MARINE STABILIZED TV-DTS ANTENNA SYSTEM

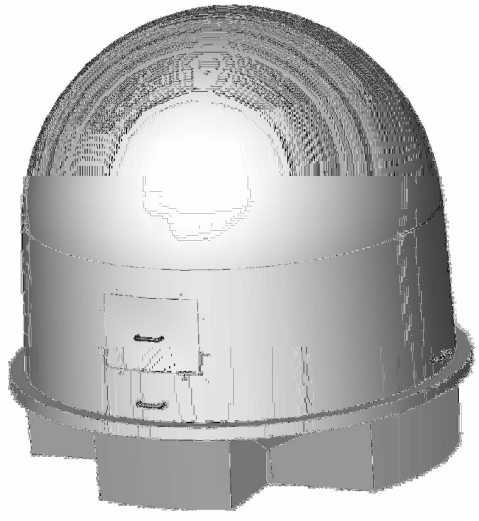
AL-7204-F System

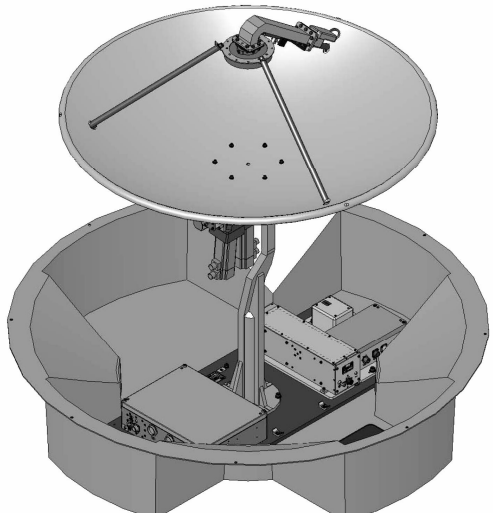
1.3-Meter Antenna System

TECHNICAL MANUAL

FOR

ORGANIZATIONAL OPERATION AND MAINTENANCE





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Revision History & Control

Revision History

Revision #	Date	Description
Rev: -	March 2007	Initial version

List of Effective Pages

TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 145 CONSISTING OF THE FOLLOWING:

TABLE OF CONTENTS

LIST OF FIGURES

SAFETY PRECAUTIONS

The following general safety information is for installing, operating, and servicing. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary. Observe the following list of safety precautions when installing, operating and maintaining the TV-DTS System:

WARNING

The antenna pedestal is equipped with high torque DC motors that develop extreme forces. These forces can be life threatening.

The radome is equipped with a safety power interlock mechanism, which removes AC power supply from the antenna assembly (ADE) when the radome hatch is opened or when the radome is removed.

The ON/OFF switch on the Servo Drive Unit (next to the green indicator light), will also remove power from the antenna drive motors and should be used appropriately.

WARNING

This equipment contains potentially harmful voltages when connected to the designated power sources. Never remove equipment covers except for maintenance or internal adjustments.

WARNING

Before removing the covers of any unit, verify that the main POWER switch is in the OFF position, and disconnect the power cable from the unit. Note: The CCU receives voltage from two sources: from the ship's power network and from the compass gyro.

CAUTION

Metal parts accessible to the operator are grounded to the chassis ground to prevent shock or fire hazard from lightning and similar hazards. The chassis ground conductor must not be removed or defeated. If necessary, make an appropriate power system ground to ensure the enclosure is at ground potential.

CAUTION

Only qualified and trained personnel should perform installation, operation and maintenance of this equipment.

CAUTION

Although the kevlar radome is light, two to three people are needed to lift it since the radome is bulky and will act as a sail in wind.

CAUTION

To prevent shock or fire hazard, do not expose the equipment (with the exception of the radome) to rain or moisture.

CAUTION

Avoid making unauthorized modifications to the circuitry.

CAUTION

Do not disconnect cables from the equipment while the system is powered-on.

NOTES

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

ACRONYMS AND ABBREVIATIONS

ADE .....Above Deck Equipment
AFRTS .....Armed Forces Radio and Television
BDE.....Below Deck Equipment
BIT .....Built In Test
CCU .....Central Control Unit
CONT.....Controller
DTS .....Direct-To-Sailors
GND.....Ground
HDD.....Hard Disk Drive
IMU.....Inertial Measurement Unit
IRD.....Integrated Receiver-Decoder
LAT.....Latitude
LHCP .....Left Hand Circular Polarization
LONG.....Lonitude
LNB.....Low Noise Block converter
LNBF .....LNB & Feed
MMI .....Man-Machine Interface
OVRD .....Override
RHCP .....Right Hand Circular Polarization
SAS .....Spectrum Analyzer Screen
SDU.....Servo Driver Unit
SRR.....Satellite Recognition Receiver
TVRO.....TV Receive Only

ABOUT THIS MANUAL

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

Chapter 1. System Description

Provides a general description of the system, including the following main subjects:

- Introduction
- System Structure and Units
- Theory of Operation
- System Specifications

Chapter 2. Basic System Operation

Provides detailed basic-operation information and instructions.

Chapter 3. Advanced Operation

Provides brief description of the advanced-operation modes, usually not used by the system's operator.

Chapter 4. Maintenance

Provides maintenance instructions, for both preventive and corrective on-ship maintenance, and a detailed troubleshooting guide.

Chapter 5. Installation Guide

Provides installation guidelines and detailed setup, configuration and installation procedures.

1. SYSTEM DESCRIPTION

1.1. AL-7200 SERIES - INTRODUCTION

1.1.1. General

ORBIT Communications-Marine Division is an experienced, dedicated designer and manufacturer of Marine Stabilized Satellite Systems covering communications and entertainment (satellite TV) systems for commercial, private and military customers.

ORBIT Communications is qualified for ISO-9001 and European CE, and uses state-of-the-art technology in order to maintain optimal performance.

The cost effective AL-7200 series is designed by ORBIT for Satellite TV Receive Only (TVRO) Marine Entertainment Systems, also referred to as TV-DTS (TV Direct-To-Sailors) systems.

It is designed to stabilize a TV antenna on ships, vessels, boats, yachts, buoys, oil rigs, etc. The System is flexible and supports different satellites, frequency bands, polarizations, antenna sizes, etc.

1.1.2. AL-7200 System Features

- Supports different antenna sizes
- No Gimbal lock during zenith pass
- Polarization stabilization support
- Independent of Pitch/Roll inertial system
- Frequency range: Ku-Band or C-Band
- Extensive maintenance and data logging features
- User-Friendly Man-Machine Interface (MMI)
- GPS Receiver
- Easy installation and maintenance
- Combination of inertial stabilization and RF step-track methods, which enable tracking under severe sea conditions
- Continuous azimuth rotation with no need of a slip-ring or a rotary joint
- High performance antennas and feeds

- Satellite World Coverage Data Base

  Available satellites are displayed on the LCD screen for selection according to the actual ship position. Complete satellite and programming channel database, derived from the industry standard International Satellite Directory, by Design Publishers, Sonoma CA.

- Capability to place some of the more advanced operational functions at the Basic Operation screen

  This function enables better control over the system to the more experienced users; all that without the need of giving away full access via the maintenance pass-name.

1.2. 1.3-M TV-DTS SYSTEM

1.2.1. Introduction

The TV-DTS terminal is capable of receiving digital signals from commercial C-Band satellites in geo-synchronous orbit which transmit television programming. The terminal is capable of receiving programming from 70°N to 70°S latitudes as beam coverage allows.

The terminal includes all items required to receive Armed Forces Radio and Television (AFRTS) MPEG 2 transmissions. The terminal provides an L-band (950-1450 MHz) signal to a splitter feeding Digital Integrated Receiver-Decoders (IRD).

As an option, requiring a Ku-Band circular feed to be mounted on the antenna instead of the C-Band feed, the TV-DTS terminal can also receive generic Ku-band Digital Broadcast Satellite Services (DBSS) programming in continental United States littoral waters and Ku-Band transmissions in other applicable locations. The terminal provides L-Band signals to appropriate splitters for up to four DBSS receivers.

1.2.2. System Description

The 1.3m TV-DTS system components are divided into two groups:

- Above Deck Equipment (ADE)
- Below Deck Equipment (BDE)

1.2.2.1. Above Deck Equipment (ADE)

The Above Deck Equipment (ADE) is installed (secured to a mounting/base plate) within a weather-tight 60" radome (comprising a base and a removable dome) which is mounted on and secured to the ship's deck. The equipment can be accessed by either opening the side hatch, opening the optional bottom hatch, or by removing the radome.

The ADE includes the following components:

- AL-7204-1B X-Y Pedestal, carrying a 1.3-m (51") reflector (antenna) which is equipped with either a C-Band or a Ku-Band LNB integrated with Feed (LNBF). The feeds can be changed easily by the system's operator.
- AL-7200-SDU-07 Servo Driver Unit (including servo cards, GPS receiver and ADE power supply). The Omni-Directional GPS Antenna is connected to the GPS receiver in the SDU.

The following items are mounted on the Upgrade plate, which is secured to the mounting plate:

- Single Board Controller (SBC) AL-7204-SBC, which serves as the ADE controller.
- Power Supply Unit (PSU) AL-7204-PSU, providing power to the ADE components.
- AL-7203-IMU-NT3 Inertial Measurement Unit including a Pitch/Roll sensor and a short-term Yaw sensor.
- RF Splitter, distributing the received signal between the BDE and the SBC,

The radome is equipped with an interlock mechanism, which disconnects power to the ADE either when the access hatch is opened or when the radome is removed.

The following figures provide ADE general views and outline drawings.

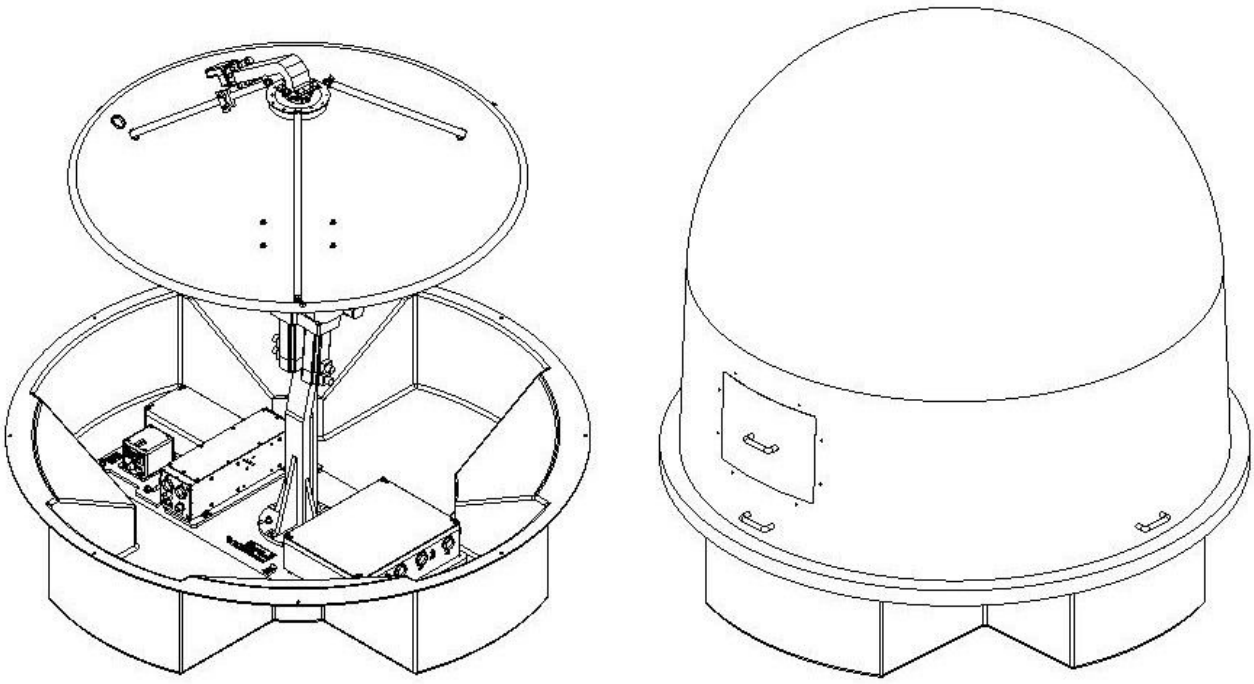


Figure 1. TV-DTS System (1.3-Meter) - ADE General Views

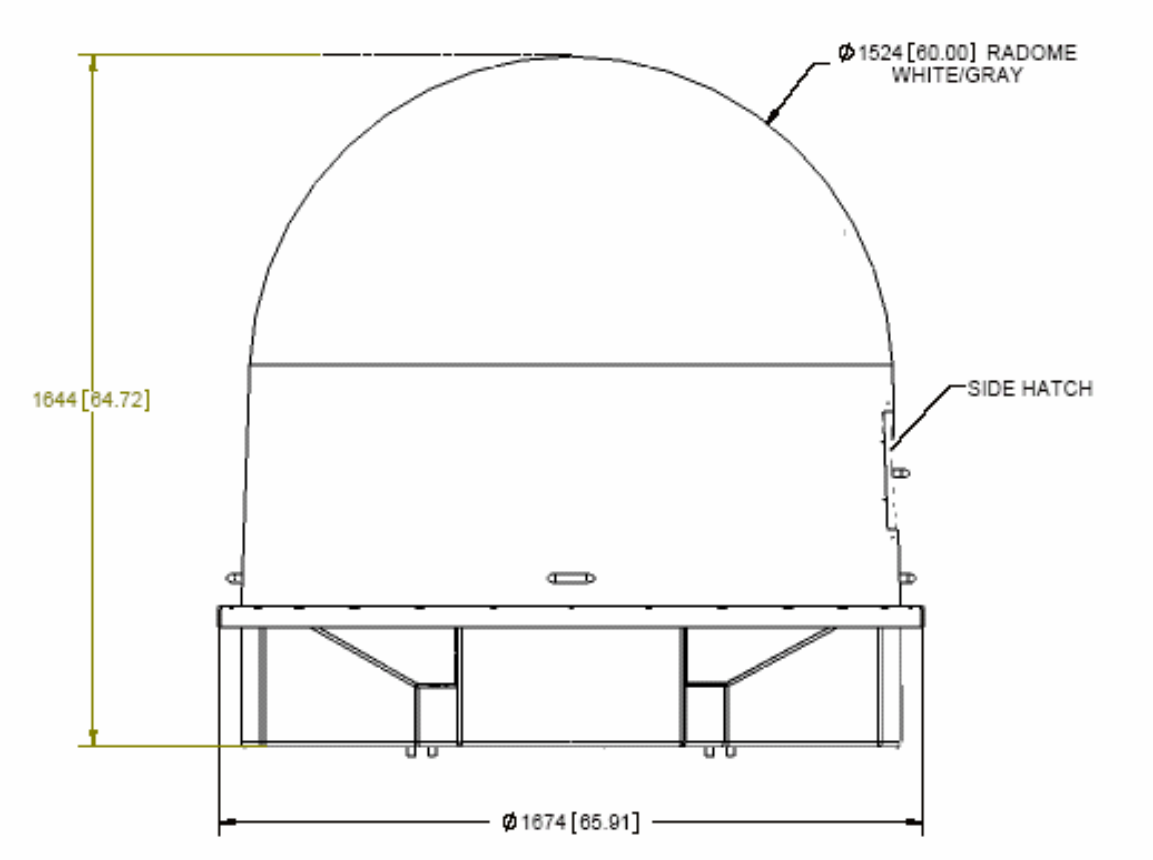


Figure 2. ADE External Dimensions (Radome Installed)

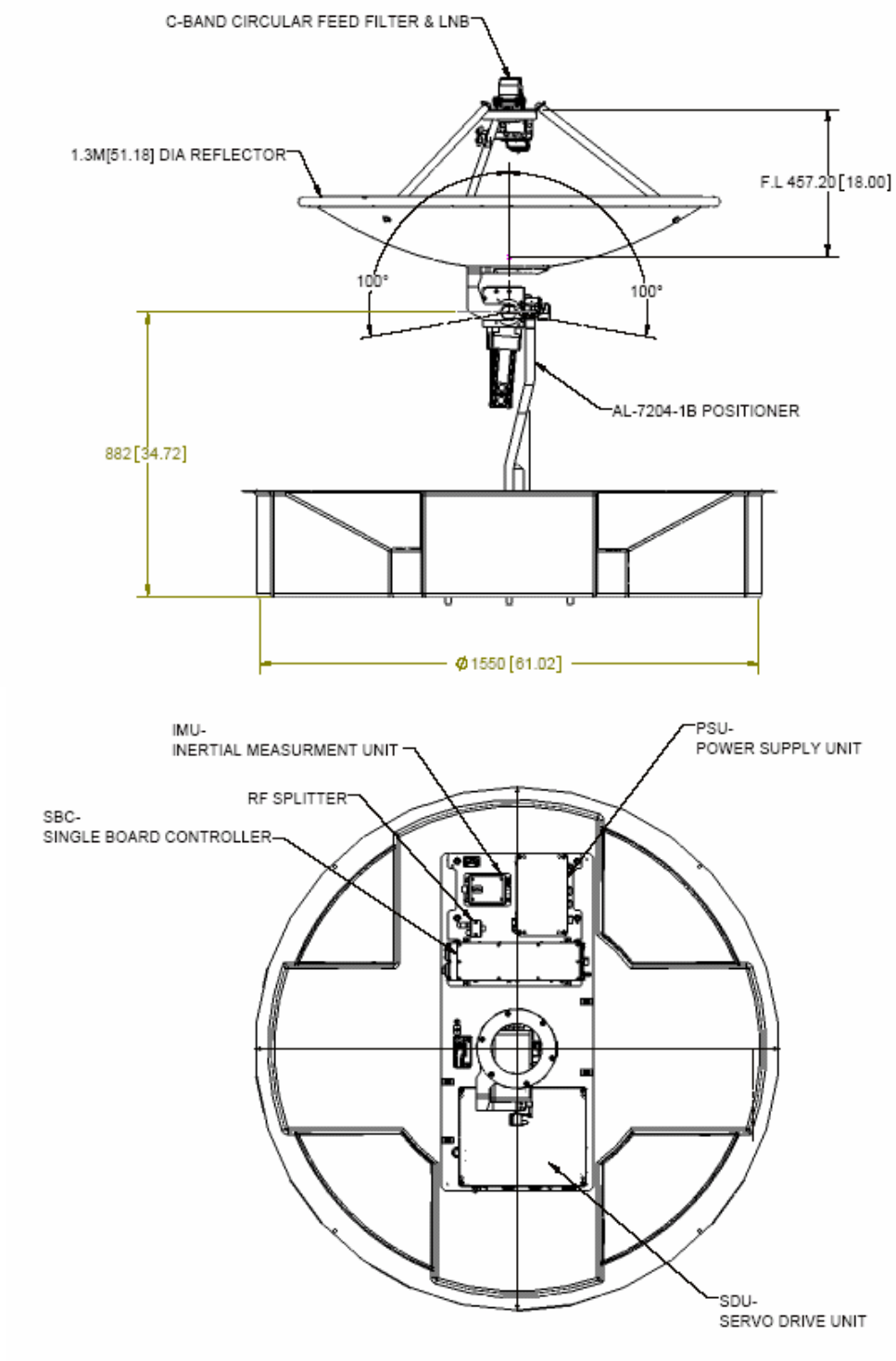


Figure 3. ADE – Internal Dimensions and Layout

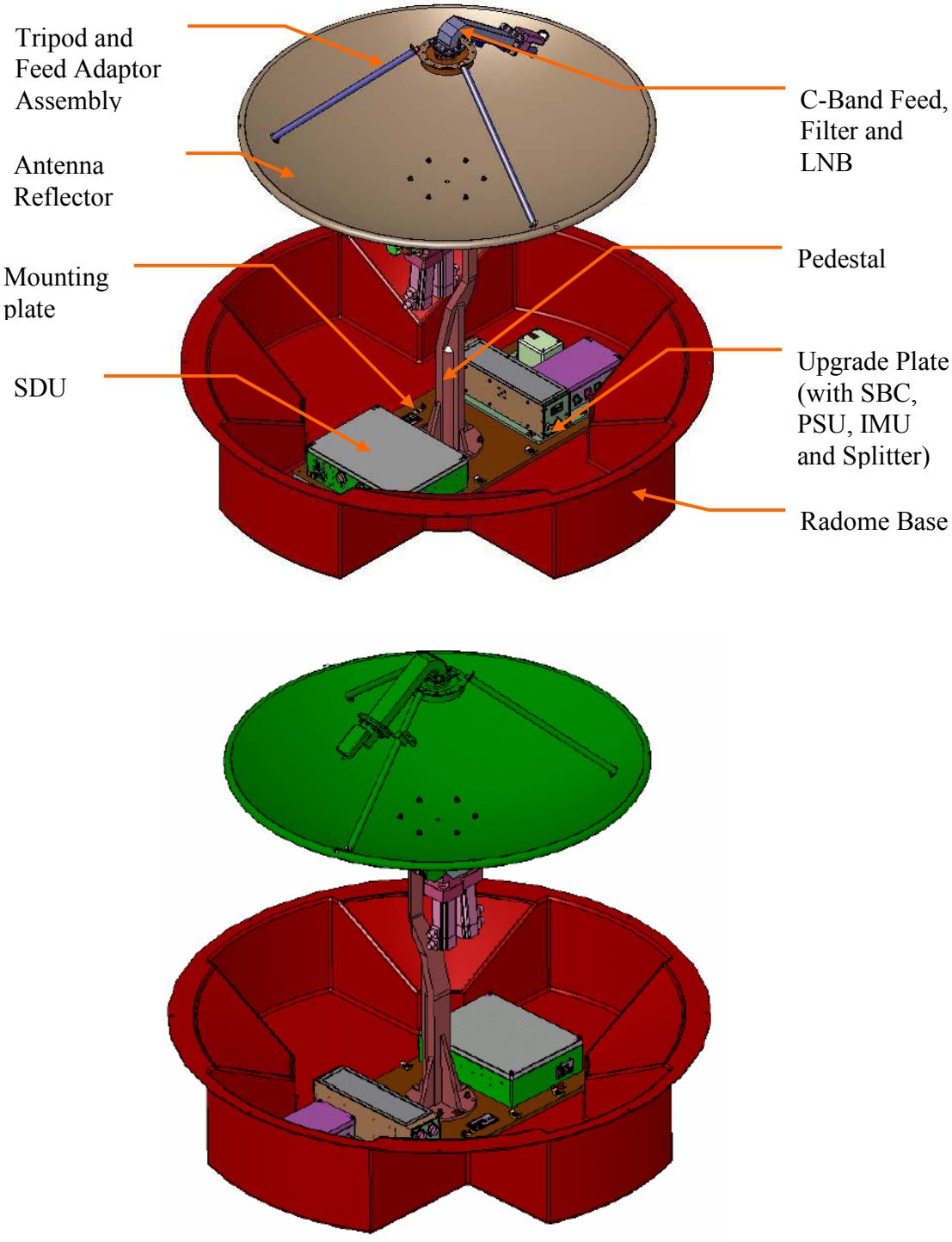


Figure 4. ADE – Units Location and Identification

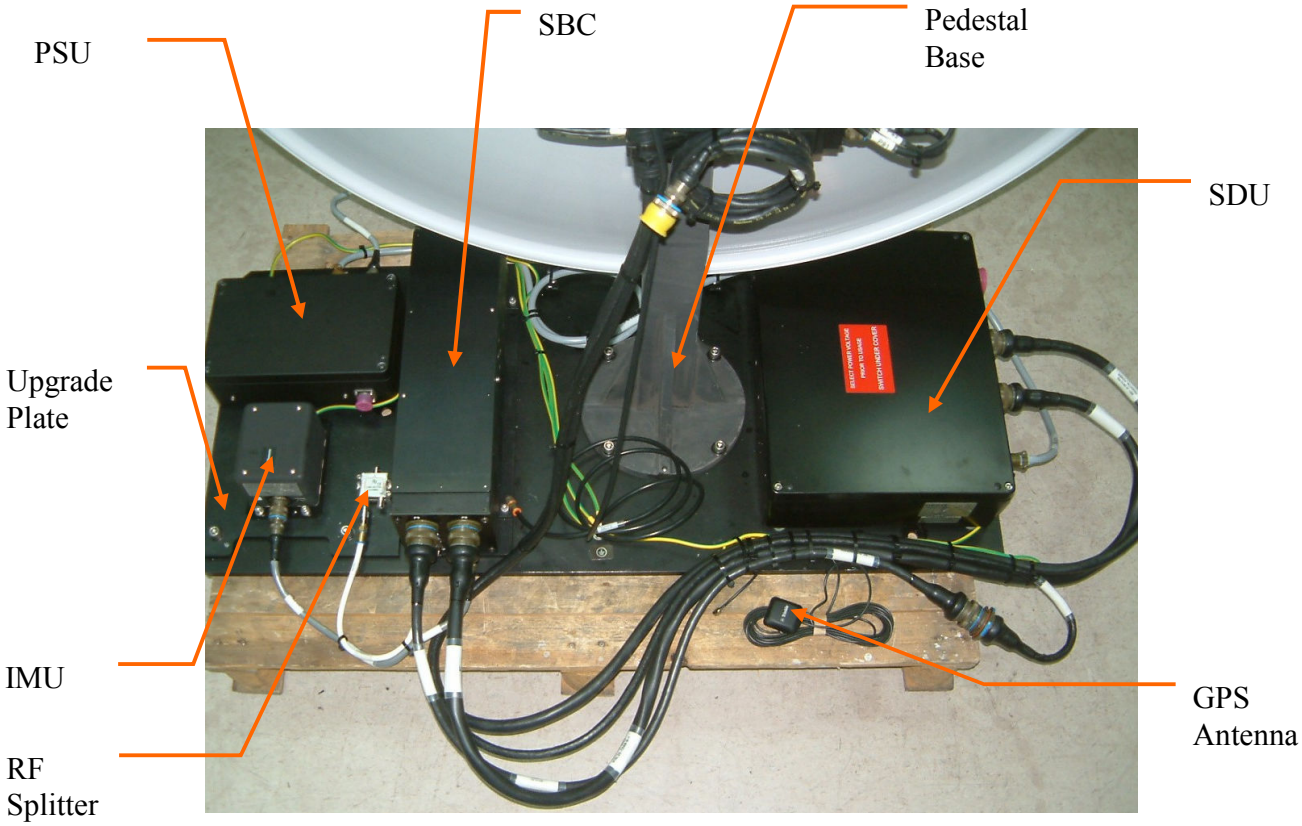
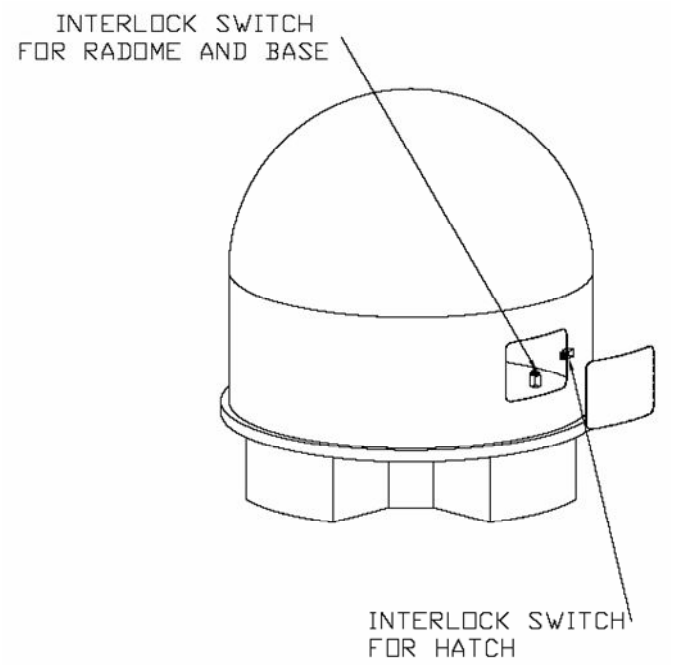
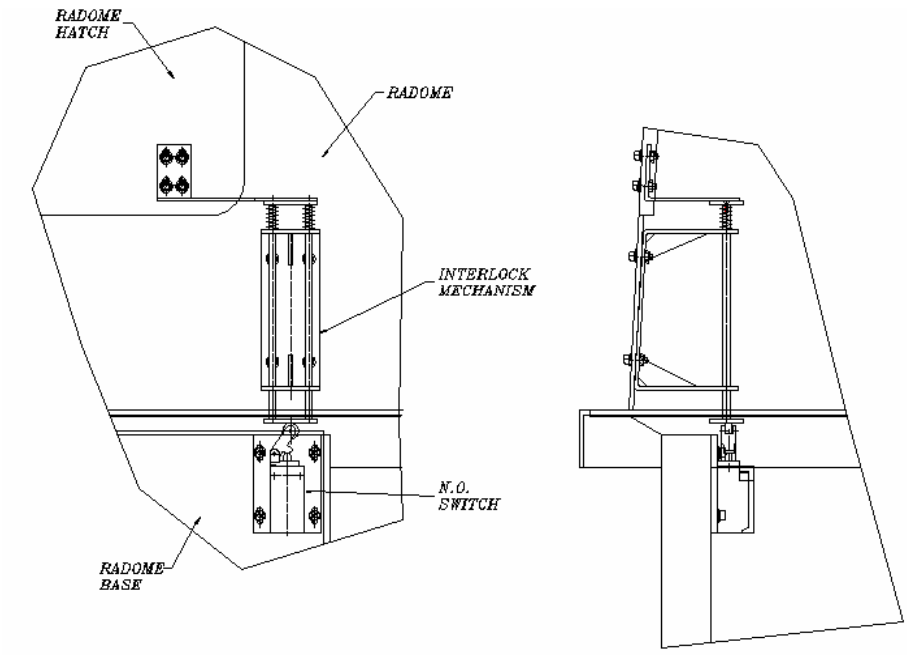


Figure 5. ADE – Mounting Plate Layout



Interlock Mechanism Location



Interlock Mechanism Structure

Figure 6. Interlock Mechanism

1.2.2.2. Below Deck Equipment (BDE)

The Below Deck Equipment (BDE) comprises the following components:

- AL-7103-CCU-DF Central Control Unit (CCU), which controls the operation of the TV-DTS system.
- Distribution Array/System.

NOTE

The distribution array items are supplied and installed by a third-party; therefore, they are not described in this manual.

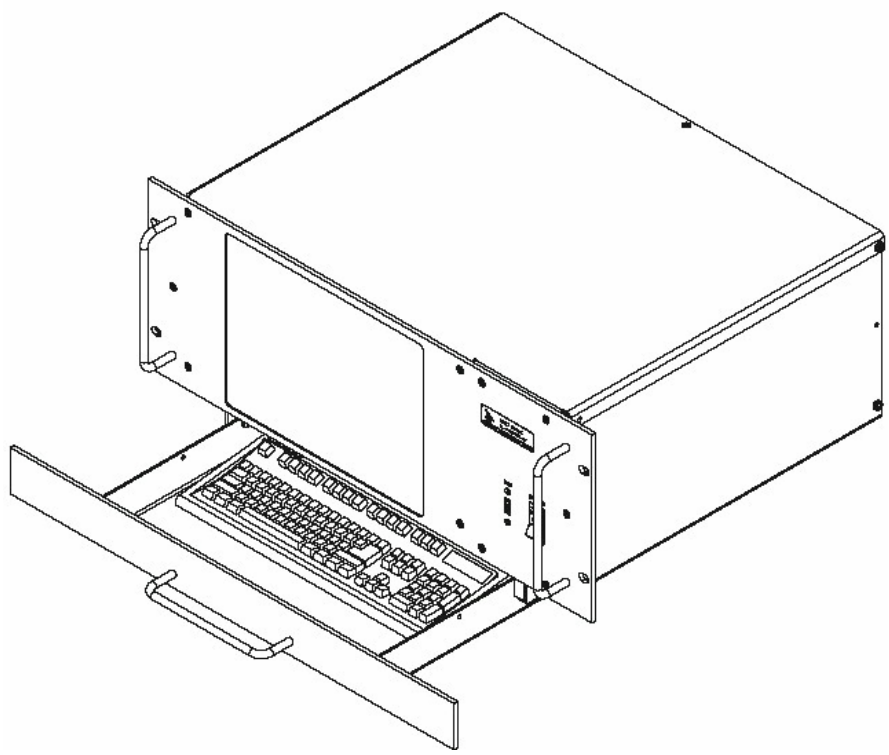


Figure 7. CCU AL-7103-CCU-DF

1.2.3. Theory of Operation

1.2.3.1. Block Diagram Description

The operation of the TV-DTS system is fully controlled from the AL-7103-CCU-DF (installed below the deck). Using the CCU, the operator may select the desired satellite and channel from a list displayed on the CCU monitor.

