

C-Nav[®]

C-Nav7050 User Guide

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Release Notice

This is the November 2020 release of the C-Nav7050 User Guide.

Revision History

0	11/1/2020	Initial release	R Morton
Revision	Date	Description	Author

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2. This device must accept any interference received, including interference that may cause undesired operation.

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Use of this Document

This User Guide is intended to be used by someone familiar with the concepts of GNSS augmentation hardware installation and rack mounted equipment in a marine environment. Revisions to this User Guide can be obtained on our website www.oceaneering.com/cnav or by contacting C-Nav Support: cnavsupport@oceaneering.com

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Manual Organization

This section describes how the manual is laid out. It gives one or two sentence descriptions about each major section.

Section 1 - Overview (Page 9) gives a brief overview of the purpose of this document.

Section 2 – Principles of Operation (Page 11) provides guidance on how the C-Nav7050 works.

Section 3 – Specifications (Page 14) gives technical specifications for the C-Nav7050.

Section 4 –Installation (Page 16) gives the installation guidelines for the C-Nav7050.

Section 5 - Operation (Page 20) provides guidance on operating the C-Nav7050.

Appendix A - Petrobras UHF (Page 22) provides the list of channels and frequencies used in Annex V.

Appendix B - ADL RXO UHF Programming Procedures (Page 23) provides instructions to the user on how to program an ADL RXO UHF module.

Appendix C - IALA Module (Page 26) provides information on the IALA module.

Manual Conventions

Arial font is used for plain text in this document.

Arial italic font is used for settings names.

“Arial quoted” font is used for settings values.

Arial Bold font is used for button names.

Arial Bold Italic font is used for menu items.

[Arial Blue](#) font is used for cross-references.

[Arial Blue Underline](#) font is used for hyperlinks.

Arial red italic is used for typed commands.

Arial Bold font size 10 is used for captions.

ARIAL BLACK ALL-CAPS font is used for port connection names.



This symbol means Reader Be Careful. It indicates a caution, care, and/or safety situation. The user might do something that could result in equipment damage or loss of data.



This symbol means Danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical and RF circuitry and be familiar with standard practices for preventing accidents.

Important notes are displayed in shaded text boxes.

Please note:

Such note boxes display important information that should not be ignored.

Simple file content is displayed in Courier New Black font in a text box.

```
#Sample File  
Version 0.1
```


Section 1 - Overview

Introduction

The C-Nav7050 is designed to select primary and secondary dGNSS corrections, and to automatically switch between them. The complete assembly is designed to meet Petrobras Annex V requirements.

Annex V requires that RTCM104 correctors from several sources be interfaced to the GNSS receivers. Since the receiver has only a single RTCM104 input this selection must be done externally.

There are three sources of RTCM104 corrections available, one is from a system of UHF transmitters located on offshore platforms, one from shore located IALA beacon transmitters and a third from an auxiliary source. In some locations, more than one UHF station can be received. It is also required to be able to switch from one UHF source to another. The user can select any of the sources as primary and another as secondary.

Table 1 shows a list of supplied equipment for the C-Nav7050. Tables 2 shows a list of optional equipment. The optional equipment will have already been installed by qualified C-Nav technicians. Note that the C-Nav7050 can supply correction to two GNSS receivers at the same time. These can be the same or different types.



Figure 1: C-Nav7050 Front View

Supplied Equipment

1	C-Nav7050 1U Rack Mount Unit w/ IALA/Dual UHF (P/N CNV7050RM1U19B)
2	6ft DC Power Supply Cable w/ Neutrik XLR Plug
3	USB Thumb Drive (P/N 7CNG002-0)

Table 1: Supplied Equipment

Optional Equipment

1	A31 Antenna, GPS L1 & Beacon (P/N CNVHEM940-2088-000)
2	12" Antenna Pole (P/N CNVWES534610)
3	UHF Antenna, 460-470MHz (P/N CNVMAXMFB4605)
4	UHF Antenna Mounting Kit (P/N CNVMAXMMK4)
5	6ft Serial Cable DB9 Male-Female (P/N CNVQVSC317-06)
6	C-Nav7000/7050 12VDC PSU Kit (P/N CNV7000-PSU-12V-K)

Table 2: Optional Equipment

Section 2 – Principles of Operation

This section provides guidance on how the C-Nav7050 works. A block diagram of the C-Nav7050 is shown in Figure 2 (Page 11) and a description of each component in the C-Nav7050.

