

Installation and Configuration Manual

RT-800

Wideband Precision Direction Finder RHOTHETA Elektronik GmbH



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Note

The manufacturer reserve the right to make modifications at any time and without previous information of the here described product.

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1 Antenna Installation Considerations

1.1 General Information

For static bearing applications like e.g. VTS (vessel traffic service), a high bearing accuracy is demanded, with small tolerable bearing errors. For this purpose the antenna unit possibly has to be calibrated in order to compensate minor unbalances in rotation, but especially the antenna position at the installation site has to be chosen properly for bearing purposes.

In case of perturbing site conditions resp. restrictions caused by the building or the environment, the bearing accuracy might be disturbed. This physical effect generally is valid for all bearing systems.

1.2 Installation Recommendation

The quality of the bearing results depends largely on the position of the antenna. So, an antenna position has to be found, where the transmitter's wavefield can reach the bearing antenna as undisturbed as possible.

In order to obtain very good bearing results, no metallic resp. RF-conducting obstacles may be around the antenna unit (in an angle of $\pm 45^\circ$ towards the horizontal). The only exception is a correctly installed Lightning Protection Rod, optional available by RHOTHETA.

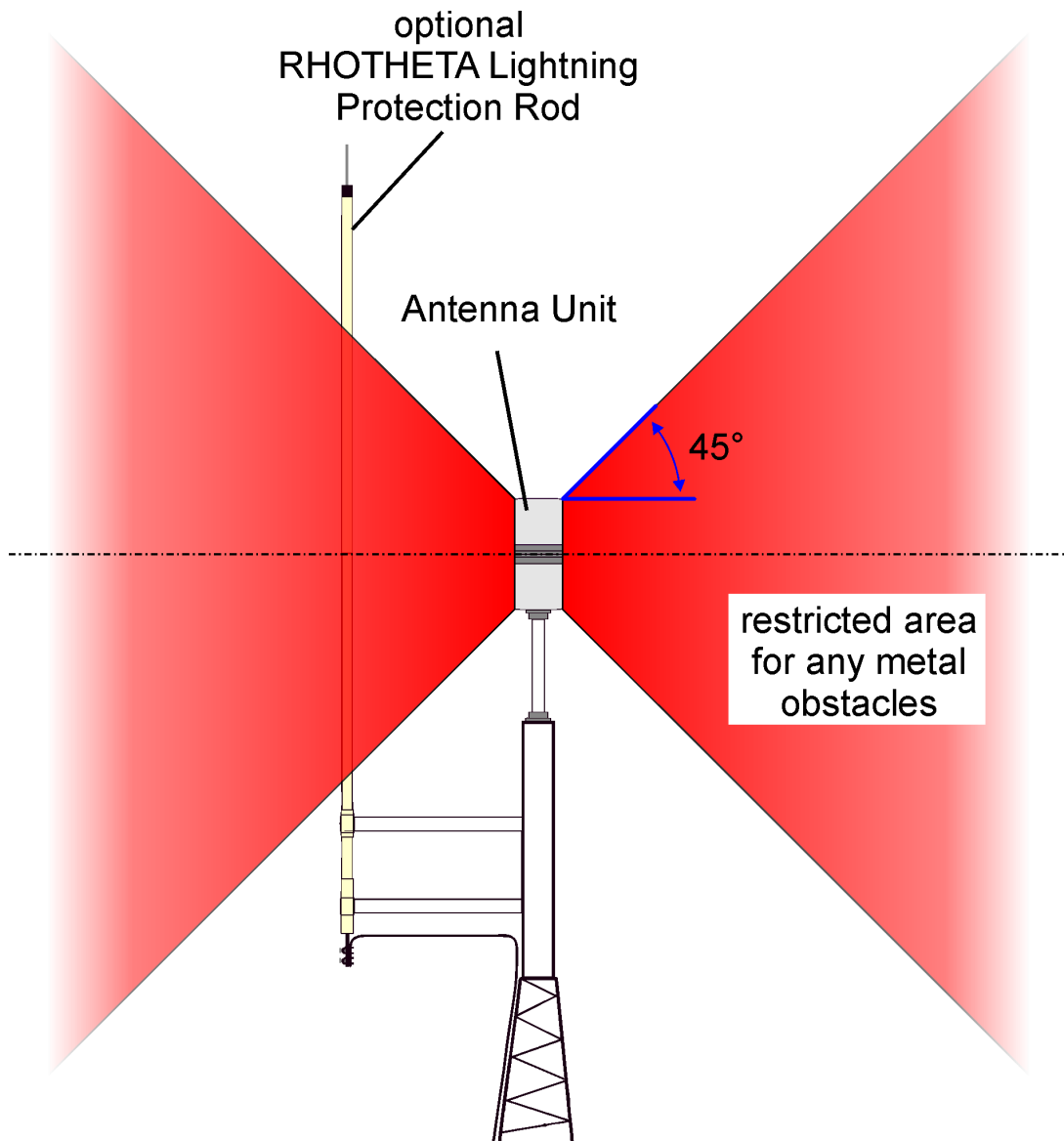


Fig. 1 Antenna Mounting

Objects being in the “restricted area” will disturb the arriving wave field. Reflections will arise which might decrease bearing accuracy.

1.3 Line of Sight and Fresnel Zone

There must be a direct line of sight between the transmitter (ship) and the antenna unit. Furthermore the Fresnel Zone (http://en.wikipedia.org/wiki/Fresnel_zone) must be free of any obstacles.

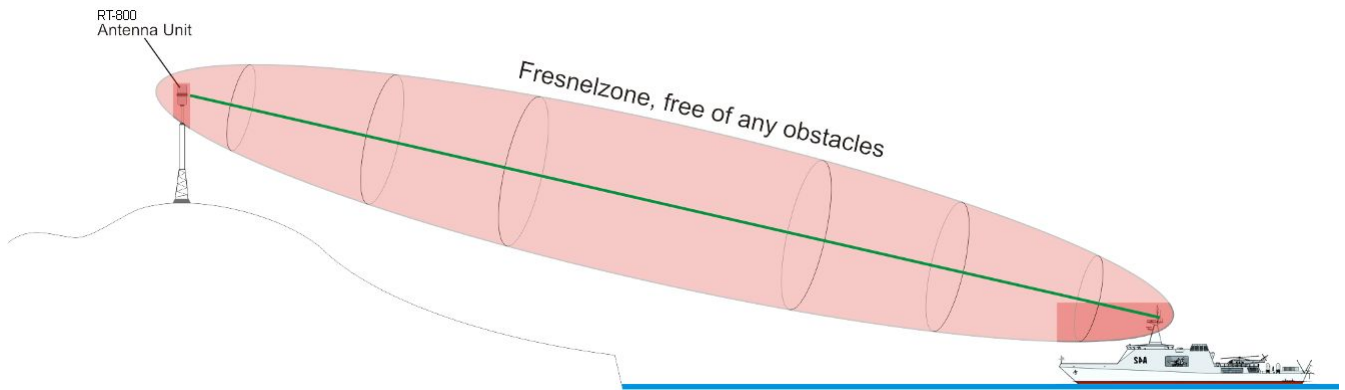


Fig. 2 Line of Sight and Fresnel Zone

In case of obstacles within the Fresnel zone, the direct RF-signal will be weakened and possibly reflections will be more noticeable.

1.4 Reduced Bearing Accuracy Caused by Reflections

Big natural reflectors in the antenna unit's surrounding are especially critical! (e. g. mountains in the back-side of the antenna, sharp rocky coasts or forests) Especially if the directly arriving wave field is very weak due to a remote transmitter, high mountains can cause reflections by receiving the signal better (due to their height) and therefore also causing stronger reflections.

