OUT connector.

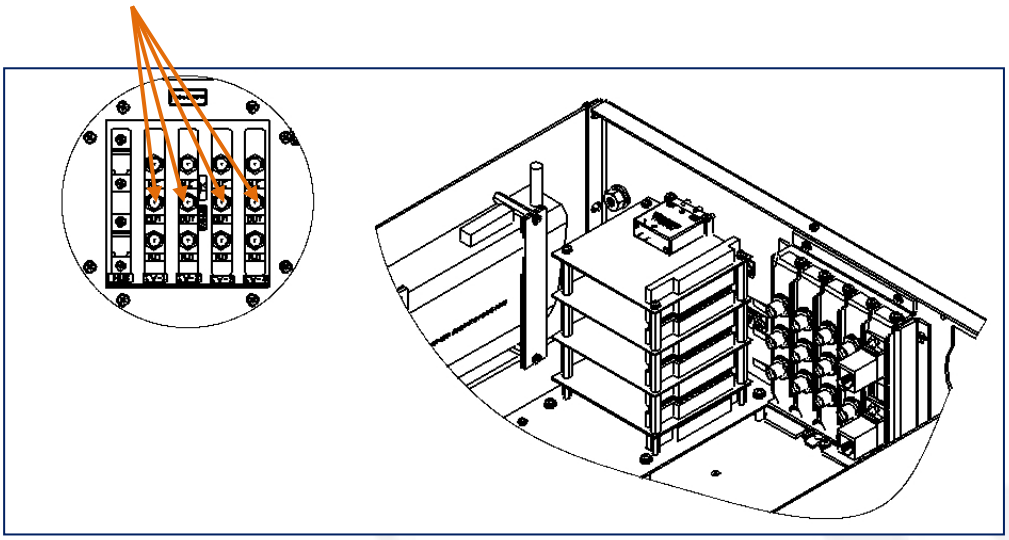


Figure 9 - CCU Rear Panel – Switch Connectors

2.3 CONNECTING THE HIGH-SPEED IF SATCOM SWITCH

The High-speed IF-Switch (19”, 2U, rack mountable) is controlled by the CCU, and provides seamless handover for the dual antenna system.

Figure 10 - IF Switch Connectors (Front and Rear Panels)

To connect the IF-Switch to the system, perform the connections listed in the following table.

Table 1 IF Switch Connectors

Function	Connector Number	Connection
POWER		Mains power inlet.
CONTROL	J7	Control cable from SW-2 OUT connector.
SWITCH 1		
N.C.	J2	RF signal received at System 1.
COM	J1	Modem's Rx Input
N.O.	J3	RF signal received at System 2.
SWITCH 2		
N.C.	J5	Transmitted RF signal to System 1.
COM	J4	Modem's Tx output
N.O.	J6	Transmitted RF signal to System 2.

3 DUAL SYSTEM OPERATION

3.1 INTRODUCTION

This section describes the operation procedures of the dual system, carried out by the system's operator using the CCU.

3.2 CCU OPERATION PRINCIPLES

Operation of the dual system is controlled from the below-deck CCU, which is used to control the system, to monitor system status, and to setup and configure operational parameters.

The CCU is a PC computer running *Windows CE* operating system and several dedicated software applications. These applications control, monitor and configure the dual-antenna system.

The CCU constantly monitors both antenna systems. It calculates their Local Azimuth and Elevation angles while comparing those against a preset obstruction zones mask, to produce an appropriate control command to the CCU's RF switches, which in turn will connect the signals from the non-obstructed antenna to the ship's Modem.

3.3 GETTING STARTED - CCU APPLICATION WINDOWS

To turn on the CCU, set its POWER switch to the ON position.