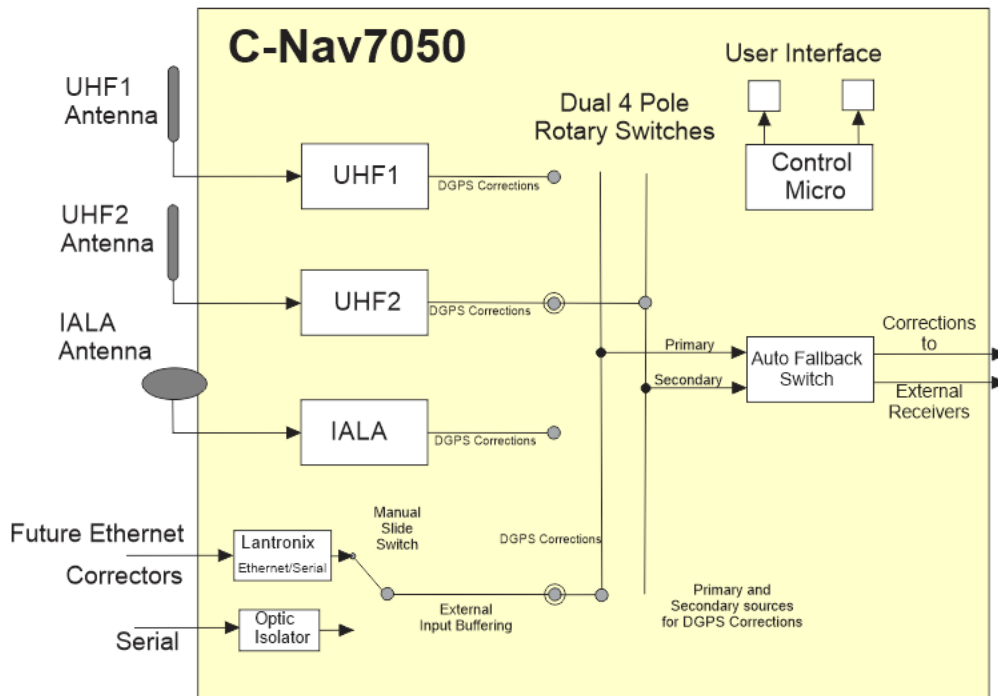


Figure 2: C-Nav7050 Block Diagram

UHF Radio Modules

Each UHF radio module is pre-programmed with the list of current Petrobras frequencies; a port on the back panel enables these frequencies to be updated.

The Channel (frequency) used by the radio is set by a combined display/switch on the front panel. This can be set to a specific channel or requested to scan the available channels for data. Data reception is indicated by turning the display background from red to green. A manual front panel selection switch determines which of the two UHF data output will be used. Note that this can be set to an inactive channel and this will still be the sampled channel even if data is present on the other receiver.

Control Micro

The control microprocessor is connected to both UHF modules and is capable of sending and confirming commands to change the current channel. The current channel number is shown on a front panel combined display / switch unit. The processor can also perform a scan of all programmed channels and select the one with the best signal to noise ratio. Frequency selection and scanning are thus possible without connection to an external PC.

IALA Radio Module

The IALA radio module can be configured via a port on the back panel. It is normally set to auto scan for the highest signal strength. The output from the IALA receiver is passed to the fallback switch. See Appendix C - IALA Module (Page 26) for further information.

Auxiliary Input

In addition to the two UHF and one IALA sources it is also possible to use corrections from an external system via a back panel serial port. These could be derived from a PPP corrected receiver or be broadcast from a local RTCM base. There is hardware present to support the future option of having the auxiliary source be an Ethernet connection. A Lantronix X-Port module converts the Ethernet data to serial. When supported in a future release, the choice of serial or Ethernet will be made by a switch on the back of the unit. At this time, the switch should always be in the “serial” position.

Fallback Switch

The fallback switch examines the output of the Primary Source for data and if data is absent for a period of time the fallback switch output changes to the Secondary correction source. The sample period can be adjusted by an internal control. Should Primary source data be detected then the corrections outputs will switch back to the Primary source.

Dual Outputs

The data stream selected by the fallback switch is output by two opto-isolated RS-232 ports. There are two RTCM104 outputs located on the rear panel of the C-Nav7050.

Power Supply

The rack is powered by an external 12V DC power source, normally from a dual redundant power supply. As a default during assembly, the input source provides power to all the modules. The unit is protected by a fuse on the back panel.

Section 3 – Specifications

This section covers the C-Nav7050 specifications, including modules.

UHF Modules

Power Requirements

Input: 3.3 V DC to 5.0 V DC + / - 0.1 VDC
During RX: 0.5 W @ 3.3 V DC; 0.7 W @ 5.0 VDC

Radio Specifications

Frequency Band: 430-470 MHz
Frequency Control: Synthesized 12.5 kHz tuning resolution
Frequency Stability: +/- 1 PPM
Channel Spacing: 12.5/25 kHz (user-selectable)
Sensitivity: -110 dBm BER = 1 x 10⁻⁵
Adjacent Channel Selectivity: > 55 dB

Type Certification

Certified for operation in the U.S., Europe, Australia and Canada
FCC, IC, EU, NZ, Australia ETS300-113-2