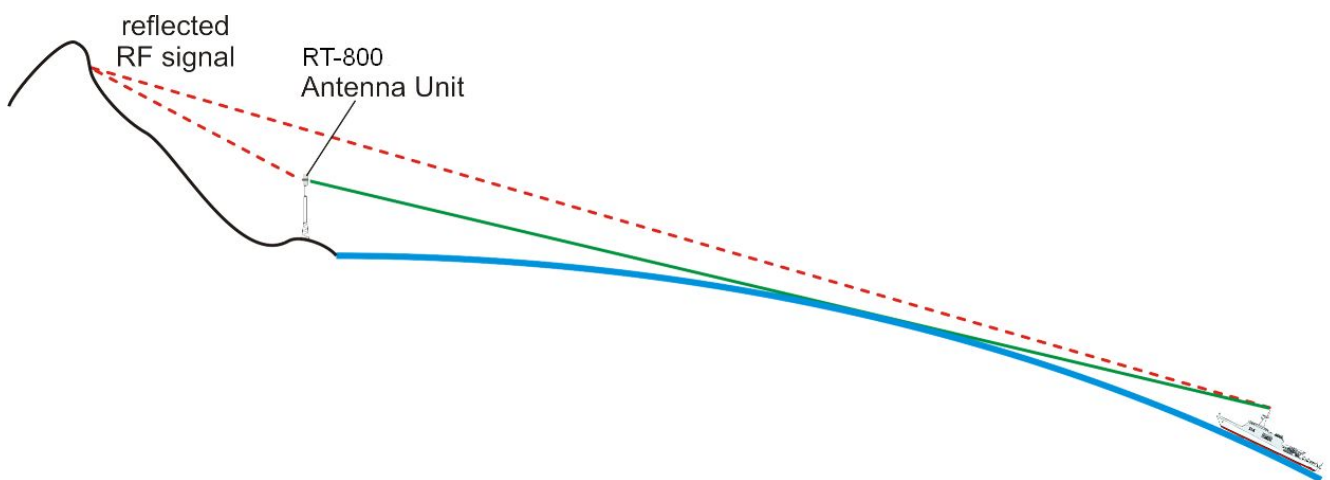


Fig. 3 Illustration of Reflections at fixed locations

1.5 Lightning Protection

When installing the RT-800 (AU) at fixed coastal locations, precautions must be taken regarding lightning protection.

For this reason RHOTHETA Elektronik GmbH offers an optional Lightning Protection Rod (LPR).

The Lightning Protection Rod for precision direction finders is designed to protect direction finders from RHOTHETA against the effects of direct lightning strokes into a direction finder system.

Normal lightning protection rods are simple metallic structures which have a large influence on the direction finding accuracy of a direction finder due to reflecting radio waves, so as any other metallic structure in proximity of the direction finder. The practical limits are in contradiction to the requirements of an efficient lightning protection system.

The RHOTHETA Lightning Protection Rod uses special technologies to reduce those reflections. This reduces the effects of the protection rod to an acceptable level, but will not completely avoid any influence.

For detailed advice on mounting the Lightning Protection Rod please refer to the Installation Manual of Lightning Protection Rod!

1.6 North Alignment

Bearing values of RT-800 are always displayed and output *relatively* to the north marking of the antenna unit.

This implies that the north marking must be aligned to North in order to display absolute, north related values!



Fig. 4 North Marking of Antenna Unit

1.7 Antenna Connection

For details about the connection between the RT-800 DCU and Antenna Unit please look at page 13 (Chapter 2.2.1 Antenna Unit Port (Connecting Cable DCU ↔ AU))!

2 Interfaces

2.1 Overview

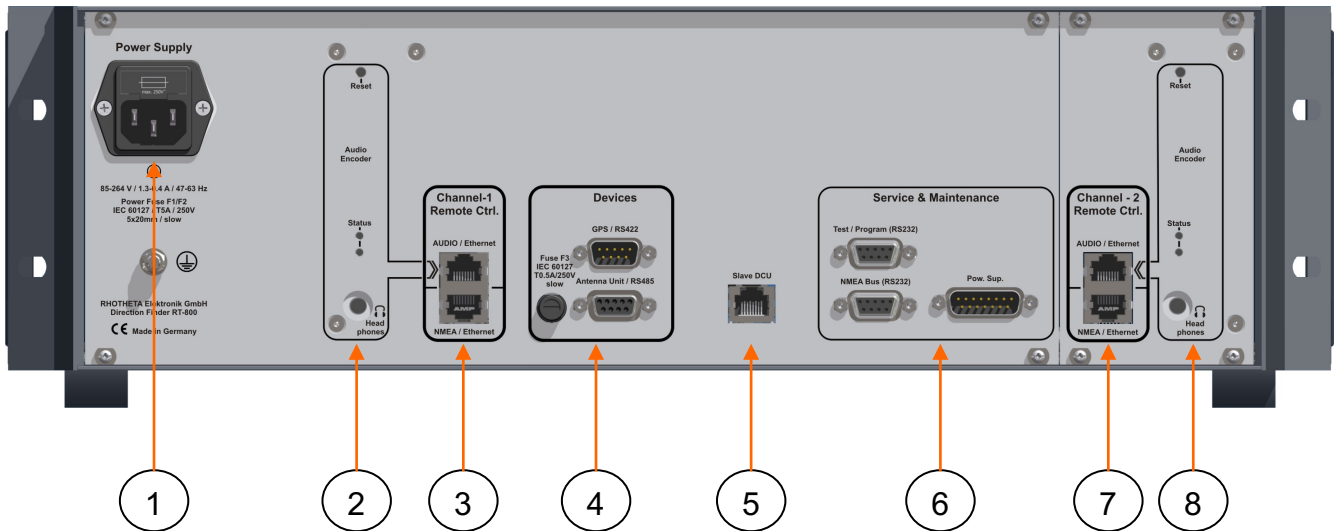


Fig. 5 Overview of Interfaces

| Pos. | Designation | Meaning | See page |
|------|------------------------------|---|----------|
| 1 | Power Supply | Power supply connector with replacable fuse | 16 |
| 2 | IP-Audio Encoder (Channel-1) | Audio Output for DF and ecoder cofiguration | 15 |
| 3 | Remote Control Channel-1 | Ethernet ports for remote control (NMEA / Ethernet) and IP-Audio (AUDIO / Ethernet) | 15 |
| 4 | Devices | Connector ports for AU (antenna unit) and optional GPS-connector for the option "UTC Time Base"; fuse for AU / GPS power supply | 13 |
| 5 | Slave DCU | Ethernet connector for factory use only | --- |
| 6 | Service & Maintenance | Ports for optional connections, SW-Update and local NMEA-Output | 17 |
| 7 | Remote Control (Channel-2) | Option: "2 nd Channel Remote Control" Ethernet ports for remote control (NMEA / Ethernet) and IP-Audio (AUDIO / Ethernet) | --- |
| 8 | IP-Audio Encoder (Channel 2) | Option: "2 nd Channel Remote Control" Audio Output for DF and ecoder cofiguration | --- |

2.2 Device Ports

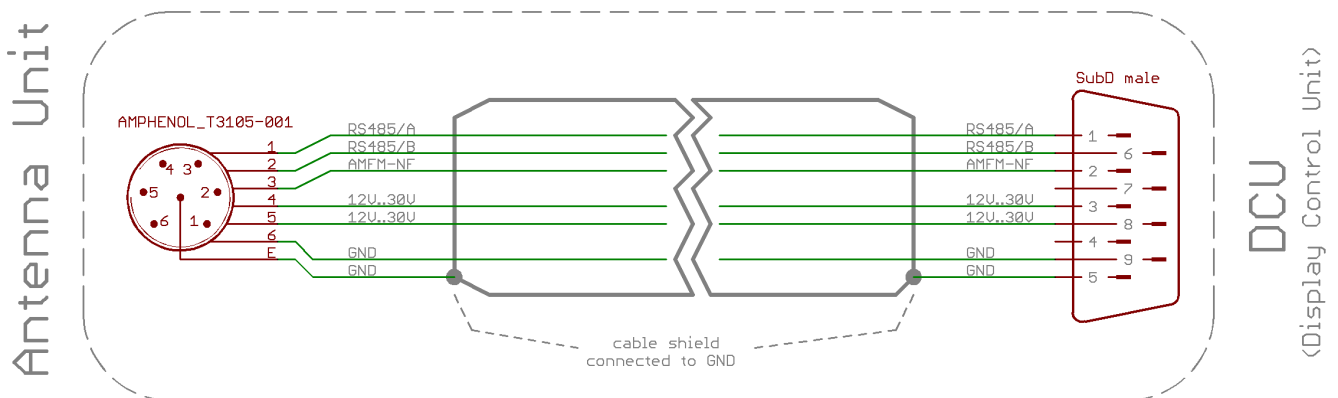
2.2.1 Antenna Unit Port (Connecting Cable DCU ↔ AU)



Contact / Pin Signal

| | | |
|---|---------------------------|---|
| 3 | +24 V_{DC} | Output power supply to Antenna Unit |
| 8 | | |
| 5 | GND | |
| 9 | | |
| 1 | RS485 A | Serial data connection DCU ↔ AU (9600 Baud / semi-duplex / receive and transmit) |
| 6 | RS485 B | |
| 2 | NF | Input audio signal resp. analog Test/Service |

Connecting cable DCU ↔ AU



Connection
Antenna Unit
Connector type:
Amphenol T3105-001

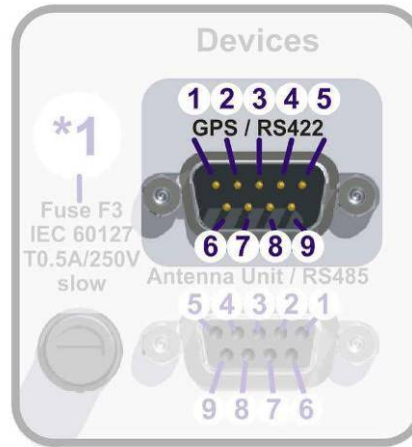
connecting cable 6-poled with shield
length 1 to 50 m: cross section of conductor min.
6 x 0.38 mm²
length 50 to 100 m: cross section of conductor min.
6 x 0.50 mm²

Connection
Display Control Unit
Connector type:
SubD 9-poled male

Fig. 6 Connecting cable DCU ↔ AU

2.2.2 GPS / RS422 Port

This optional (Build-To-Order Option) input is used to connect an external GPS-device to set the internal system clock. This is required for synchronisation of the bearing values if several direction finders are connected together by a command and control center.