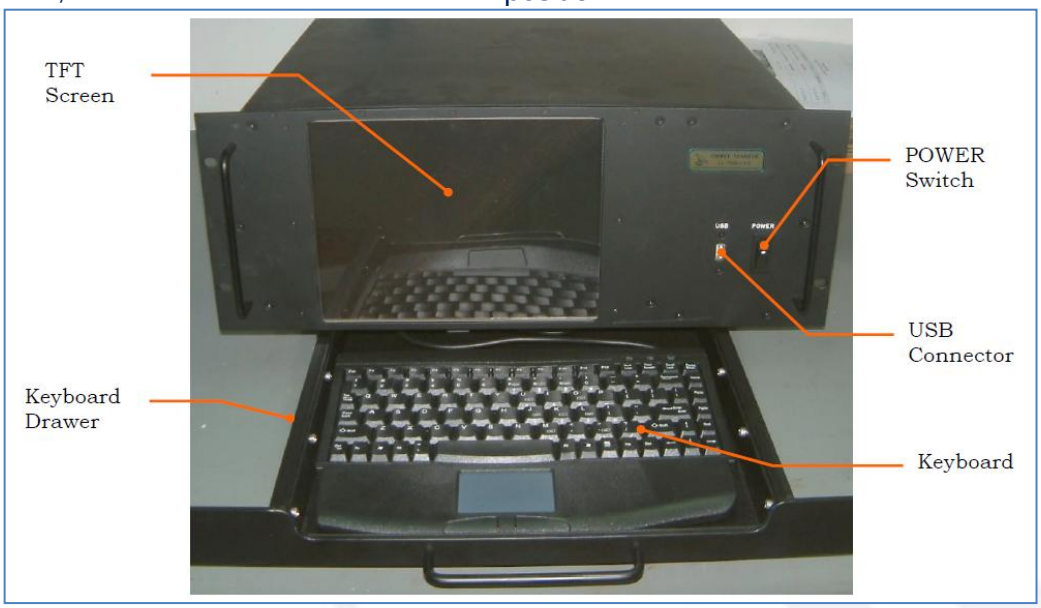


Figure 11 - CCU Front Panel

The CCU invokes the *Windows CE* operating system and automatically opens the following 'Dual Antenna Operation' screen:

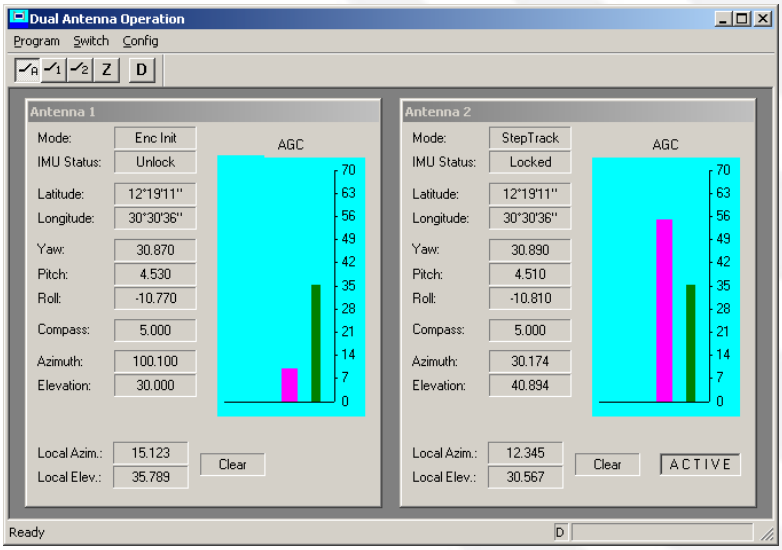
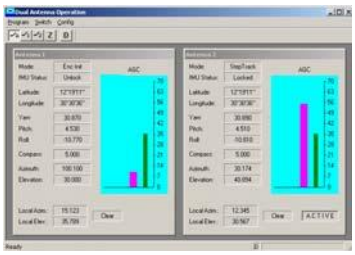


Figure 12 - Dual System Operation Screen

This screen allows access (using windows tabs) to the following windows (Applications):



Dual Antenna Operation:

This window, which is the main application of the CCU, monitors the status of both systems, allows manual or automatic switching of RF signals from the systems' antennas, and enables configuration of obstruction zones.

Marine Tracking System (Antenna 1) – Basic Operation Screen:

This window provides remote monitoring and operation of system #1.

Marine Tracking System (Antenna 2) – Basic Operation Screen:

Same as the above - for system #2

The following paragraphs describe the above windows and detail the operation procedures available from each window.