Link Rate / Modulation

4FSK: 9600, 19,200 bps
GMSK: 4800, 8000, 9600, 16,000, 19,200 bps
Link Protocols: Transparent EOT/EOC, Transparent FST,
Packet-Switched, Trimble®, SATEL®
Forward Error Correction: Yes

IALA Beacon Receiver

Radio

Channels: 2-channel parallel tracking
Frequency Range: 283.5 - 325.0 kHz
Channel Spacing: 500 Hz

MSK Bit Rate:	50, 100 and 200 bps
Operating Modes:	Manual, automatic and database
Cold Start Time:	< 1 minute typical
Reacquisition Time:	< 2 seconds typical
Demodulation:	Minimum shift key (MSK)
Sensitivity:	2.5 microvolts/meter for 6 dB SNR @ 200 bps
Out of Band Rejection:	60 dB < 204 kHz and > 404 kHz
Spurious Response:	< -55 dB (0.1 MHz to 1.6 MHz)
Ripple (in-band):	3 dB
Dynamic Range:	100 dB
Frequency Offset:	+/- 8 Hz (~ 27 ppm)
Adjacent Channel Rejection:	61 dB +/- 1 dB @ frequency center +/- 400 Hz
Antenna Input Impedance:	50 Ohms
Decoding:	RTCM 6/8
Frequency Selection:	Manual or offset
Serial Ports:	2 full-duplex
Interface Level:	HCMOS, tracks input voltage
Data Port Baud Rate:	4800, 9600, 19200, 38400 and 57600 baud
Corrections Output Protocol:	RTCM SC-104
Data input / Output Format:	NMEA 0183

C-Nav7050

Voltage:	12V DC regulated, 60 W
UHF #1 Antenna:	TNC
UHF #2 Antenna:	TNC
IALA Antenna:	TNC
Auxiliary Input	Serial DB9, Ethernet RJ45
RTCM104 Dual Outputs:	DCE DB9 female tx out pin 2 (back panel)
UHF Configure:	DCE DB9 female back panel
IALA Configure:	DCE DB9 female back panel

Section 4 –Installation

This section provides guidance on hardware installation. Figure 3 (Page 16) shows the rear panel of the C-Nav7050.



Figure 3: C-Nav7050 Rear Panel

Please note: Prior to commencing any installation, discuss proposed mounting locations / methods and cable routes with those involved to ensure all parties are aware of the work to be done and the risks involved.

Rack Installation

Refer to Figure 1 for the steps below:

- 1) If a 19" rack has not been provided, find a suitable rack on board the vessel to mount the 1U (1.75") tall C-Nav7050.
- 2) Secure the outer sliding rails to the rack.
- 3) If there are no front rack nuts already on the rack, use the nuts provided with the C-Nav7050.
- 4) Slide the C-Nav7050 onto the rails, ensuring that the C-Nav7050 is secured onto the outer rails.
- 5) Connect the IALA antenna cable to the TNC receptacle labeled "IALA" (if this option is installed). See [Installation of Antennas](#) (Page 17)
- 6) Connect UHF antenna cables (if this option is installed). See [Installation of Antennas](#) (Page 17)
- 7) Connect a serial cable from the **RTCM104** Out port(s) to each device that is receiving the RTCM104 corrections data.
- 8) Connect the XLR plug from the power supply cable (or the optional power supply kit P/N CNV7050PS-OPT) to the power socket labeled "12V DC".
- 9) Slide the rack back out, ensuring that there is enough slack for the cables that are connected to the back of the C-Nav7050. Once you have the necessary slack, dress up the cables.
- 10) Place the cover back on top of the C-Nav7050. Secure the six Phillips-head screws on top and the seventh (also a Phillips-head) screw in the rear.

- 11) Slide the C-Nav7050 back into the rack. Secure the C-Nav7050 front panel with the existing screws.

Installation of Antennas

⚠ Always wear appropriate protective equipment, including a certified fall arrestor harness and hardhat when working at heights to prevent injury to personnel, or death. Prior to commencing any work on the mast, ensure that all radar systems are switched off and isolated.

If the C-Nav7050 has either the IALA and/or the UHF option installed, it will come with the antennas mentioned in Figure 4 (Page 17).