Contact / Pin

Signal

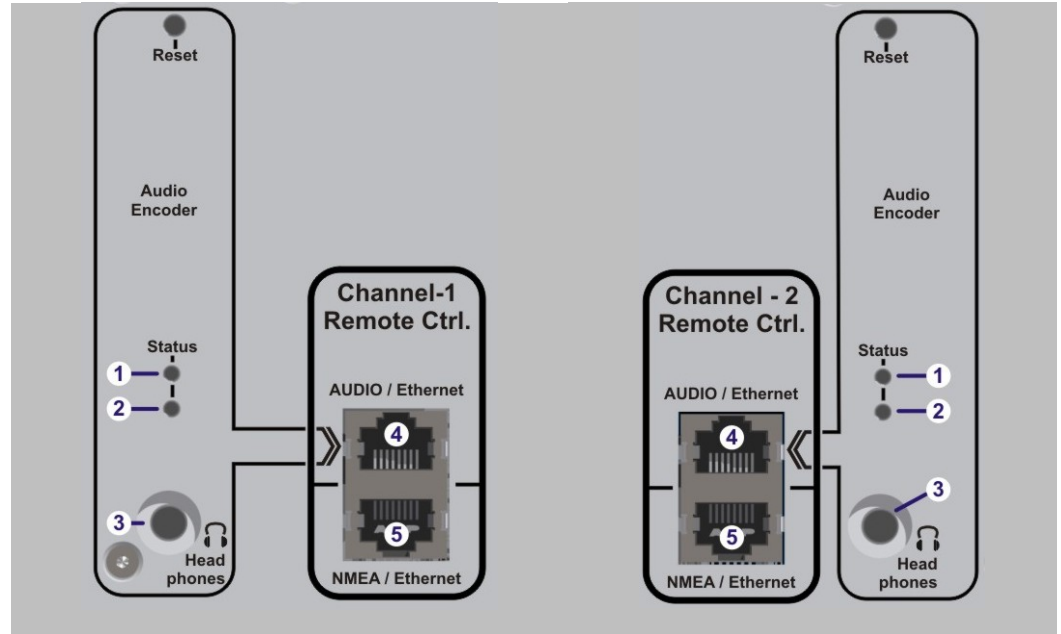
| | | |
|---|--------------------------|---|
| 6 | RS422 Rx / A | Input of serial GPS data with RS422 level |
| 1 | RS422 Rx / B | |
| 5 | GND | Output power supply for external GPS |
| 9 | +24V_{DC} | |

2.2.3 Fuse F3



This protection fuse covers the power supply of antenna unit as well as external GPS.

2.3 Remote Control and IP-Audio Encoder Ports

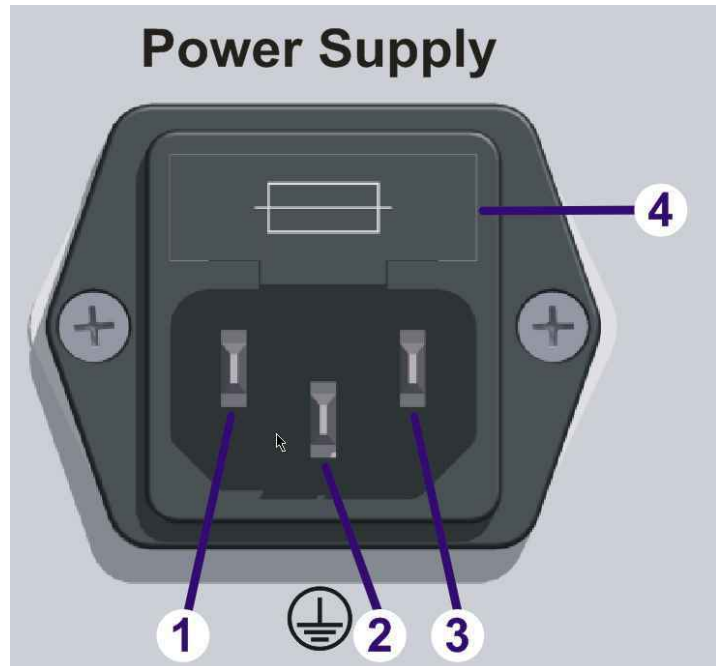


Item **Marking**

| | | |
|---|-------------------------|---|
| 1 | Status LED (red) | Blinks during boot process of IP Audio Encoder |
| 2 | Status LED (green) | Blinking: IP Audio Encoder is sending On: IP Audio Encoder is not sending |
| 3 | Head phones | After switching on the DCU, the current IP-address of the IP Audio Encoder is output to connected headphones. (This is only used during configuration process!) |
| 4 | Audio / Ethernet | Ethernet connection of IP Audio Encoder must be connected to LAN! |
| 5 | NMEA / Ethernet | Ethernet connection of NMEA remote control must be connected to LAN! |

If the option “2nd Remote Control Channel” is used, so it has the same connectors as the Channel-1

2.4 Power Supply



115-230 V / 1.0-0.5 A / 50-60 Hz

Power Fuse F1/F2

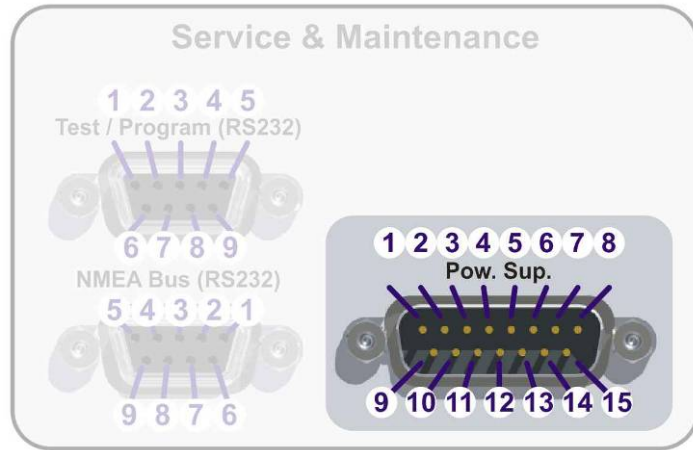
IEC60127 / T5A / 250V

5x20mm / slow

| Item / Pin | Marking | |
|------------|---------------------------------|---|
| 1 | N (Neutral) | IEC 60320 / C14 inlet for use of power cords with IEC 60320 / C13 plugs. 115-230 Volts / 1.0 – 0.5 Ampere / 50 – 60 Hz |
| 2 | PE (protective earth) | |
| 3 | L (Line) | |
| 4 | Built-In Fuse (replacable) | Embedded replaceable Fuse of type IEC 60127 / T5A / 250V / 5x20mm / slow |