3.4 DUAL SYSTEM OPERATION SCREEN

3.4.1 Introduction

The Dual Antenna Operation screen is divided into several display and control zones, as shown in the following Figure:

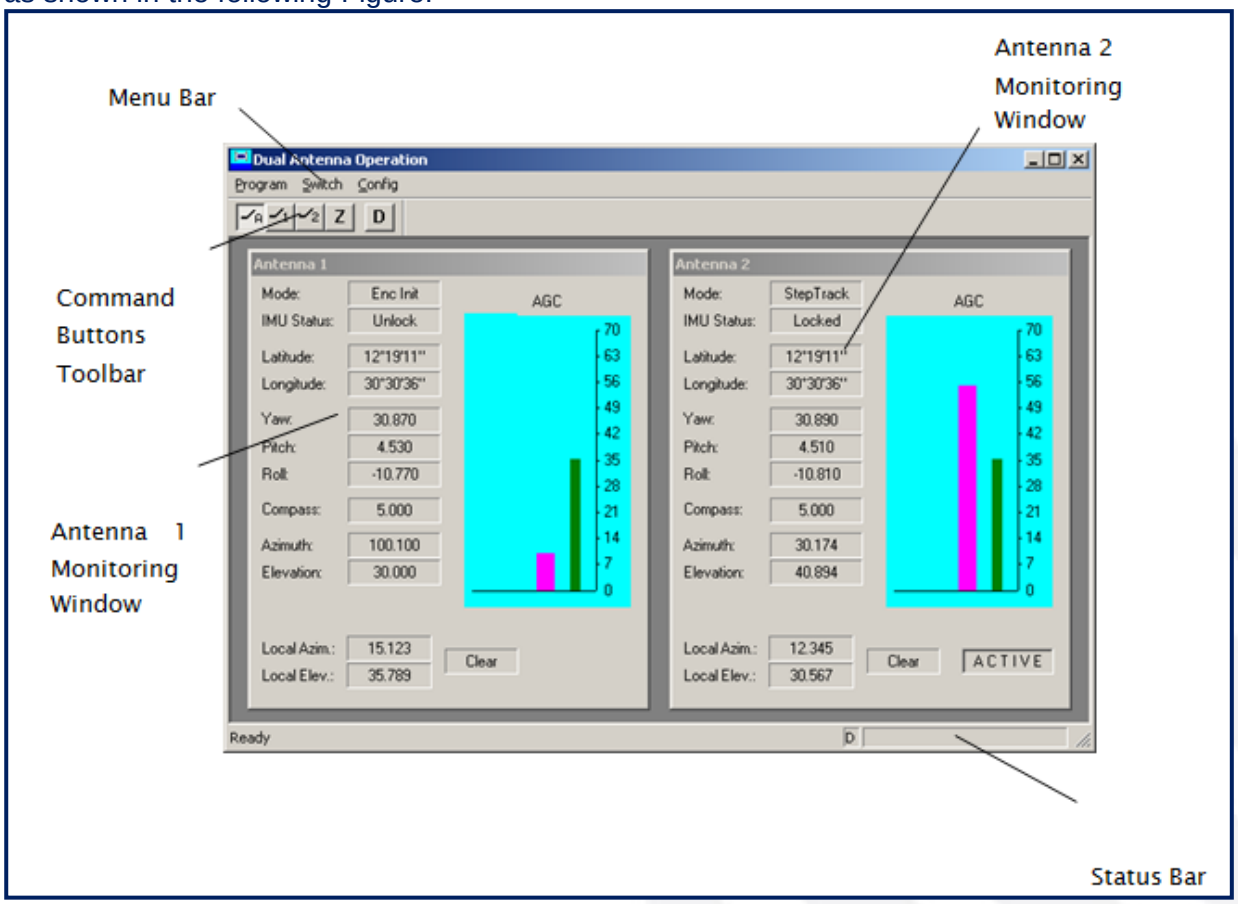


Figure 13 - Dual System Operation Screen

3.4.2 Antenna 1 / 2 Monitoring Window

The Antenna Monitoring window provides remote monitoring of a system, displaying operation modes, parameters and status indications of the system.

A display configuration function is used to determine the fields to be presented on the screen.