The system automatically recognizes the desired satellite, acquires it and tracks the selected satellite by pointing the antenna towards the satellite, while compensating for the platform pitch, roll and yaw movements.

CCU Operation

The AL-7103-CCU-DF, which is fed by 115/230 VAC, 50/60 Hz single-phase power supply (from the ship's power system), receives the following data:

- Ship's gyro compass signals - The CCU can be connected to most standard ship gyro compass types. The following are typical gyro compass types:
  - Synchro compass 1:1, 36:1, 60:1, 90:1 or 360:1 [115VAC, 50Hz or 400 Hz]
  - NMEA-0183 (RS-422 interface) - default configuration
  - Step-by-Step.
- GPS data (from the SDU internal receiver).
- Antenna position signals from the pedestal encoders.
- Ship's angular position signals from the IMU.
- L-band RF signals from the antenna's LNB output.
- Fiber optic communication with the ADE SBC.

The CCU uses the above data to produce control signals that are sent to the pedestal via the SBC. These control signals provide antenna azimuth and elevation direction to position the antenna correctly in order to optimally receive the satellite signals.

CCU-SBC Operational Concept:

The SBC and CCU are connected by a fiber-optic communication link, and provide distributed control concept – SBC running real-time software for stabilization and control, while the CCU presents the man-machine interface to the operator.

The CCU and the SBC are connected by two multi-mode fiber-optic cables (Rx and Tx), utilizing LAN communication channel between the two units.

SDU Operation

The SDU contains servo cards, which drive the pedestal axes, and a single DC driver card for driving an optional Ferotor /Motorized Polarizer.

The Omni-Directional GPS Antenna is connected to the GPS receiver in the SDU.

PSU Operation

The PSU is fed by 115/230 VAC, 50/60 Hz single-phase power supply (from the ship's power system) and provides power to the SDU and the SBC.

IMU Operation

During operation, the IMU provides the SBC with the following ship's position information:

- Pitch, Roll – measured by two rate-gyro sensors (short-term information) and two inclinometers (long-term information). The Pitch and Roll short-term data is integrated with the long-term data to provide a smooth and stable signal for antenna stabillization.
- Yaw variations – measured by a rate-gyro sensor (short-term information). The Yaw short-term data is integrated with the long-term Yaw data received from the ship's gyro compass.

The following figures provide the block and interconnection diagrams of the TV-DTS system.

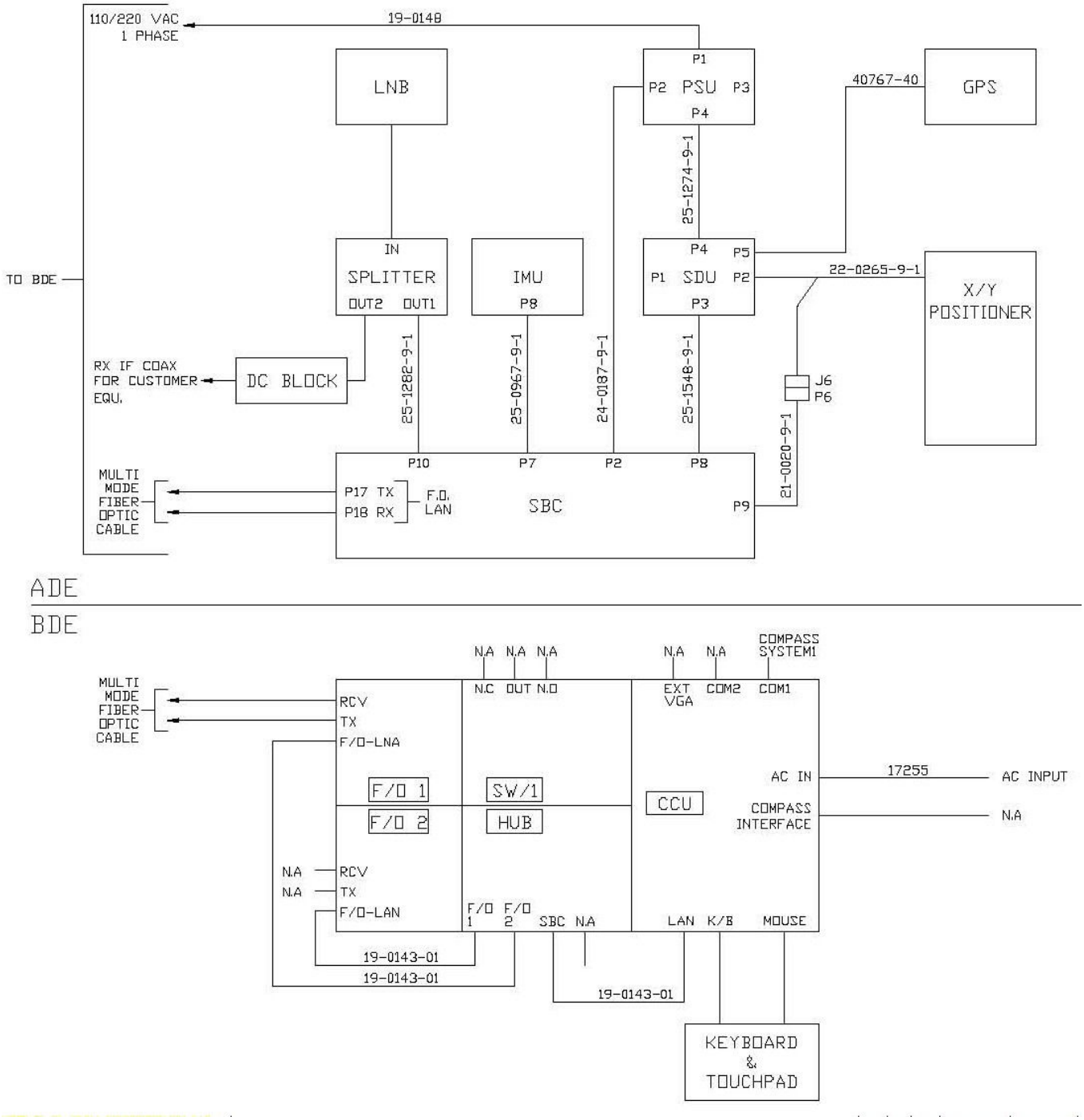


Figure 8. TV-DTS System - Block Diagram

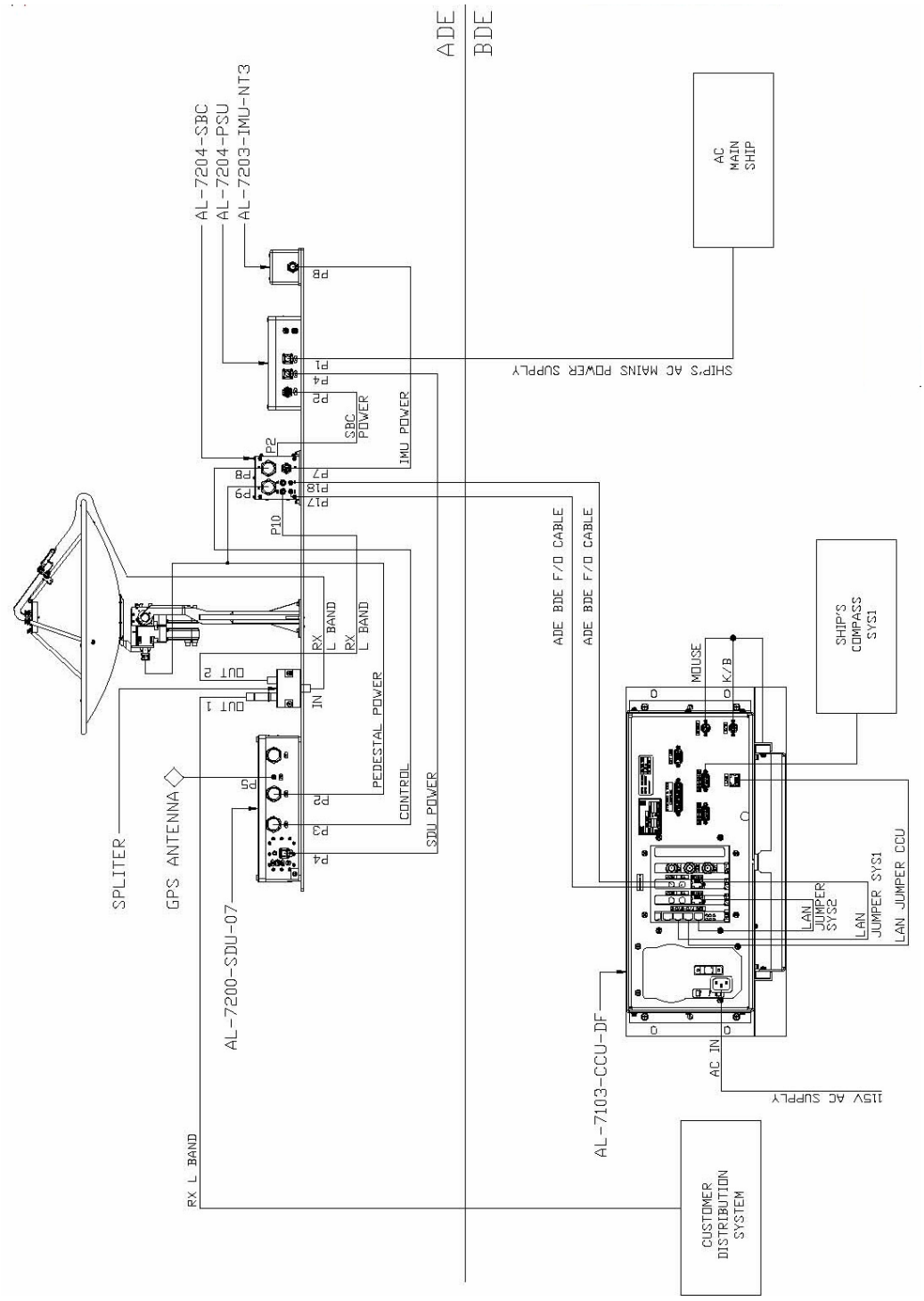


Figure 9. TV-DTS System – Detailed Interconnection Diagram

1.2.3.2. Satellite Acquisition and Tracking Principles

NOTE

Total time required to acquire a satellite, during normal operation, is less than 1 minute. After power-up, acquisition time is approximately 7 minutes.

Auto-Restart

When the system is turned-on, an Auto-Restart sequence is initiated, which includes the following steps:

- Encoder Initiation procedure, which lasts up to 40 seconds. At the end of this procedure, the antenna is positioned at the 0, 0 position (zenith).
- IMU Initiation procedure, which lasts up to 360 seconds. At the end of this procedure, the IMU is "locked", i.e., the antenna is slaved to and stabilized by the information supplied by the IMU.
- Satellite acquisition (point-to-SAT), which lasts up to 30 seconds. During this period, the antenna moves to the estimated position of the last-selected satellite. When the satellite is found, the system diverts to the Step-Track mode, maintaining the antenna boresight directed towards the satellite.

CAUTION

Do not select a satellite until the auto restart sequence is terminated, and the IMU status is "Locked".

Manual Satellite Selection

When the operator activates the Satellite Selection mode, the system automatically identifies all satellites that are within the parameters set in the CCU configuration, and displays a menu that lists all these satellites. The operator selects a satellite and thus activates the Acquisition Mode.

Acquisition Mode

In this mode, the system automatically acquires the desired satellite according to the following parameters:

- Satellite position selected by operator from the CCU monitor, or the last-selected satellite before shut-down

- Ship's position (given by the GPS)
- Ship's heading (given by the ship's gyro compass, or manual pier-side input)
- Ship's Pitch and Roll (given by the IMU pitch and roll sensors)

The CCU calculates the satellite direction relative to the ship and antenna positioner and points the antenna to the best-estimated satellite direction. The system will then revert to step-track (Acquisition Steps feature).

Step-Track Mode

In this mode, which is intended for tracking low angular-dynamic targets such as geo-stationary satellites having some inclination, the system maintains the antenna boresight directed towards the satellite.

In this mode, the CCU implements periodic step-track of the antenna positioner in the Elevation axis (Up/Down) and in the Azimuth axis (CW/CCW) for re-positioning to the point of the maximal reception level.

Step-Track Features:

- *Minimal signal threshold level*

If most of the AGC samples gathered during step-track are below the minimal level, the step is proclaimed as a "low signal step" and the disregarded - previous peak point prevails.

This effectively improves the situation where the system does not see any signal and just wonders off, as in temporary blockage of signal.

- *Acquisition Steps*

The first few steps after Step-Track is invoked are referred to as "acquisition steps". Those steps differ from the normal operation steps to improve system capability to quickly catch onto a target:

The first two steps span is double the size of the normal steps (as per operator set-up).

The first five steps will not have any delay between them (continuous steps), even if the Step-Track set-up specifies for "Re-Step time" other then 0 seconds.

The acquisition steps are a fully automatic feature: there is no set-up for it in the controller configuration.

- *Low Signal Timeout*

When a "low signal step" situation (see above) is identified, a clock count-down is initiated. Meanwhile, the Step-track keeps on step-tracking around the very same

position. If the count-down of the predefined timeout elapses, the Step-Track reverts to either one of the following pre-defined modes:

Peak, Search, Box-Scan, Pnt-to-Sat, Acquire, Preset, Stand-by, Step-Track, Restart.

Search Mode

In this mode, the CCU performs a spiral-type search around the current positioner's location, within a pre-defined Az/El sector, for initial target acquisition.

The search mode moves the antenna in an expanding-contracting spiral trajectory, not necessarily round.

The purpose of this mode is to acquire a satellite signal having strength of just a little bit above the Step-Track threshold level. In this case the Search mode will automatically revert to Step-Track, in order to lock on the signal.

The Search mode has a Timeout. If during the pre-defined amount of seconds, a signal is not acquired, it will revert to a pre-defined revert mode.

Available revert modes are:

Peak, Search, Box-Scan, Pnt-to-Sat, Acquire, Preset, Stand-by, Step-Track, Restart.

1.3. 1.3-M TV-DTS SYSTEM SPECIFICATIONS

Table 1. Technical Specifications

Parameter	Specification
RF System:	
Antenna type	1.3 m (51"), Prime focus
Frequency band & Operating frequency	C-Band (3.9 - 4.2 GHz)
	Optional Ku-Band (12.000 - 12.750 GHz)
Antenna polarity	C-Band: LHCP
	Optional Ku-Band: LHCP & RHCP
LNB noise (typical)	C-Band noise temp.: 20° K
	Optional Ku-Band noise figure: 1.1 dB
Radome size	Radome diameter - 60”
Radome RF attenuation	<0.3 dB @ 4 GHz
Tracking System:	
Pedestal type	AL-7204-1B
Axis configuration	ROLL/X/Y
Central Control Unit	AL-7103-CCU-DF
Servo Drive Unit (SDU)	AL-7200-SDU-07
Pitch/Roll sensors - IMU	AL-7200-IMU-NT3
Single Board Controller (SBC)	AL-7204-SBC
Tracking receiver	Yes

Table 1. Technical Specifications

Parameter	Specification
Ship Gyro Compass Interface	▪ Synchro compass 1:1, 36:1, 60:1, 90:1 or 360:1 [115VAC, 50Hz or 400 Hz] ▪ NMEA-0183 (RS-422 interface) - default configuration ▪ Step-by-Step.
GPS	Yes
Fiber Optic Cables standard length	Up to 1.2 miles
Performance:	
Pointing accuracy	0.5 dB RMS (sampled over 2-hour time period)
Azimuth range	360° Continuous
Elevation range	± 110° from zenith
Ship Motion:	
Roll	±30° @ 4 second periods
Pitch	±10° @ 3 second periods
Yaw	±8° @ 5 second periods
Turn rate	>10 degrees per second
Surge	±0.2 G
Sway	±0.2 G
Heave	±0.5 G
Headway	> 30 Knots
Environmental (Above Deck Equipment):	
Temperature, Operational	-30° C to 50°C
Temperature, Storage	-40° C to 70°C

Table 1. Technical Specifications

Parameter	Specification
Humidity	95% @ 40°C (including condensation)
Spray, sand, dust, solar radiation	Radome-protected
Wind speed, Operational	100 knots, gusts up to 130 knots
Wind speed, Survival	100 knots, gusts up to 155 knots
Power requirements	115/230 VAC (± 5%), 50/60 Hz (+0, -3%)

1.4. ADE UNITS

1.4.1. Single Board Controller (SBC) AL-7204-SBC

The Single Board Controller (SBC) is a real-time tracking controller, based on an industry-standard CPU with on-board Flash and SDRAM memory that controls system operation according to CCU commands and system modes.

The SBC interfaces with the ADE components via its front-panel and rear-panel connectors.

The SBC runs a Real-Time OS reading all system sensors, performing 3D mathematical transformations, controlling (in closed position and velocity loops) the movement of the axes and providing on-line communication to the Below-decks Central Control Unit (CCU) by the means of fiber-optic Ethernet-LAN connection

The SBC is fed by +24VDC and incorporates an internal DC-DC power supply providing +5, +12 and –12VDC voltage to its internal circuits.

The SBC also incorporates a Wide-band as well as Narrow-band Tracking receiver for Step-track feedback.

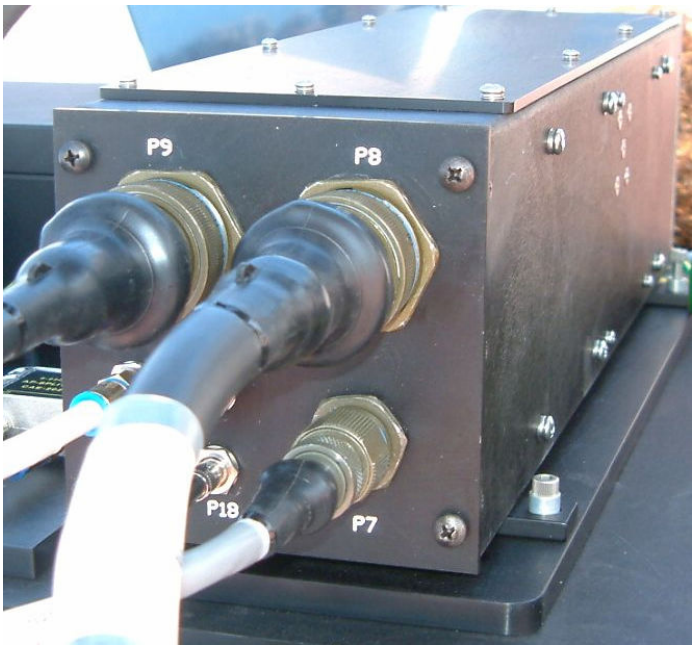


Figure 10. Single Board Controller (SBC) AL-7204-SBC General View

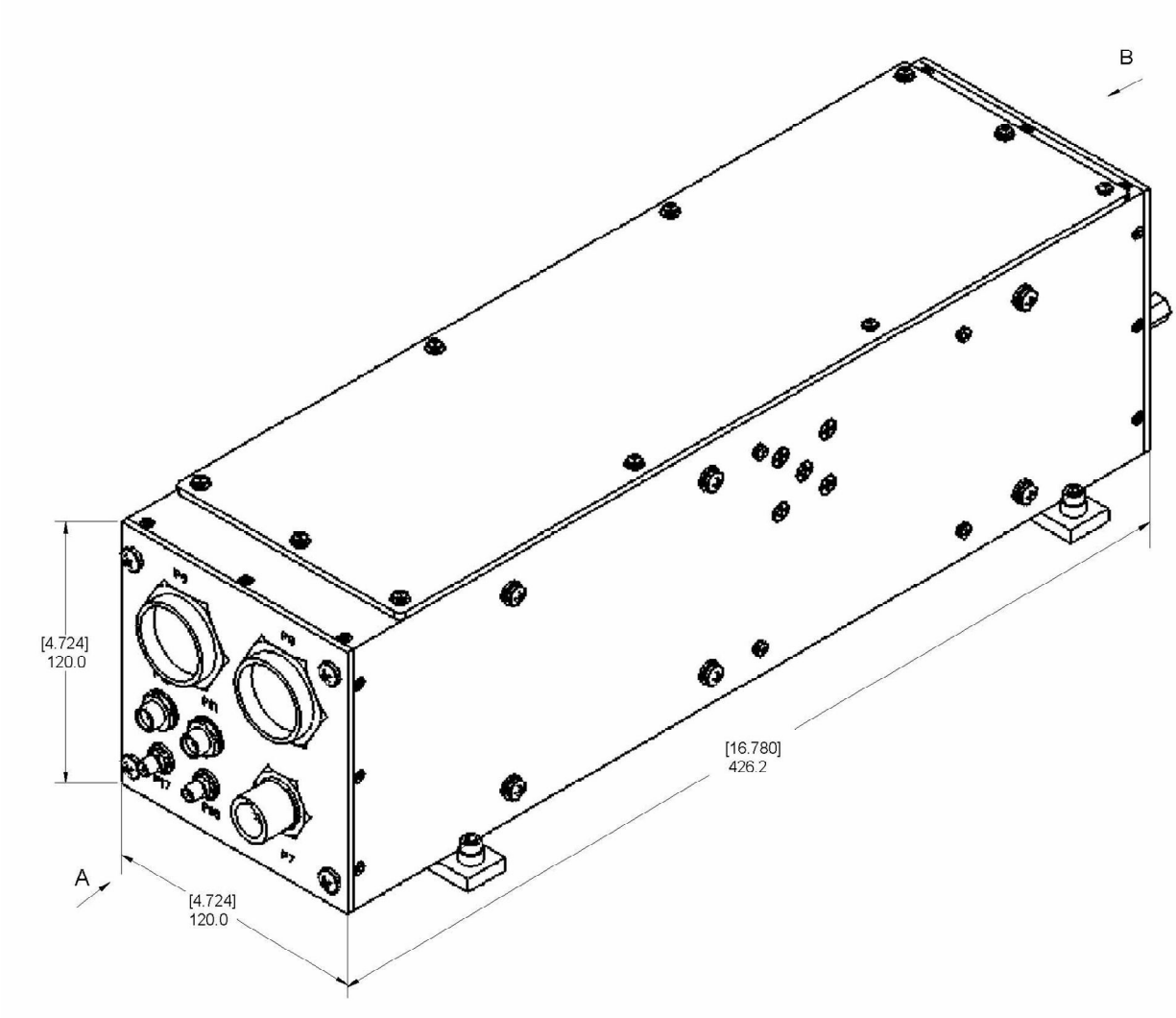
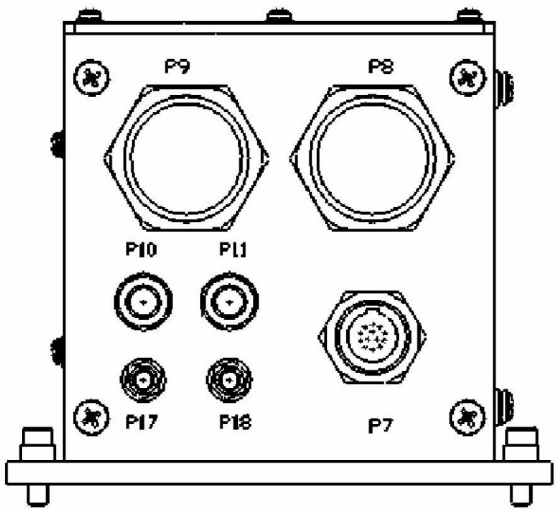
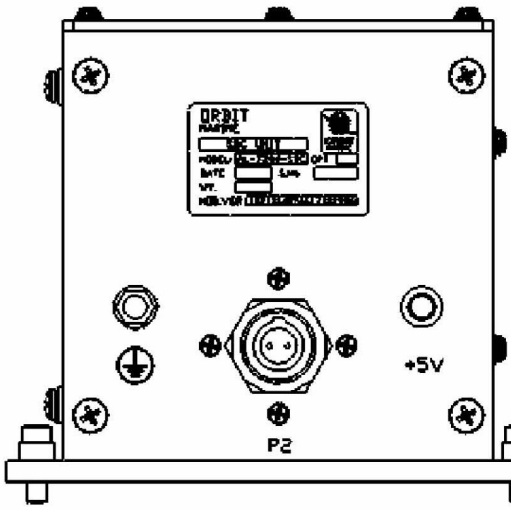


Figure 11. SBC Outline Drawing



VIEW A



VIEW B

NAME	PURPOSE	TYPE
P7	IMU	D38999/24WB35SN
P8	SDU	MS3474W20-41SX
P9	PEDESTAL	MS3474W20-41P
P10	IF1	BNC
P11	IF2	BNC
P17	TxLAN	ST
P18	RxLAN	ST

NAME	PURPOSE	TYPE
P2	+24v	D38999/24WB02SN
+5v	LED	
GND	GROUND	

Figure 12. SBC Connectors

1.4.2. Power Supply Unit (PSU) AL-7204-PSU

The AL-7204-PSU Power Supply Unit serves as the ADE power supply and distribution unit. The PSU distributes the mains voltage to the SDU, and produces 22VDC voltage for the SBC and for auxiliary future equipment.

Figure 13. Power Supply Unit (PSU) AL-7204-PSU General Views

PSU Connectors

The PSU panels include the following items:

- **AC IN Connector P1** – Mains power inlet – from the ship's power source (115/230V, 50/60 Hz).
- **DC OUT Connector P2** – Supplies 22 VDC voltage to the SBC.
- **AUX OUT Connector P3** – Supplies 22 VDC voltage. Not used in this system.
- **AC OUT Connector P4** – Supplies mains voltage to the SDU.
- **Grounding Jack.**

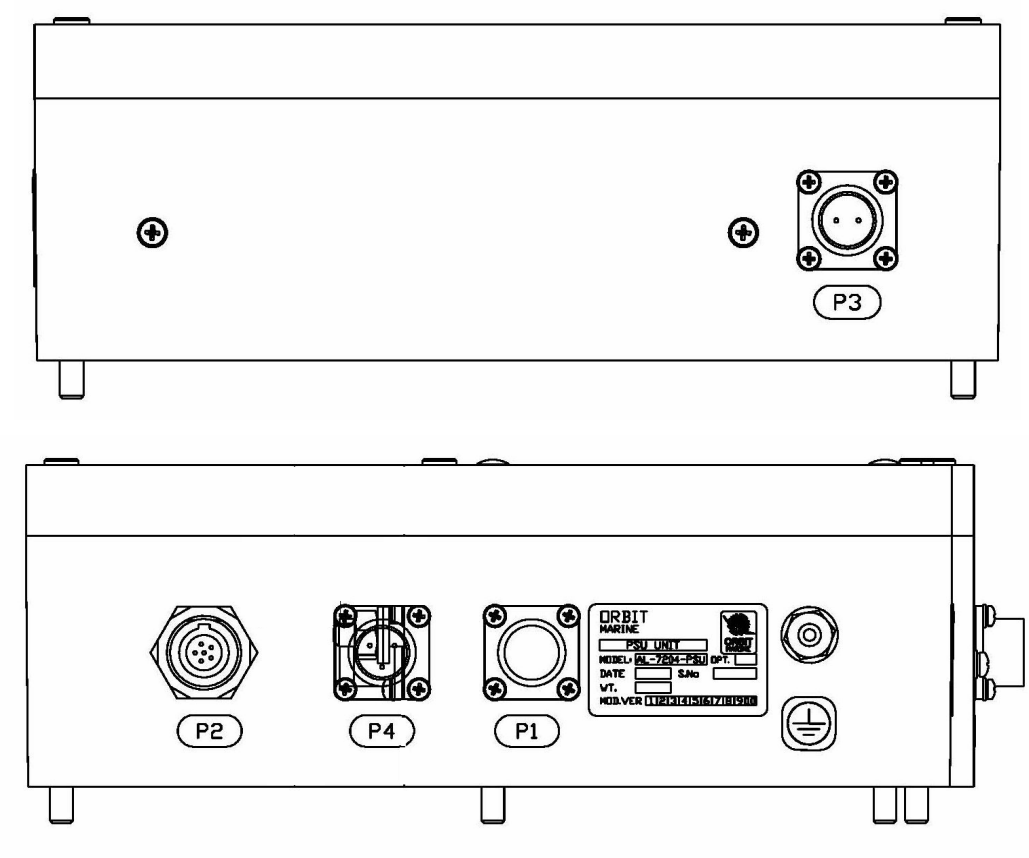


Figure 14. PSU Connectors

1.4.3. Servo Driver Unit (SDU) AL-7200-SDU-07

The AL-7200-SDU-07 Servo Driver Unit is an outdoor, compact sized box including Brushless-Motors Servo Drivers as well as a GPS Receiver. The SDU also provides power to the ADE.

The AL-7200-SDU-07 provides the following:

- GPS receiver
- EMI/RFI protection
- Servo Drivers for 2 brushless motor axes (Pedestal axes X and Y)
- DC Driver for Polarizer skew motor
- Brakes power supply (for Pedestal axes X and Y)
- Power: 115/230V, 50/60 Hz
- ADE power indicator
- 24 VDC power supply for brake release
- Fuses.
- 2 Brakes override switches (Pedestal axes X and Y)

SDU Front-Panel Connectors, Controls and Indicators

The SDU front panel includes the following items:

- **IMU POWER Connector P1** – Not used in this system.
- **PEDESTAL POWER Connector P2** – Supplies power to the pedestal motors.
- **CONTROL Connector P3** – Accepts motion control (azimuth and elevation) signals from the CCU. These signals are used to position the antenna correctly in order to optimally receive the satellite signals.
- **POWER IN Connector P4** – Mains power inlet (115/230V, 50/60 Hz).
- **GPS ANTENNA Connector P5** –The Omni-Directional GPS Antenna is connected to the GPS receiver in the SDU via this connector.
- **Grounding Jack.**
- **SDU Power Switch and Indicator** – SDU's ON/OFF switch. In the ON position, the green LED illuminates.