2.5 Service & Maintenance Ports

2.5.1 Power Supply and Optional Connections



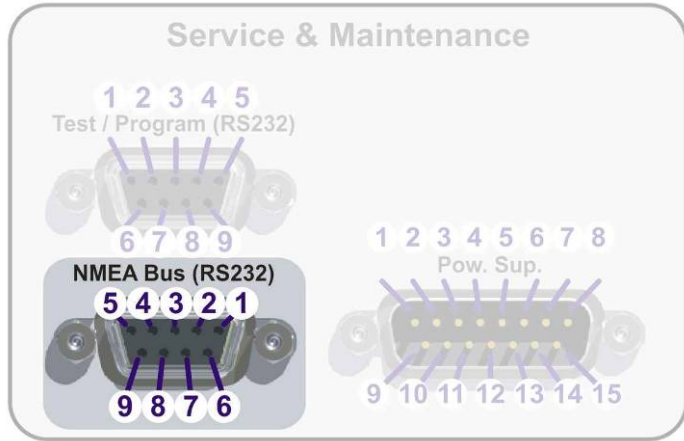
Contact / Pin

Signal

| | | |
|----|---------------------|--|
| 15 | +12 V to +30 VDC | No connections required (internally connected)! |
| 8 | GND (Ground) | |
| 7 | Permanent Operation | No connections required (internally connected)! |
| 14 | PTT / SBS | Optional input in order to suppress self bearing. When connecting input PTT/SBS (Self Bearing Suppression) to Ground, self bearing is suppressed |
| 6 | GND | |
| 12 | Squelch Out | Optional output for audio connection. When receiving a signal this pin is connected to ground by the means of an Open Collector output. |
| 4 | GND | |
| 1 | Alarm Relay | Optional alarm contact (mechanical relay as NOC, Normal Open Contact) max. 1 A at 30 V _{DC} resp. max. 0.3 A at 125 V _{AC} |
| 9 | | |
| 3 | Speaker + | No Connection required, because this ports are connected to the internal speaker! |
| 11 | Speaker - | |
| 13 | Audio Line Out | Connection not recommended, because this port is connected to the IP Audio Encoder! |
| 5 | GND | Audio output (connected to ground with fixed level. Adjustable in menu, from 200 mV _{SS} at 10% to max. 2 V _{SS} at 99% |

2.5.2 NMEA Bus (RS 232)

This is an additional NMEA interface of the DCU. It is recommended to use it only for local tests, because commands sent to the DCU may be interfere with commands sent through NMEA - Ethernet interface!

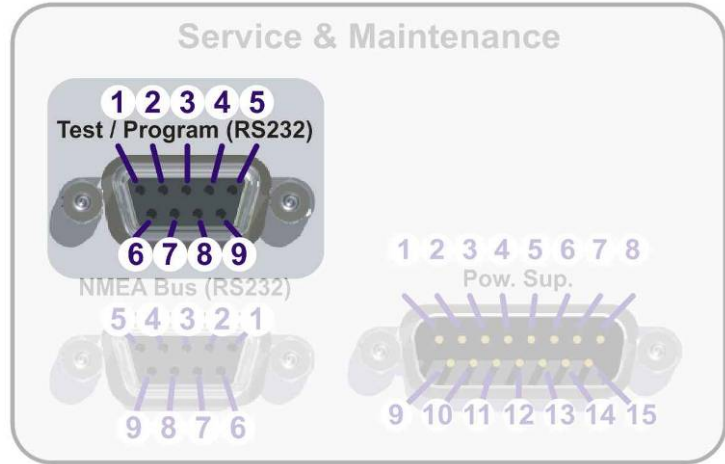


Contact / Pin **Signal**

| | | |
|---|-----------------|--|
| 2 | RS232 Tx | Output of serial data with RS232 level |
| 3 | RS232 Rx | Input of serial data with RS232 level |
| 5 | GND | GND level for RS232 connection |

2.5.3 Test / Program

Port for service or test operation (Software and new firmware upload).



**Contact
/ Pin**

Signal

| | | |
|---|-----------------|-------------------------------------|
| 2 | RS232 Tx | Output serial data with RS232 level |
| 3 | RS232 Rx | Input serial data with RS232 level |
| 5 | GND | GND level for RS232 connection |

3 Configuration

3.1 Configuration Considerations of “Menu – Setup”

Within this manual there are described only a couple of the internal settings of “Menu – Setup” which are related to remote control and IP Audio.

For description of the other settings please refer to “*Operating and Installation Manual Part I!*”

3.1.1 Menu Interface

Menu Interface contains settings related to remote control using NMEA-Sentences.

3.1.1.1 NMEA Talk-Mode

There are basically two operation modes for getting standard bearing data from the RT-800.

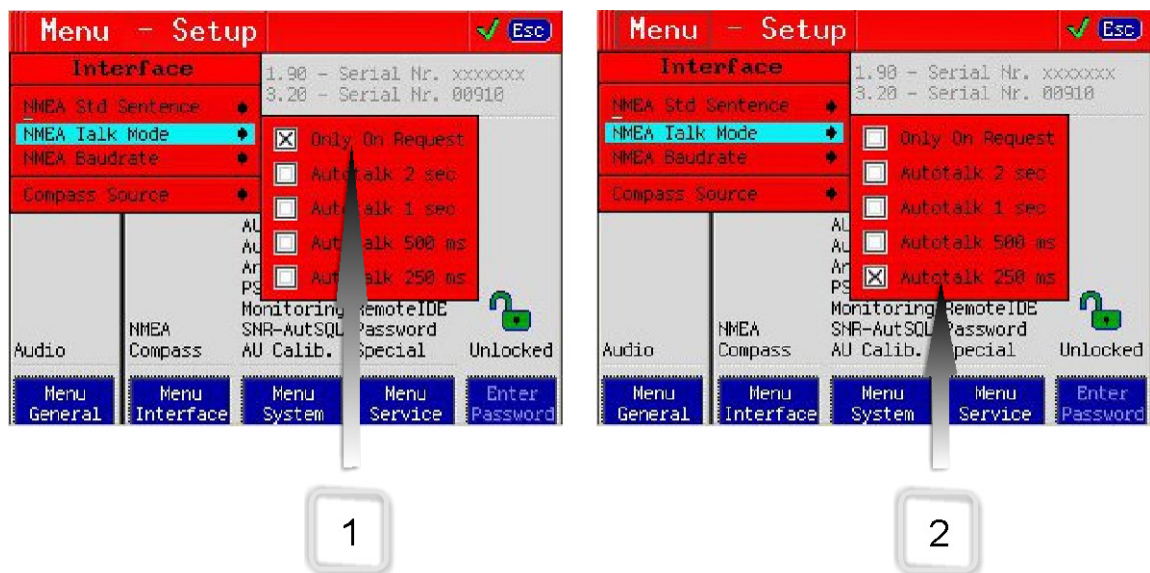


Fig. 7 NMEA-Talkmode Settings

1. On Request: The RT-800 sends the data only on request.
2. Autotalk: The RT-800 sends out the standard bearing data cyclically

Which mode to choose depends on the user supplied software controlling the RT-800!

3.1.1.2 NMEA Internal Baudrate

Internally the control panel of the RT-800 (display with buttons) is connected to a serial-to-ethernet converter by a serial line.

This implies that the **same** serial configurations must be used in both, the control panel and the serial-to-ethernet converter. Configuration of serial-to-ethernet converter is described on page 23 in chapter 3.2 Configuration of Remote Control over IP!

Standard configuration is: 4800Baud / 8 databits / 1 stopbit / no parity / no flow control

- It is strictly not recommended to change this values

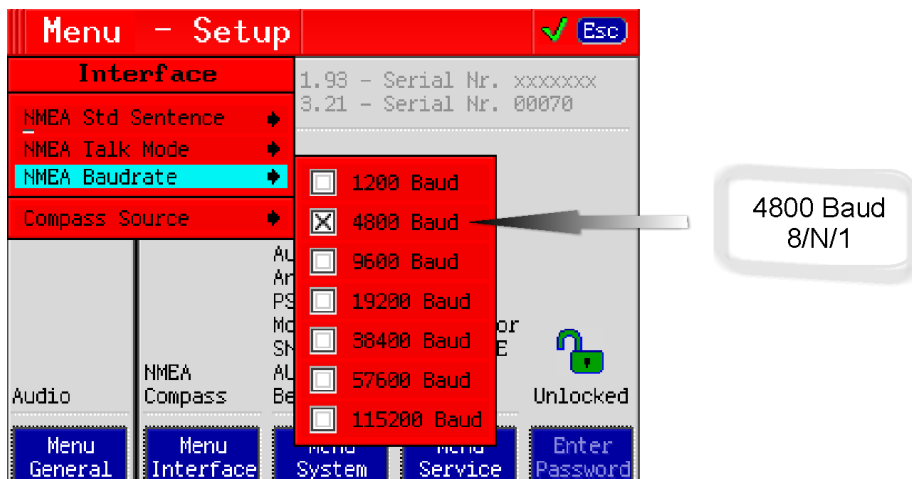


Fig. 8 NMEA-Baudrate Settings

3.1.2 Menu System

3.1.2.1 Audio Line Output

RT-800 control panel audio output consists of two parts:

1. The first audio output is connected directly to the internal speaker and its volume can be controlled by the “Volume”-Dialogue of the control panel.
2. The second audio output is connected to the input of the IP Audio converter. With the “Audio Line Output”-Setting of control panels “System Menu” the level of this audio signal can be adjusted from 200 mV_{SS} at 10% to max. 2 V_{SS} at 99%.