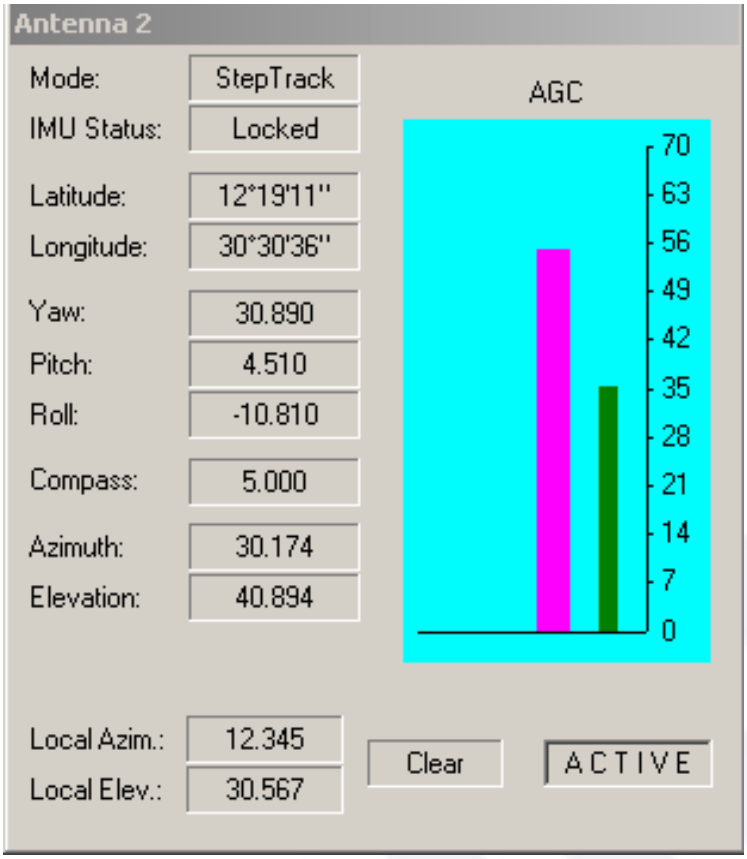


Figure 14 - Antenna Monitoring Window

The window includes the following display fields:

Mode and IMU Status:

- **Mode**- Current system operation mode
- **IMU status**- Current system's IMU status (locked, unlocked)

Ship Position Data:

- **Longitude** - Ship's longitude (from the system's GPS receiver)
- **Latitude** - Ship's latitude (from the system's GPS receiver)
- **Yaw -** Ship's yaw angle (from the system's IMU)
- **Pitch -** Ship's pitch angle (from the system's IMU)
- **Roll -** Ship's roll angle (from the system's IMU)
- **Compass** - Ship's heading (as read from the ship's compass or as entered manually)

Antenna Position Data:

- **Azimuth** - Azimuth axis angle
- **Elev.** - Elevation axis angle

AGC Field:

This field graphically presents the AGC signal level, which represents the strength of the satellite's signal received by the antenna, side-by-side with the Acquire threshold level.

Local Angles Data:

- **Local Azim.** – Local Azimuth angle
- **Local Elev.** - Local Elevation angle
- **Local Azim. Clear/Blocked** - Local Azimuth clear/blocked indicator
- **Local Elev. Clear/Blocked** - Local Elevation clear/blocked indicator

Switching Indicator:

- **ACTIVE** – When the Antenna system's RF signals (Tx and Rx) are switched to the ship's Modem, this indicator appears on the window.

3.4.3 Menu Bar

The Menu Bar provides access to the following functions:

The underlined letters denote the fast activation keys (shortcuts) for the same functions.

- **Program** – Displays the following drop-menu:
  - **Show Version** – Displays the Version window, containing software Versions data
  - **Esc-Exit** – Terminates the application
- **Switch** - Displays a drop-menu which allows to manually switch the RF signals from either Antenna 1 or Antenna 2, or to select Automatic switching.
- **Config** – Displays the following drop-menu:
  - **Zones** – Opens the Blocked Zones window
  - **Display** – Opens the Display Configuration window
  - **Link** – Opens the Link Setup window

3.4.4 Command Buttons Toolbar

Selects automatic switching of RF signals from the antenna systems to the ship's Modem. In this mode, the RF switch is controlled by the CCU according to the obstruction zones

Manually switches the RF signals from Antenna 1 to the ship's Modem

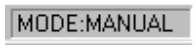
Manually switches the RF signals from Antenna 2 to the ship's Modem

Opens the Blocked Zones window

Opens the Display Configuration window

3.4.5 Status Bar

The Status Bar displays the current CCU mode:



MANUAL - RF switch is manually forced to one of the antennas

AUTO - RF switch is controlled by the CCU

3.5 Display Configuration Screen

3.5.1 Introduction

As stated above, the Antenna Monitoring windows display status and operational parameters read from the systems' controllers.