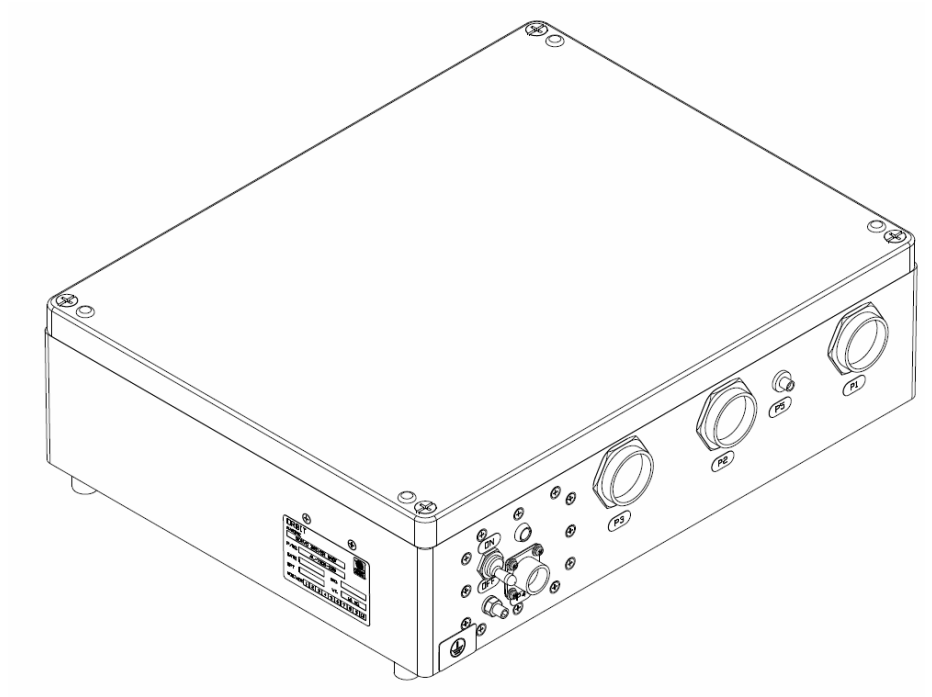


Figure 15. SDU AL-7200-SDU-07 General View

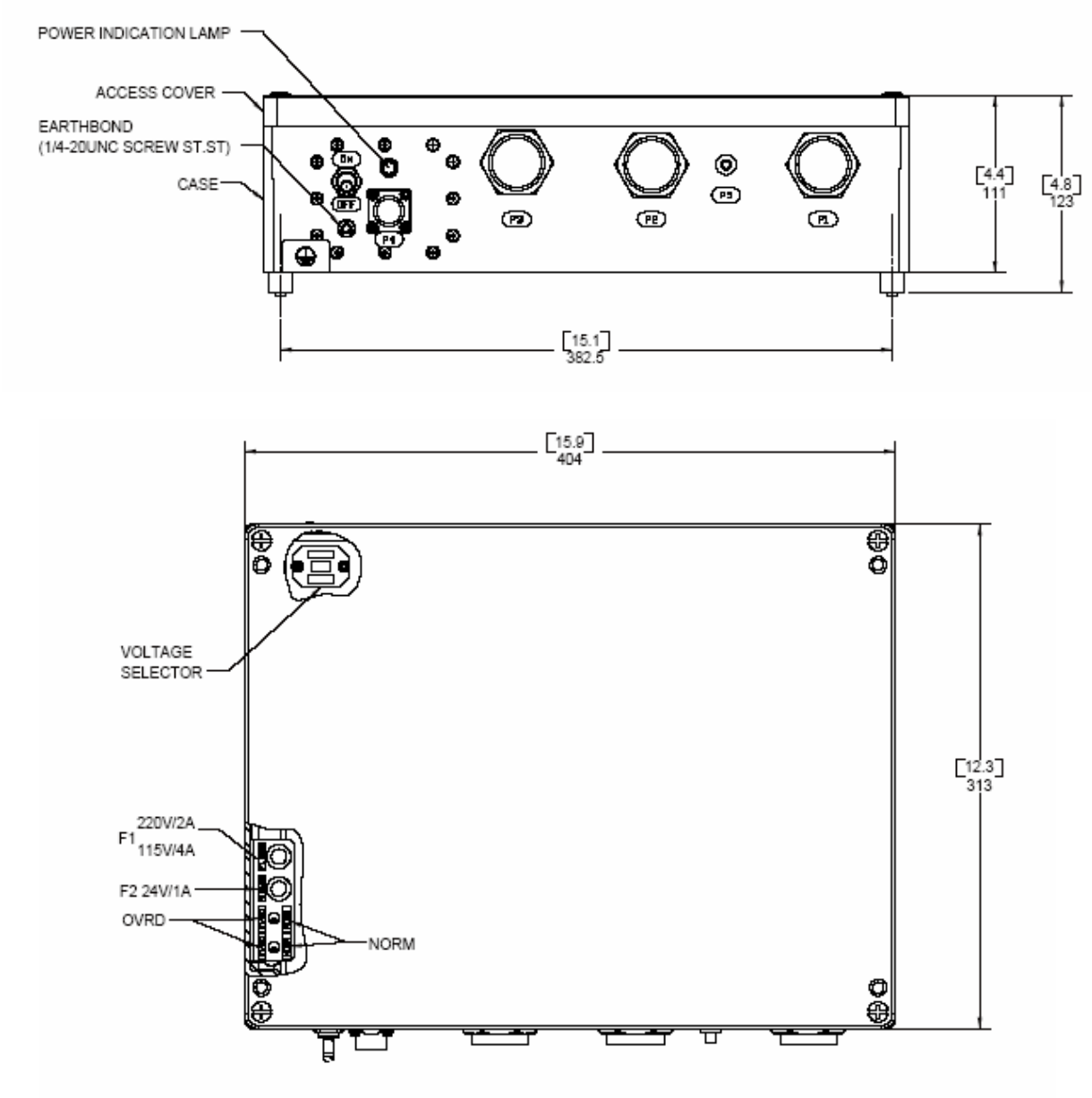


Figure 16. SDU Outline Drawing

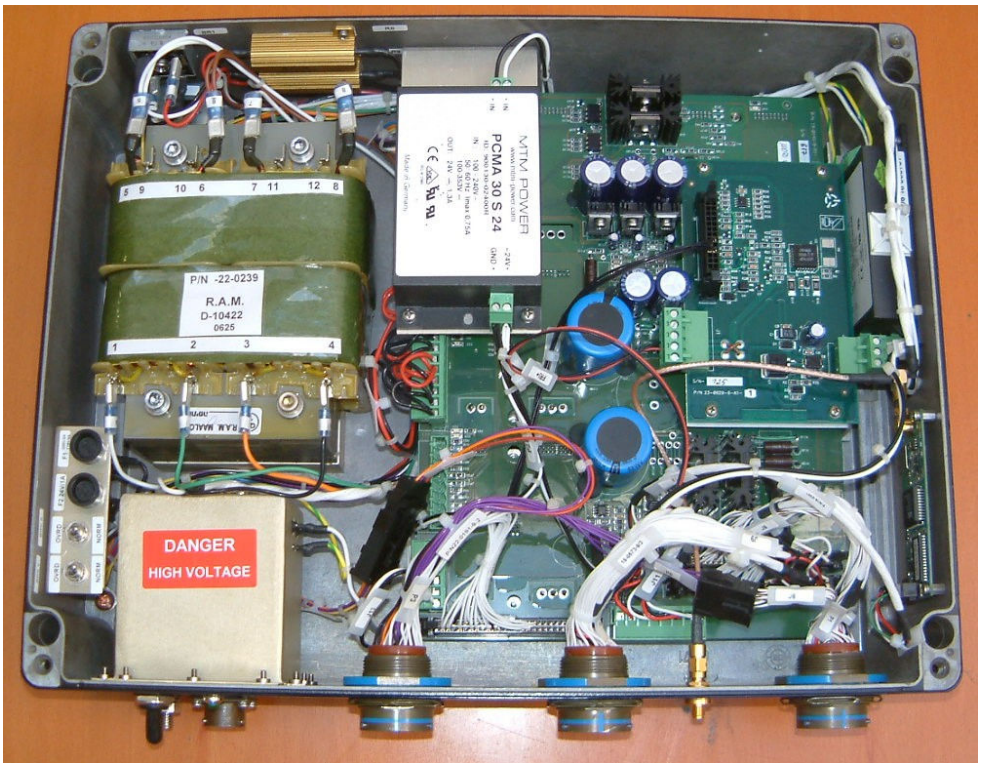


Figure 17. SDU AL-7200-SDU-07 Internal View

1.4.4. Inertial Measurement Unit (IMU) AL-7203-IMU-NT3

The Inertial Measurement Unit (IMU) is the "heart" of the antenna stabilized TV-DTS system. The IMU task is to provide accurate dynamic readings of the antenna platform roll pitch and yaw angles at all times. To produce a true yaw angle the IMU relies on a long-term reference feedback from the ship's gyro.

The AL-7203-IMU-NT3 is a solid-state (static sensor platform) inertial measurement unit, designed to stabilize a Ku antenna on a small ship, using the ship's gyro as a heading long-term reference. The IMU provides extremely aacurate information on ship's motion in Pitch, Roll And Yaw axes.

The Controller software utilizes a 3D-calibration algorithm to correct the individual sensor readings in real-time, thus producing over-all pitch-roll-yaw angle accuracy of better then 0.5 degree. This makes the AL-7203-IMU ideal for applications with antennas of up to 1.5m in Ku-Band and C-band.

The AL-7203-IMU-NT3 is an accurate and agile device, suitable of operating in harsh dynamics of a relatively small vessel, such as a yacht.

Specications

Dimensions:	104 x 145 x 88 mm
Weight:	1 Kg.
Power Consumption:	7 Watt
Accuracy:	1° envelope
Dynamics:	30°/s in pitch & roll
	10°/s rate of turn in heading
Output:	Analog or Digital (high rate serial comm. link).

NOTE

Each IMU is individually pre-calibrated in the factory. The calibration data resides on the Controller's non-volatile memory and it is also supplied with the IMU (on a floppy disk). If an IMU is to be replaced, its individual set of calibration-parameters must be copied into the Controller's memory.

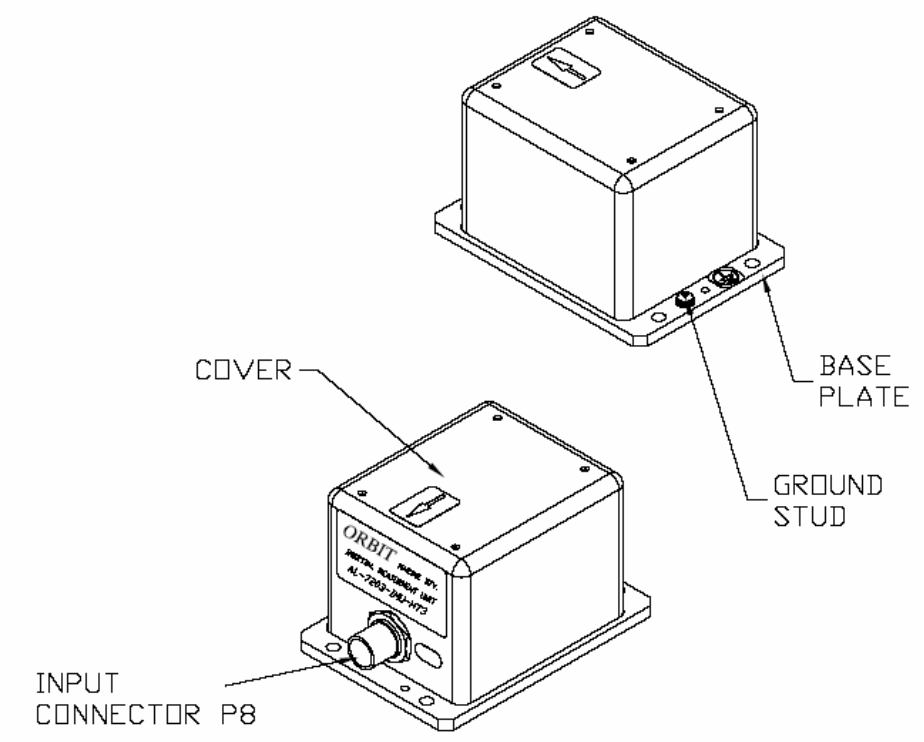


Figure 18. AL-7203-IMU-NT3 General View

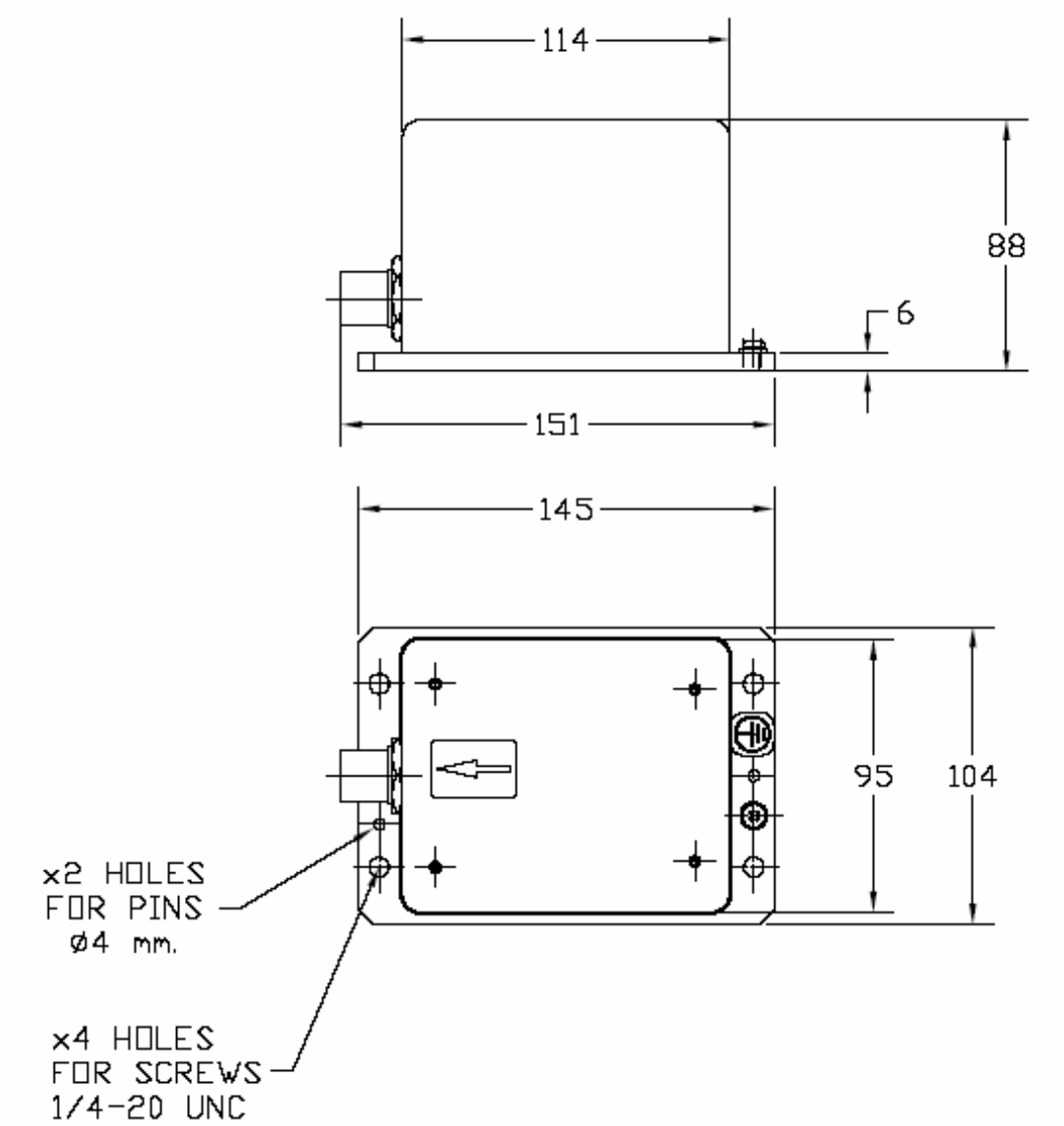


Figure 19. AL-7203-IMU-NT3 Outline Drawing

1.4.5. X/Y Pedestal AL-7204-1B

The X/Y pedestal can carry the antenna to any required angle, at high speed and high accuracy with continuous axis movement (no Azimuth limits), without the need of slip-rings or rotary joints. The X/Y configuration also eliminates the ZENITH PASS problem. The X/Y Pedestal utilizes brushless motors that contribute to high reliability.

The elevation axis is capable of continuous movement from -10° to 190°, providing a total of 200° of uninterrupted movement. In addition, the system has no cable wrap (unlimited azimuth) and no requirement for rotary joints or slip rings.

NOTES

- *The dish is mounted on the Y axis.*
- *To improve operation, the system should be installed with the X axis pointed toward an obstruction to satellite visibility. The X axis direction is marked by an arrow on the IMU. This arrow also indicates the "0" reference of the Azimuth axis*

The pedestal comprises the following sub-assemblies as shown in the following figure:

- Pedestal leg and base
- Two axes, each equipped with a motor, gear and encoder
- Antenna adapter
- Interconnection cables

The AL-7204-1B Pedestal Main Features are:

- High torque brushless motors
- High accuracy planetary gear
- No azimuth slip rings, rotary joint or cable wraps are needed
- Continuous rotation
- High accuracy at extreme dynamics
- Exceptional reliability by use of brushless motors and encoders

- Unique and clean design
- Easy installation and maintenance

NOTE

The pedestal nameplate indicates the factory-measured Encoder offset values of the X and Y axes. When replacing the pedestal, these values must be entered into the CCU, via the Maintenance screen, as the Pedestal X and Y axis offsets.

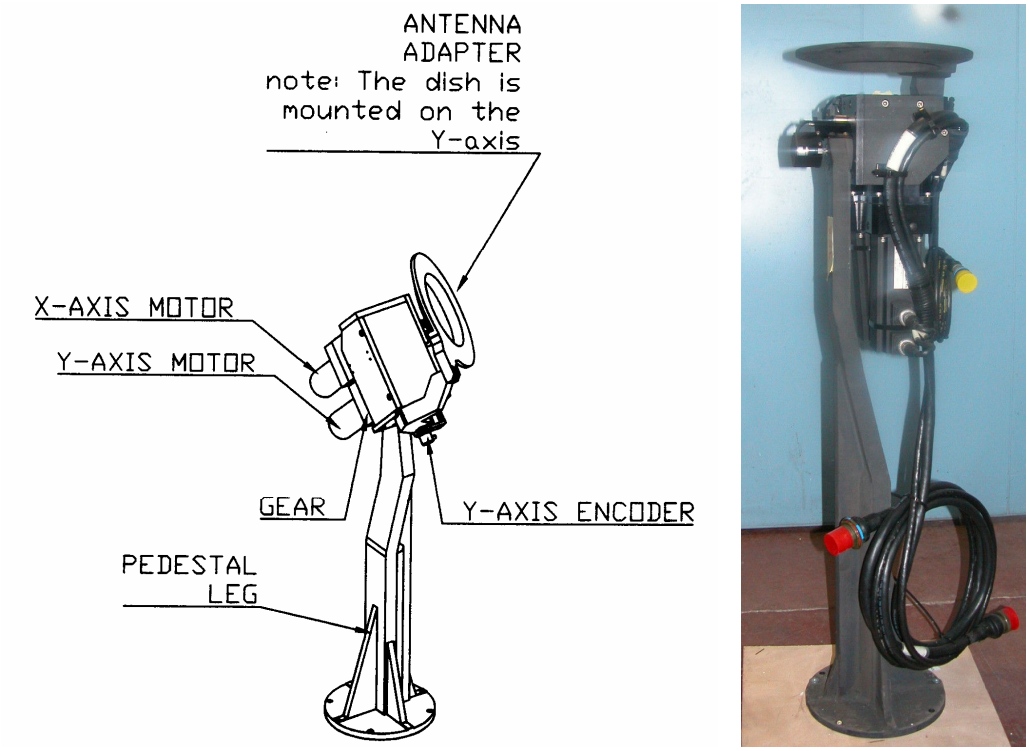


Figure 20. Pedestal General View

1.4.6. Antenna and Feed Assembly

1.4.6.1. Tripod and Feed Adaptor Ring

The System's antenna reflector is equipped with a tripod and feed adaptor ring, which facilitates easy and quick installation of a variety of feed assemblies, thus providing worldwide coverage.

The system is supplied with a C-Band Feed, LNB and Filter Assembly, which can be replaced with an optional DBS LNBF (Ku-Band feed) Assembly for USA DBS coverage.

Figure 21. Antenna Reflector, Tripod and Feed Adaptor (with C-Band Feed Mounted)

1.4.6.2. C-Band Feed

1.4.6.2.1. Radio Frequencies

The system is supplied with a C-Band feed and LNB. The system operates in the C-Band receive band between 3900 MHz-4200 MHz.

1.4.6.2.2. Polarization

- C-Band signals: Left Hand Circular Polarized (LHCP)

1.4.6.2.3. Pointing Accuracy

The TV-DTS antenna system is not degraded more than 0.5 dB RMS sampled over any 2 hour time period due to ship's motion at C-Band.

1.4.6.2.4. IF Interface

The C-Band LNB provides L-Band output (950-1450 MHz) to provide the proper signal levels for the IRDs and receiver via the TV distribution system.

1.4.6.2.5. C-Band Feed/LNB Characteristics

Parameter	Specification
Type	Integral Feed and LNB
Frequency Range	3.9 GHz - 4.2 GHz
Output Frequency	975 MHz - 1750 MHz
Local Oscillator	5150 MHz
L.O. Stability	500 kHz to 1 MHz
Noise Temp	20°K
Output Connector	F-type
Cross Pole Isolation	32 dB
DC Voltage	13V – 18V

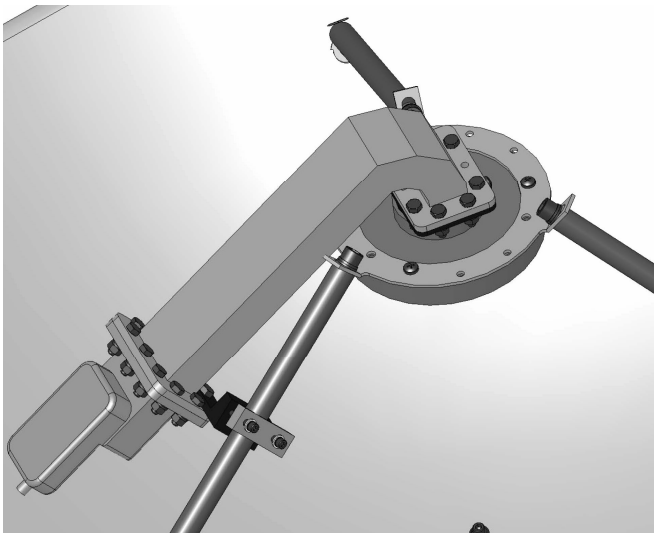


Figure 22. C-Band Feed, LNB and Filter Assembly

1.5. BDE UNITS

1.5.1. Central Control Unit (CCU) AL-7103-CCU-DF

The Below Deck Equipment (BDE) comprises an AL-7103-CCU-DF Central Control Unit (CCU), which can be used as a controller for a single-antenna or dual-antenna system, using fiber-optic communication links.

The CCU serves both as the AL-7204-F system Man-machine terminal as well as the interface to the ships Gyrocompass and the customer's modem.

The CCU provides host-computer control via Ethernet communication link. Operating under a Windows operating system, the CCU uses the MtsLink software to control and monitor the system.

The CCU is based on a 19" rack-mounted 5U industrial PC (including a 1U keyboard-and-mouse drawer), and it is usually located in the Radio Room or the TV Distribution Room.

The front panel includes a TFT screen, and together with an external keyboard (mounted on a dedicated drawer), they both provide convenient Man-Machine Interface (MMI) with the CCU. The front panel also includes a power switch, and a USB connector that allows software updates and data downloads, using a memory stick.

The rear panel includes several connectors, which are used for interface with the ADE, with the modem, and with the ship/vessel, e.g. interface to ship gyro compass (NMEA-0183, Synchro & S.B.S).

The CCU is also able to provide on-line GPS info to the satellite modem, if needed.

The following Figures provide external and internal views of the CCU.

The CCU contains the following cards:

- CPU Card
- Receiver Card
- 2 Ethernet-to-Fiber converter cards
- Ethernet Hub.
- L-Band switch card.
- Power Supply

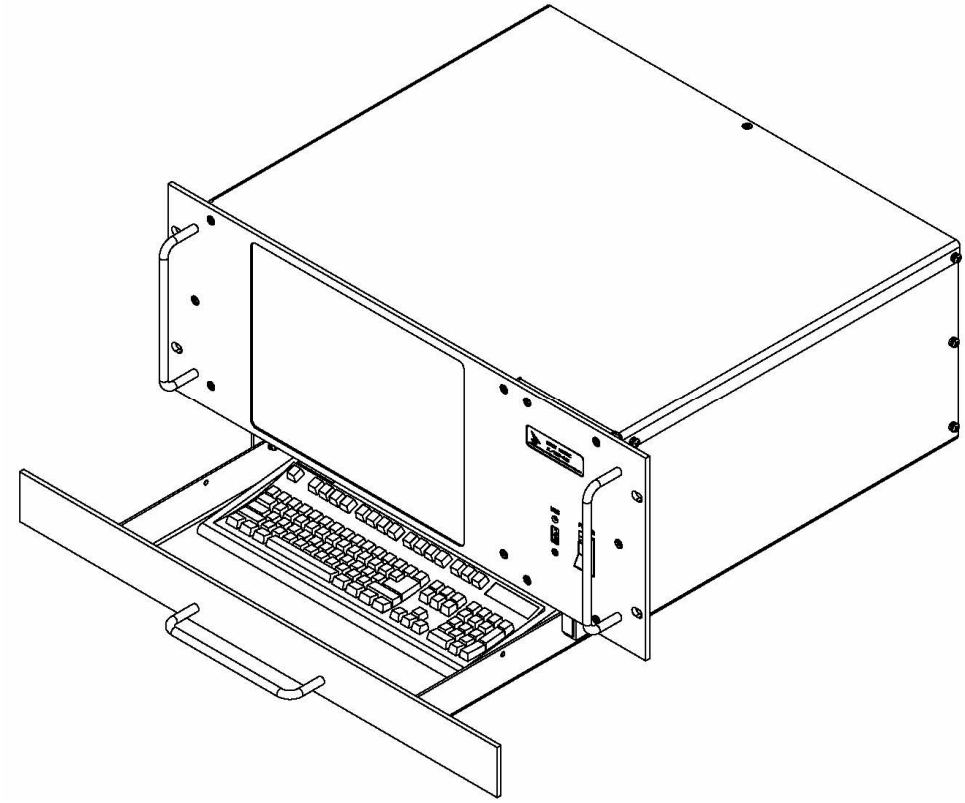


Figure 23. CCU General View

Figure 24. CCU Front Panel

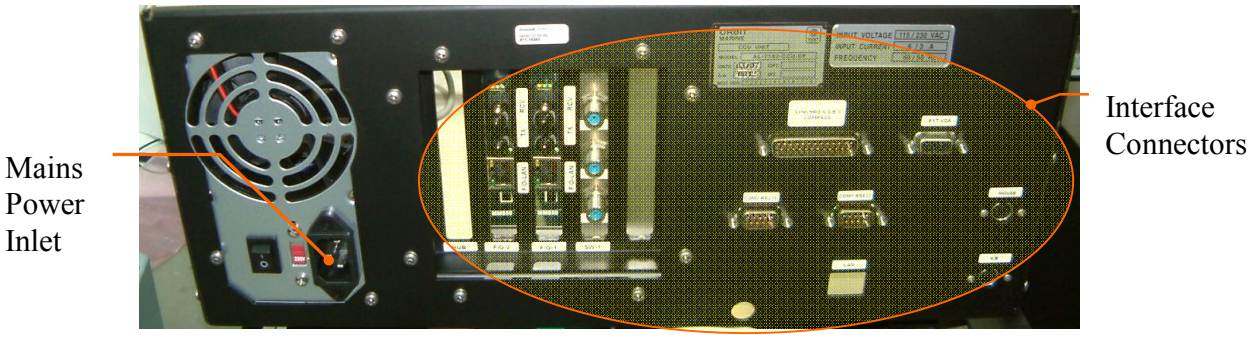


Figure 25. CCU Rear Panel

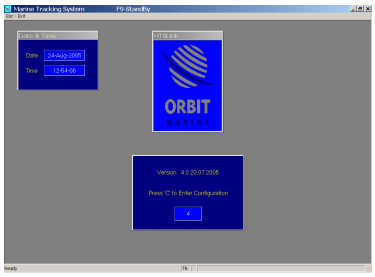
2. BASIC SYSTEM OPERATION

2.1. SYSTEM START-UP

➢ **To Power Up the System:**

- Turn the ADE and the CCU's POWER switch ON.

Operating system messages are displayed, and then the Banner/Self-Test screen appears for a period of 10 seconds, during which a 10-to-0 countdown is displayed.



The system can be operated from Basic Operation screen or Operation screen, which provides additional operating capabilities.

Under normal conditions the ship's operator will use the **Basic Operation screen**. To enter Basic Operation screen, wait for the 10-to-0 countdown to end.

If you need to enter the Operation screen, press <C> key during the 10-to-0 countdown, or <O> in the Basic Operation screen.

The ENTER PASSWORD window is displayed. Type your password and press ENTER.

The power-up sequence is fully automatic, provided that the system is configured to Auto-Start (default setting). At the end of power-up, the system is locked on the satellite that was last selected and saved prior to system shutdown.

2.2. BASIC OPERATION SCREEN

The Basic Operation screen is the main system screen for the operator, which provides basic needed operation capabilities.

The following Figure illustrates Operation screen main sections.

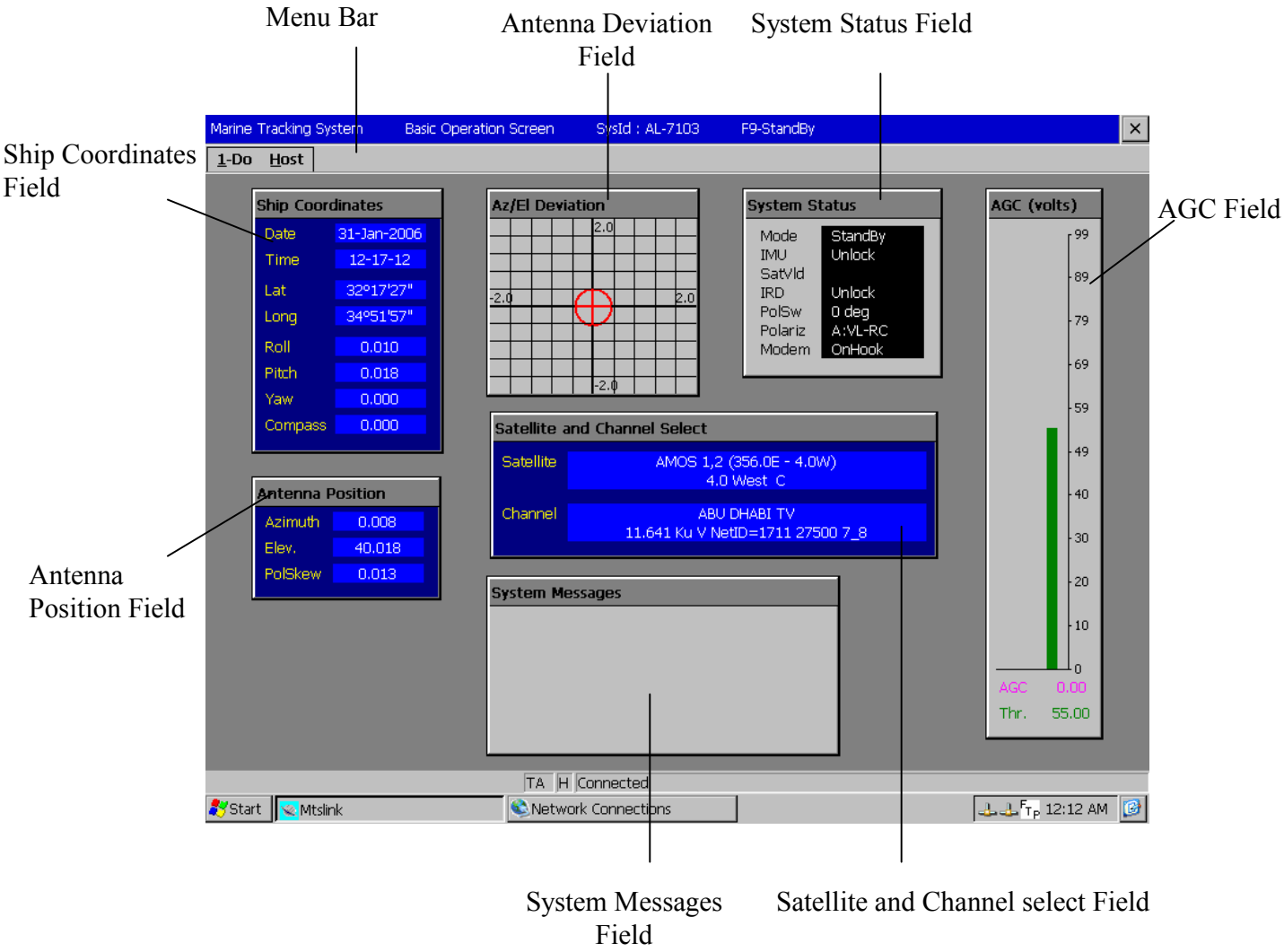


Figure 26. Basic Operation Screen

Selecting the Do option from the menu bar will open the operation menu that allows basic functions to be activated. These operations will be explained later in this manual.