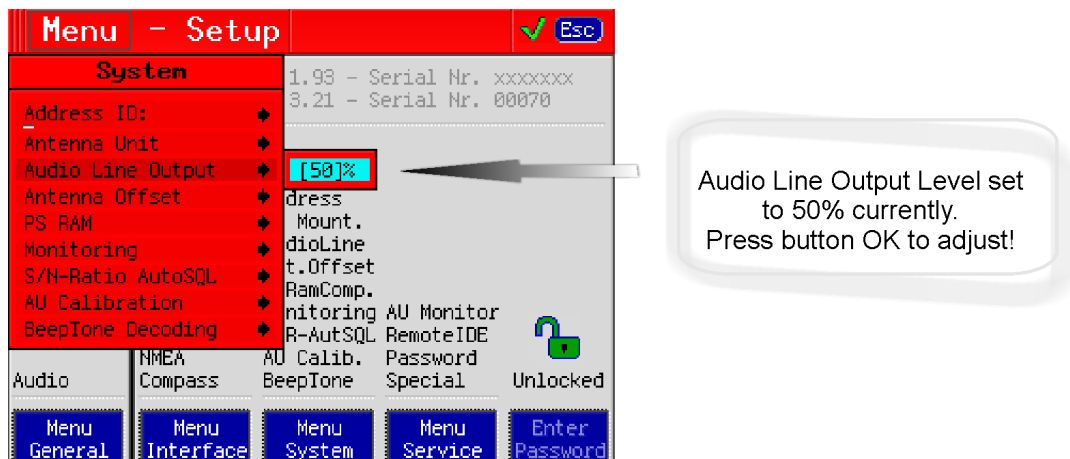


Fig. 9 System – Audio Line Output Setting

3.1.2.2 Antenna Offset

If a fixed bearing offset is present after mechanical installation of the RT-800 AU (i.e. Antenna Unit is not exactly aligned with North), this offset could be compensated using the “Antenna Offset” setting of control panel’s “Menu System”.

An offset of 0 – 359° can be entered, what means if you need to correct -5°, you enter 355°!

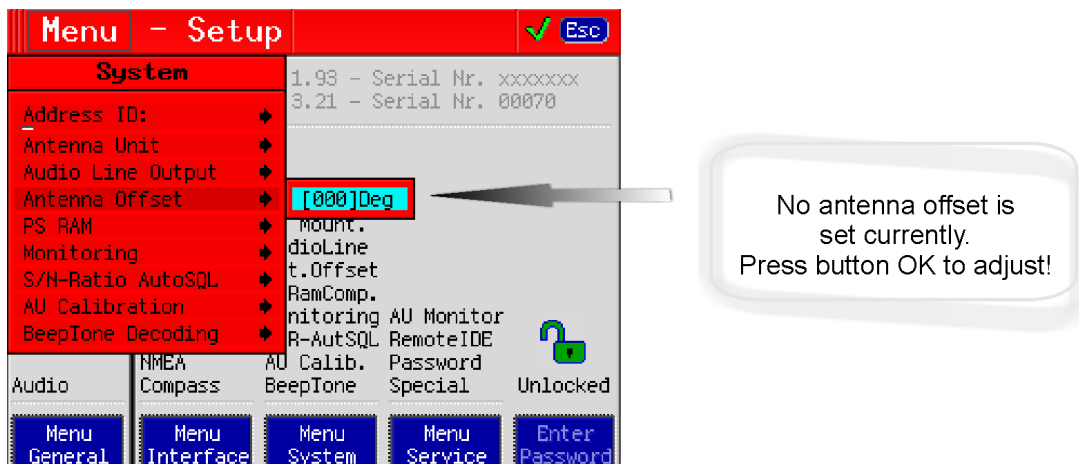


Fig. 10 System – Antenna Offset Settings

3.2 Configuration of Remote Control over IP

See also >> Example of complete Network Scenario (page 31)

3.2.1 Introduction / Concept

The RT-800 Display Control Unit is already prepared to be connected via the NMEA/Ethernet connector to an IP-based Ethernet LAN, making it possible to access the direction finder located anywhere on a local LAN, or the Internet.

For this, the RT-800 Display Control Unit contains an industrial device server (MOXA NPort 5150) which is internally connected to serial line signals.

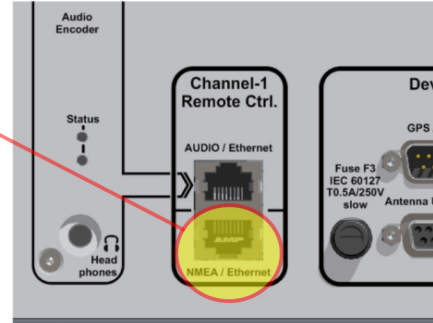


Fig. 11 Remote Control LAN connector

The MOXA NPort 5150 device supports several operation modes (TCP, UDP, Pair connection...) and some configurations have to be done in any case by the user for proper operation at custom specific IT environment conditions.

For additional detailed informations, see also www.moxa.com > support > NPort 5150.

The next chapters describe the exact configuration for best performance of this MOXA device using a standard web console.

3.2.2 IP Network settings & Web Console connection to configure the device

To access the direction finder from remote, it is common to use static IP & Port addresses. For this the MOXA device itself can be configured to a static IP address or, which is normally the better solution, to configure the router in the local network with a DHCP reservation to allocate the direction finder identified by its MAC address to a fixed/static IP address.

- the RT-800 is preconfigured after delivery to **DHCP mode**
- if **NO DHCP** server is available, the initial RT-800 IP address = 192.168.127.254

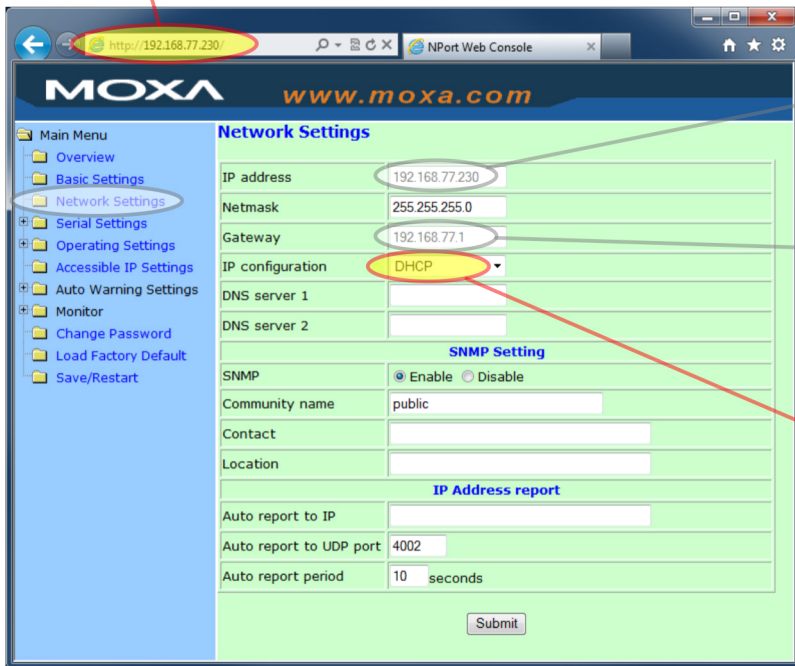
A standard Web Browser/Console is the most user-friendly method available to configure the MOXA NPort 5150 and thus the RT-800 network connectivity . You can use as example Google Chrome or the Microsoft Internet Explorer.