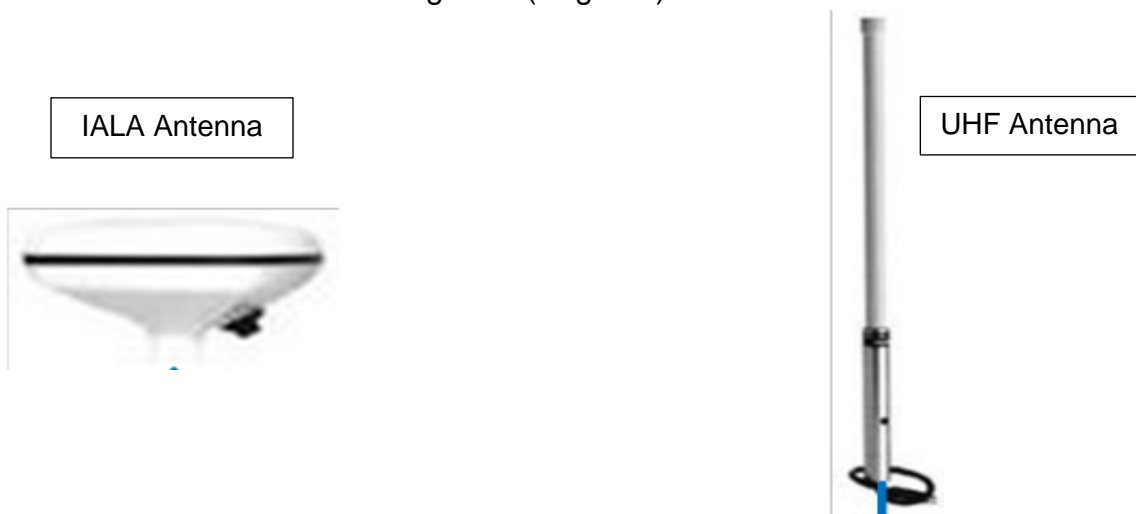


Figure 4: Supplied Antennas

Determining Proper Antenna Placement

UHF and Beacon antennas may be placed along handrails with a clear view horizontally as the UHF and Beacon signals are land-based, rather than the space-based GNSS and SBAS signals.

Antenna Installation

Once the antenna location has been determined based on the aforementioned criteria, mount the antenna onto an antenna-mounting pole via the antenna mounting pole adaptor. This should be done on deck prior to climbing the mast as mounting the antenna aloft poses potential risks to personnel and equipment due to possible dropped object hazards.

Install the antenna with an antenna-mounting pole in the predetermined location. The pipe can either be welded to the mast for a more permanent installation or secured using stainless steel hose clamps.

Coaxial Cable Installation

Proper installation of coaxial cables is important to ensure successful communication between the antenna and sensor.

When choosing a cable route for coaxial cable, consider the following:

Avoid running coaxial cable across, or parallel to power cables and high-power RF cables.

- 1) Ensure that the cable route is free of sharp edges or places where the cable could become pinched, kinked, sliced or damaged in any way.
- 2) Determine the manufacturers' specifications for the coaxial cable in use. This should include impedance, diameter, attenuation in dB/100 ft and dB/100 m for the frequencies used, and velocity of propagation.
- 3) Ensure the cable does not exceed the recommended minimum bend radius suggested by the manufacturer. LMR400 has a bend radius of 1" (installation) and 4" (repeated).
- 4) Ensure there is sufficient space at the cable entry point to the bulkhead as to not damage the connector during installation.
- 5) Measure the length of the cable route and determine the acceptable cable length in relation to attenuation loss at the frequencies in use.

Please Note: Prior to connecting the coaxial antenna cable to the antenna, ensure that all connections are free of dirt and other debris. Apply silicone grease to the connector threads and wipe off any excess, ensure not to get any lubricant on the contact. Connect the coaxial cable and hand-tighten firmly. Wrap the connection with self-amalgamating tape or rubber tape and then with vinyl tape. Cover the taped area with Scotchkote[®] to prevent water ingress.

- 6) Slacken the coaxial cable and tape firmly to the antenna-mounting pole. This will prevent any undue strain on the cable connector and antenna.
- 7) With the cable connected to the antenna, create a service loop to account for future re-terminations and run the cable down the mast, securing with zip ties every 2 or 3 feet. Carefully lay the cable along the chosen route to further detect any potential kinks, bends or spots where the cable may become damaged.

- 8) Secure the cable along the cable route with tape or zip ties and place a label at the sensor end of the cable for identification purposes.
- 9) Connect the coaxial cable to the sensor. Ensure that any slack in the cable is neatly stowed and that the minimum bend radius is not exceeded during this process.

Interconnection Diagram

The following diagram see [Figure 5](#) (Page 19) shows the interconnection from the C-Nav7050 to the various antennas and data connections.