Table 2. Basic Operation Screen Fields

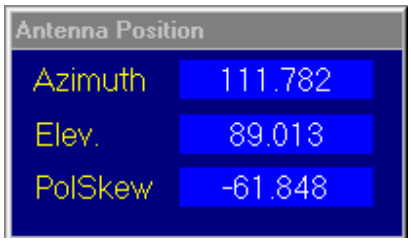
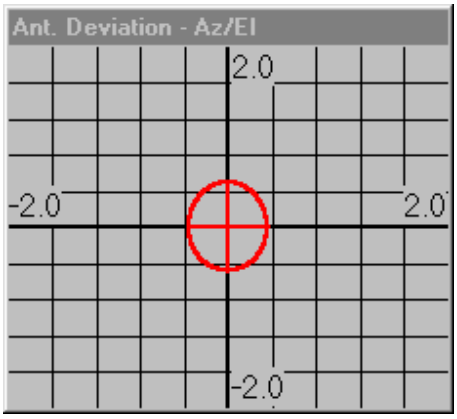
Field	Description
	**Ship Coordinates Field:** • **Date -** From the internal CPU Card • **Time-** From the internal CPU Card • **Lat** - Ship's latitude- From the GPS receiver • **Long** - Ship's longitude - From the GPS receiver • **Yaw -** IMU Yaw • **Pitch -** IMU Pitch • **Roll –** IMU Roll • **Comps** - Ship's Heading (as read from the ship's compass or as entered manually)
	**Antenna Position Field:** The CCU constantly calculates and presents the following parameters: • **Azimuth** - Azimuth axis angle • **Elev.** - Elevation axis angle • **PolSkew** - Polarization Skew axis angle.
	**Antenna Deviation Field:** This field graphically depicts the tracking error of the antenna (the error between true boresight as calculated by each step-track and the mechanical boresight to which the antenna is pointed), presented in two-dimensional cross-hair type error display. The deviation is presented in degrees of AZ/EL.

Table 2. Basic Operation Screen Fields

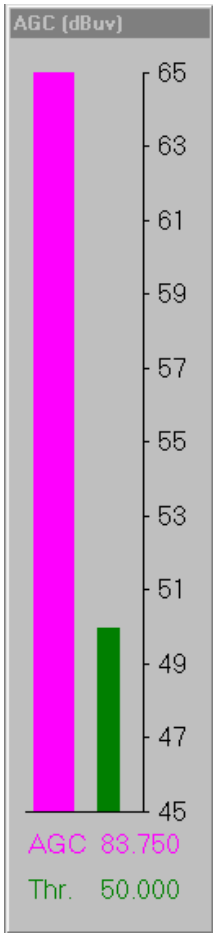
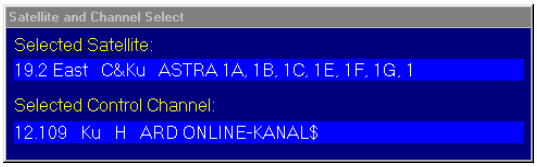
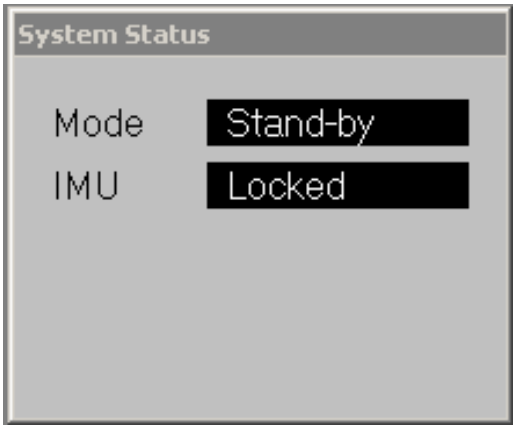
Field	Description
	**AGC Field:** This field presents (both graphically and numerically) the AGC signal level, which represents the strength of the satellite's signal that is received by the antenna. In addition, a threshold level is presented for reference.
	**Satellite and Channel Select Field:** This field presents the following information: • **Selected Satellite** - current selected satellite (e.g. 19.2 East C&Ku ASTRA 1A 1B 1C 1E 1F 1G) • **Selected Control Channel** - current selected channel (e.g. 12.109 Ku H ARD ONLINE-KANAL)

Table 2. Basic Operation Screen Fields

Field	Description
	**System Status Field:** This field presents the following information: • **Mode –** Current operational mode (StndBy, Step-Track, etc.) • **IMU -** IMU status (locked, unlocked, init, preset).
	**System Messages Field:** The System Messages Field displays the following types of indications: • Messages (green and have no preamble) - Such as "Auto-Restart in progress" or "Acquiring a satellite"… • Warnings (blue and have a "Wrn:" preamble) - Such as "No GPS Position Updates" or "Synchro Compass Fault"… • Errors (flashing-red and have an "Err:" preamble) - Such as "Auto-Restart Failed" or "Pedestal Axis X Mech Fault"…

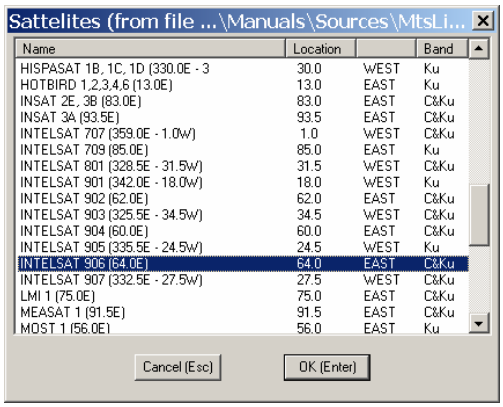
2.3. SELECTING A SATELLITE AND CHANNEL

When power-up is completed, the system is automatically locked onto the satellite that was last selected and saved prior to system shutdown.

➢ **To select a different Satellite:**

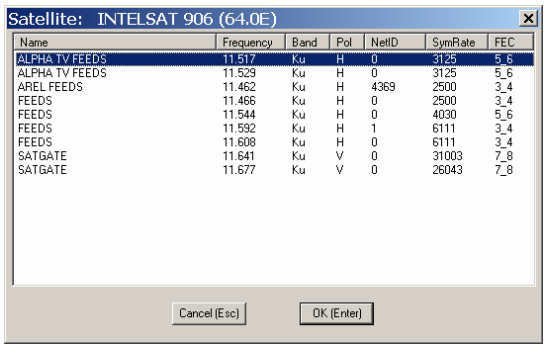
1. Type <1> for the DO MENU bar (or click on DO), Type <S> for SATELLITE (or click SATELLITE).

The SATELLITE window appears.



2. Click on the desired satellite, and select it by pressing ENTER or clicking OK.

The SATELLITE window appears, listing the available selected-satellite tracking control channels. **Disregard this window-by pressing enter.**

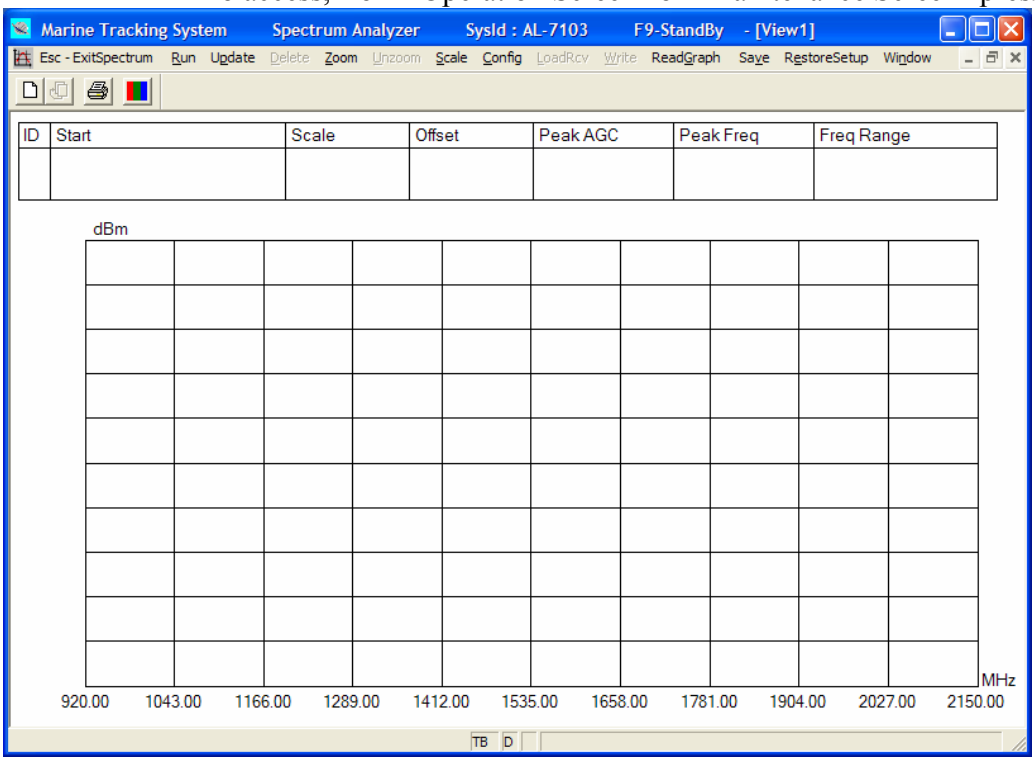


To select the optimal tracking frequency use the Spectrum Analyzer Screen (SAS) as described below.
Remember that the receiver incorporated in the SBC is a Wide-band receiver, and looking on signals narrower then a few MHz of bandwidth may be not feasible

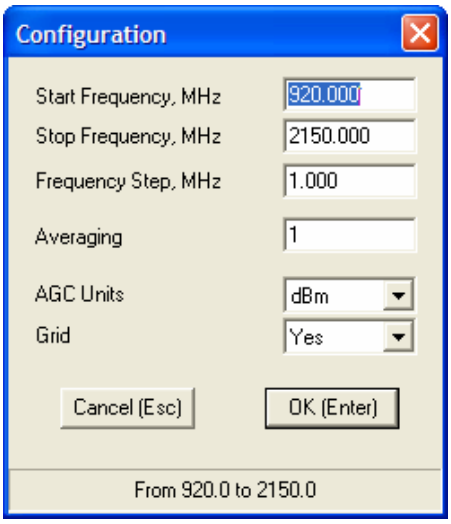
When selecting the tracking frequency also take notice that it may be resident also on the adjacent satellite. If such a frequency is selected, the antenna will wonder off to the other satellite. In that case – return the antenna back to it nominal satellite view angle by the "Point-to-Sat" command and use the SAS to pick another frequency.

3. Spectrum Analyzer Screen (SAS) for Viewing Wide-Band Satellite Spectrum.
   The Spectrum Analyzer screen will only work with Wide-band tracking receiver selected.

   To access, from "Operation Screen" or "Maintenance Screen" press "R"



To configure the Spectrum Analyzer measurement, press “C”:



Start and Stop frequency values may be used to set up a full or partial range of measurement.

For Ku-Band full range is: 920 to 2150 MHz

For C-Band full range is: 950 to 1450 MHz

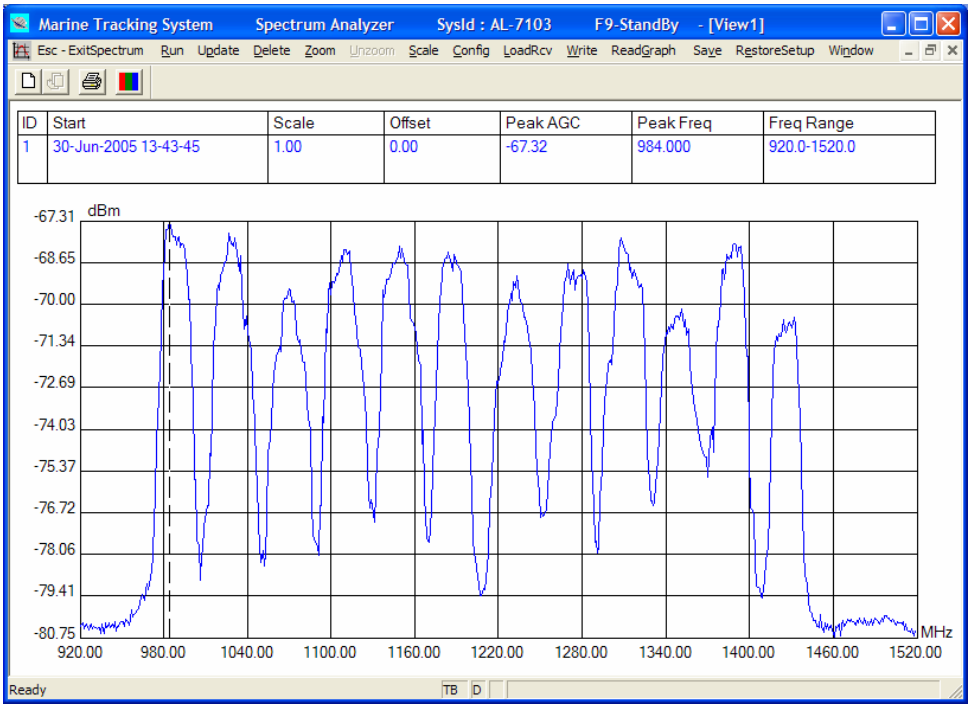
Frequency Step may be set up to as fine as 0.125 MHz, but one mast take into consideration that the measurement time will rise proportionally.

A scan of full Ku-Band range in 1MHz steps without averaging (Averaging set to 1) takes about 3-4 seconds
To make a measurement, one must first make sure that the system is not in "Step-track". The reason for this is that "Step-track" is using the Tracking receiver resource. If the system is currently in "Step-track" – turn it to "Peak".

To run the Spectrum Analyzer measurement press "R".

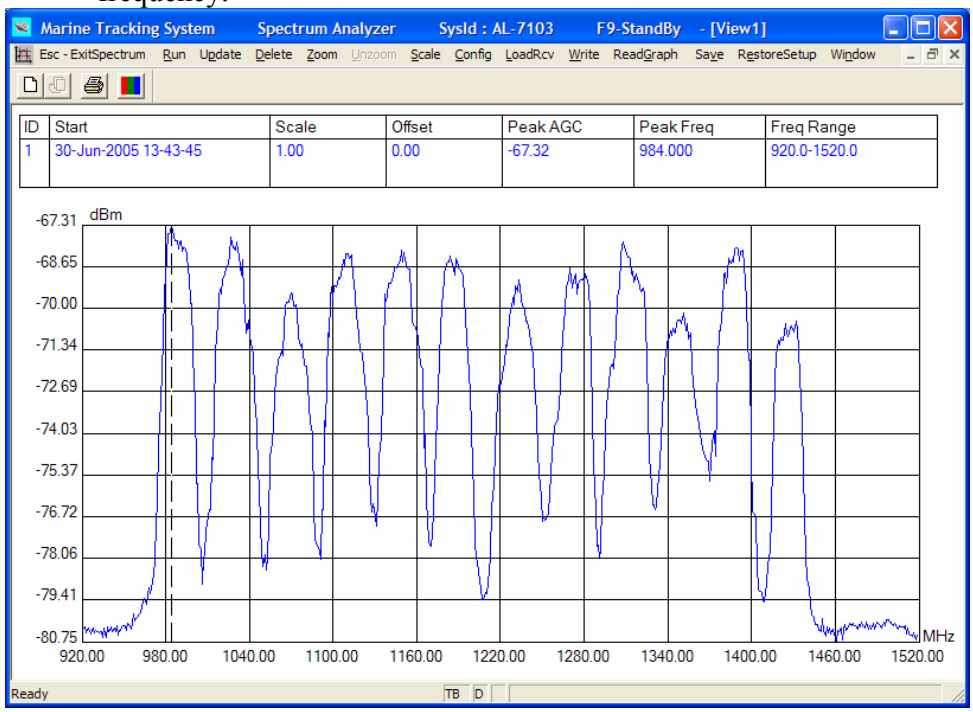
To Store a recorded Pattern, press "W" then select a filename and save.

Below find an example of a Satellite Spectrum recording:



Satellite: Arabsat 26.0 East, C-Band, Linear Pol Satellite as seen with Circular Pol antenna

4. Using SAS to Select Optimal Tracking Frequency for Wide-Band Receiver
   Once a Satellite Spectrum is presented on the Spectrum Analyzer Screen (see paragraph above), a vertical dotted line marks the highest-level frequency:

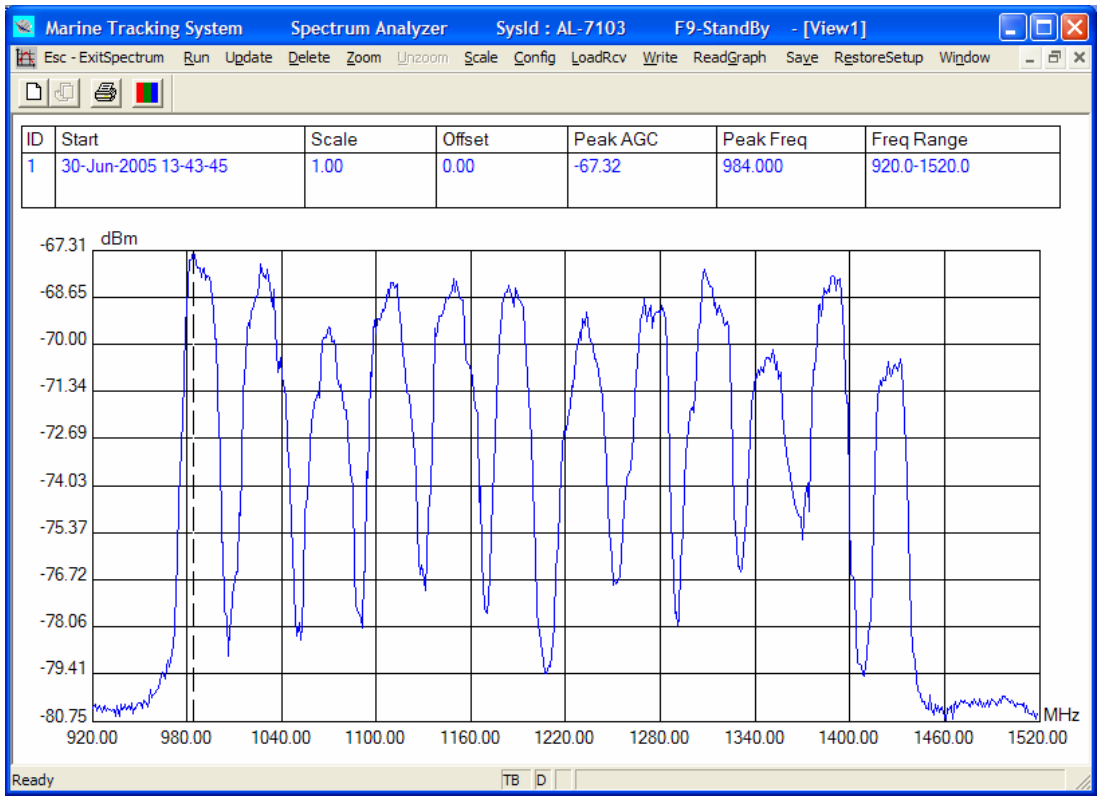


This frequency is also stated as “Peak Freq” at the top of the screen: 984.000 MHz. If the “LoadRcv” function is activated, this frequency will be loaded into the tracking receiver.
Now, check by exiting the Spectrum Analyzer screen and viewing the “Receiver” sub-window in Maintenance Screen. Selected “Freq” will be: 984.000 MHz

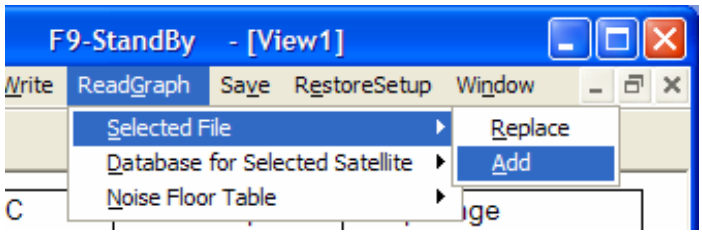
5. Using SAS for Satellite Identification

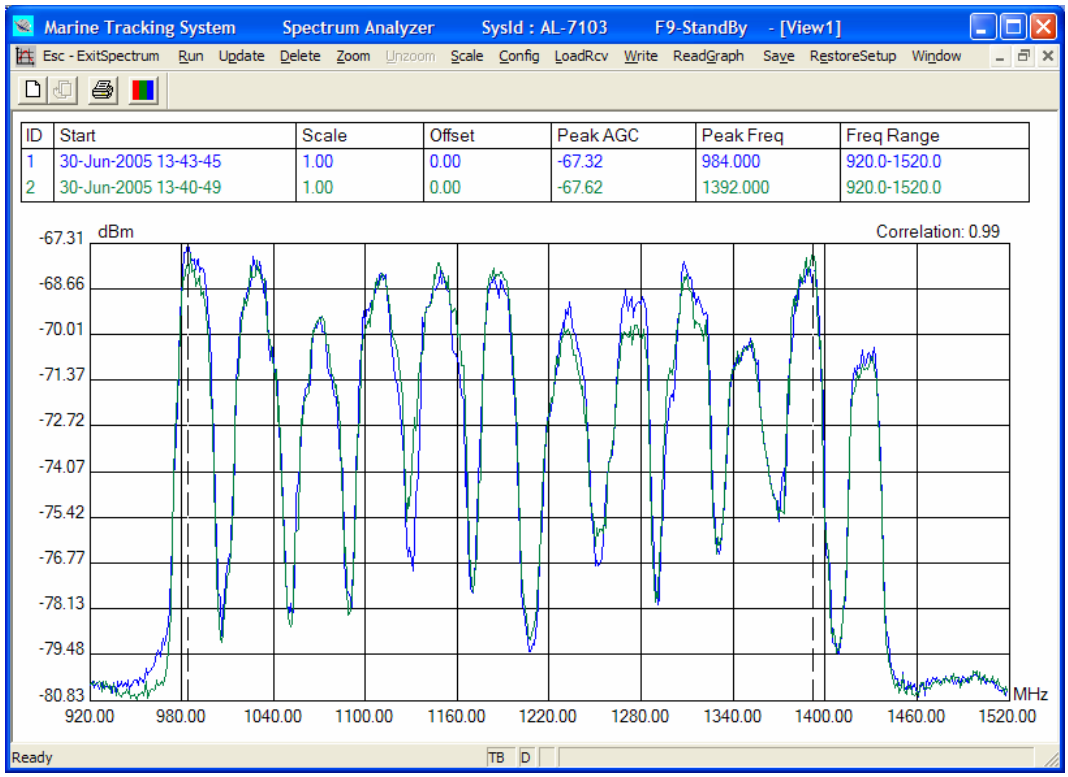
   Spectrum Analyzer Screen may also be used to help identify a satellite. This may be done by comparing a measured pattern with a stored reference pattern.

   First measure the current satellite pattern:



Press “G” to recall previously saved pattern and add it to the same graph:





In the given example it is pretty obvious that the measured satellite is indeed the same satellite which pattern was saved as a reference.

If the two curves are not so obviously similar, one may use the “Correlation” number, which is calculated and presented on the upper right corner. In the case above the Correlation is 0.99 out of 1.00.
Usually Correlation of over 0.8 means positive satellite identification.

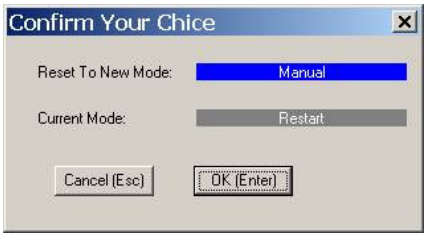
2.4. MOVING THE ANTENNA USING MANUAL MODE

The following procedure is used for maintenance and testing purposes, or for finding the satellite when the system does not acquire it automatically.

➢ **To move the Antenna in Manual Mode:**

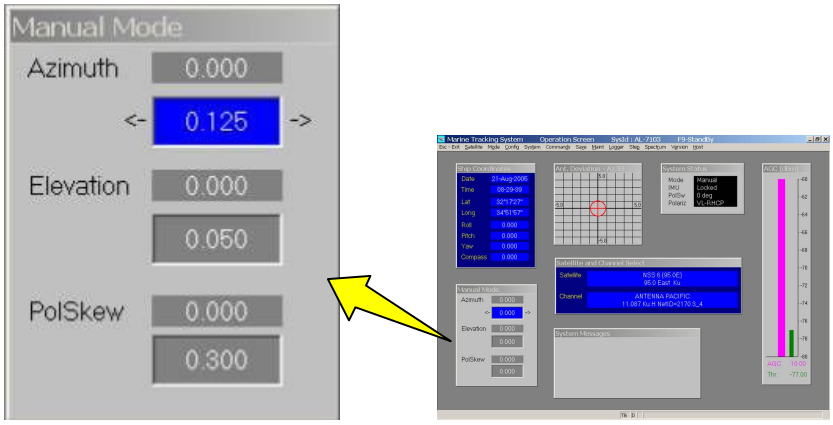
1. From the menu bar, select DO MENU and click MANUAL.

   The CONFIRM YOUR CHOICE window appears.



2. To confirm, press ENTER or click OK.

   MANUAL MODE window appears at the bottom left corner of the OPERATION screen.



3. To move the antenna to any direction, use the up/down arrow keys or the mouse to highlight the pertaining axis bottom-field, and use the right/left arrows or the mouse to increase/decrease the angle in step increments.

   For each axis (Azimuth, Elevation and PolSkew).

   The MANUAL MODE window provides two display fields: the upper field displays the current angle of the axis, and the bottom one displays the new manually changed angle.

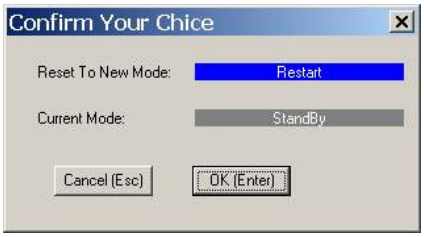
2.5. RESTARTING THE SYSTEM

If the system did not complete the Auto Start sequence, or you want to initialize the system, use the following steps:

➢ **To restart the system:**

1. From the menu bar, select DO MENU and click RESTART.

   The CONFIRM YOUR CHOICE window appears.



2. To confirm your command, press ENTER or click OK. The system will initialize the Pedestal X, Y and Z encoders and initialize the IMU for 6 minutes.

- While the Restart is in progress you can not operate the system, a message will appear on the System Messages window: 'Auto Restart in Progress', The IMU will countdown for 6 minutes. After the IMU countdown will finish, the system will lock on the last saved satellite.

2.6. MANUAL SETTING OF HEADING

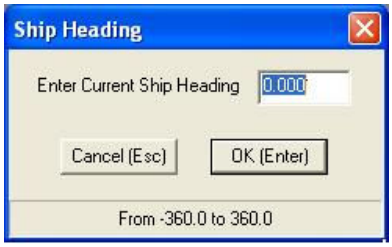
Manual setting of heading is needed if:

- Ship's compass is either inactive or not yet connected (ex: in midst of system installation)

➢ **To Set the Heading:**

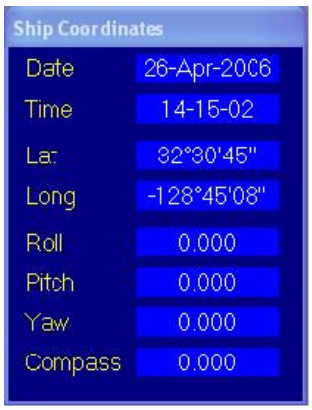
1. From the menu bar, select DO MENU and click SETCOMPASS.

   The SHIP HEADING window appears.



2. To confirm, press ENTER or click OK.

   The system will update the Ships Heading.



For incremental compass types (Step-by-Step, Synchro 36:1, Synchro 360:1), a start value of the compass may be set.

- For absolute type, (NMEA-0183, Synchro 1:1), a default compass value may be set. This value will prevail until a valid compass update is received.
- When entering a Compass value, it might affect the accuracy of the IMU X Y Z sensors. It is then recommended to run the System Restart process again.

2.7. ACTIVATING STEP-TRACK MODE

The Step-Track mode is automatically activated under normal working conditions. However, if you need to manually activate it for maintenance and testing purposes, perform the following steps.

Make sure you are on the correct satellite with the correct tracking channel.

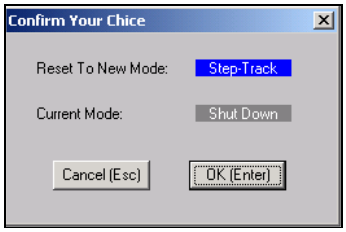
Make sure the AGC level is above the noise floor (-80 dBm).

Make sure the AGC is above the Threshold. If the AGC is below the Threshold the system will go automatic to Search mode after 60 second of Step track.

➢ **To activate the Step-Track Mode:**

1. From the menu bar, select DO Menu and click Step Track.

   The Confirm Your Choice window appears.



2. To confirm, press ENTER or click OK.

   The system will switch to STEP TRACK mode.

2.8. MANUAL SETTING OF GPS LAT/LONG LOCATION

If for some reason there are no GPS position updates, or the GPS is Malfunctioning/Disconnected you can enter the ship's position manually.

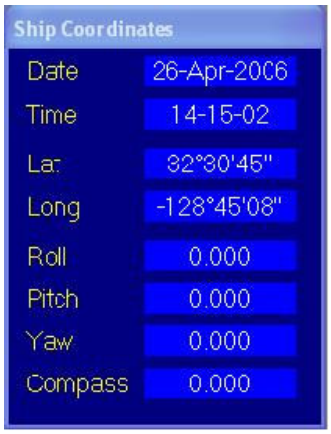
- **To enter the GPS position manually:**

1. From the menu bar, select DO MENU and click SETGPS.

   The CONFIRM YOUR CHOICE window appears.

2. To confirm, press ENTER or click OK.

   The GPS position will update.



The Latitude and Longitude angles are entered in their decimal form, meaning that +32.5125 degree Latitude are actually 32 deg 30 minutes 45 seconds of arch North to Equator, while –128.7523 degrees Longitude are actually 128 degrees 45 minutes and 8 seconds of arch West of Greenwich.

To make those calculations you must remember that 1 degree of arch is divided into 60 minutes, while each minute of arch in turn contains 60 seconds, so that each degree of arch actually contains 3600 seconds.

32.5125 degrees of Latitude are 32 degrees and 0.5125*3600 = 1845 seconds.

1845 seconds are 1845/60 = 30 minutes and 0.75 * 60 = 45 seconds. The fact that 32.5125 Latitude is a positive number means that it's given North of the Equator. 32.5125 degrees of Latitude are therefore 32 degrees 30 minutes and 45 seconds North of Equator.

Similarly it may be shown that –128.7523 degrees translate to 128 degrees 45 minutes and 8 seconds of arch. The fact that it is a negative number means that it is given West of the Greenwich line.

2.9. CLEAR GPS

The above command is used to initialize GPS data when A GPS-related error message is displayed

- **To Clear the GPS:**

1. From the menu bar, select DO MENU and click CLEARGPS.

   The CONFIRM YOUR CHOICE window appears.

2. To confirm, press ENTER or click OK.

   The GPS receiver is reset. All GPS readings will be lost for a few minutes, until the GPS is relocated.

2.10. SETTING AGC THRESHOLD

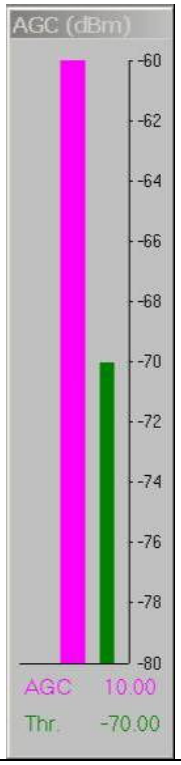
➢ **To set the AGC Threshold:**

1. From the menu bar, select DO MENU and click SET THRESHOLD.

The SET THRESHOLD LEVEL window appears.

2. Type in a new value (in dbm) into the window, and to confirm, press ENTER or click OK.

The THRESHOLD LEVEL is updated.