- Connect the RT-800 NMEA/Ethernet port to your local LAN network.
- If a DHCP server is available in your network, the RT-800 will get an initial IP address depending on your DHCP router settings. You can use an IP scanner or just look at your router configuration console or as example windows DHCP server at the new clients table to see the actual RT-800/MOXa IP address.
 - Name of the RT-800/MOXa device = "np5150_ ..."
 - Manufacturer ID = "MOXA ..."
- If NO DHCP server is available, the RT-800 will use the factory default IP address 192.168.127.254. In this case you have to configure the laptop/computer you use for

this configuration also temporary to a static IP address of the same subnet
192.168.127.xxx

Network configuration:

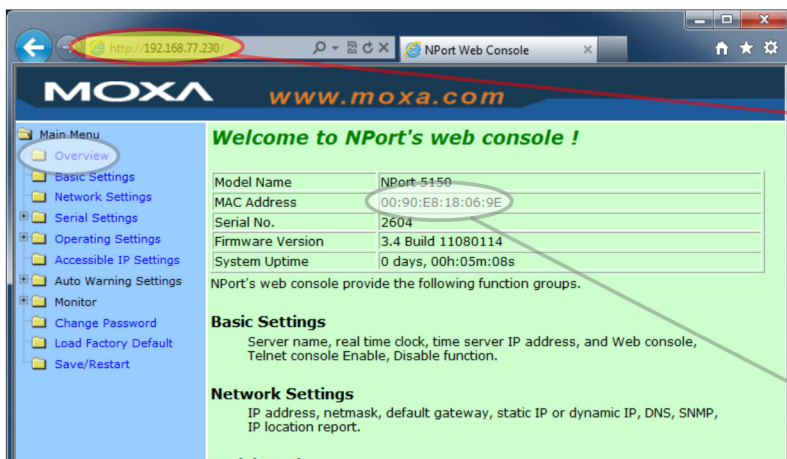
- Start a standard web browser console and input the actual detected IP address of the RT-800 / MOXA device.



Actual IP address.
Changed/configured only when not working with DHCP.

Gateway information of local network is always necessary if the remote control is done from another network. When DHCP mode is active and available, the gateway values are normally automatically filled. Setting for DHCP or static mode possible. Depends on your network configuration.

MAC address info:



Fixed MAC address of the RT-800 / MOXA device.

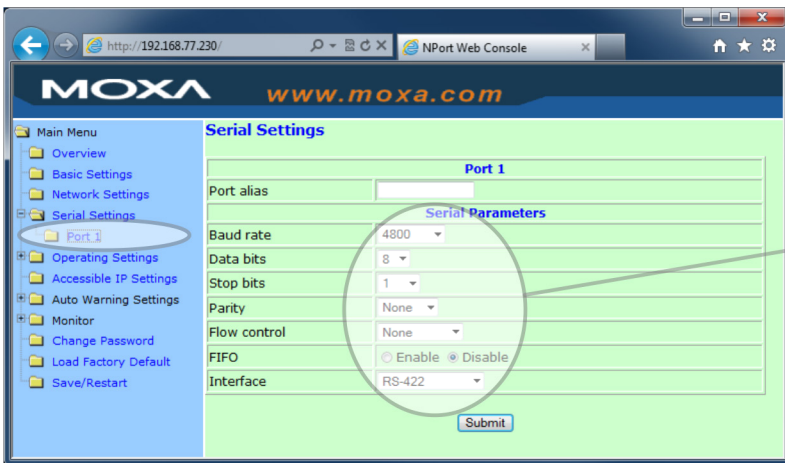
Used for DHCP router reservation table.

Basic Infos:



Name of RT-800 / MOXA device.

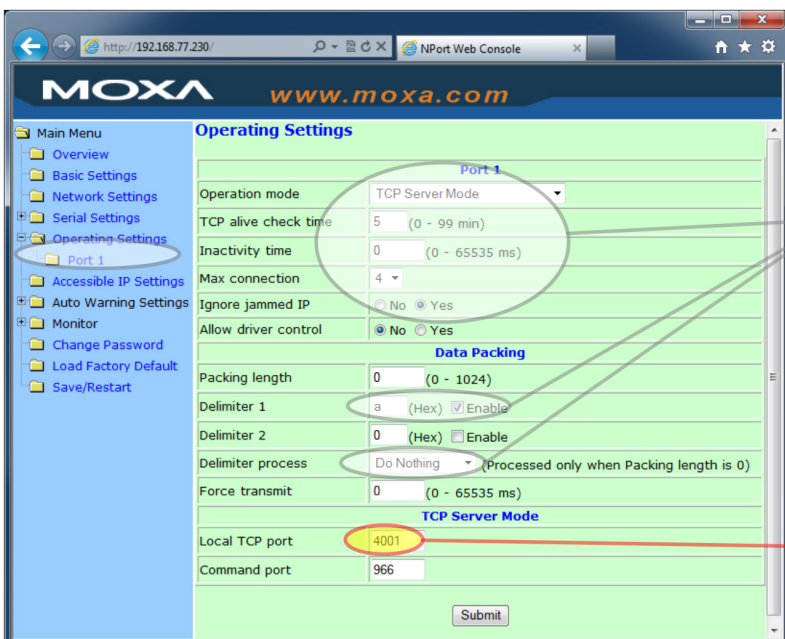
Internal serial Settings



Attention:
Any change of this values will result in no more proper operation of the RT-800.

➤ Do not change

Operating (TCPIP) settings:



Strictly recommended configuration for a TCPIP connection.
With this settings, each RT-800 NMEA output sentence will be packed in one Ethernet package.
Up to 4 independent simultaneous active TCPIP connections are possible.

TCP Port for RT-800 NMEA protocol data

3.3 Configuration of Audio over IP (streaming into LAN)

See also >> Example of complete Network Scenario (page 31)

3.3.1 Introduction / Concept

The RT-800 Display Control Unit is already prepared to be connected via the AUDIO/Ethernet connector, for streaming the audio signal to the Ethernet LAN (voice over IP).

For this, the RT-800 Display Control Unit contains an industrial audio streaming device / live IP audio encoder (BARIX Instreamer).

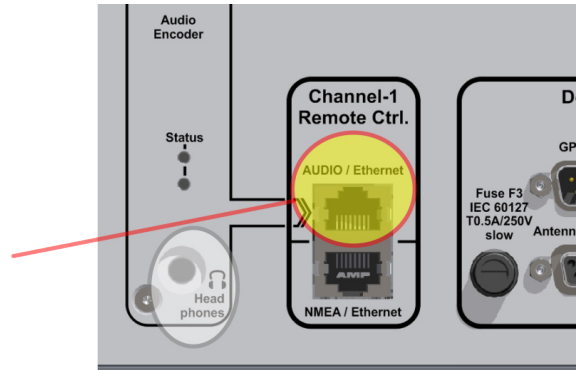


Fig. 12 Audio streaming to LAN connector

This BARIX Intreamer device supports a lot of streaming modes also for custom specific conditions. The device is already pre-configured for two simultaneous streaming modes.

- **BRTP:** Barix extended protocol. The use of this mode is strictly recommended. It offers very fast reaction time even for short voice communication audio signals on VTS/ATC applications. This protocol can only be used, if at the remote control site a BARIX Exstreamer is used. This optional additional small device is described at the next chapter.
- **HTTP as Internet Radio.** This stream can be decoded as example directly from the remote application with a VLC player. Because it uses larger streaming buffers, the delay times can increase up to a few seconds, which is mostly unwanted for short signals.

For additional detailed informations, see also www.barix.com (Instreamer, Exstreamer)

3.3.2 IP Network settings & Web Console connection to configure the device

To access the direction finder audio from remote, it is common to use static IP & Port addresses. For this the Barix device itself can be configured to a static IP address or, which is normally the better solution, to configure the router in the local network with a DHCP reservation to allocate the direction finder audio identified by its MAC address to a fixed/static IP address.

- the RT-800 Audio/Barix device is preconfigured after delivery to **DHCP mode**
- if **NO DHCP** server is available and no static IP mode is configured, it can take up to 4 minutes before the IP address will be announced over the speaker.

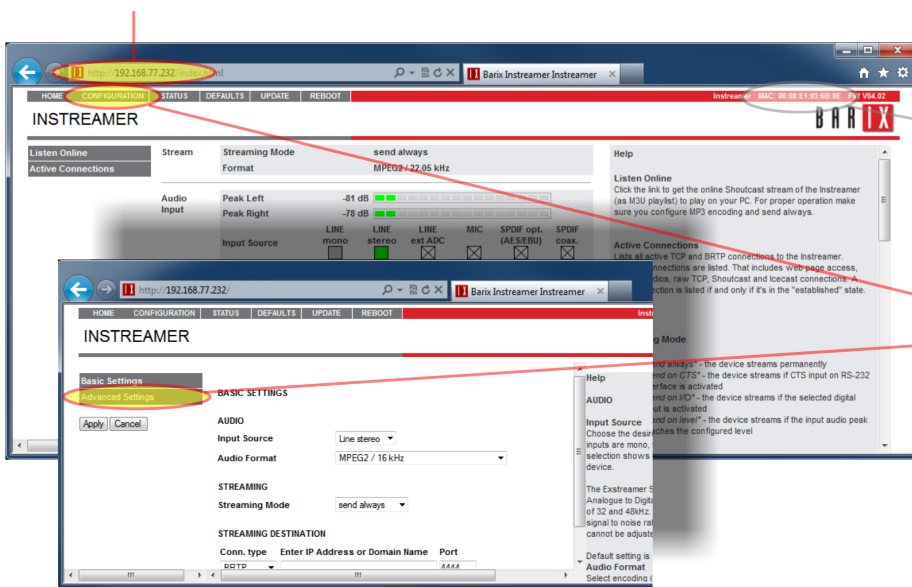
The actual RT-800 audio IP address will be announced after Power On of the RT-800 over the headphone connector near the Audio/LAN connector on the back side.