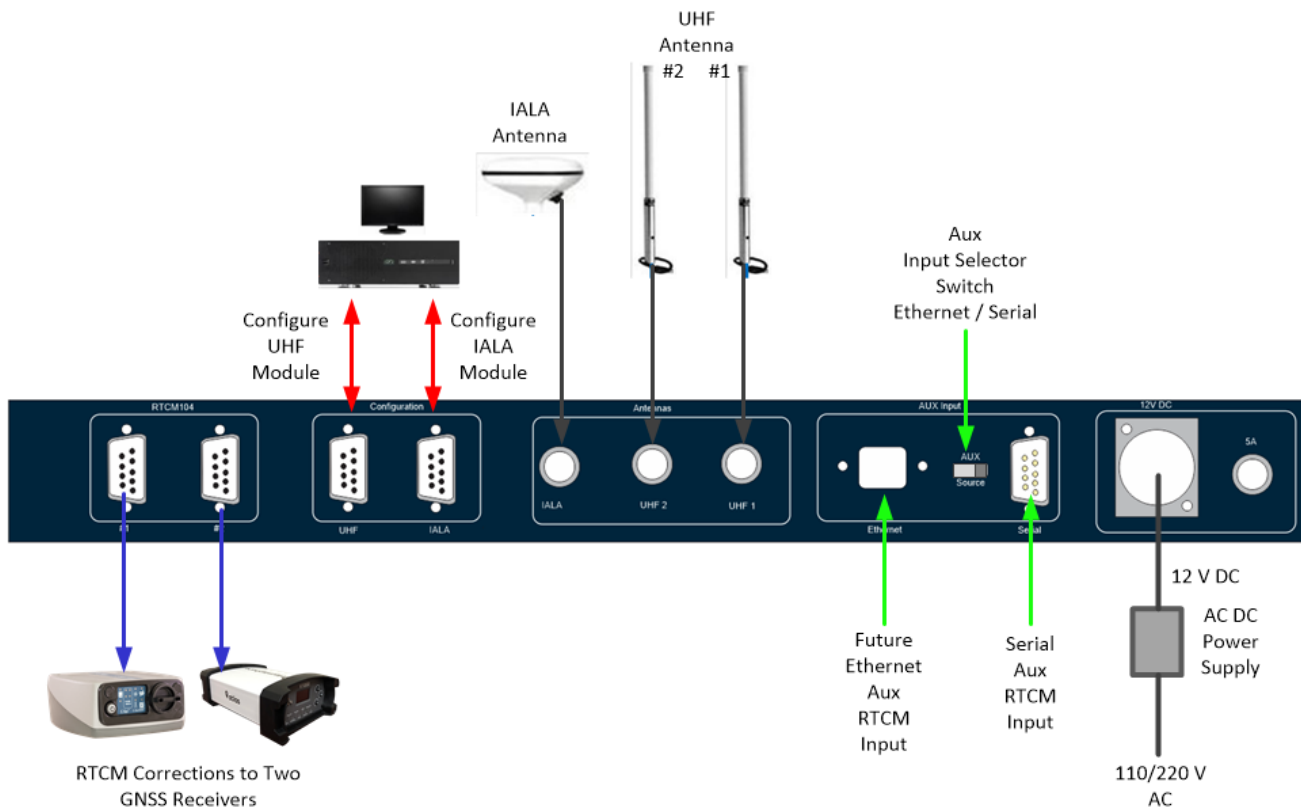


Figure 5: C-Nav7050 Interconnection Diagram

Section 5 - Operation

This section provides guidance on operating the C-Nav7050. [Figure 6](#) (Page 20) shows the front panel of the C-Nav7050 with its buttons, switches and indicators.



Figure 6: C-Nav7050 Front Panel

Refer to [Figure 6](#) (Page 20) for the following from left to right:

- 1) **ON/OFF** Pushing this button turns the UHF and IALA receiver modules on; this button will illuminate green. Pushing this button again turns the UHF and IALA receiver modules off; the lamp is extinguished.
- 2) **Channel Select Screen Keys:** These allow the user to select the appropriate channel for each of the two UHF receivers. When the proper UHF Receiver is selected, the user can either advance to a known channel or scan to a receiving channel. Channel selection is performed by:
 - a. Press the **Screen Key** in $\frac{1}{2}$ second intervals to advance the channel manually (channel numbers only increase). An amber background on the **Screen Key** denotes that the channel is in a manual change state.
 - b. To scan a channel, press and hold the **Screen Key** for 5 seconds and release. The receiver will search for the channel that is receiving data by staying at that channel for 5 seconds before moving up to next channel if no data has been received.
 - c. If a channel is receiving data, the background of the **Screen Key** will illuminate green as seen in [Figure 7](#) (Page 20).



Figure 7: Receiving Data

- d. If a channel is not receiving data, the background of the **Screen Key** will illuminate red as seen in [Figure 8](#) (Page 21).



Figure 8: Not Receiving Data

- e. The C-Nav7050 controller saves channel frequencies displayed on both Screen Keys into memory after it has been left untouched for 5 minutes.
- 4) **Primary Source Selector Switch:** This four-position rotary switch selects the primary source of RTCM corrections between:
- a **UHF #1**
 - b **UHF #2**
 - c **IALA**
 - d **Aux**
- 5) **Same Source Selection Warning:** This red LED is illuminated if the user sets both the primary and secondary switches to the same position.
- 6) **Secondary Source Selector Switch:** This four-position rotary switch selects the Secondary source of RTCM corrections between:
- a **UHF #1**
 - b **UHF #2**
 - c **IALA**
 - d **Aux**
- 7) **Data Indicators:** These 3 green LEDs indicate:
- a **Top:** IALA data available
 - b **Middle:** Auxiliary data available
 - c **Bottom:** Source of auxiliary data
 - i **ON** Ethernet
 - ii **OFF** Serial
- 8) **Fallback Control Indicator:** Two green LEDs indicate if the outgoing correction stream is from the primary or secondary source.