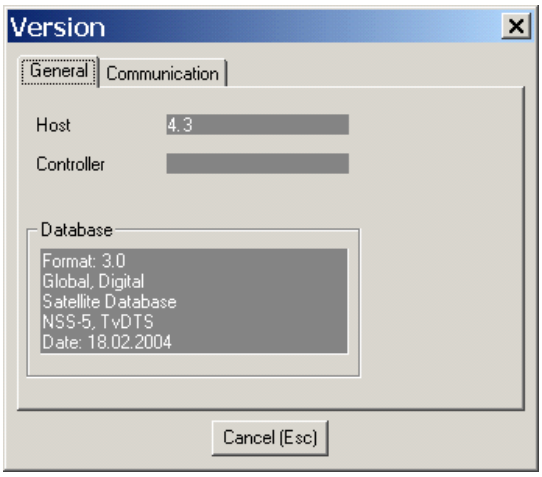
The THRESHOLD LEVEL should be approx 5 dB below the maximum AGC level

2.11. VIEWING SOFTWARE VERSION DETAILS

➢ **To view the software version details:**

- From the menu bar, select DO MENU and click SHOW VERSION.

The VERSION window appears, listing version numbers and dates of the PROGRAM and COMMUNICATION software modules.



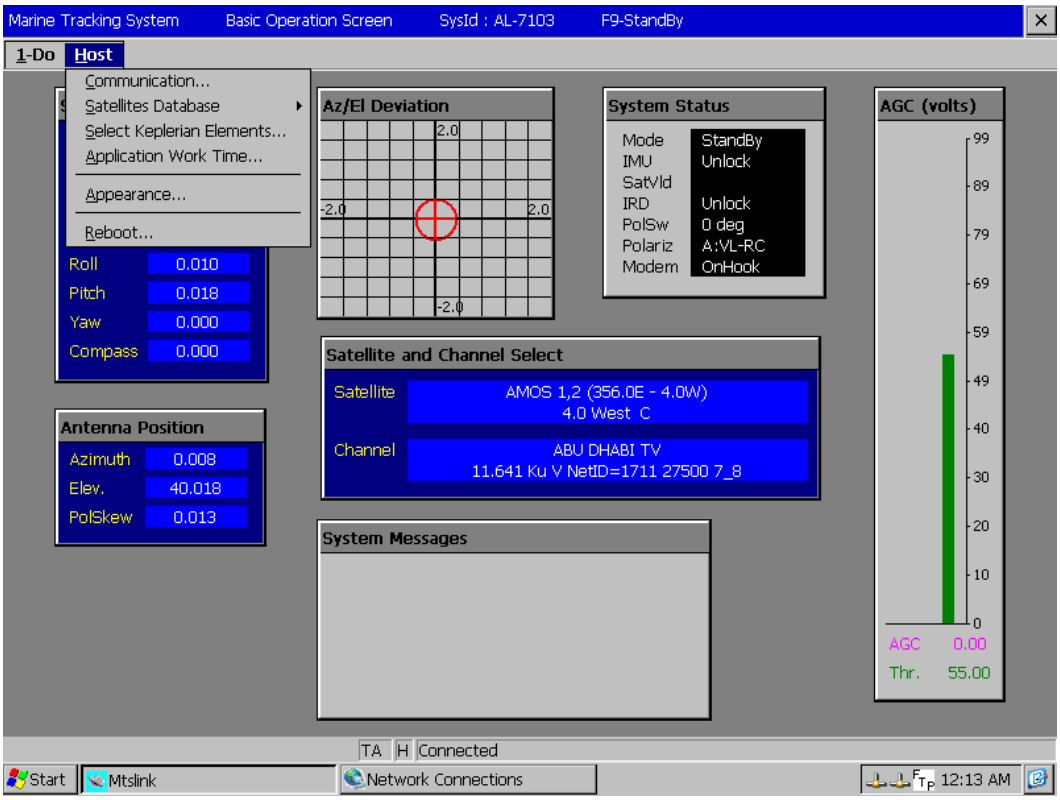
For proper CCU- Controller (SBC) communication, the Program and Communication versions installed on both units should be the same, respectively.

2.12. USING HOST MENU

➢ **To use the Host menu:**

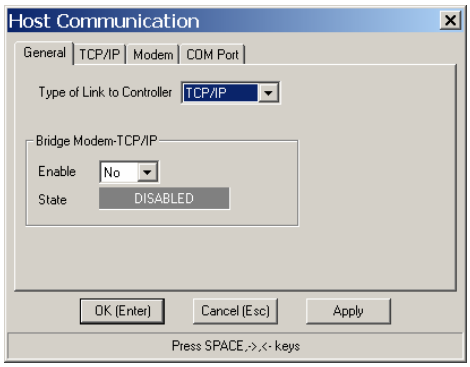
Type <H> or from the menu bar, click HOST.

The HOST sub-menu appears.



1. To use the **COMMUNICATION** functions, click the COMMUNICATION.

The HOST COMMUNICATION screen appears.



In order to update the SBC IP address, click on the TCP/IP tab and update.

The SBC IP address by default is always: 192.9.200.10.

2. To use the **SATELLITE DATABASE** functions, click the SATELLITES DATABASE option.

The SATELLITES DATABASE sub-menu appears.

The Satellite data base is loading automatically from the controller (SBC) when the communication between the CCU and SBC is initiated.

2.13. STOW AND SHUT-DOWN SEQUENCE

➢ **To Stow the system:**

1. From the menu bar, select DO MENU and click STOW.

   The STOW window appears.

2. To confirm, press ENTER or click OK.

   The system will switch to STOW mode - the antenna moves to the pre-defined Stow position and then halts. In this situation the IMU is unlocked and the antenna is not stabilized.

3. Turn OFF the power switch.

The Stow mode is used to move the system into a certain position, to allow an easy accessibility for maintenance on the ADE.

3. ADVANCED OPERATION

3.1. INTRODUCTION

This section describes the advanced control functions of the Controller Software.

CAUTION

Only authorized and qualified personnel (installation and service personnel) are allowed to use the advanced functions. System operators are not allowed to perform advanced functions.

3.2. ACCESS TO ADVANCED CONTROL FUNCTIONS

1. While in the Basic Operation screen, press the "O" key. The password window appears:

2. Enter the password. The Operation screen is displayed (refer to the following figure).

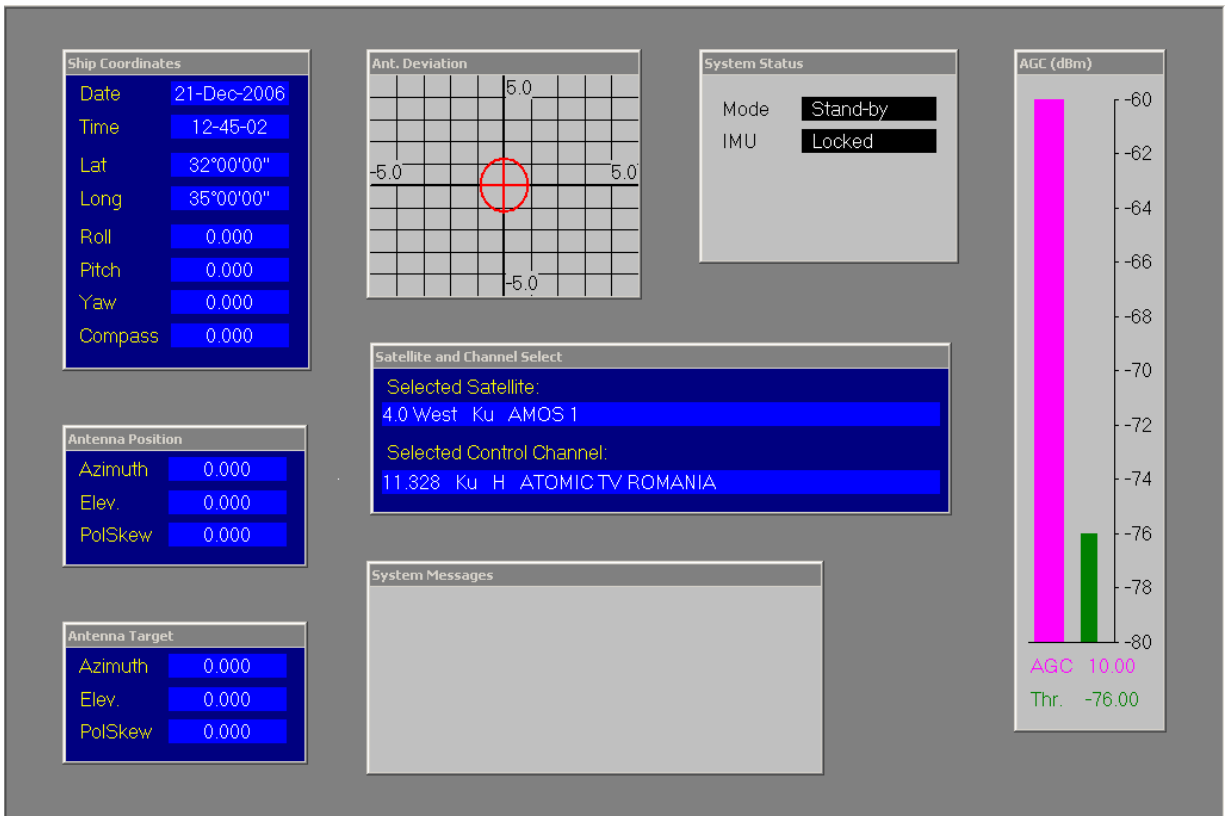


Figure 27. Operation Screen

3. The Operation Screen menu presents the available advanced functions. Each function can be accessed by selecting the option or by pressing the appropriate shortcut key. Refer to the following table.

NOTE

To return to the Operation screen from any one of the advanced screens press the "Esc" key; to revert to the Basic Operation screen press the "U" key.

Table 3. Advanced Operation Modes

Menu Option	Shortcut Key	Function	Description
Esc-Exit	<ESC>	Exit	Terminates the application.
Satellite	S	Satellite Selection	Invokes the Satellite Selection procedure. Same as in Basic Operation screen.
Mode	O	Operation Modes	Allows to change current operating mode of system, by selecting an available mode from a list: • Standby – Places the system in the standby mode and stops all current operations • Manual – Allows operator to move the antenna in Azimuth and Elevation (operates by left and right arrow keys selection) • Restart – Manually restarts system • Preset – Sends antenna to a pre-defined position. Allows to enter settings for: Azimuth (-180 - 180°), Elevation (0.0 - 90.0°), Polarization • Search – Starts system search for a satellite in a round spiral trajectory • Peak – Tells the system to go to the peak received signal determined by the step-track • Step Track – This is the systems normal operating mode. Starts the system step track function to determine peak receive signal • Pnt to Sat – Sends the antenna to the last calculated position on the current satellite selection • Encoder init – Initializes all system encoders • Test Traj – Starts the positioner on a pre-determined test program • Box Scan – Starts system search for a satellite in a rectangular spiral trajectory • Acquire – Initiates the Pnt-to-Sat and then Step Track mode

Table 3. Advanced Operation Modes

Menu Option	Shortcut Key	Function	Description
			• Satellite Preset – Sends the antenna to a satellite according to its location on the geo-synchronic arc • Stow – Sends the antenna to a stow position • Stow Up - Sends the antenna to its Zenith position (x=y=0 degrees) • Slave - Sends the antenna to an Azimuth/Elevation position received from a host computer via communication link.
Logger	L	Data Logger	The Data Logger is a data recorder, which can monitor and record information from over 200 points in the system. Up to 4 different tracks can be recorded and viewed at any one time. The overall sample time can be varied as can the scale of the display. In addition the Data Logger can be set-up in advance and set to trigger at a given change in system performance.
Save	V	Save Configuration	Allows saving various system configuration changes that have been made.
Maintenance	M	Maintenance	Presents detailed system information and technical data relating to the pedestal axes, Receiver, GPS and SDU power. For each axis, the maintenance screen allows monitoring and changing of operational parameters, changing individual axis modes, and enabling system's Calibration and Alignment.
Config	C	Operational Configuration	Allows configuration of system modes such as: Manual Mode (change azimuth increment size), Search Mode (change sector step, velocity for azimuth), Step-Track, etc.
SystemConfig	T	System Configuration	Allows changes to system parameters such as: General parameters, GPS, Set clock, etc.
Commands	D	Commands	This menu provides quick access to several commands, such as SetGPS, IMU Init, etc.

Table 3. Advanced Operation Modes

Menu Option	Shortcut Key	Function	Description
StepTrack	P	Step Track	This screen provides a graphical display of AGC variations while the step track mode is activated. This display clearly shows the small step-track displacements, at both the Azimuth and Elevation antenna axes.
---	U	Basic Operation	Reverts to the Basic Operation screen.

4. MAINTENANCE

4.1. INTRODUCTION

This section provides instructions and procedures for Organizational Level (O-Level / Shipboard) Maintenance of the TV-DTS system.

4.2. TOOLS AND TEST EQUIPMENT

The TV-DTS system does not require any special tools or test equipment for maintenance.

Use the following standard tools and equipment to accomplish prescribed maintenance:

- Philips screwdriver, #2
- Flat-blade screwdrivers, set of small and large
- Open-ended wrenches
- Allen wrenches, standard set of small ones (inches)
- Allen wrench, standard set of small ones (metric)
- Locking compound, LocTite 270
- Multi Meter
- Flashlight.

4.3. PREVENTIVE MAINTENANCE

4.3.1. Semi-Annual Inspection

The Above Deck Equipment (ADE) of the TV-DTS system should be visually examined twice a year, using the following procedure:

- Turn OFF power to the ADE.
- Remove the radome hatch; Check the radome hatch interlock mechanism for proper operation.
- Open the radome hatch or remove the radome completely.

CAUTION

Although the kevlar radome is light, three people are needed to lift it since the radome is bulky and will act as a sail in wind.

- Visually inspect the cables for rubbing or chafing.
- Check the inside of the radome for excessive moisture and/or corrosion.
- Verify that there are no screws, nuts, washers lockwashers or other parts in the radome base.
- Check feed tightness.
- Check for areas of chipped or peeling paint. Use only non-metallic paint for touch-up painting.
- Verify that all assembled nuts and bolts are secured and tightened. If nuts and bolts are loose, apply LocTite 270 and fasten them.
- Install and secure the radome to the radome base.

NOTE

If the system has not been operated within the last 30 days, it should be initialized and operated to verify proper operation and acquisition capabilities.

4.3.2. Yearly Maintenance

Replace the dessicant cartridge (Hydra crystal bag) inside the SDU and the PSU.

NOTE

The TV-DTS system does not require any lubrication.

4.4. ERROR MESSAGES

In case of a malfunction, the CCU displays a Message, Warning or an Error, depending on the malfunction classification.

The messages are classified into three categories, each identified by a different color:

- Message - green (e.g. System Shut-Down, Pedestal Y Axis Jammed)
- Warning – blue (e.g. Compass Communication Failed)
- Error –red (e.g. Pedestal X Axis Encoder Fault).

The following Table lists all the messages.

Table 4. Troubleshooting Guide- CCU Messages

Message	*Possible Cause*
Error Messages	
"Error: SDU/IMU Power out of tolerance"	IMU +5VDC, or the Servo Drive power indications exceeded the predefined tolerance limits
"Error: Restart timed out"	The system was not able to complete the restart routine in the predefined time (normally set to 10 minutes)
"Error: Pedestal X Axis Jammed"	No movement is recorded from Pedestal X-axis encoder, while the controller produces a steering command
"Error: Pedestal Y Axis Jammed"	No movement is recorded from Pedestal Y-axis encoder, while the controller produces a steering command
"Error: No Maintenance Configuration File"	The SBC couldn't find the Maintenance Configuration file in its Flash memory (disk C:\), on power-up.
"Error: No Operational Configuration File"	The SBC couldn't find the Operational modes Configuration file in its Flash memory (disk C:\), on power-up.
"Error: No Satellite Database File"	The SBC couldn't find the Satellite Database file in its Flash memory (disk C:\), on power-up.

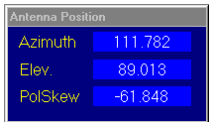
Table 4. Troubleshooting Guide- CCU Messages	
Message	***Possible Cause***
"Error: No System Configuration File"	The SBC couldn't find the System Parameters Configuration file in its Flash memory (disk C:\), on power-up.
"Error: No Valid IMU Calibration File"	The SBC couldn't find the IMU Calibration file in its Flash memory (disk C:\), on power-up.
"Error: Satellite File Read Error"	The SBC couldn't read the Satellite database file from its Flash memory (disk C:\), during operation.
"Pedestal X Axis Encoder Fault"	X-axis Encoder communication failure.
"Pedestal Y Axis Encoder Fault"	Y-axis Encoder communication failure.
"Error: SBC Pwr/Tmpr out of tolerance"	One of the SBC power indications (+5v,+/-12v,+2.5v etc.) exceeded the predefined tolerance limits. This error will also appear if the SBC internal temperature exceeded its tolerance limits.
Warning Messages	
"Warning: LNB Power Over-Current"	The controller 13/18VDC power supply, feeding the LNB is overloaded
"Warning: Compass Communication Failed"	No valid communication frames were received on the NMEA-0183 compass Com port for over 1.5 seconds.
"Warning: GPS Communication Failed"	No valid communication frames were received on the GPS Com port for over 5 seconds.
"Warning: No GPS Position Updates"	No GPS position-fix frames were received on the GPS Com port for over 30 seconds.
"Warning: System not initialized"	The AL-7103 didn't undergo the process of initialization which includes all axes Encoder init as well as IMU init.
"Warning: LNB voltage out of tolerance"	The controller 13/18VDC power supply, feeding the LNB, is exceeding its predefined tolerance levels

Table 4. Troubleshooting Guide- CCU Messages	
Message	***Possible Cause***
"Warning: Antenna view blocked"	The Antenna has moved into one of the predefined blockage areas
"Warning: No communications with host"	The communications with the host computer, identified by a predefined IP address, has timed-out (10 seconds).
"Warning: Signal below threshold"	The controller signal strength indication (AGC) on the selected frequency is lower then the predefined threshold level.
"Warning: IMU-ACU Communication Fault"	The communications between IMU and the controller has timed-out.
"Warning: Receiver Cal Table not Found"	The SBC couldn't find the internal wide-band receiver linearization calibration file in its Flash memory (disk C:\), on power-up.
"Warning: X-Axis Forward Limit"	The position encoder readout of the X-axis exceeded its Forward Limit configuration definition.
"Warning: X-Axis Reverse Limit"	The position encoder readout of the X-axis exceeded its Reverse Limit configuration definition.
"Warning: Y-Axis Forward Limit"	The position encoder readout of the Y-axis exceeded its Forward Limit configuration definition.
"Warning: Y-Axis Reverse Limit"	The position encoder readout of the Y-axis exceeded its Reverse Limit configuration definition.
"Warning: Tracking Error Exceeds Limit"	Tracking Error Exceeds Limit.
Messages (Information)	
"Auto-Restart in progress"	System is going thru initialization stage including – IMU init, Encoder init and optionally, Satellite acquisition
"Acquiring a Satellite"	System is currently acquiring a satellite
"System no initialized"	Encoder and IMU were not yet initialized.

Table 4. Troubleshooting Guide- CCU Messages	
Message	***Possible Cause***
"System Shutdown"	System was shut down
"System Shutdown, Ped-X Jammed"	System was shut down due to "Pedestal-X Jammed" fault (No. 36)
"System Shutdown, Ped-Y Jammed"	System was shut down due to "Pedestal-Y Jammed" fault (No. 37)
"System Shutdown, Ped-X Encoder"	System was shut down due to "Pedestal-X Encoder Fault" (No. 8), or "Pedestal-X NE2 Encoder Fault" (No. 104), or "Pedestal-X NE2 Enc Init Fault" (No. 111)
"System Shutdown, Ped-Y Encoder"	System was shut down due to "Pedestal-Y Encoder Fault" (No. 9), or "Pedestal-Y NE2 Encoder Fault" (No. 105) or "Pedestal-Y NE2 Enc Init Fault" (No. 112)
"System Shutdown, Power Loss"	System was shut down due to "SDU/IMU power lout of tolerance" (No. 15)
"System Shutdown, Restart Time"	System was shut down due to "Restart time-out" (No. 17)
"System Shutdown, SBC Power/Tempr"	System was shut down due to "SBC Pwr/Tmpr lout of tolerance" (No. 121)
"System Halted, Axes Jammed"	System has experienced multiple jammed-axis faults. More than 6 occurred in two minutes – the system is therefore halted.

4.5. BASIC TROUBLESHOOTING

- If you experience persistent problems while acquiring a satellite, and ***no error messages appear***, check that all the system parameters are correctly set.
- Check the parameters on the BASIC OPERATION screen in accordance with the following table:

Parameter	Check	Display	Corrective Action
Pitch and Roll	Verify that the readings displayed in the Ship Coordinates fields appear to be abnormal at the dockside (i.e., there is a pitch or roll of 2º and more).		Restart the system.
Latitude and Longitude	Check with Bridge to verify that the parameters displayed in the Ship Coordinates fields are correct.		Carry out a Clear GPS procedure, and check for updates in the Maintenance screen.
Compass heading	Check with Bridge to verify that the parameters displayed in the Ship Coordinates fields are correct.		Check that if necessary, the Compass Offset has been set. For a step-by-step compass, use the Set Compass mode to enter initial values. Otherwise, check that the Compass' wiring is in order.
Visual inspection of antenna	Verify that the antenna appears to be actually pointing in the direction stated in the Antenna Position fields.		Restart the system.

4.6. CORRECTIVE MAINTENANCE

WARNING

DANGER – HIGH VOLTAGE

The SDU contains potentially harmful voltages when connected to the designated power source.

4.6.1. Introduction

Corrective organizational (shipboard) maintenance is limited to the following activities:

- Replacement of SDU Fuses
- Replacement of SDU
- Replacement of pedestal harness.

4.6.2. 90-Days Spare Parts

The system is supplied with spare parts that support a deployed system for up to 90 days. The spare parts are:

- C-Band LNB (x1)

4.6.3. Replacement of SDU Fuses (F1, F2)

To replace a SDU fuse, perform the following procedure:

1. Verify that the SDU is turned OFF.
2. Disconnect Connector P4 from the SDU.
3. Unfasten 4 captive screws securing the SDU top cover to the chassis. Remove the top cover.
4. Use a flat-blade screwdriver to remove the fuse housing by pressing the fuse housing and turning it a half turn counter-clockwise.
5. Remove the base from the fuse housing and put in a new fuse. For F1, use a 4-Amps slow-blow fuse (115V systems), or a 2-Amps slow-blow fuse (220V systems); For F2, use a 1 Amps fuse.
6. Install the fuse housing by pressing it and turning it a half turn clockwise to its locked position.

CAUTION

Setting the SDU voltage selector S2 to the incompatible AC voltage will cause damage to the equipment.

7. Verify that the internal SDU voltage selector S2 is set for the correct AC voltage (115VAC or 220VAC).
8. Install the SDU top cover and fasten 4 screws securing it to the chassis.
9. Re-connect Connector P4 to the SDU.
10. If required, turn the SDU ON.

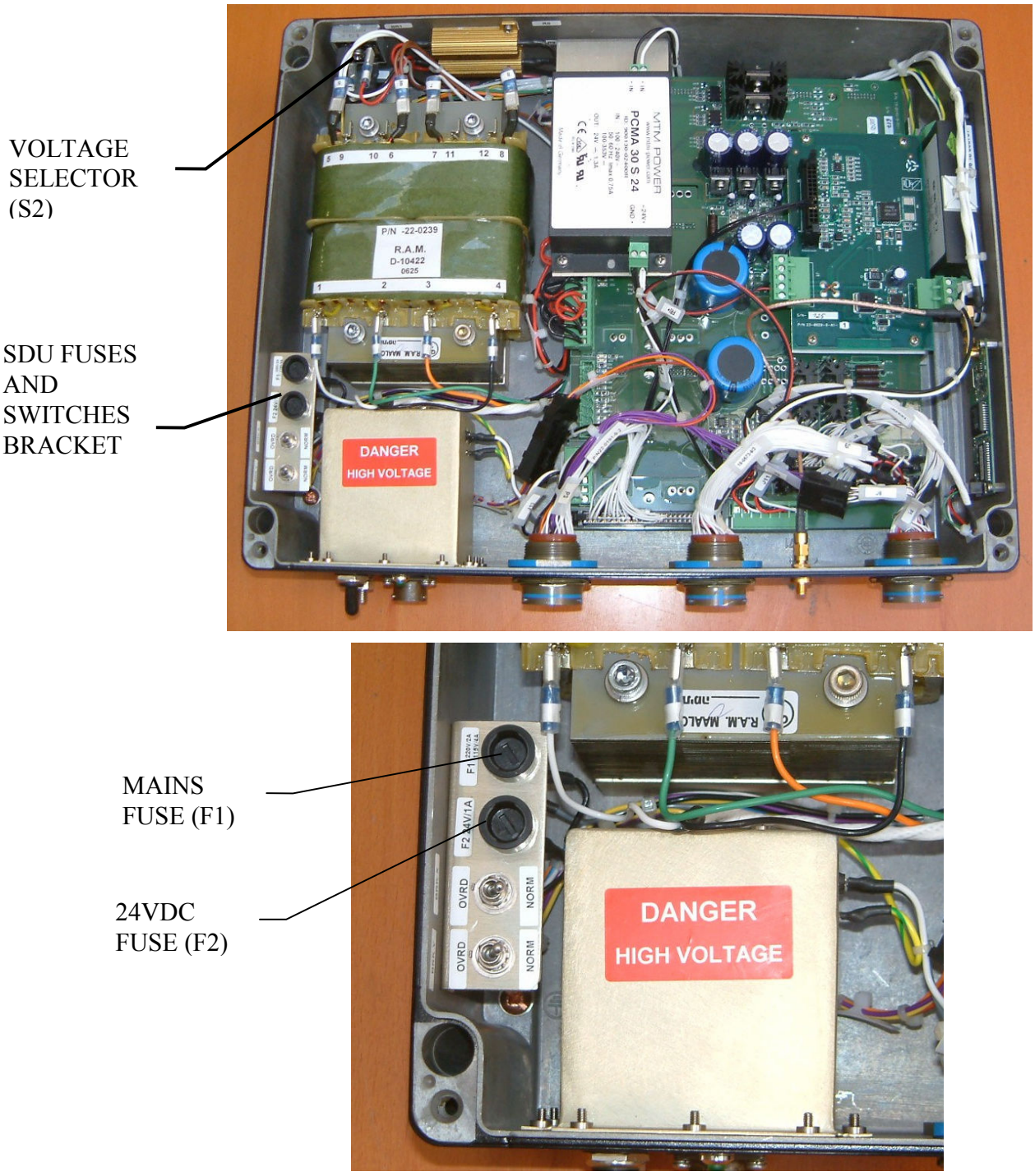


Figure 28. SDU Internal View

4.6.4. Replacement of SDU

To replace the SDU, perform the following procedure:

1. Turn OFF the SDU.
2. Disconnect all cables from the SDU connectors (P1, P2, P3, P4, P5 and Ground jack).
3. Unfasten 4 captive screws securing the SDU top cover to the chassis.
4. Remove 4 bolts securing the SDU to the mounting plate through the holes in the SDU chassis.
5. Place a new SDU on the mounting plate, with its cover removed.

CAUTION

Setting the SDU voltage selector S2 to the incompatible AC voltage will cause damage to the equipment.

6. Verify that the internal SDU voltage selector S2 is set for the correct AC voltage (115VAC or 220VAC).
7. Fasten the SDU to the mounting plate using 4 screws, through the holes in the SDU chassis.
8. Install the SDU top cover and fasten 4 screws securing it to the chassis.
9. Connect all cables to the SDU connectors (P1, P2, P3, P4, P5 and Ground jack).
10. If required, turn ON the SDU.

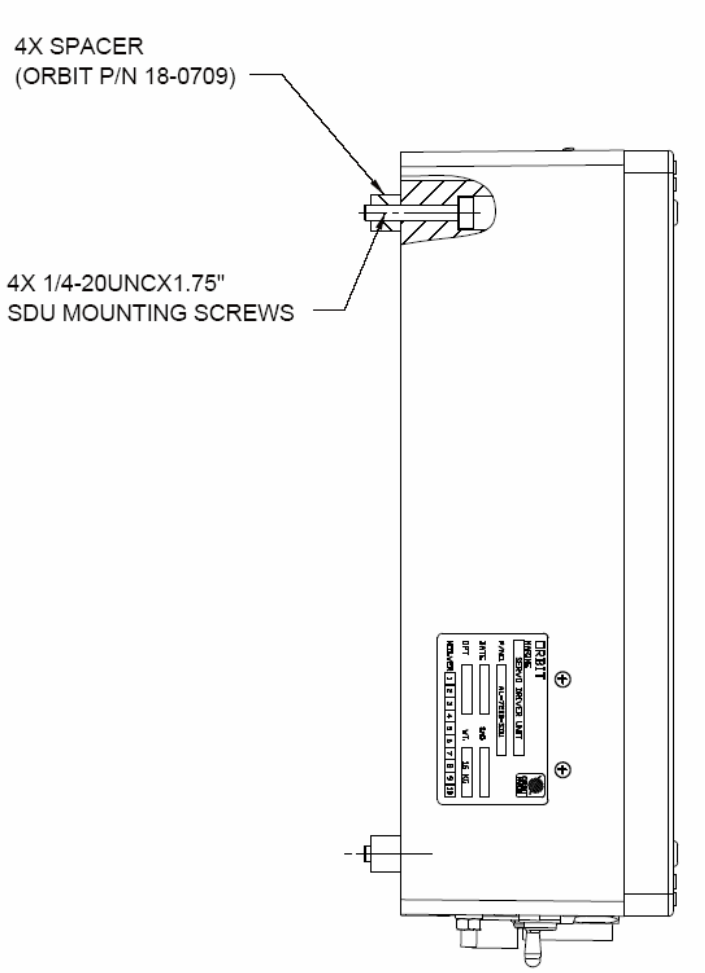


Figure 29. SDU Mounting Screws

4.6.5. Replacement of Pedestal Harness

1. Turn OFF the SDU and the Controller.
2. Disconnect all Pedestal Harness connectors (P14, J2, J6, P51, P52, P91, P92, P3, and P7). Refer to the following Figure.
3. Cut and remove the tie-wraps securing the harness to the pedestal. Remove the Pedestal Harness.
4. Place and assemble a new harness on the Pedestal.
5. Verify that all connections are correct.
6. If required, turn ON the SDU.