A standard Web Browser/Console is the most user-friendly method available to configure the Barix Instreamer audio device. You can use as example Google Chrome or the Microsoft Internet Explorer.

- Connect the RT-800 NMEA/Ethernet port to your local LAN network.

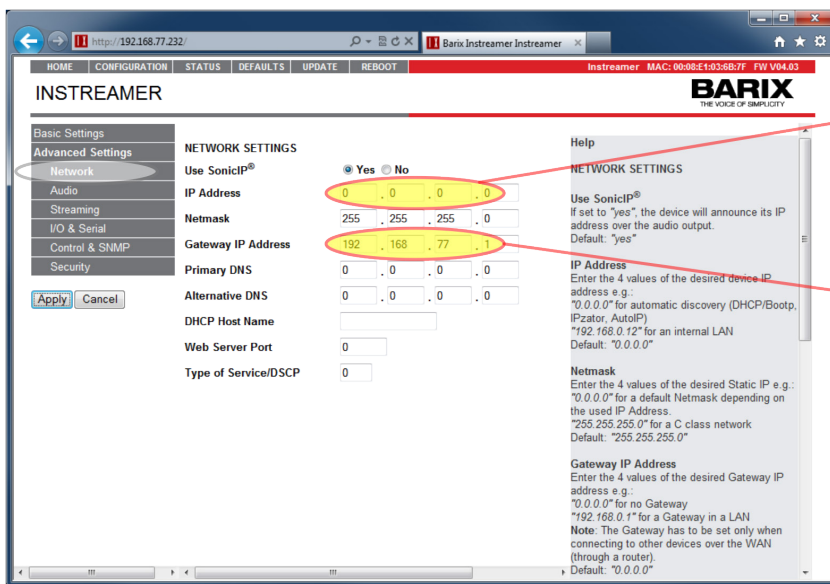
Network configuration:

- Start a standard web browser console and input the actual detected/static IP address of the RT-800 Audio Barix device.
At the example shown here, the IP address is assigned by a DHCP server to 192.168.77.232



Actual MAC address for information

Select > Configuration and then > Advanced Settings

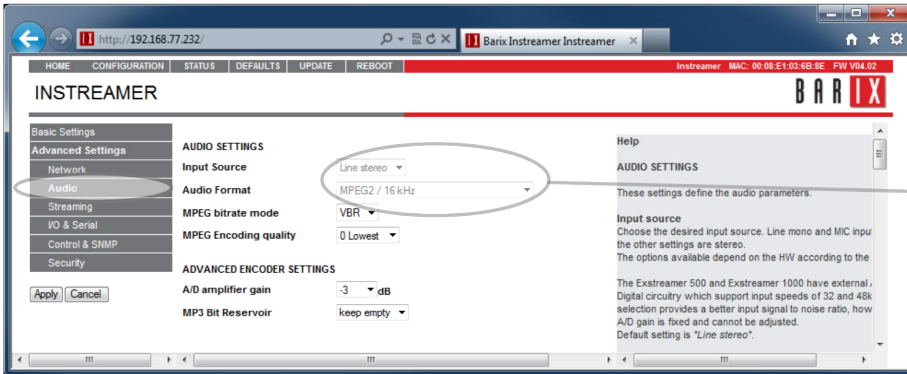


“0.0.0.0” for automatic DHCP mode

or any valid static IP address

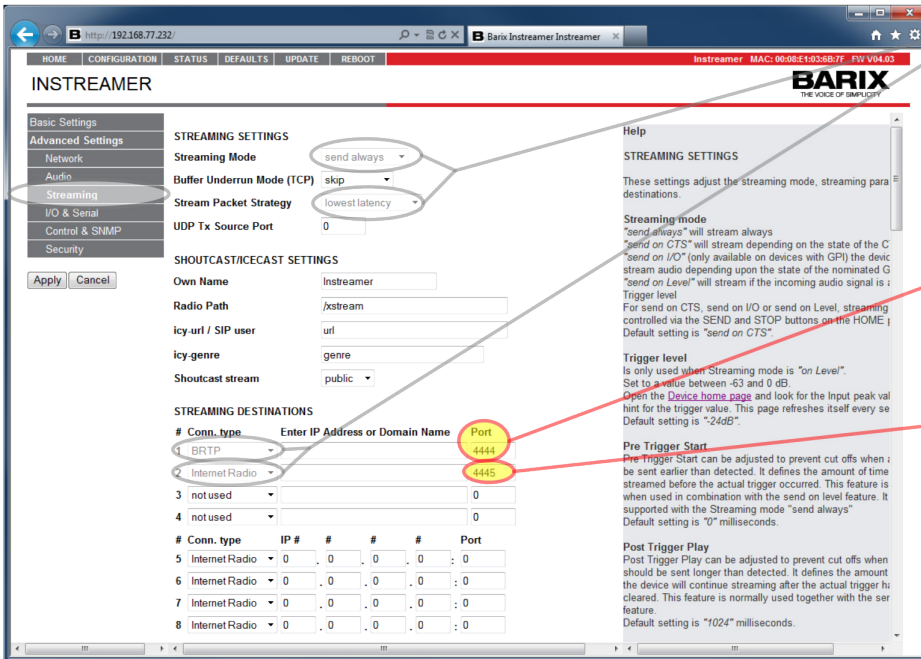
Valid Gateway address if routing/streaming to other devices outside the local network.

Audio configuration:



recommended audio settings

Streaming configuration:



recommended settings

Individual port value for BRTP protocol

Individual port value for second optional Internet radio (VLC) protocol

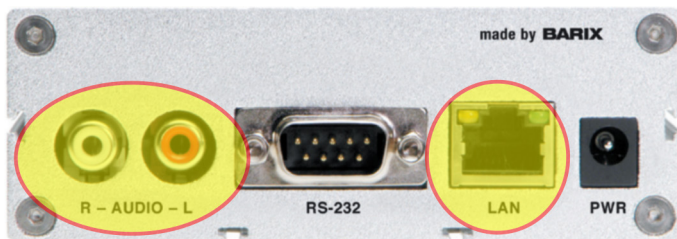
3.4 Configuration of Audio Exstreamer (streaming from LAN)

See also >> Example of complete Network Scenario (page 31)

For the remote control site audio generation, this optional additional small stand alone device is the recommended solution and provided by RHOTHETA. This device (Exstreamer) decodes audio streams and play out the received audio signals to amplifiers or speakers. Supporting a large number of protocols, encoding methods and application specific firmware, the products can be used for Broadcast, Internet Radio, as well as VoIP applications.