Appendix A - Petrobras UHF Channels with Frequencies

This appendix shows the Petrobras UHF channels used for Annex V.

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	459.2500	03	459.4250	06	469.2750	09	469.4500
01	459.2750	04	459.4500	07	469.4000		
02	459.4000	05	469.2500	08	469.4250		

Table 3: Petrobras DGNSS UHF Channels and Frequencies

Appendix B - ADL RXO UHF Programming Procedures

This appendix provides guidance on programming the Pacific Crest ADL UHF RXO modules. Although the modules are programmed at our Lafayette office, there may be a time where the end user will have to add or edit frequencies and reprogram them. This appendix assumes that the end user has a copy to ADLCONF software (click [here](#) to download the latest ADLCONF software). The user can click [here](#) for generic instructions on using the ADLCONF software. The user can also contact [C-Nav Support](#) if they require any further assistance.

To program the UHF modules, use the following steps:

- 1) Connect the DB9 Serial cable from a computer terminal (that has ADLCONF) to the **UHF Config** port.
- 2) Place both the **Primary Source Selector Switch** and the **Secondary Source Selector Switch** to the UHF1 position to program the primary UHF module, or place both the **Primary Source Selector Switch** and the **Secondary Source Selector Switch** to the UHF2 position to program the secondary UHF module.
- 3) Click on the **ADLCONF** icon on the computer.
- 4) Click on **Connect...**, and wait until the **Connect to ADL Radio** window opens, see [Figure 9](#) (Page 23).

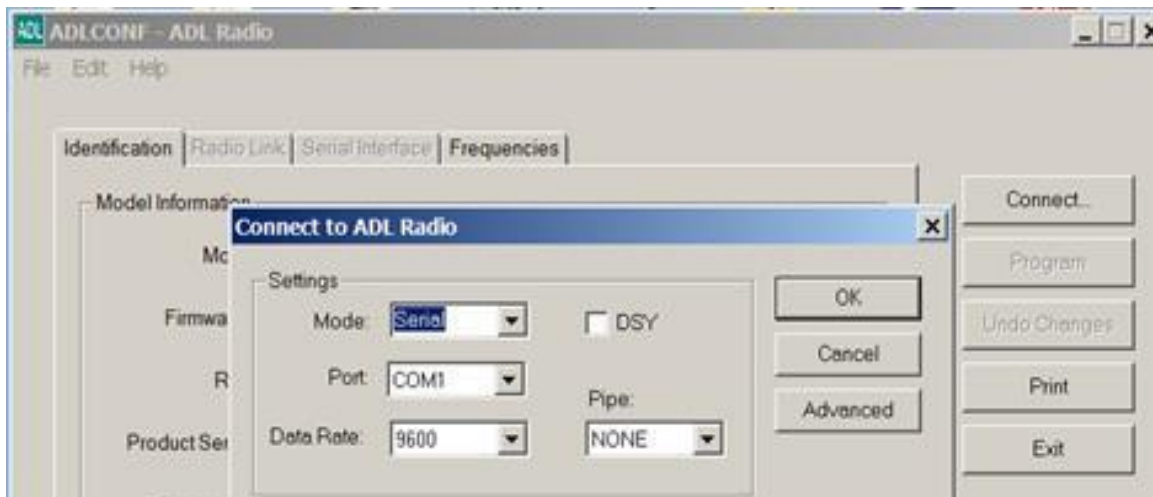


Figure 9: Connect to ADL Radio Window

- 5) Select the correct mode, port and 9600 baud and click on **OK**.

- 6) After clicking on **OK**, a window with the text “*This action will overwrite the current configuration. Continue?*” will pop up. Click **YES** to continue.
- 7) Click on the Frequencies Tab see [Figure 10](#) (Page 24). Select **File** and click on **Import** to upload the Petrobras Configuration File and press **Open**.