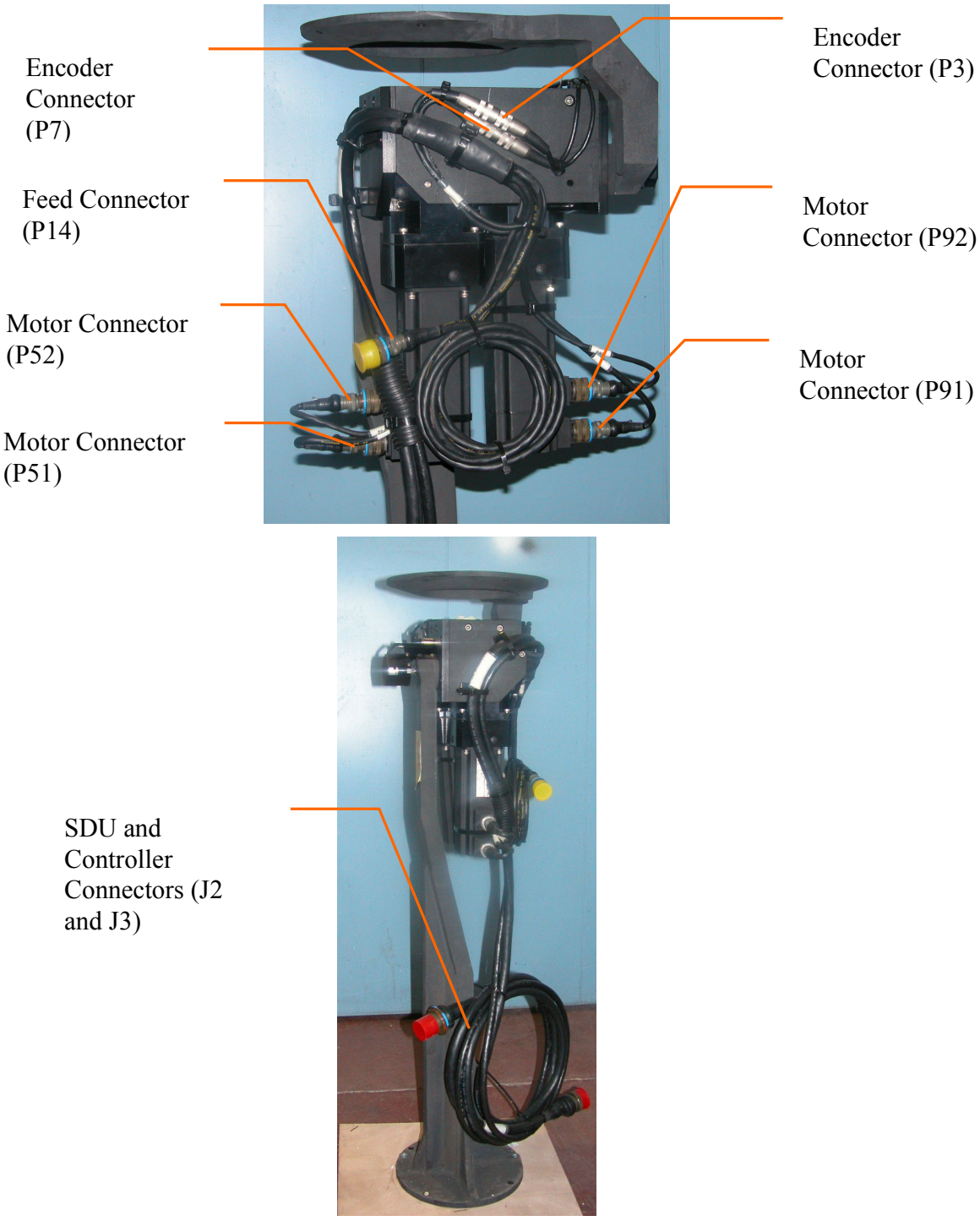


Figure 30. Pedestal Harness Installation

5. INSTALLATION GUIDE

5.1. INTRODUCTION

The purpose of this chapter is to establish the plan, guidelines and procedures for installation the AL-7204-F Marine Stabilized TV-DTS System aboard a designated ship/vessel.

The processes and procedures outlined provide the basic step-by-step structure necessary to successfully accomplish system installation and checkout.

The procedures provided in this chapter are intended for implementation by personnel with a background in electronics, standard shipboard installations, and in-depth familiarity with the operation of the AL-7204-F System. Installing personnel should be totally familiar with the content of this AL-7204-F Technical Manual.

5.2. SEQUENCE OF INSTALLATION

Regardless of the varying installation requirements and working conditions onboard different ships, the following sequence of installation is recommended.

1. **Ship Survey and Installation Planning** - ship's survey and installation planning, including choosing the mounting sites, and preparing an installation plan.

NOTE

Preliminary activities such as system site preparation and installation planning must be pursued before installation operations may be started.

2. **On-Site Unpacking and Inspection** – unpacking and inspection of the system's components at the installation site (harbor or shipyard).
3. **On-Ship installation** –mounting the ADE and BDE on the ship; laying and connecting system cables and wiring (between the system's units); connecting the system to ship's power supply and gyrocompass.
4. **System Power-Up and Setup** - power-up, setup, and testing.
5. **System Commissioning** – commissioning and acceptance of the system.

NOTE

System installation involves the deployment of several units, components and cables on the ship. Since the working conditions are strenuous, the process must be properly coordinated among the installation staff and ship crew.

5.3. SHIP SURVEY

5.3.1. Introduction

A Pre-installation Site/Ship Survey should be conducted. The site survey is very important in that it allows an opportunity to collect valuable information on ship facilities and the parameters affecting installation decisions. This site survey is best conducted with a representative of ship's personnel in attendance.

5.3.2. Survey Report

During the site survey particular attention should be given to requirements for cable runs, available, interfaces to the ship's systems (power, gyro, etc.), intended locations for equipment placement, etc. Upon completion of the site survey, collected data should be incorporated into a Site Survey Report which will detail specific installation processes and include "red-lined' drawings to document pending changes to ships configuration.

During the site survey particular attention should be given to location of both equipment groups associated with the system. These groups are the Above Deck Equipment (ADE) and Below Deck Equipment (BDE).

5.4. INSTALLATION PLANNING

5.4.1. Introduction

Installation planning is one of the most important stages in any installation. Correct planning will lead to a successful installation with minimum trouble before and throughout system operation.

Before installation, make sure that:

1. The ship has been visited and the ship layout was recorded, or a filled-out Survey Report is available.
2. Existing ship layouts have been received, as may be available:
   - Ship's construction plan
   - Ship's electric mains layout and UPS access (if available)
   - Ship's gyro compass interface type, wiring and availability.
3. The following are identified: the ship's power supply voltage, Gyro compass (standard and voltage), and Gyro repeater output (standard and voltage).

CAUTION

The ship's Gyro repeaters may convert the original signals accepted from the compass. Therefore, verify that the appropriate signal is supplied to the system.

Use these data to prepare the installation plan, which should include equipment locations, installation details, cable runs, etc.

5.4.2. Installation by Location

Typically, the system installation is divided into two stages, in respect to the installation place:

- Above Deck Equipment (ADE) Installation
- Below Deck Equipment (BDE) Installation.

5.4.3. Choosing the Best ADE Location

Special consideration must be given to selection of installation locations for the ADE. The following paragraphs describe the special considerations for assessing selected installation sites for the equipment:

- Mechanical stability
- Radome Outline Dimensions
- Line Of Site (LOS)
- Distance between ADE and BDE
- Maintenance access
- Other considerations for proper location.

5.4.3.1. Mechanical Stability

Verify that the mounting surface intended for the ADE is rigid, flat, free of vibration, leveled and stable surface. The mounting surface should be capable of supporting the total equipment weight (about 200 kg).

In addition, the mounting surface should be able to withstand lateral wind loading forces, and should be stable with natural resonance frequency of above 30 Hz.

5.4.3.2. Line Of Site (LOS) Considerations

Line Of Site (LOS) is a straight line between the antenna and the satellite. Obstructions to LOS will typically be the ship's funnels and masts.

Ideally, the optimum ADE site will have no obstructions to the LOS, i.e., clear view of the horizon/satellite all around. However, it is normal that a compromise will have to be made between the required LOS and other considerations.

NOTE

To improve operation, the system should be installed with the X-axis pointed toward an obstruction to satellite visibility. The X-axis direction is marked on the Radome. If no such obstruction exists, it is recommended to install the system with the X-axis pointing toward and aligned with the bow.

5.4.3.3. Radome Outline Dimensions

When selecting the ADE location, be sure to account for the Radome envelope dimensions, as illustrated in the following Figure:

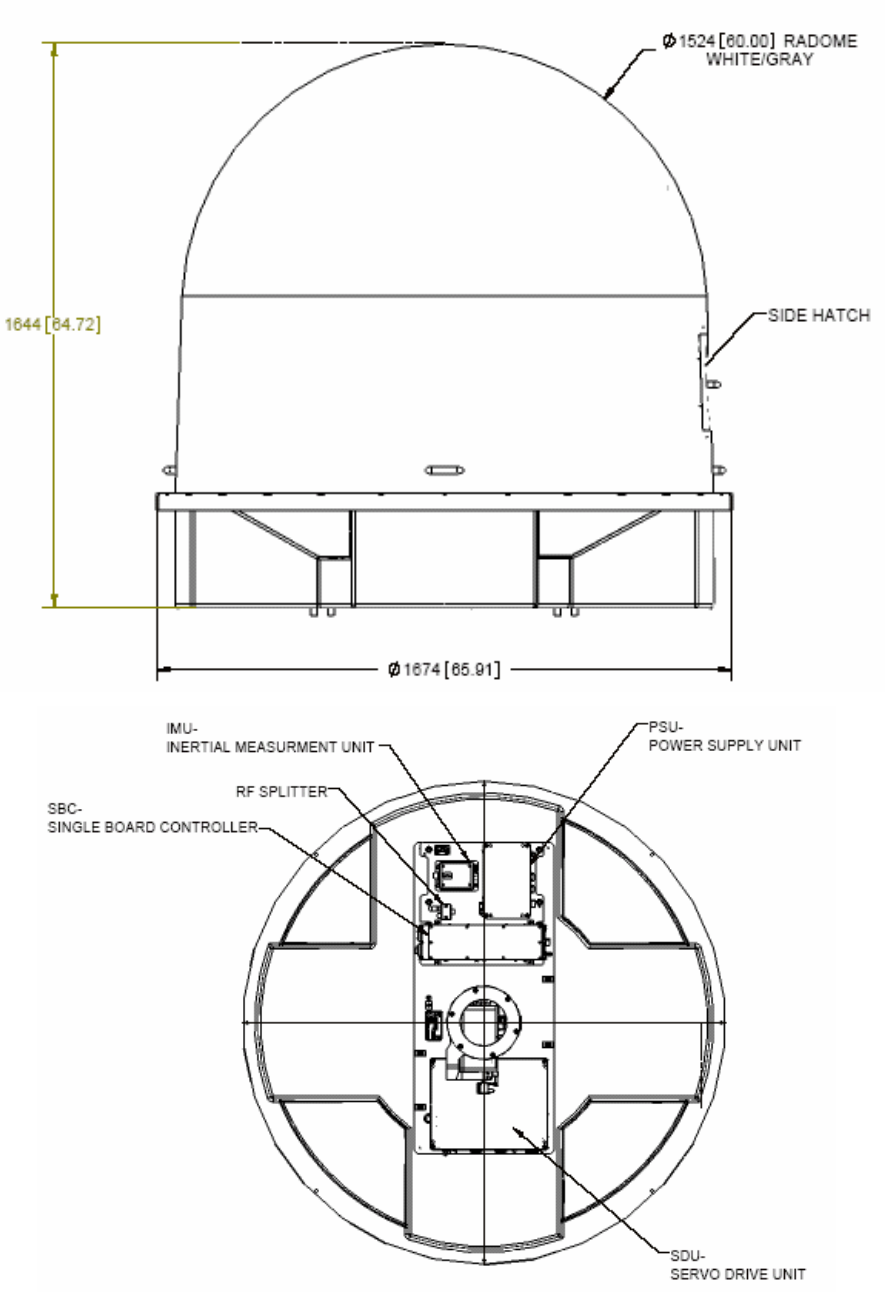


Figure 31. Radome Outline Drawing

5.4.3.4. Maintenance Access

Consideration should be given to allow free-of-obstacles space below the ADE support construction, to allow sufficient maintenance access for technical staff.

5.4.3.5. Other Considerations (for Location Selection)

The following paragraphs provide general guidelines of installation aboard ships:

- The mounting location should not be immediately adjacent to high-power radars or other communication equipment.
- The location selected for installation should have maximum non-blocked hemispheric view down to 10 degrees visibility.
- The orientation on azimuth, given that there is a direction of blockage, is to point the x-axis toward this blockage. To improve operation, the system should be installed with the X axis (horizontal keyhole) pointed toward an obstruction to satellite visibility. The X axis direction is marked by a pointed arrow on the IMU chassis.

5.4.3.6. Power Supply Considerations

It is highly recommended that power supplies to both the ADE and BDE shall be conditioned, preferably with appropriately rated Uninterruptible Power Supply (UPS).

5.4.4. ADE Support Construction

If the need arises to elevate the ADE, the radome can be mounted on an optional structure, supporting the radome with all ADE units installed in it.

The following Figure provides outline drawings of the recommended support construction and mounting plate, which are designed to carry the AL-7204-F System onboard the ship.

NOTE

The holes on the support plate are intended for the bolts securing the Mounting plate to the support construction.

Although it is advisable to use the recommended support, any other construction that shall support the weight of the system and fit the radome base dimensions can be used.

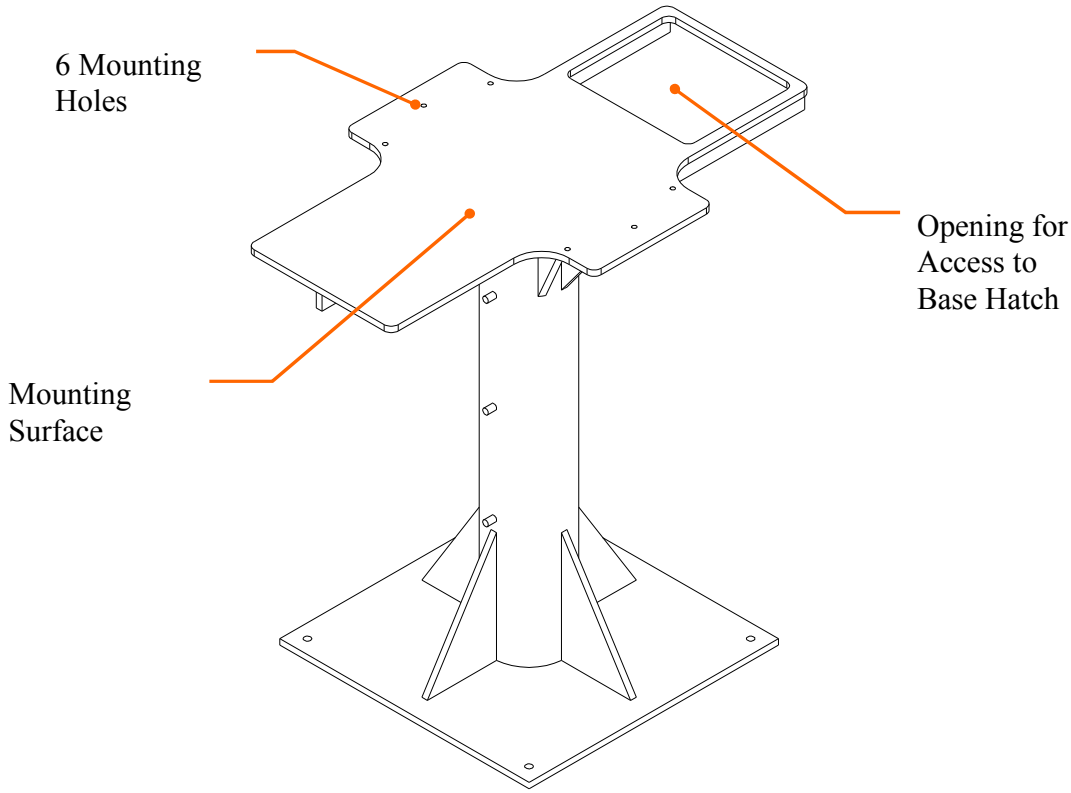


Figure 32. Recommended Support – General View

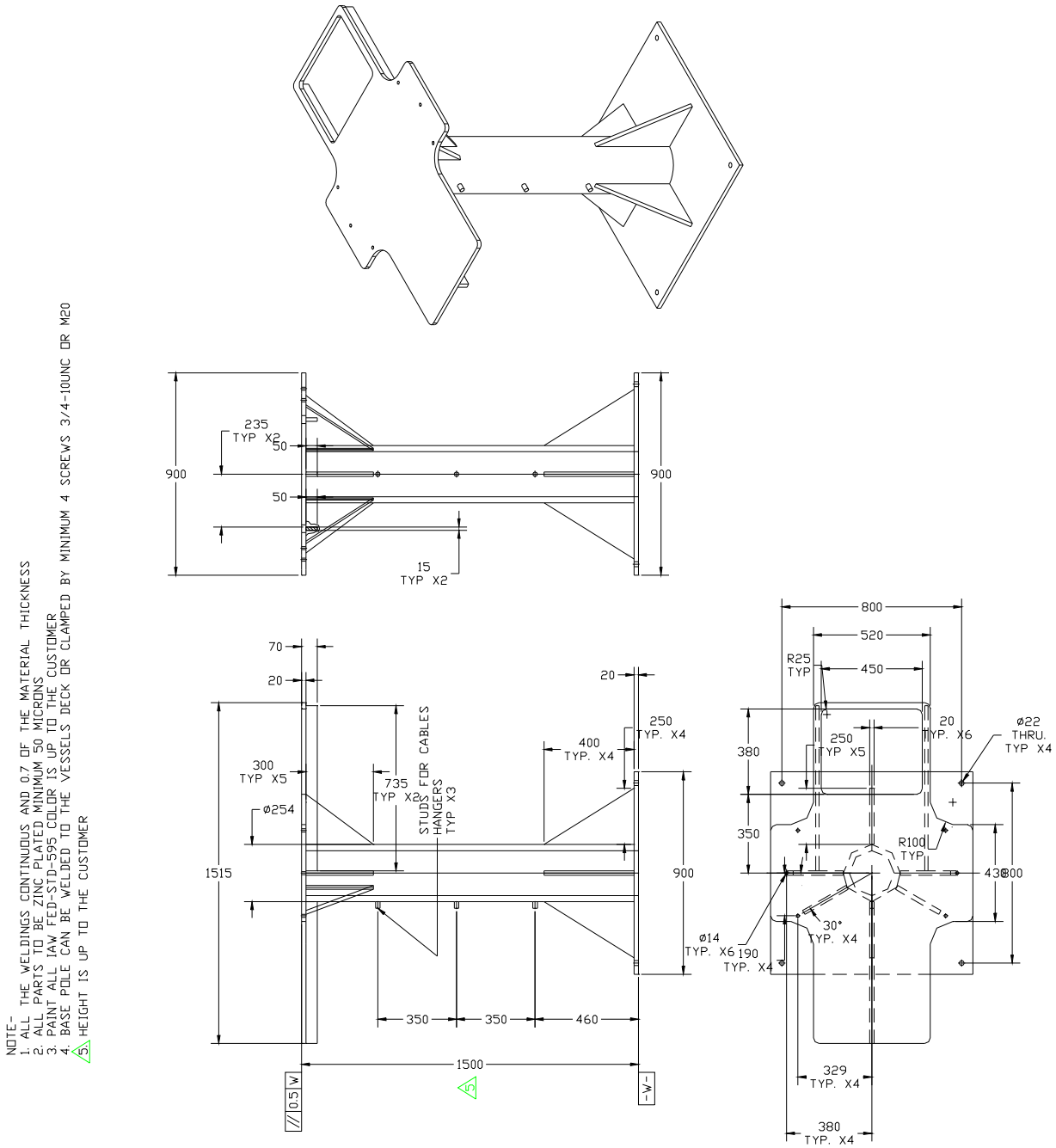


Figure 33. Recommended Support Structure

5.4.5. Mounting Surface (Foundation)

The mounting surface intended for the ADE should be a stable (with natural resonance frequency of above 30 Hz) flat surface, capable of supporting the total equipment weight (radome with all units installed in it).

The following Figures depict the layouts and mounting-holes location of the recommended mounting surface (foundation), and of the ADE Mounting plate. The foundation and ADE Mounting Plate holes should match, thus allowing insertion of the bolts securing the ADE to the foundation.

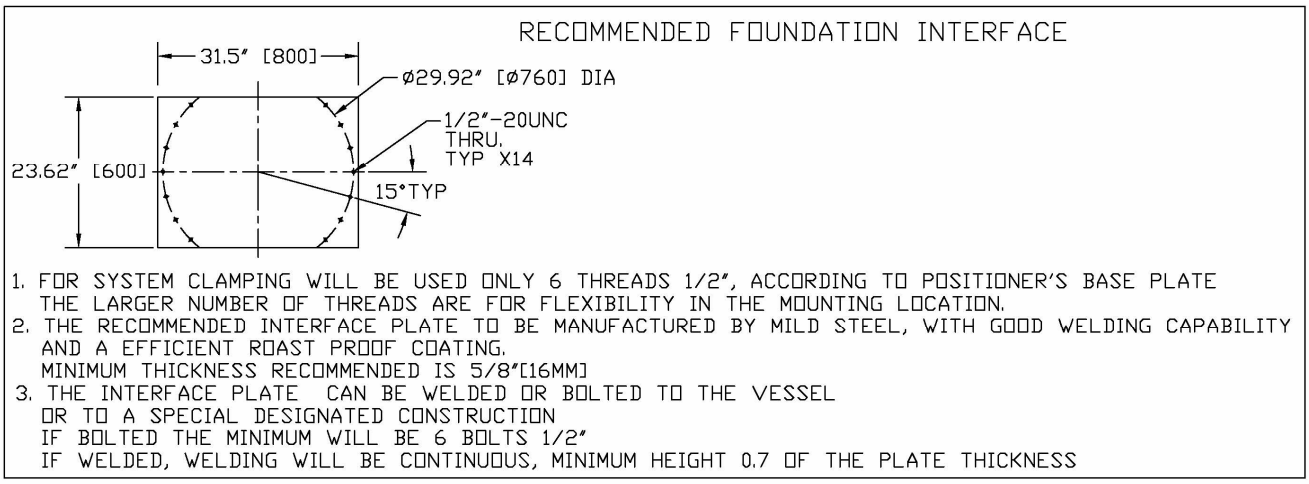


Figure 34. Recommended Mounting Surface (Foundation) Layout

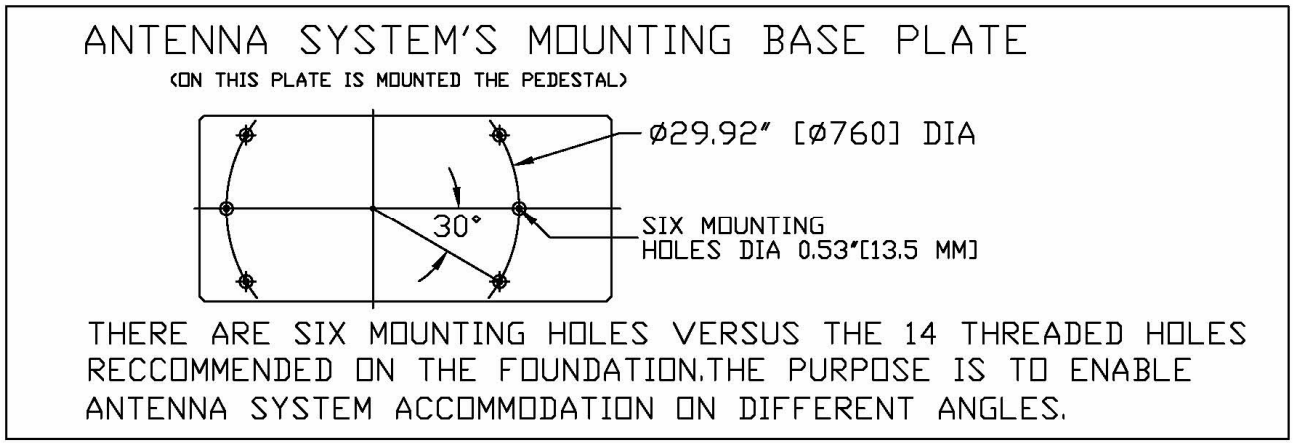
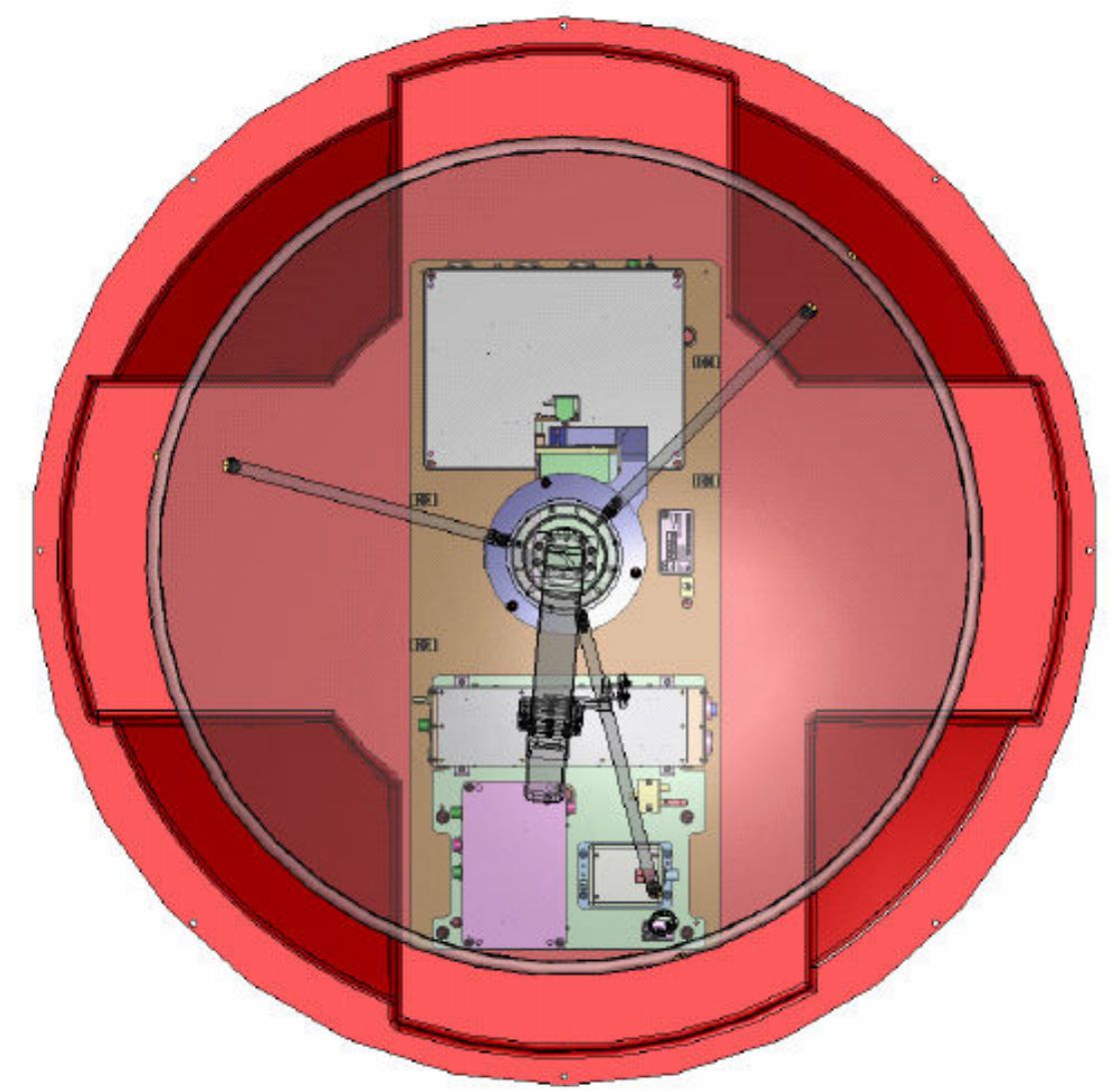


Figure 35. ADE Mounting Base Plate Layout



NOTE: Several bolt holes on the Mounting plate are concealed under the SDU, PSU and SBC. Therefore, these units should be removed from the plate to allow access to the mounting holes.

Figure 36. ADE's Mounting Plate Orientation

5.4.6. BDE Location Considerations

5.4.6.1. Installation Method

The BDE units should be mounted and secured to solid surfaces.

NOTE

The BDE environment should be climate-controlled.

5.4.6.2. BDE Cables Length Considerations

When planning the BDE units' location, verify that the distance between the CCU and display is in accordance with the length of the supplied 8-m Controller-display cable.

5.4.6.3. ADE-BDE Cables

The CCU and the ADE's SBC are connected by a multi-mode, duplex, fiber-optic cable, with ST connectors. This cable is supplied by the customer.

In addition, the ADE's RF splitter output can be connected to the customer's distribution system by an RG-6 or RG-11 coax cable, terminated by F-Type connectors. This cable is also supplied by the customer.

5.4.6.4. Operator/Maintenance Accessibility

The BDE operation is largely automatic, but it is desirable that it be monitored periodically. Therefore, it is beneficial that it be sited in a location with easy operator access.

In addition, consideration should be given to allow free-of-obstacles space around the equipment to allow sufficient maintenance access for technical staff to the rear panel, where cables are connected to the equipment.

CAUTION

Verify that the CCU is installed at a distance of at least 5 meters from the vessel's Compass.

5.5. ON-SITE UNPACKING AND INSPECTION

5.5.1. Shipping Crate

NOTE

This section presents a typical shipping configuration.

Typically, the AL-7204-F System (without the radome) and installation tools/materials are sent to the installation site packed into a single shipping crate.

The radome is sent to the installation site, directly from the radome manufacturer, packed in another shipping crate.

The system crate specifications are:

- Crate dimensions (L x W x H) - 136cm [53.5”] x 136cm [53.5”] x 122cm [48”]
- Crate Weight – 250 kg (550 lb).

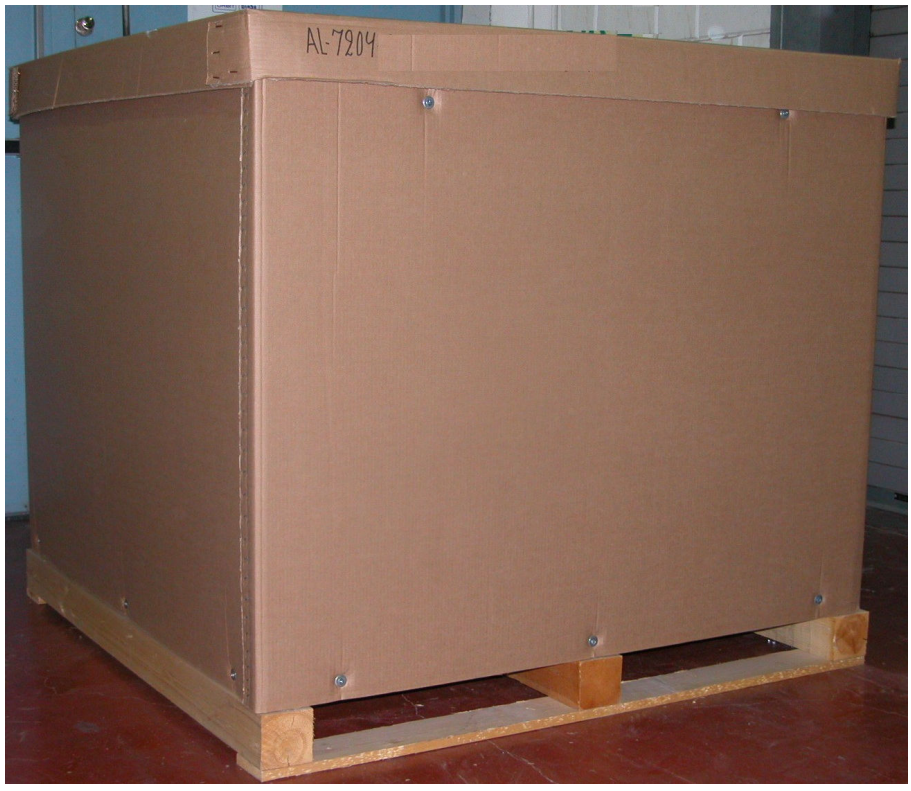


Figure 37. AL-7204-F System Shipping Crate

5.5.2. Shipping Crate Packing List

The shipping crate contains the following major assemblies (for a typical installation):

Table 5. AL-7204-F System - Packing List / Bill of Materials

Component	*ORBIT P/N*	*Notes*	*Equipment Verification*	
			Check	*Record S/N…*
PEDESTAL ASSEMBLY:				
• Positioner	AL-7204-1B			
• IMU	AL-7203-IMU-NT3			
• SDU	AL-7204-SDU-07			
• SBC	AL-7204-SBC			
• PSU	AL-7204-PSU			
• SBC	AL-7204-SBC			
• RF Splitter	5-2150 MHz			
ANTENNA ASSEMBLY:				
Antenna Reflector, with Tripod and Feed Adaptor	---			
C-Band Feed Assembly	18-0478-4-1			
OTHER ASSEMBLIES:				
CCU	AL-7103-CCU-DF			
Interlock Assembly	18-0717			

5.5.3. Shipping Plate Arrangement

The shipping plate, on which the system items are mounted for shipment, is shown in the following Figure. Note that the SDU and SBC are supplied detached from the Mounting Plate and should be mounted and connected during the installation procedure.