The Display Configuration screen allows selecting or de-selecting the indicators to be displayed on the Antenna Monitoring windows.

3.5.2 Using the Display Configuration Screen

To invoke the Display Configuration screen, select either the menu bar's **Config>Display** option or the 

command button. The following window is displayed:

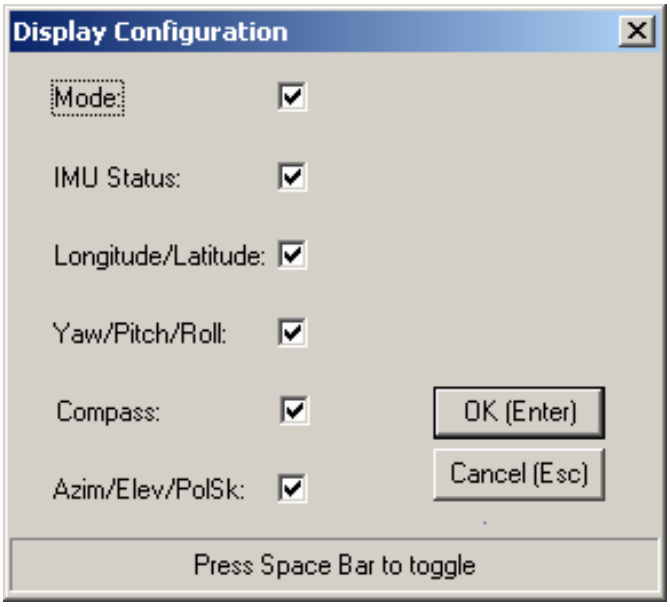


Figure 15 - Display Configuration Screen

Select (by checking - √) or de-select the pertaining boxes to configure the Antenna Monitoring windows display.

For example, the following Figure shows the Dual Antenna Operation screen with all display fields de-selected (minimal display):

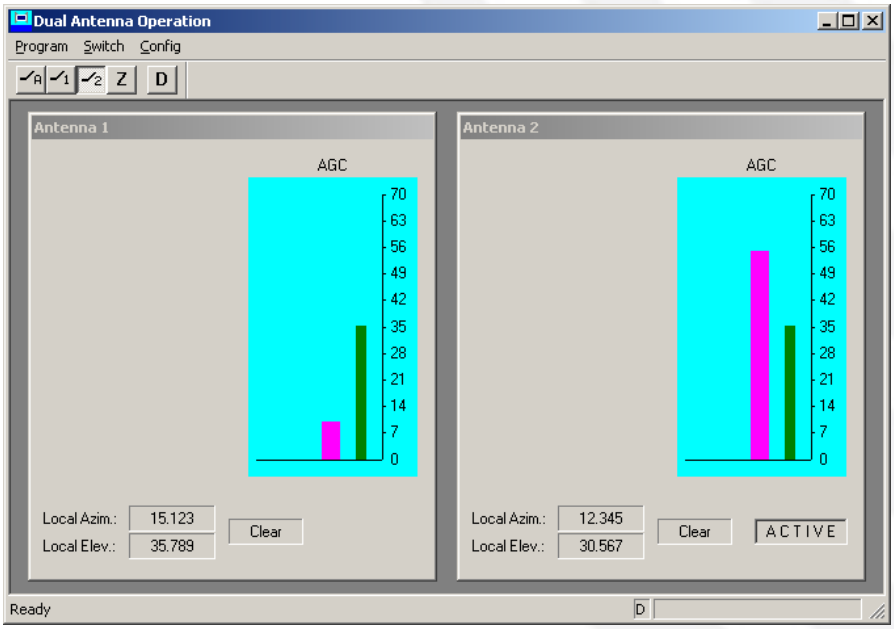


Figure 16 - Dual System Operation Screen – Minimal Display

3.6 Obstruction (Blocked) Zones Screen

3.6.1 Introduction

For each one of the systems, an Obstruction Zone screen allows defining of up to four obstruction zones, at which the antenna line-of-site (LOS) is blocked.