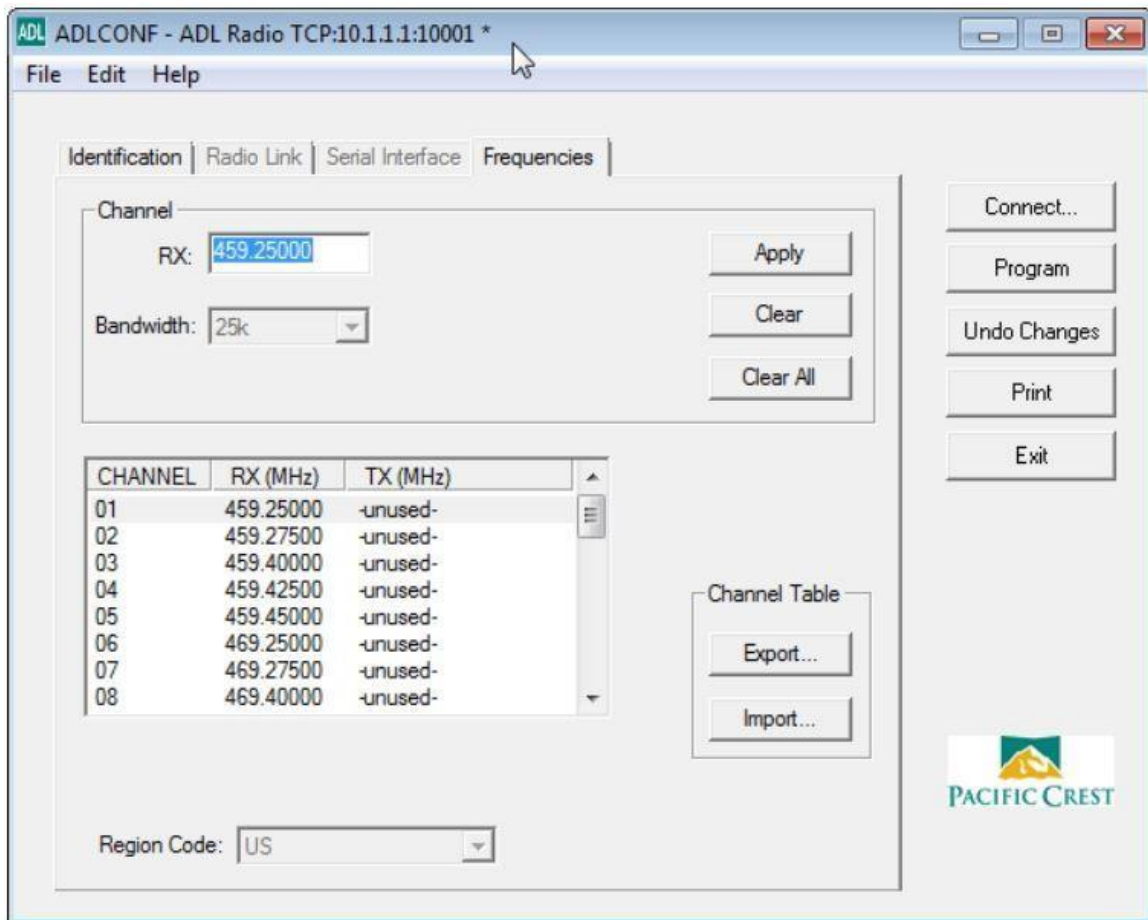


Figure 10: Frequency Configuration Window

Please Note: If the Petrobras Configuration File is not available, then manually enter the frequencies using the ones in Appendix A. The bandwidth will be configured for 12.5KHz.

- 8) Click on the **Program** button.
- 9) Once again, another window with the text “*This action will overwrite the current configuration. Continue?*” will pop up. Click **YES** to continue, see [Figure 11](#) (Page 25).

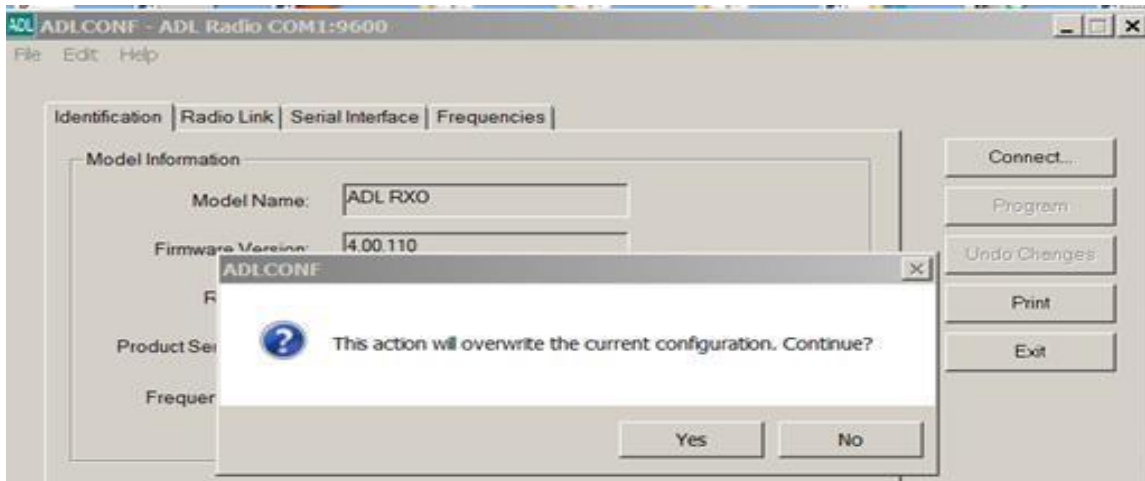


Figure 11: Action Overwrite Window

10) [Figure 12](#) (Page 25) shows the configuration being read.