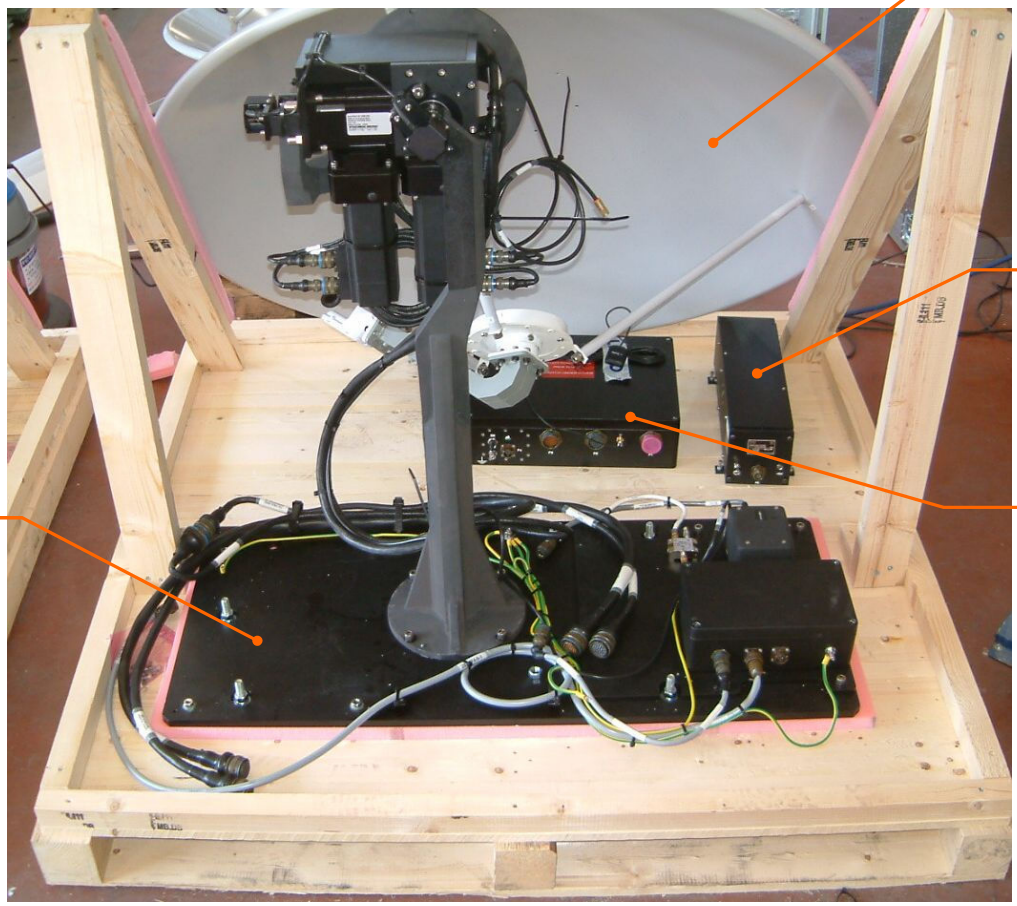


Figure 38. AL-7204-F System Shipping Plate

5.5.4. Unpacking and Inspection Guide (At the Installation Site)

NOTE

The following instructions refer to both the system and radome shipping crates.

NOTE

Before unpacking, check the contents of the shipping crate, and verify that all components are present.

Where applicable, record the components' serial numbers. The serial numbers are marked on the components' nameplates. The service department will request these numbers when contacting ORBIT for technical assistance.

1. Liaise with Client Representative and Site Foreman to locate the crate supplied to the site by the Installation Contractor.
2. Find a suitable build area according to pre-install checklist.
3. Locate the packing manifest on the side of the crate.
4. Inspect all contents and ensure all items are accounted for.
5. Place the shipment crate on a rigid, leveled surface.
6. Open the crate without damaging the contents.
7. Carefully remove all packages, and place them at a designated storage area in an orderly manner.
8. Visually inspect the exterior of the equipment for evidence of any physical damage that might have occurred in shipment/storage.
9. Tighten any loose mounting screws and terminal board screws.
10. Clean the exterior of the equipment.

CAUTION

Check all components for shipping damage, and report all damage to shippers immediately, as units damaged in shipping will not be replaced under Warranty terms and conditions.

5.6. ON-SHIP INSTALLATION

5.6.1. ADE Installation

To mount the ADE on the support / mounting surface, perform the following procedure:

1. Place the Radome Base on the support, with the base hatch above the support's opening. Verify that the Radome Base mounting holes match those of the support.
2. Remove the PSU from the Upgrade Plate in the following manner:
    a. Remove four caps from the PSU cover.
    b. Insert a screwdriver througj the holes, and loosen four scres securing the PSU screws to the Mounting plate.
    c. Remove the PSU.

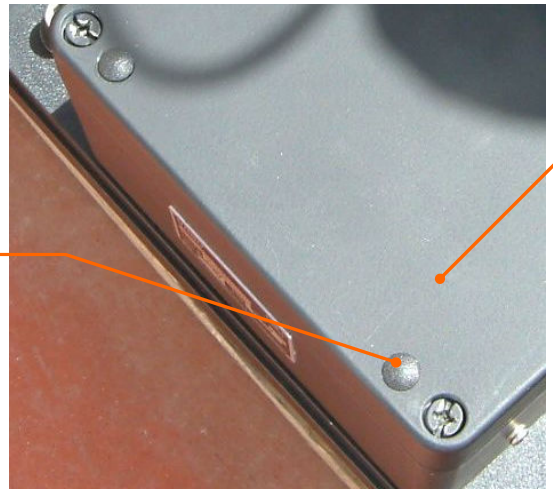


Figure 39. PSU Cover Caps

3. Lift and place the Pedestal (Mounting plate with ADE) on the Radome Base in the proper orientation.

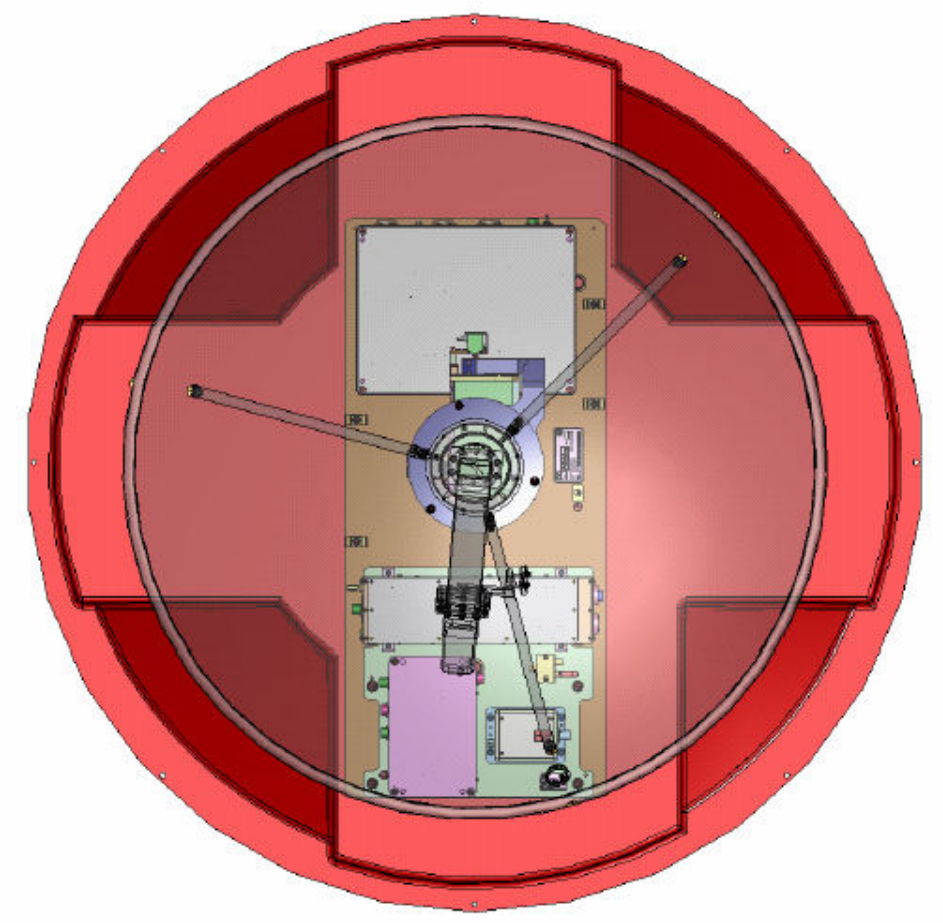


Figure 40. ADE Base Plate Mounting Orientation

4. Insert and fasten six ½" bolts through the Mounting plate, Raome Base and mounting surface holed. Seal the mounting screws protruding below mounting surface. Use silicon sealing compound.
5. Install the SDU to the Mounting Plate in the following manner:
    a. Place the SDU on the Mounting Plate.
    b. Remove four caps from the SDU cover.
    c. Insert a screwdriver through the holes, and fasten four screws securing the SDU screws to the Mounting Plate.
    d. Connect cables to the SDU connectors. refer to Figure 9

Figure 41. SDU Cover Caps

NOTE

If the SDU cover is already removed (for setting the input power voltage, the SDU screws can be accessed directly.

6. Install the SBC on the Upgrade Plate in the following manner:
    a. Place the SBC on the Mounting Plate.
    b. Fasten the four SBC captive screws.
    c. Connect cables to the SBC connectors. refer to Figure 9

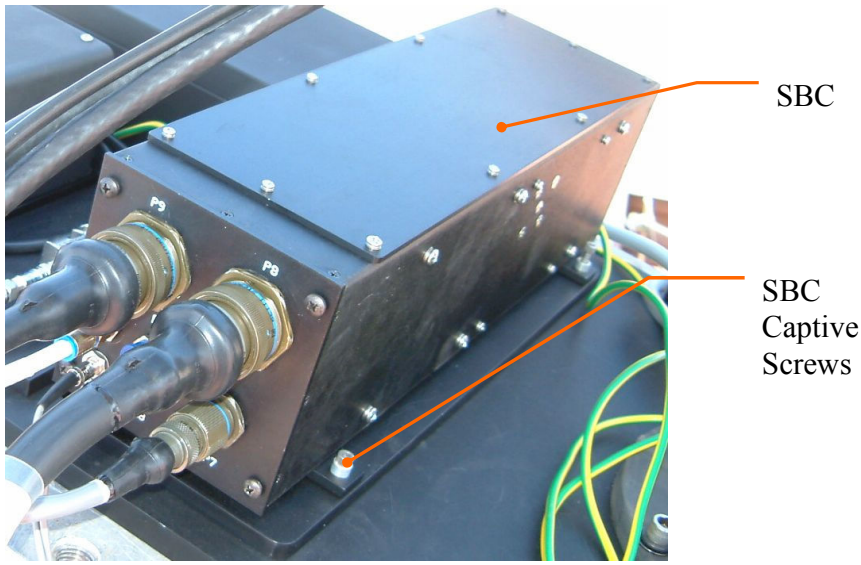


Figure 42. SBC Installation

7. Reinstall the PSU on the Mounting Plate, and connect cables to the PSU connectors. refer to Figure 9.
8. Install the antenna assembly (reflector with feed) on the positioner in the following manner:
    a. Place the antenna assembly on the positioner antenna adaptor, Verify that the arrow marked on the antenna is aligned with the one marked on the adaptor.
    b. Fasten six screws securing the antenna replector to the positioner's antenna adaptor.

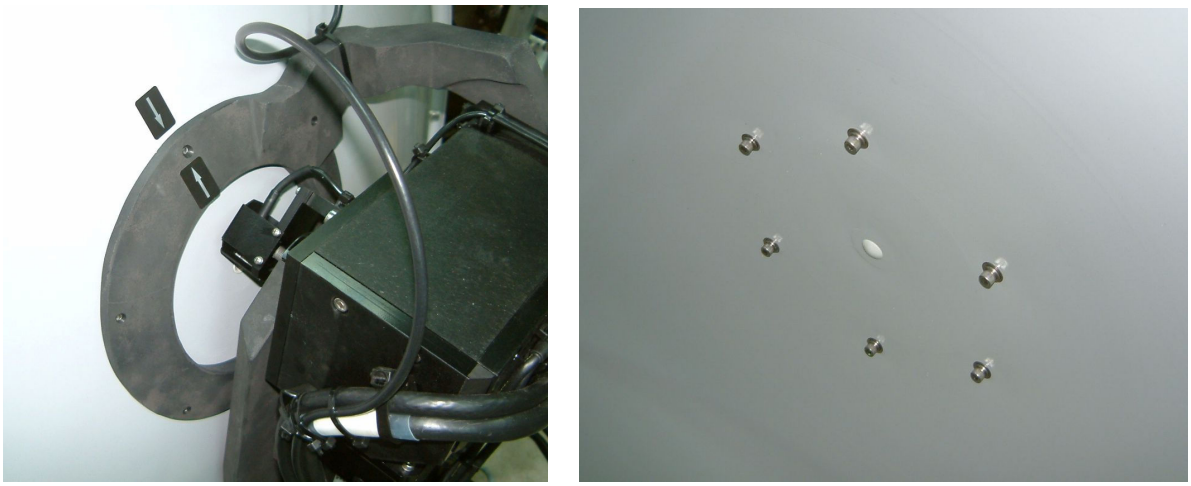


Figure 43. Antenna Assembly Installation

9. Mount and secure the dome to the radome base. Verify that access to the side hatch is clear of obstacles.

Figure 44. Typical ADE Installation

5.6.2. ADE-BDE Cables Routing

Lay and route the cables connecting between the ADE and BDE (fiber optic cable and RF cable). Use standard cables routing practices.

5.6.3. Connecting Cables to the ADE

NOTE

For the system's block / interconnection diagram, refer to Figure 9.

5.6.3.1. General

The system is shipped with the ADE units installed on the Mounting Plate interconnected by cables. Therefore, during installation, only the following connections should be made:

- Connecting the mains Power cable to the PSU.
- Connecting two ADE-BDE Fiber-Optic cables to the SBC.
- Connecting the ADE-BDE RF IF coaxial cable to the RF Splitter.
- Connecting the Grounding cable to the mounting plate.

The following paragraphs describe the connection procedures.

5.6.3.2. Connecting the mains Power cable to the PSU

5.6.3.2.1. PSU Power Cable Termination

The PSU POWER cable is supplied by ORBIT, without the utility-side plug.

Figure 45. PSU Power Cable

WARNING

Terminating the Power cable with a pertaining plug should be performed only by a certified electrician.

CAUTION

When connecting a utility plug to the POWER cable, pay special attention to the wire labels (phase, neutral, ground).

Connect a utility plug to the POWER cable, in the following manner:

- Phase wire (~) to pin A
- Neutral wire (∅) to pin C
- Ground wire to pin B.

Use a DVM to check and verify the above connections.

5.6.3.2.2. Connecting the PSU Power Cable

Connect the POWER cable to connector P1 on the PSU.

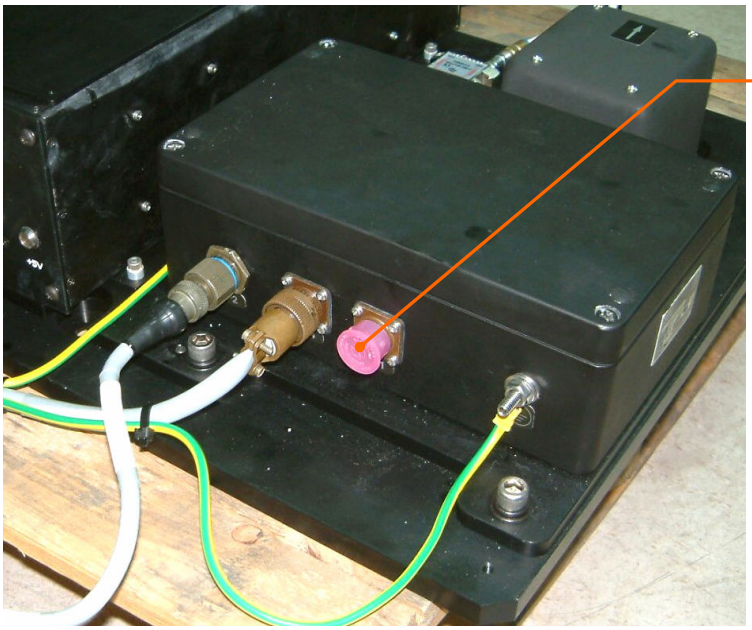


Figure 46. PSU Power Input

5.6.3.3. Connecting ADE-BDE Fiber-Optic cables to the SBC

The SBC is connected to the CCU by a multi-mode fiber optic cable with two connectors.

Connect the fiber optic cable to SBC connectors P17 and P18.

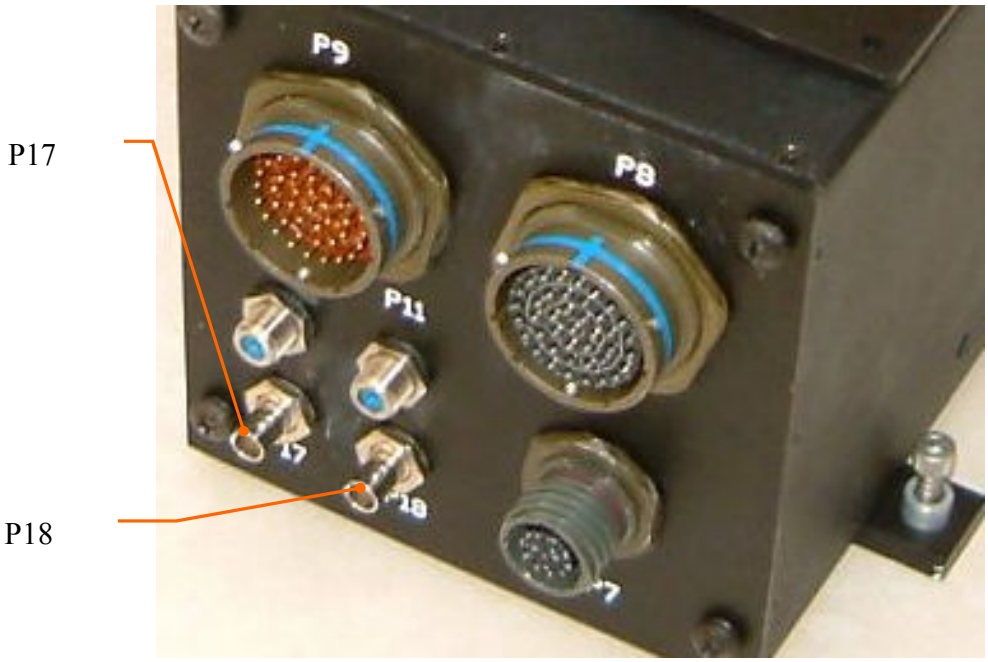


Figure 47. SBC Fiber Optic Connectors

5.6.3.4. *Connecting ADE-BDE RF Coax Cable to the Splitter*

The RF output from the feed's LNB is fed via the RF splitter to the BDE CCU, which in turn feeds the signal to the distribution system.

Connect the ADE-BDE RF cable to the OUT connector of the RF splitter.

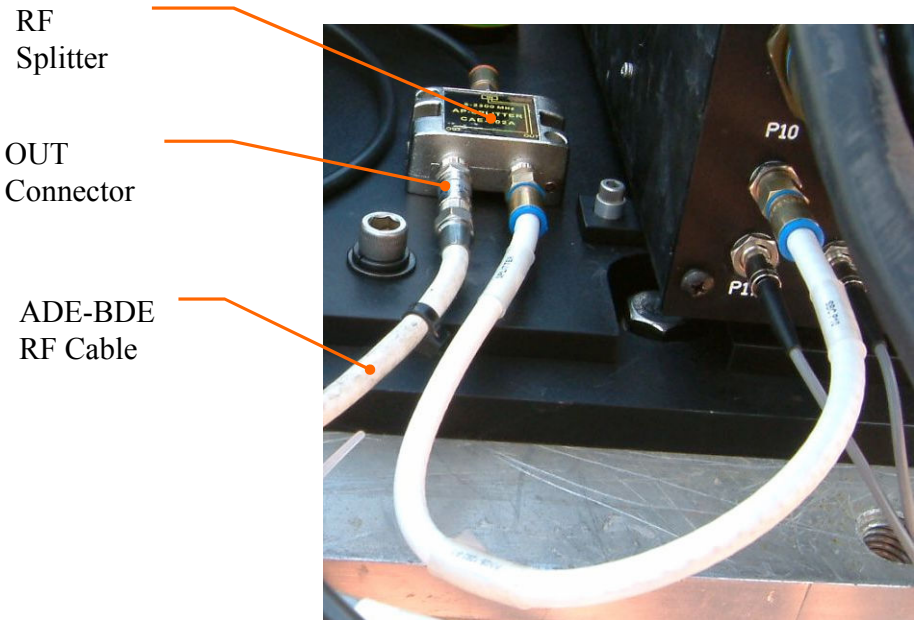


Figure 48. SBC Fiber Optic Connectors

5.6.3.5. *Connecting the Ground Cable*

Use a 14# GND wire, terminated with a terminal lug. Connect the grounding cable to the mounting Plate GND jack.

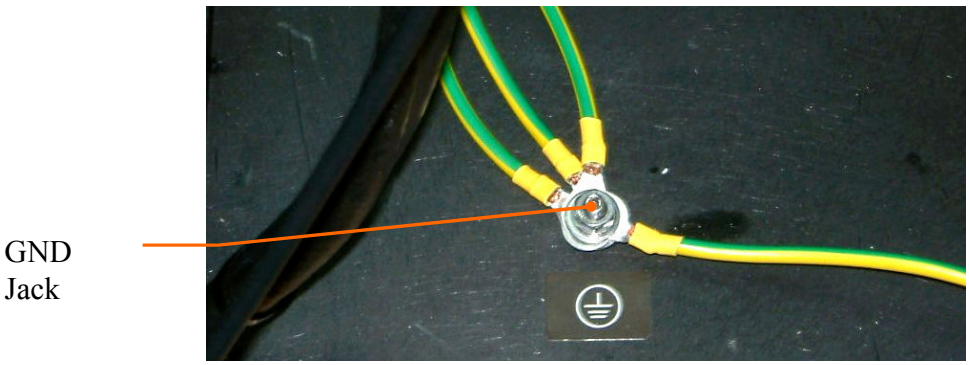


Figure 49. Mounting Plate GND Jack

5.6.3.6. Feed RF cable connection

Insert the RF cable (connected on the other end to the RF splitter) via the hole in the antenna reflector.

Connect the RF cable to the Feed Assembly connector.

Use tie-wraps to secure the RF cable to the reflector's tripod leg.

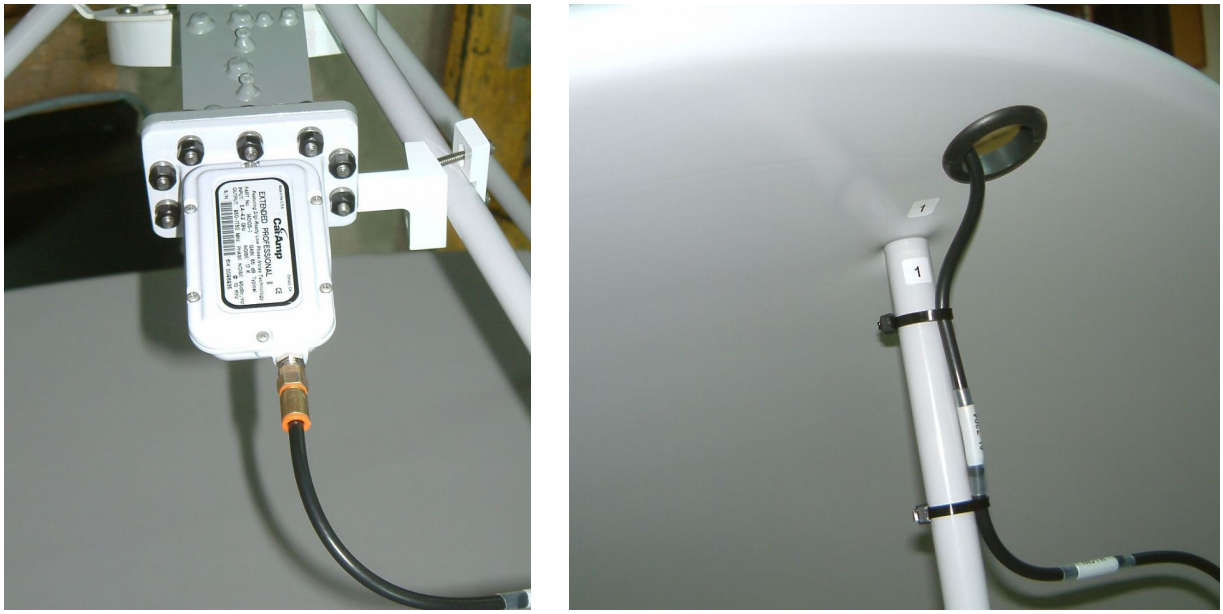


Figure 50. Routing, Securing and Connecting the RF Cable

5.6.4. Setting the SDU Input Voltage

WARNING

DANGER – HIGH VOLTAGE

The SDU contains potentially harmful voltages when connected to the designated power source.

CAUTION

Setting the SDU voltage selector S2 to the incompatible AC voltage will cause damage to the equipment.

1. Verify that the SDU is turned OFF.
2. Unfasten 4 captive screws securing the SDU top cover to the chassis. Remove the top cover.
3. Verify that the internal SDU voltage selector S2 is set for the correct AC voltage (115VAC or 220VAC).
4. Verify SDU fuse F1 rating is compatible with the input voltage: 4-Amps slow-blow fuse for 115V systems, and a 2-Amps slow-blow fuse for 220V systems. Replace the fuse if nesseccary.
5. Install the SDU top cover and fasten 4 screws securing it to the chassis.

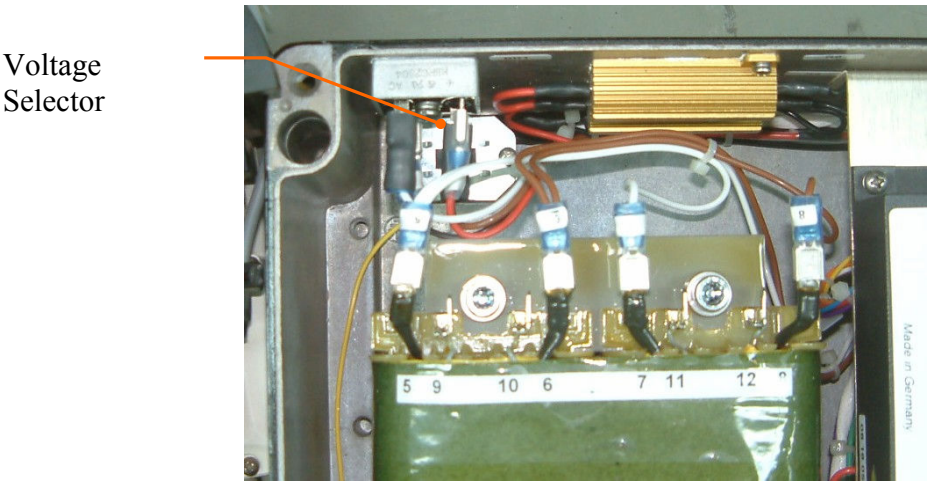


Figure 51. SDU Voltage Selector S2

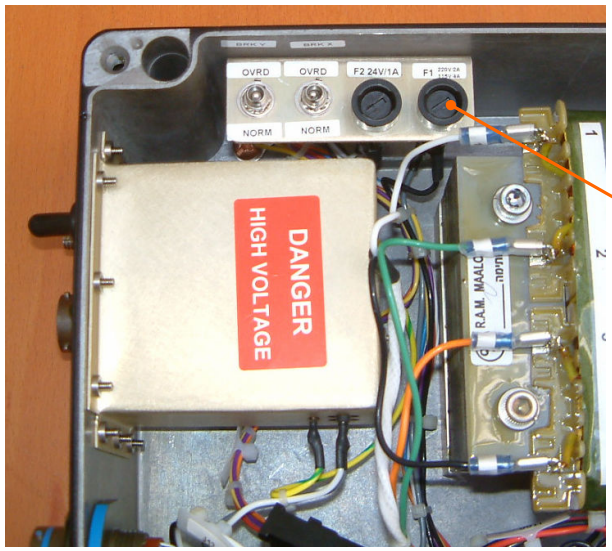


Figure 52. SDU Voltage Fuse F1

5.7. BDE Installation

5.7.1. CCU Installation

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

Figure 53. CCU - Typical Rack Installation

Verify that the CCU is installed at a distance of at least 5 meters from the vessel's Compass.

5.7.2. Connecting CCU Cables

5.7.2.1. 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.

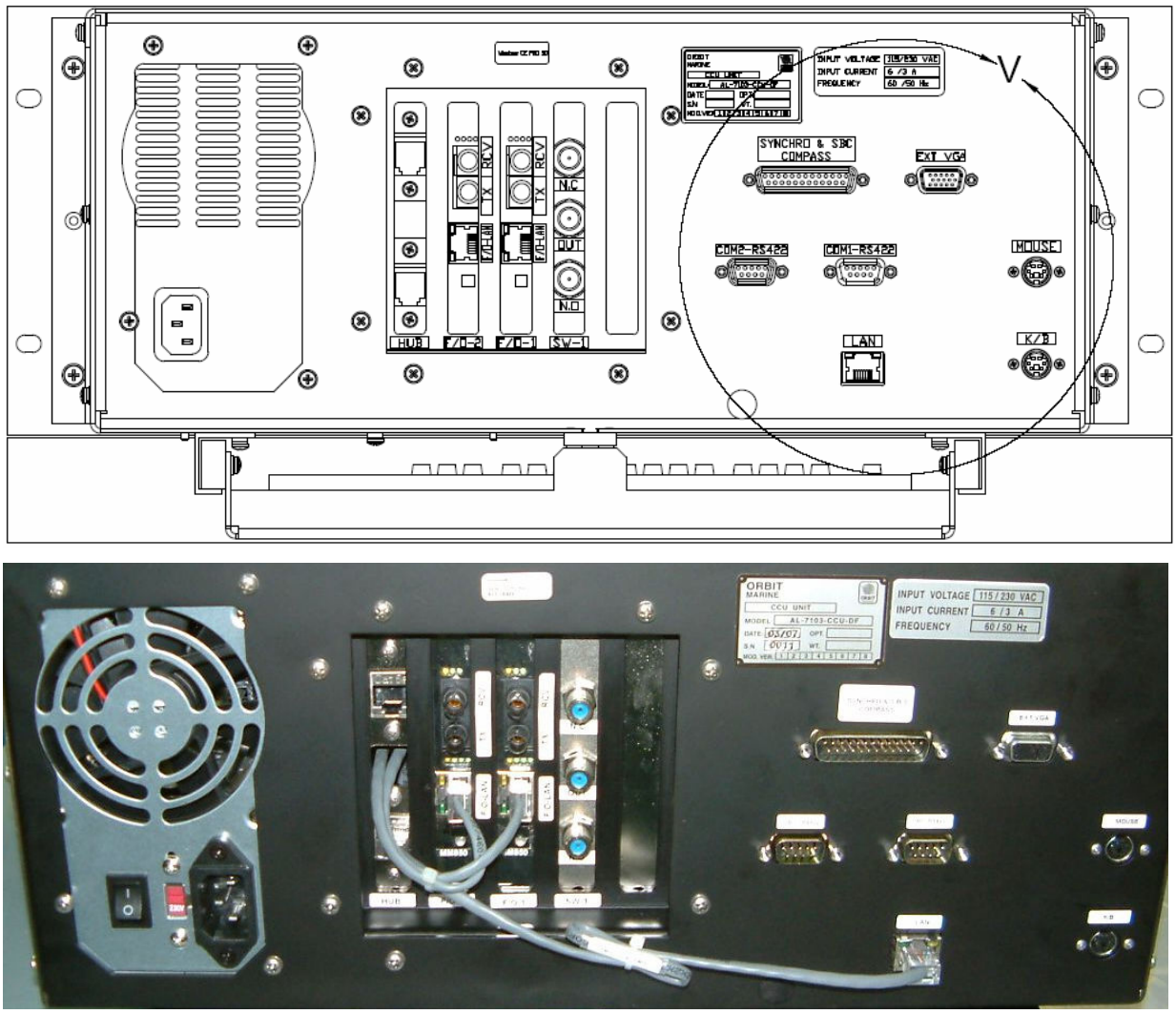


Figure 54. CCU Rear Panel Connectors

Table 6. CCU Rear Panel Connectors

Connector	Connector Type	Function
Power Supply	Integrated plug	From ship's Mains power source.
LAN	RJ-45	LAN connector. Connected to the Hub by a jumper cable.
K/B	MINI-DIN	Connects the Keyboard located at CCU drawer.
MOUSE	MINI-DIN	Connects the mouse located at CCU drawer.
SYNCHRO & SBS COMPASS	DB25 male	Connects the customer's Compass (SYNCHRO & SBS).
COM1-RS422	DB9 male	Connects the customer's Compass (RS-422 port) - for System 1 in a dual configuration.
COM2-RS422	DB9 male	Connects the customer's Compass (RS-422 port) - for System 2 in a dual configuration.
EXT VGA	DB 15-Pin HD	Connects an external monitor.
SW-1 Board Connectors		
N.C.		RF signal received at System 1.
OUT		Switch Output – provides the received RF signal to the distribution system.
N.O.		RF signal received at System 2.
F/O-1 Board Connectors		
F/O TX		CCU – SBC1 fiber optic communication link – transmit line
F/O RCV		CCU – SBC1 fiber optic communication link – receive line
F/O LAN	RJ-45	Connects to the Hub's F/O 1 LAN Connector via a jumper cable
F/O-2 Board Connectors		
F/O TX		CCU – SBC2 fiber optic communication link – transmit line
F/O RCV		CCU – SBC2 fiber optic communication link – receive line

Table 6. CCU Rear Panel Connectors

Connector	Connector Type	Function
F/O LAN	RJ-45	Connects to the Hub's F/O 2 LAN Connector via a jumper cable
HUB Connectors		
F/O 1	RJ-45	LAN port for F/O 1 Board
F/O 2	RJ-45	LAN port for F/O 2 Board
LAN	RJ-45	LAN connector. Connected to the CCU LAN connector by a jumper cable.