Front side:
Headphone connector



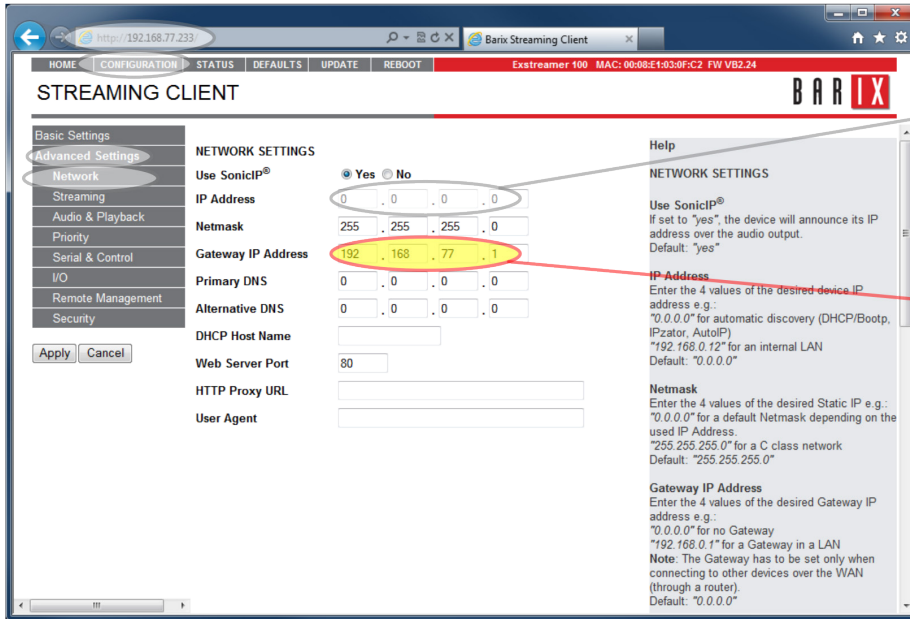
Back side:
Line out for connection
to an amplifier or active
speakers.
LAN connector

Fig. 13 BARIX Exstreamer 100

3.4.1 Configuration of Exstreamer at Remote Site

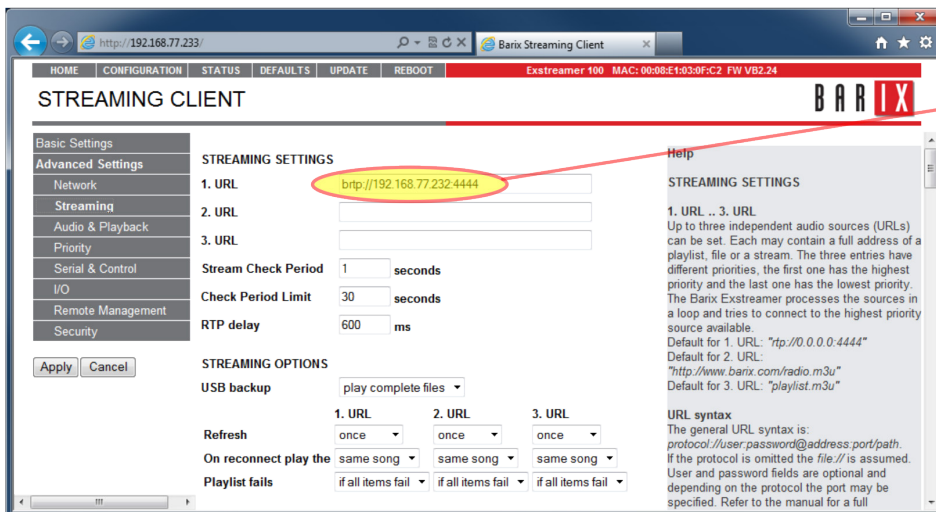
The BARIX Exstreamer device is also configured with any standard web browser/console.

The IP address will be announced after Power On over the headphone connector. This can take up to 4 minutes if no DHCP server is available at the connected LAN network.



The IP address for this Exstreamer is preconfigured to DHCP

Please input here the Gateway address if the RT-800 is not in this LAN



Please input here the accurate Source IP address of the RT-800 and the used Port.

3.5 Example of complete Network Scenario

At this example a complete network scenario is shown. There is used a public Internet connection with port forwarding.

For professional uses, with as example VPN connection, no port forwarding is necessary because then all devices are working (virtually) in the same network without the use of gateway addresses.

- All IP addresses and port values are just example values and can be configured.

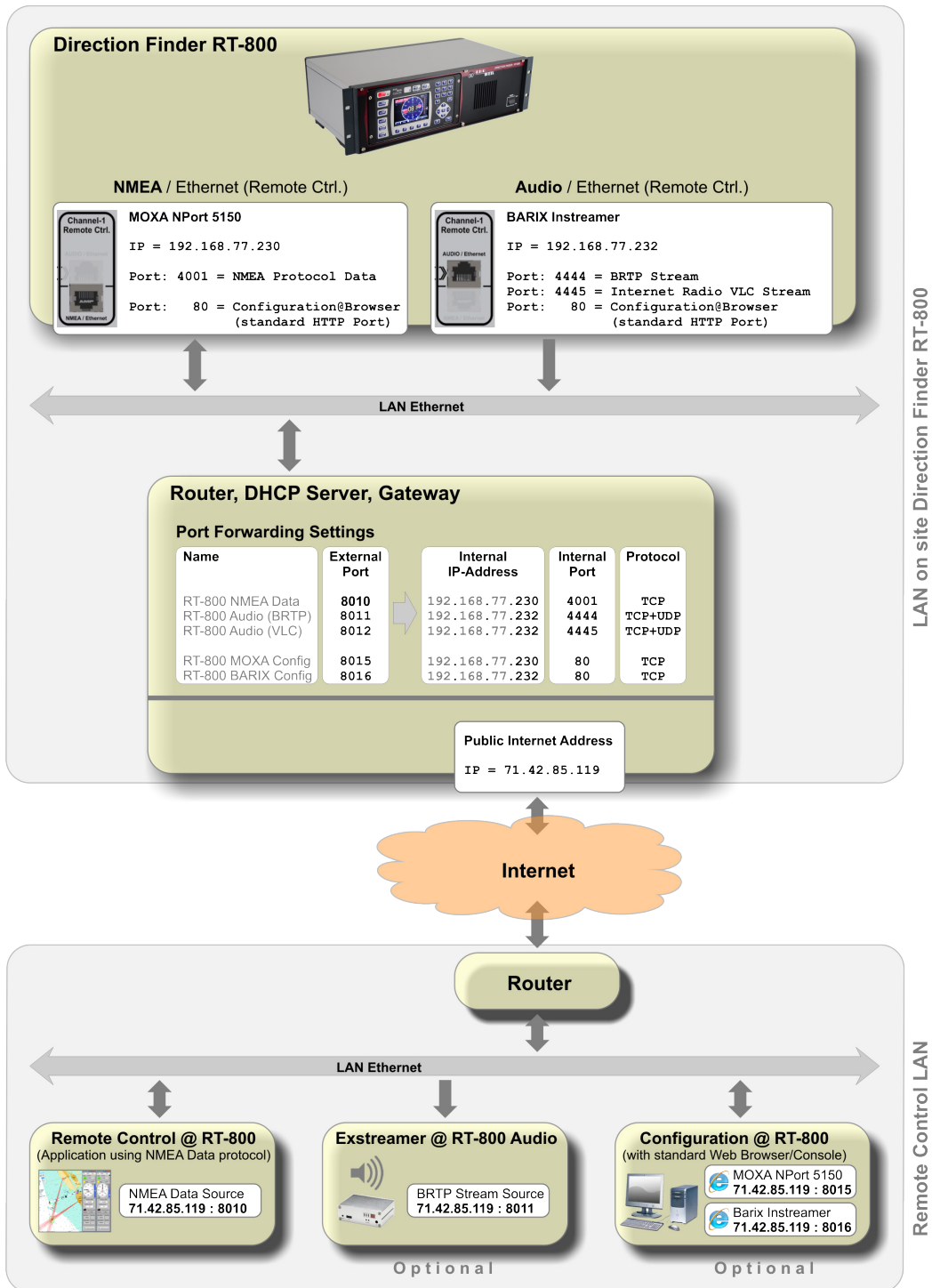


Fig. 14 Example of complete Network scenario

4 Appendix

4.1 List of abbreviation

| Abbreviation | Meaning | Remarks |
|--------------|---|---------------------------------------|
| AU | Antenna Unit | |
| CP/SS | Cospas-Sarsat | |
| DCU | Display & Control Unit | |
| DF | Direction finder | |
| Deg | Degree (° = 60') | |
| ELT | Emergency Locator Transmitter | |
| GND | Ground | |
| GPS | Global Positioning System | |
| ID | Identification | |
| IP | Internet Protocol | |
| LAN | Local Area Network | |
| LCD | Liquid Crystal Display | |
| LED | Light-Emitting Diode | |
| MOB | Man-Over-Board | |
| MSSI | Maritime Mobile Service Identity | Ship's Ident. No. |
| NF | Audio Frequency | |
| NMEA (0183) | National Marine Electronics Association | Interface- and data telegram standard |
| PLB | Personal Locator Beacon | |
| PS RAM | Averaging Random Access Memory | |
| PTT/SBS | Push-To-Talk/ Self Bearing Suppression | |
| RAM | Random Access Memory | |
| Rx | Receiver | |
| S/N | Signal to Noise | |
| SAR | Search And Rescue | |
| SNR | Signal to Noise-Ratio | |
| SQL | Squelch | |
| TFT | Thin Film Transistor (see also LCD) | |
| Tx | Transmitter | |
| V | VTS Version | AU-Variant V |
| VDC | Volts of Direct Current | |
| VTS | Vessel Traffic Service | |