To define an obstruction zone, four angular points (at Local angles values) are entered into the CCU:

- Azimuth Start (from)
- Azimuth End (to)
- Elevation Start (from)
- Elevation End (to)

It is not mandatory to enter values for all the zones – leaving blanks in the “from” and “to” fields will effectively disable the relevant zone. However, if a zone is to be defined only in Azimuth, the Elevation angles should be set from 0 to +90 degrees.

3.6.2 Using the Obstruction Zone Screen

There are two ways to invoke an Obstruction Zone Screen: Select the menu bar’s

Config>Zones option;

-or-

Select the Z command button

The following window is displayed:

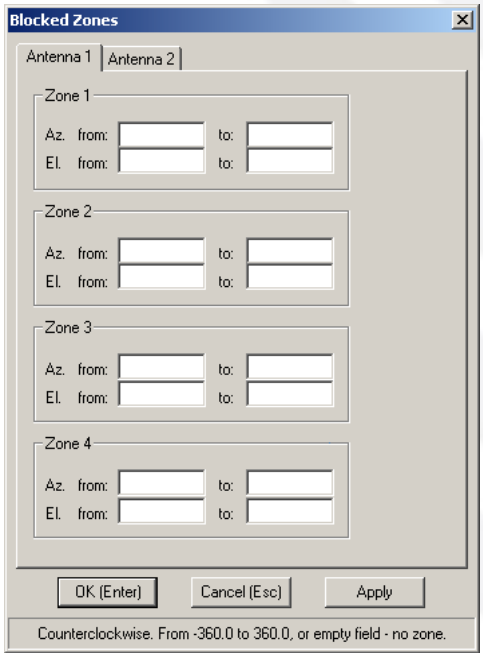


Figure 17 - Blocked Zones Screen

Select the **Antenna 1** or **Antenna 2** tab on the screen.

Define the obstruction zones by entering the pertaining angular points. Refer to the following example.

Obstruction Zone Setting - Example

An example for a simple obstruction zone setting is presented herein:

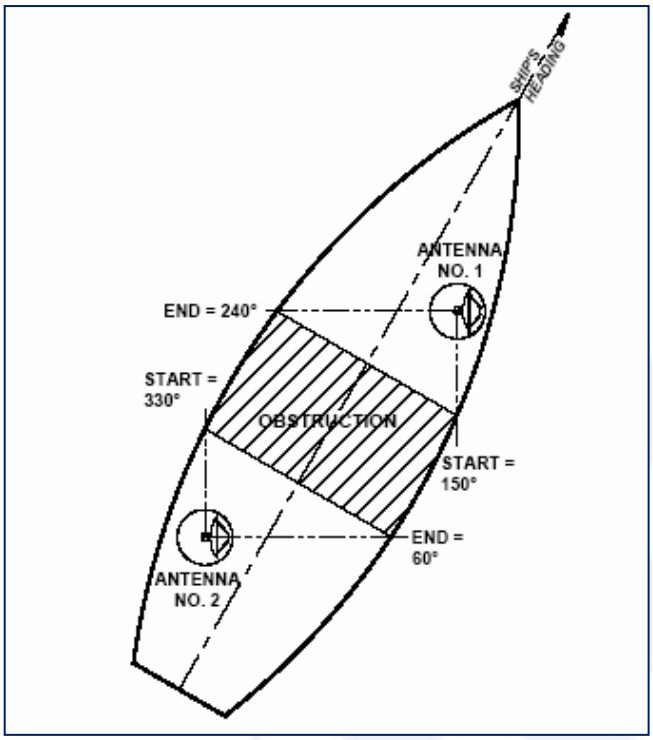


Figure 18 - Dual System - Layout Example

In the case above, Antenna 1 is blocked in the range of 90 degrees, starting from 150.0 to 240.0 degrees. Antenna 2 is also blocked in the range of 90 degrees, starting from 330.0 to 60.0 degrees (all angles are in Local Azimuth terms).

Note that the obstruction zone is defined by a “start” angle, which is always clockwise before an “end” angle.