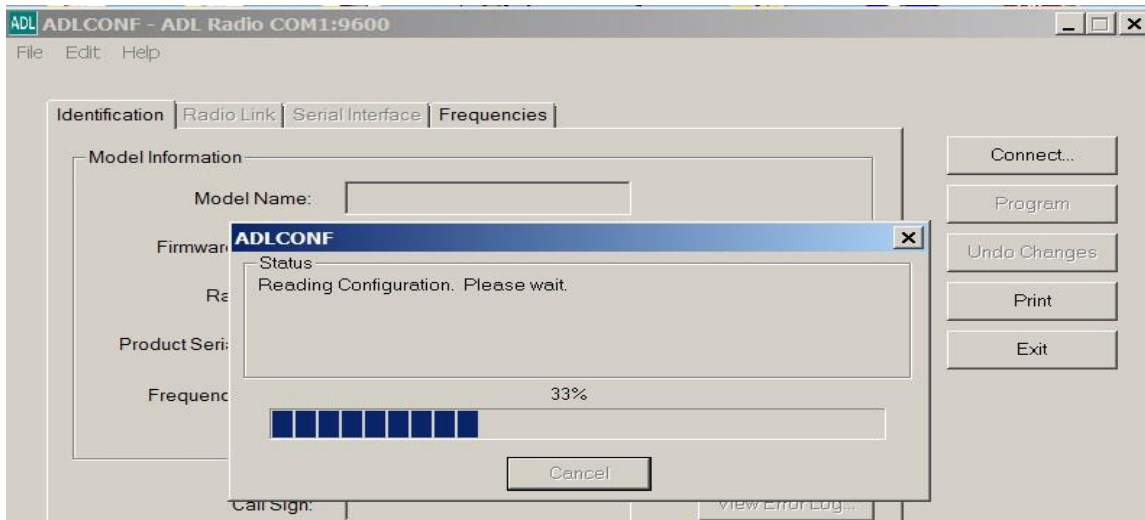


Figure 12: Reading Configuration Window

11) Click **OK** on the window that states “*Radio’s configuration loaded successfully*”, see [Figure 13](#) (Page 26).



Figure 13: Successful Radio Configuration

- 12) Click the **Exit** button and then click **Continue**
- 13) If necessary, change the front switch to the other UHF module and follow steps 1-13.
- 14) Turn off the C-Nav7050 for 1minute; then turn it on.
- 15) Check if any channels are displayed on the screen keys. 16) Then turn off the C-Nav7050.

Appendix C - IALA Module

The IALA module has been configured at the C-Nav Lafayette office. However, this appendix allows the user to send commands to the module if necessary. It is not recommended to make any changes to the IALA module, unless instructed by a C-Nav Technician for testing purposes. The receiver has two ports, P0 is the RTCM104 output port and has been configured to be at 9600 baud, 8, N, 1 and P1 is the configuration port at 4800 baud, 8, N, 1.

The IALA module has been configured to operate in ABS (Automatic Beacon Search) mode by default, selecting and tuning to the most appropriate beacon without operator intervention. ABS mode is ideal for navigation applications over considerable areas with various beacon stations available, eliminating the need for operator intervention when traveling from one beacon coverage zone to another. A continuous search for the strongest RTCM signal is always

performed using one of the two ports in the background, without affecting the performance of the locked channel. If the operator decides to use the manual mode to tune to specific frequency, using the \$GPMSK NMEA 0183 command, please contact Techsupport@HGNS.com

See the instructions below on how to communicate to the IALA module using the configuration port (IALA Config):

- 1) Change the RS-232 Cable from the UHF config connector at the rear of the enclosure to the IALA config.
- 2) Open Tera Term (Terra Term is a serial terminal program that allows the communication to the receiver by using commands on the computer) and refer to the GNSS diagrams (if applicable) to see which port is currently used for IALA. Click [here](#) to download the latest version (Note: file size is approximately 11MB)
- 3) Select *Serial* and then the appropriate *Port*. Press **OK**.
- 4) Click **Setup / Serial port...**
- 5) Configure the serial ports settings to be 4800, 8, N, 1. Press **OK**.
- 6) Click **Setup / Terminal....** Configure *Transmit* to "CR +CL" and check *Local echo*. Press **OK**.
- 7) To test the communication type the following command on the terminal **\$PCSI,0** and press **enter**. The response should be:

```
$PCSI,P030-0,004
$PCSI,0 ->HELP Msg
$PCSI,1 ->Status line A,<T>,<S>
$PCSI,2 ->Status line B,<T>
$PCSI,3 ->Dump Search,<x>
$PCSI,4 ->Wipe Search
$PCSI,5 ->Port Rate,<P0>,<P1>
$PCSI,6 ->Reset
$PCSI,7 ->RTCM Mode
```

This quick test prepares for any commands that are instructed by the C-Nav Technician.