The following paragraphs provide information and instruction pertinent to the available CCU connections.

5.7.2.2. General-Purpose Connections (Power, LAN, KB, Mouse)

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

- Power cable
- LAN Jumper cable between the the CCU LAN connector and the HUB
- Keyboard
- Mouse.

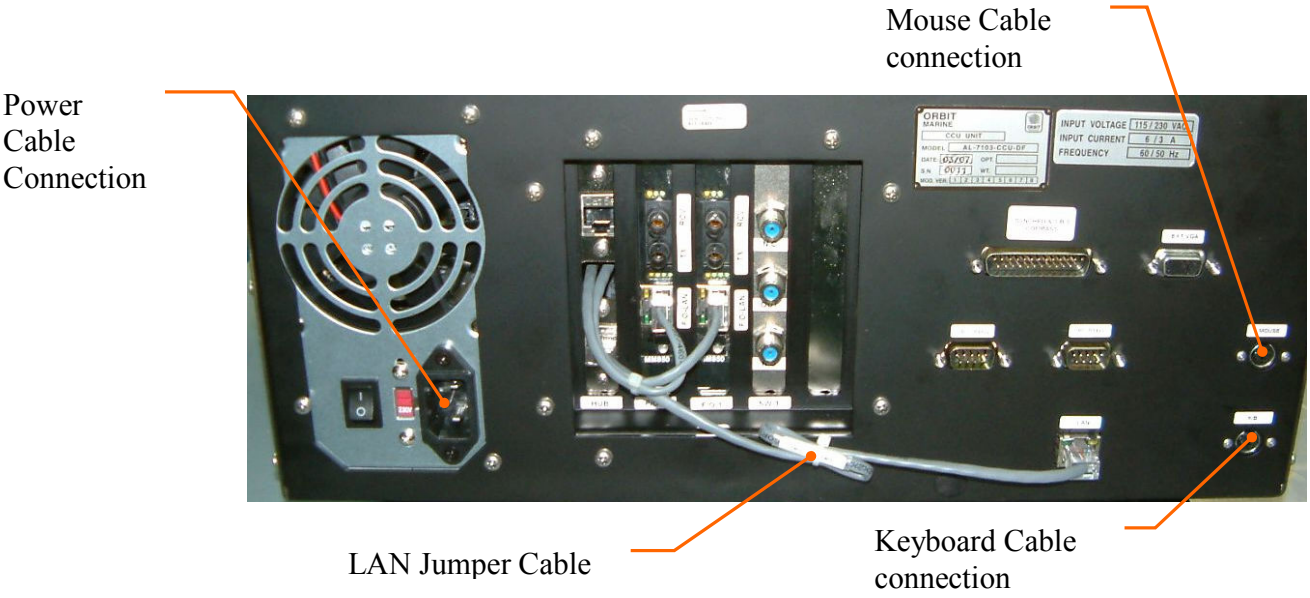


Figure 55. CCU Rear Panel – General Purpose Connections

5.7.2.3. ADE-BDE Fiber Optic Cables Connection

The ADE SBC is connected to the CCU by a multi-mode fiber optic cable with two connectors.

Connect the fiber optic cable coming from SBC 1 to F/O 1 Card connectors RCV and TX.

If a dual system is used, connect the fiber optic cable coming from SBC 2 to F/O 2 Card connectors RCV and TX.

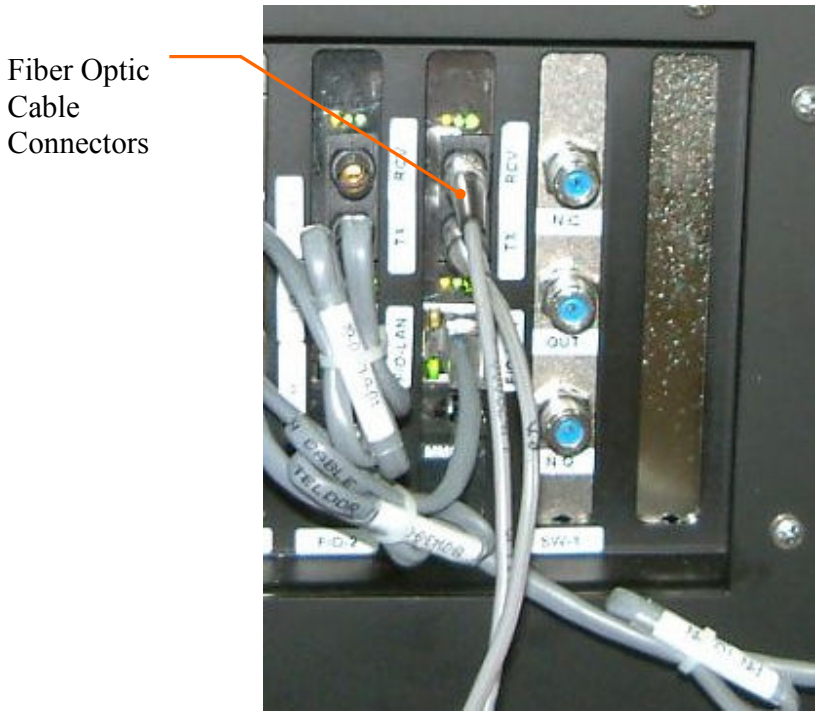


Figure 56. CCU Rear Panel – Fiber Optic Connectors

5.7.2.4. ADE-BDE RF Cable Connection (RF Switch Connections)

When a single system is used:

The RF output from the feed's LNB is connected directly to the distribution system, and the RF switch is not used.

When a dual system is used:

The RF outputs from both systems are connected to the CCU's RF switch, in the following manner:

- Connect the RF cable of System 1 to the N.C. connector of the switch.
- Connect the RF cable of System 2 to the N.O. connector of the switch.

5.7.2.5. CCU-Distribution System RF Cable Connection

When a single system is used:

The RF output from the feed's LNB is connected directly to the distribution system, and the RF switch is not used.

When a dual system is used:

Connect the RF cable from the distribution system to the OUT connector of the switch.

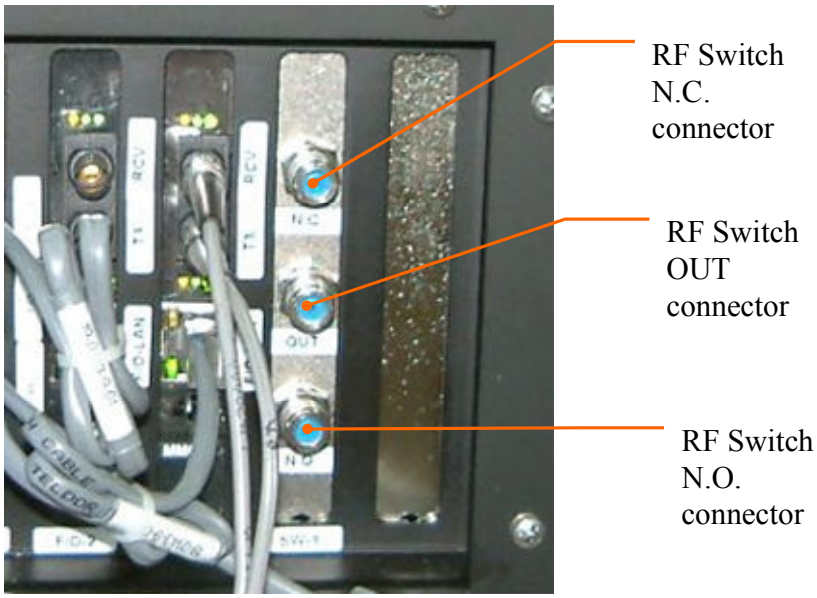


Figure 57. CCU Rear Panel – Switch Connectors

5.7.2.6. Serial Communication and Compass Connectors

The CCU rear panel includes three communication connectors, which are used as follows:

When a single system is used:

- COM1 – RS-422 - Connects CCU to customer's Compass (RS-422 port).
- COM2 – RS-422 – Not used.
- Synchro and SBS Compass - Not used in this system.

When a dual system is used:

- COM1 – RS-422 - Connects CCU to customer's Compass (RS-422 port) – for System 1 in a dual system configuration.
- COM2 – RS-422 - Connects CCU to customer's Compass (RS-422 port) - for System 2 in a dual system configuration.
- Synchro and SBS Compass - Not used in this system.

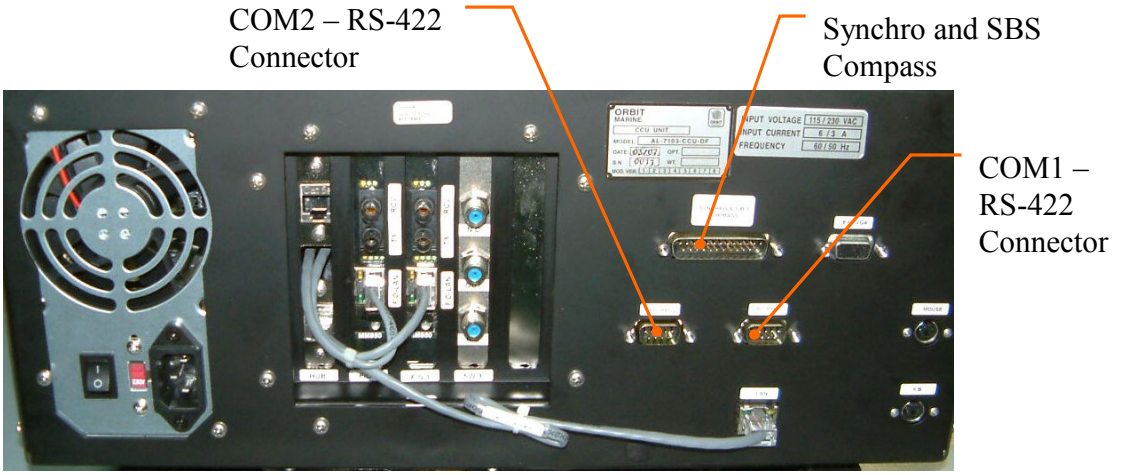


Figure 58. CCU Rear Panel – Serial and Compass Connectors

The following Table specifies the communication connector pin-out.

The subsequent paragraphs describe how to use each connector.

Table 7. CCU Communication Connectors Pin Out

COM1	RS422
PIN 1	TX +
PIN 2	RX -
PIN 3	TX -
PIN 4	RX +
PIN 5	GND
PIN 6	NC
PIN 7	NC
PIN 8	NC
PIN 9	NC

COM2	RS422
PIN 1	TX +
PIN 2	RX -
PIN 3	TX -
PIN 4	RX +
PIN 5	GND
PIN 6	NC
PIN 7	NC
PIN 8	NC
PIN 9	NC

SYNCHRO & S.B.S. COMPASS	
PIN 1	NC
PIN 2	GND
PIN 3	NMEA -
PIN 4	NMEA +
PIN 5	GND
PIN 6	NC
PIN 7	NC
PIN 8	REF +
PIN 9	NC
PIN 10	REF -
PIN 11	NC
PIN 12	S.B.S. - COM
PIN 13	S.B.S. - A
PIN 14	NC
PIN 15	GND
PIN 16	NC
PIN 17	NC
PIN 18	S1
PIN 19	NC
PIN 20	NC
PIN 21	GND
PIN 22	S2
PIN 23	S3
PIN 24	S.B.S. - C
PIN 25	S.B.S. - B

5.7.2.7. NMEA-0183 RS-422 Compass Connection

General

The National Marine Electronics Association (NMEA) 0183 standard defines an electrical interface and data protocol for communications between marine instrumentation.

The NMEA-0183 standard is 4800 baud and consists of several different ASCII sentences.

Electrical Interface

This standard allows a single "talker" and several "listeners" on one circuit. The recommended interconnect wiring is a shielded twisted pair, with the shield grounded only at the talker. The standards do not specify the use of any particular connector.

NMEA-0183 recommends that the talker output comply with EIA-422. This is a differential system, having two signal lines, A and B.

The voltages on the "A" line correspond to those on the older TTL single wire, while the "B" voltages are reversed (while "A" is at +5, "B" is at ground, and vice versa).

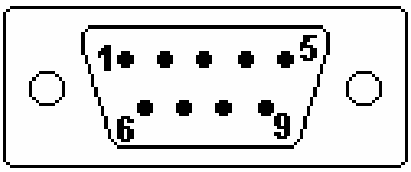
In either case, the recommended receive circuit uses an opto-isolator with suitable protection circuitry. The input should be isolated from the receiver's ground.

In practice, the single wire, or the EIA-422 "A" wire may be directly connected to a computer's RS-232 input.

The following Figure depicts how to connect an RS-422 NMEA-0183 Compass to the CCU's COM1 Connector.

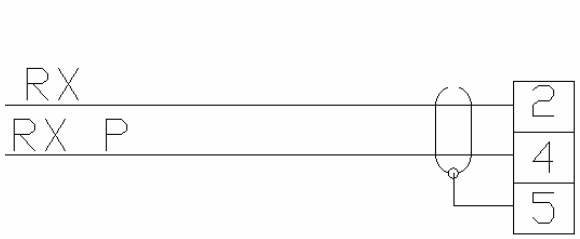
Connecting an RS-422 NMEA-0183 Compass to COM1 Connector:

CCU Connector



COM1-RS422

Mating Connector Wiring Diagram



Mating Connector Pin Out	
Pin	**Signal**
2	RXD-
4	RXD+
5	GND

Figure 59. RS-422 NMEA-0183 Compass - Connection Scheme

Compass Configuration Procedures:

To find and enter the system's Offset to Ships Compass, refer to "Finding and Setting of Heading (Compass) Offset".

To change the default NMEA-0183 sentence, "Changing the Default NMEA-0183 Compass Sentence".

5.8. SYSTEM POWER-UP AND SETUP

Upon completion of the installation, as described in the preceding sections, the system should be energized to perform system setup, functional tests and operability verification (satellite tracking/acquisition and RF aspects of system operation).

The System Power-Up and Setup phase includes the following procedures:

- Initial Inspections
- System Power-Up and Setup Procedure
- Pre-Commissioning Checks
- System Commissioning and Acceptance

5.9. INITIAL INSPECTIONS

Perform the following visual inspections before starting up the system:

1. Rack Wiring - Inspect all internal wiring terminations and labeling as appropriate
2. Mechanical Completion - Inspect all metalwork and moving parts and ensure that all edges are smooth and moving parts are operating correctly.
3. Labeling - Inspect all equipment labels and equipment tag numbers are correct and that power supplies are properly identified.

5.10. SYSTEM POWER-UP AND SETUP PROCEDURE

5.10.1. Introduction

The purpose of the following is to set-up the system and verify the ability of the stabilised pedestal to track a carrier under normal operating conditions prior to Final Commissioning and Acceptance.

CAUTION

Before the system is powered up, verify that the radome is closed and secured.

5.10.2. Initial Set-up

1. Using the relevant terminations detail drawings, ensure all interconnection cables are correctly terminated between below deck equipment (BDE) and above deck equipment (ADE).
2. Carry out verification checks of shipboard mains supply, ensuring that the supply is suitably conditioned.
3. Apply power to BDE/ADE equipment and observe the following:-

- BDE Equipment:-
    a. Tracking Controller has powered up and loaded control software.
    b. The monitor displays the manufacturer's logo whilst it carries out a self-test routine. **During self-test countdown, press the 'c' key and then enter the password to prevent auto-restart**.
- ADE Equipment:-
    a. SDU front-panel POWER LED is illuminated.

5.10.3. Status and Indications Check

Operation Screen

1. If still at the Basic Operation screen, enter password to enter into the Operation screen (AL-7200).
2. On the 'Operational Screen' check the following:-

- Check for error/warning messages in the message window for. Refer to each as appropriate.
- Check that the pertaining system's ID is displayed (AL-7204).
- Check that the time and date are displayed.

Satellite Selection

1. Press 'S' to select the required satellite and known channel with high signal (within the band and polarity of the installed system feed).

NOTE

For tests and commissioning, it is recommended to select a known accessible satellite.

2. Press 'D' and set the receiver. Press ENTER twice.

Maintenance Screen

1. Press 'M' to enter the Maintenance Screen.
2. Monitor the SDU Power indicators, and verify a reading of 4.9-5.0V on the 5V indicator, and 12V on the 12V indicator. Press 'P' and monitor the Power Parameters. Verify that are no red-colored parameters.
3. Check for GPS updates. Verify that the X, Y, Z coordinates are displayed, and that the PDOP, HDOP, VDOP, TDOP fields display valid values.

NOTE

It is recommended to compare the GPS readings with a reference GPS unit.

5.11. PRE-COMMISSIONING CHECKS

5.11.1. Checking of Axes Movement

1. Press 'M' for Maintenance, then 'S' for Select Window and select 'Pedestal X'.
2. Select 'Mode', press enter and select 'Slew' and perform the following tests: -
    a. Use '↓' to move cursor to the velocity readout.
    b. Use the '←' and '→' keys to change the velocity to 1 or –1, and slew the axis by no more than 15 degrees in either direction of the starting position. Monitor the axis' position and velocity displays, and verify that the position tracking is smooth and consistent, and that the actual axis velocity is within ±0.2 deg/sec of the velocity command.

CAUTION

If any problem arises during slew, shut down the axis immediately.

    c. Use '↓' to move the cursor to 'mode' and select 'Halt' to stop the axis movement
    d. Use '↓' to move the cursor to 'mode' and select 'Enc Init'.
    e. Ensure the velocity remains steady and the encoder position varies steadily and does not jump. In this case disregard the warnings appearing in the axis window (Jmm, Rlm, Flm).
    f. Verify that the red Init flag is turned off after the axis movement.
    g. Select new mode of 'slew' again and slew the axis 60 degrees in either direction around the zero position.
3. Repeat steps (1.) to (2.) for 'Pedestal Y' axis.
4. Perform Enc Init test of all axes: Select 'O' at the Operation Screen and select 'Enc Init'. Verify that all axes are moving properly and zeroing.
5. Perform IMU Init test: Select 'D' at the Operation Screen and select 'IMU Init', and confirm by pressing ENTER twice.
6. Monitor Pitch and Roll, taking into consideration the leveling degree of the ADE mounting plate with the ship's deck.

NOTE

It is recommended to visually inspect the Pedestal's leveling within the Radome.

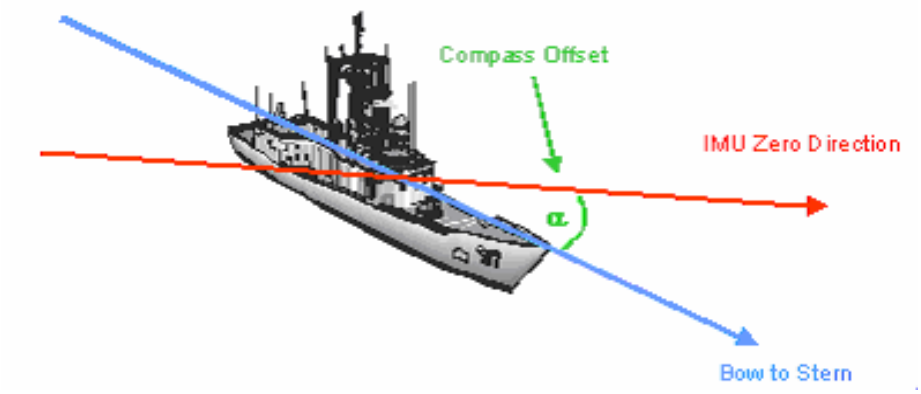
IMU Initiation procedure lasts for about 4 minutes. At the end of this procedure, the System Status field indicates that the IMU is "locked", i.e., the antenna is slaved to and stabilized by the information supplied by the IMU.

5.11.2. Restart Initiation

1. On the Operation Screen, press "O" for operation mode and press "Restart" and press ENTER twice. The system will perform a full restart procedure, point to the selected satellite, and then step-track on the selected channel.
2. If there is no AGC level, perform the following procedure:
    a. Press "M" on the Operation Screen for manual and press ENTER twice.
    b. Move in Azimuth axis until the AGC level rises.
    c. Verify that the system is pointed to the correct satellite and press "O". Select step-track and press ENTER twice.

5.11.3. Finding and Setting of Heading (Compass) Offset

When the system is installed onto a vessel, it is not aligned with the bow of the ship. This means that the compass offset will need to be set, so that the system is aligned with the vessel's gyro compass:

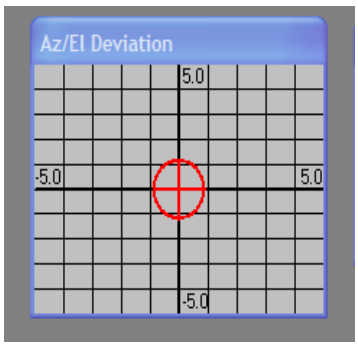


As marked in the drawing above, Compass offset is the angle between the ship's Compass direction, represented by the Bow-to-Stern line and the IMU direction, represented by a black arrow marking on the exterior of the AL-7204-F radome.

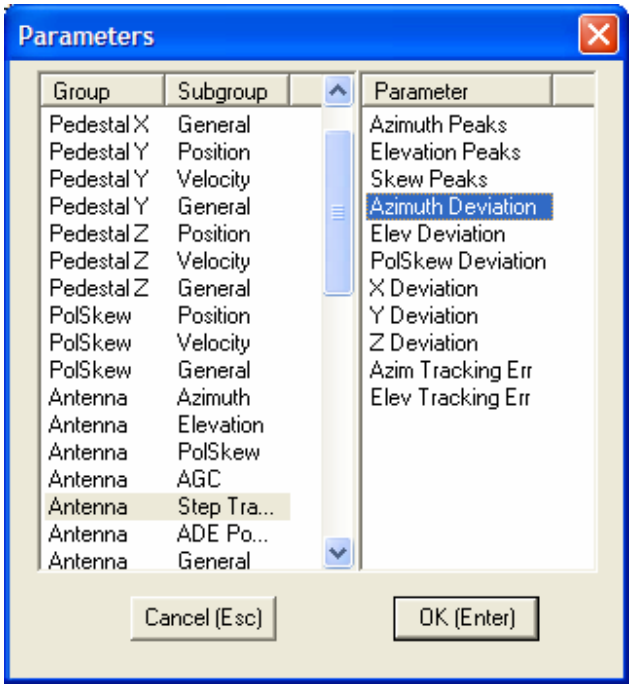
To establish the exact offset angle the following steps should be taken:

1. Make a "naked-eye" rough estimate for the offset angle. Looking on the drawing above that would be something like -30 degrees (negative because the offset in the example is counter-clockwise from ship's bow).
2. Make a "naked-eye" rough estimate for the offset angle. Looking on the drawing above that would be something like -30 degrees (negative because the offset in the example is counter-clockwise from ship's bow).
3. Set the "naked-eye" estimate into the controller (as shown below).
4. Point antenna to satellite. Record the antenna Azimuth at this point as "Nominal Azimuth".
5. Use Manual mode (see appropriate paragraph in this document) to move the antenna Azimuth orientation to point it onto the satellite. The amount of expected movement depends on how accurate was your initial estimate. Most people can tell direction within +/-10 degrees…
6. Once the satellite is acquired (Beacon receiver locked or, SatModem has locked on the Downstream data channel or, Spectrum analyzer screen shows a recognizable signal pattern or any other way of validating that's the right satellite) put the antenna to Step-track.

7. Find “Azimuth Deviation”, which is how far away is the actual antenna Azimuth from the expected one.
8. To do so, use the graphical cross hair display, which is calibrated in degrees, showing a total of +/- 5 degrees:

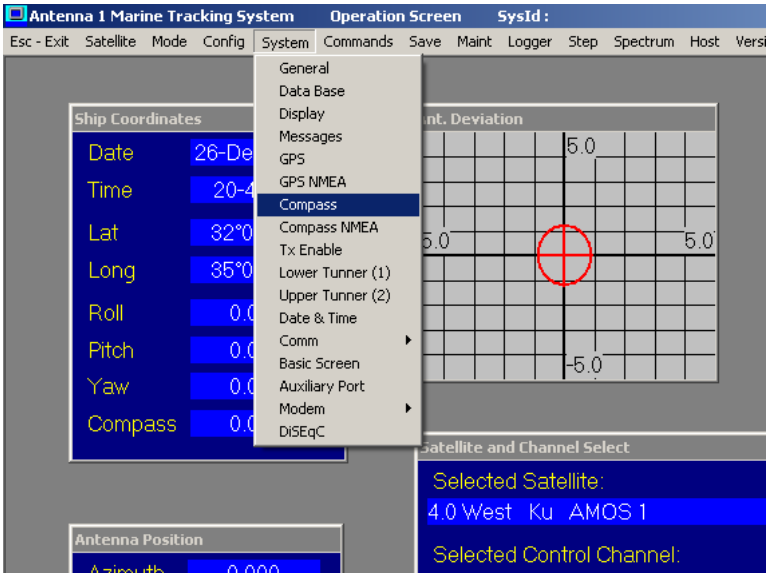


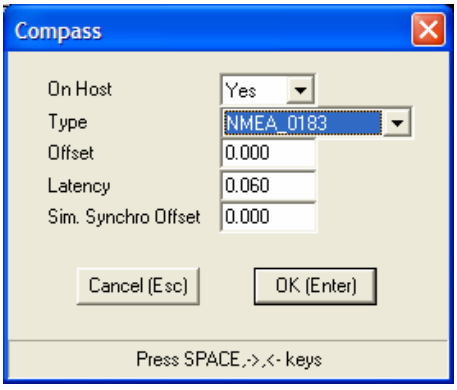
9. Or use the Graphical logger, recording the Azimuth Deviation:



10. Or put the antenna to “Peak” mode and find the “Azimuth Deviation” by calculating the difference between the current antenna Azimuth and the “Nominal Azimuth” as noted above.
11. The “Azimuth Deviation” obtained in one of the methods shown above will be used to refine the “naked-eye” offset estimate. This will be given by:

12. Compass Offset Correction = Azimuth Deviation / Cosine (Antenna Elevation).
13. For example, we found the satellite with the cross-hair mark three notches right of center (+3 degrees), while the antenna Elevation is 41.4 degrees.
14. That means that our initial "naked-eye" estimate of –30 degrees must be corrected by:
15. 3/Cos (41.4) = 4.0 degrees, resulting in overall Compass Offset of –26.0 degrees
16. How to set the Offset to the controller-
17. From "Operation Screen" press "I" then select "Compass":



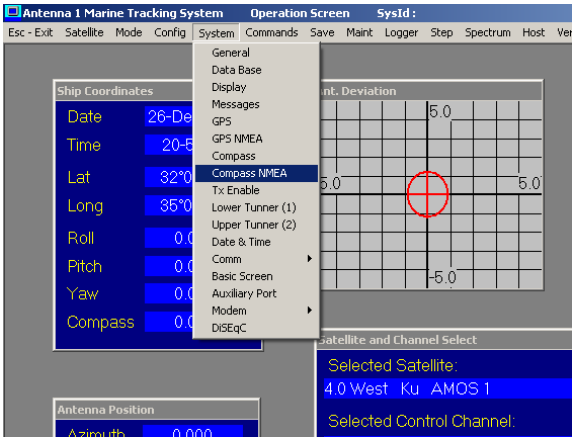


18. Enter the Offset (third line from the top), OK and save into CCU non-volatile memory.

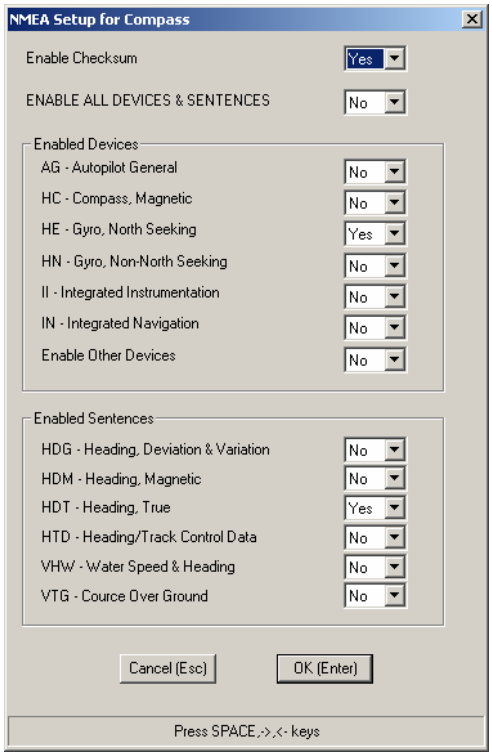
5.11.4. Changing the Default NMEA-0183 Compass Sentence

When connecting an NMEA-0183 compass, perform the following to change the default sentence:

From “Operation Screen”, press “I”, and then select “Compass NMEA”:



At the NMEA Setup screen, select the relevant NMEA sentence, and then select OK to save into the CCU non-volatile memory.



5.11.5. Setting Noise floor and Threshold Values

1. Make a note of the 'On Satellite' receive signal strength in dBμV.
2. Make a note of the 'Off Satellite' receive signal strength in dbμV. This can be obtained by pressing 'O' for Mode in the Operation screen and selecting 'Manual' and using the arrow keys to move the antenna off satellite.
3. Press 'D' for System Configuration, select 'Set Threshold' and enter the Off Satellite AGC value.

5.11.6. Saving the configuration Settings

CAUTION

The pre-commissioning procedures may take some time, under non-stable ship's power supply. Therefore, it is recommended to save the configuration parameters frequently, using the Save Configuration function.

1. Press 'V' for Save, and select 'All' or the desired option.

5.11.7. System Restart

1. Power down the system.
2. Re-apply the power to the system.
3. Observe the following: -
   - The system re-boots.
   - The encoders initiate.
   - The IMU initiates.
   - The system acquires the satellite.
   - The system goes into Step-Track.