According to the above example, the obstruction zone setting for both antennas will be as follows:

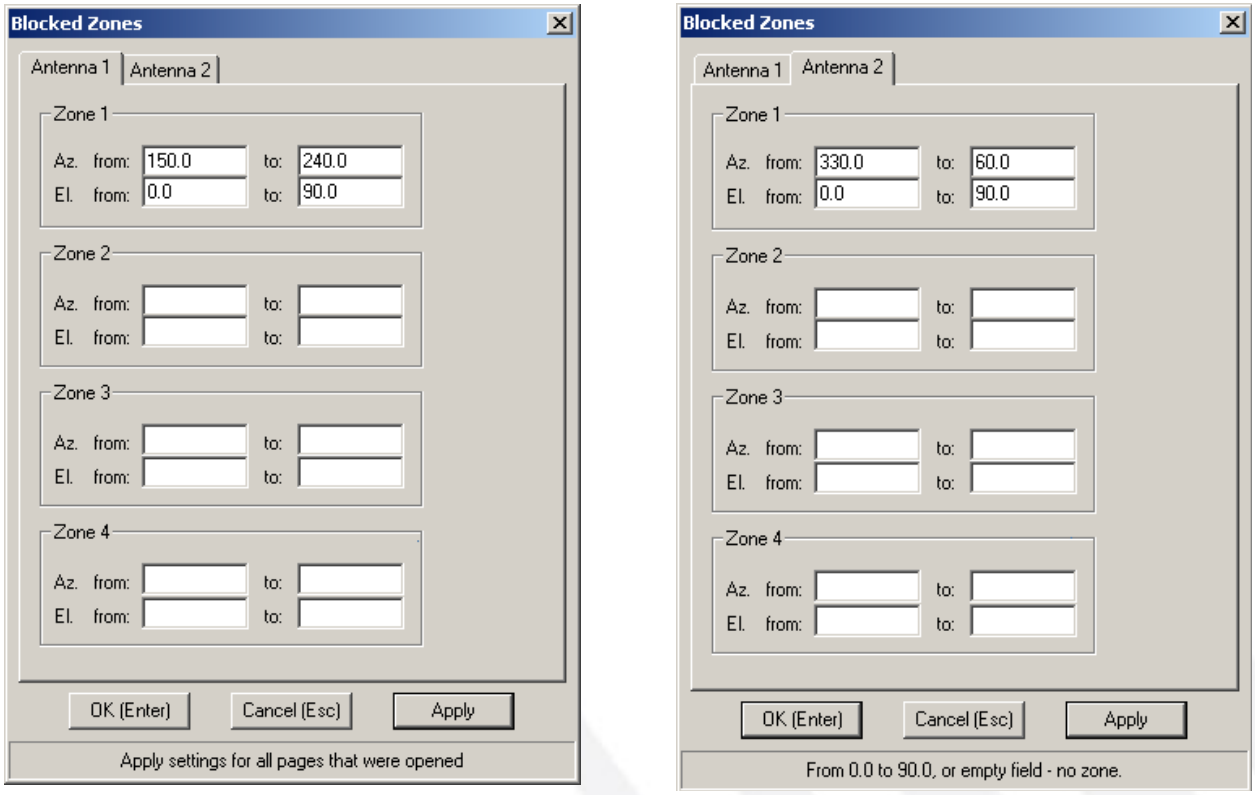


Figure 19 - Obstruction Zones Setting - Example

3.6.3 REMOTE BASIC OPERATION SCREENS

The CCU presents two Basic Operation Screens, for remote monitoring and operation of the systems.

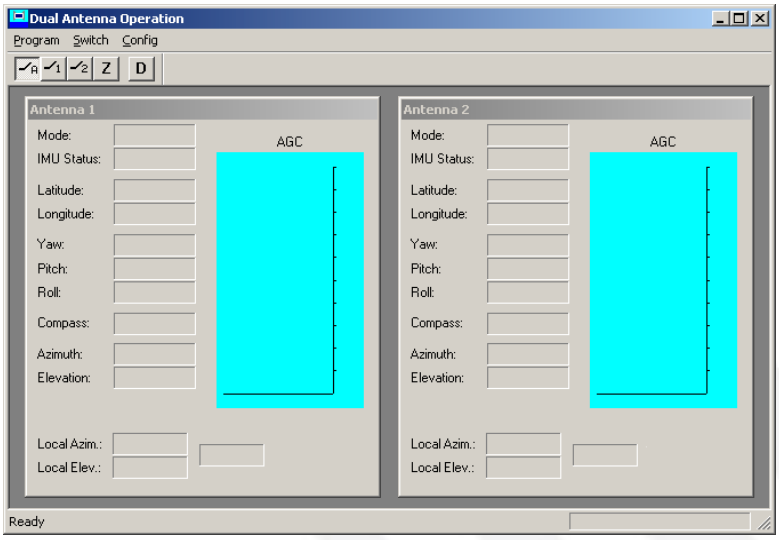
Each Basic Operation Screens provides all controls and indications needed for normal basic operation of the system. This screen enables the operator to activate the basic modes of operation (satellite and channel selection), while monitoring system's parameters and indicators.

For more advanced control and configuration features, a series of password- accessible screens are available.

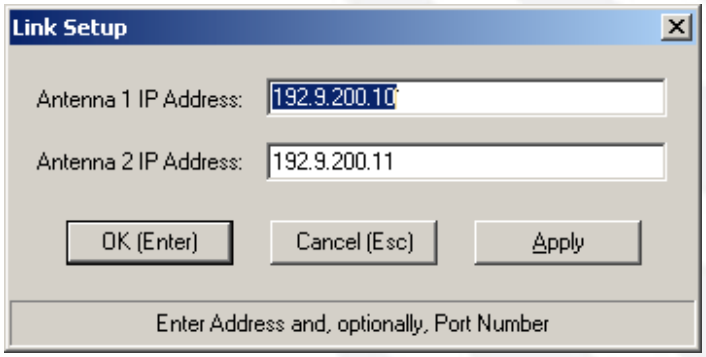
4 REMOTE DAOLINK APPLICATION

The Remote Dual System Operation (DaoLink) application enables to monitor the systems from a remote computer/laptop, which is connected to the CCU via LAN connection.

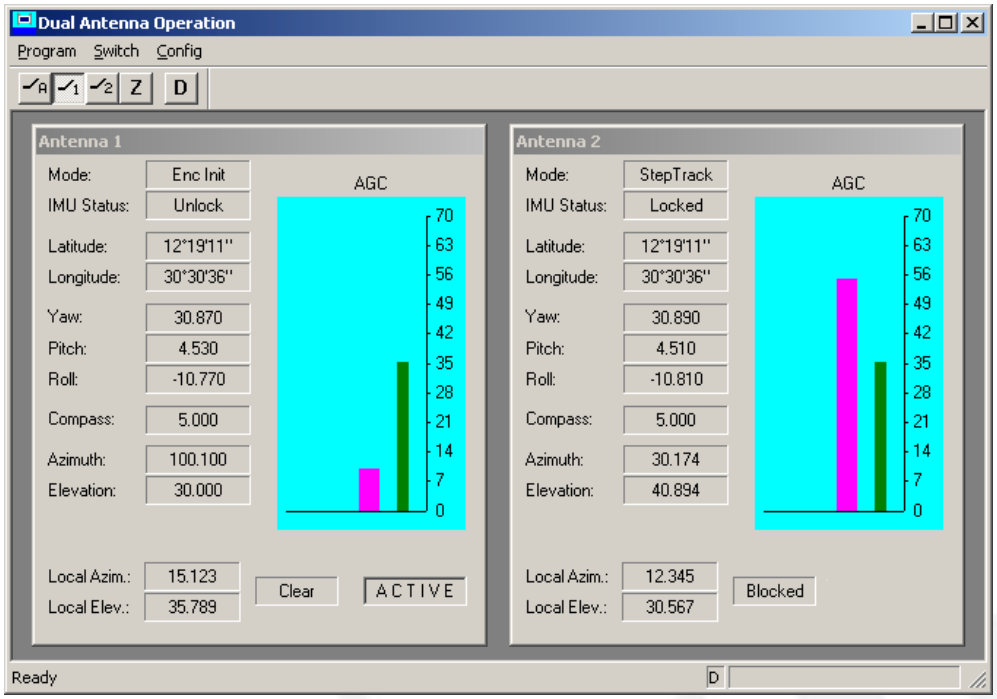
Invoke the application by clicking the **DaoLink** shortcut icon, located under **Start > Programs> Startup**.
The DaoLink application screen is displayed:



Select the **Config > Link** menu option.
The Link Configuration window is displayed:



Verify that the proper IP addresses of both systems are entered into the **IP Address** fields.
Then, the following screen is displayed, presenting the systems' status and data.



The Remote DaoLink application is identical to the local DaoLink application, excluding the use of the switch functions - the remote application is used for monitoring only and does not control the CCU switch.