# User Manual

# RT-400

RHO THETA
Elektronik GmbH

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**Note**

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

# Content

# 1 Legend of Signal Words

**Note**

This symbol designates tips or additional notes that must be paid attention to and that make work easier.

**Caution**
means that ignoring the instructions may lead to property damage or loss of data.

**Warning**
means that upon ignoring the instructions, there may be a danger to health or life.

# 2 Safety

## 2.1 General Safety Information

RHOTHETA Elektronik GmbH is constantly trying to keep the safety standards of their products up to date, and to offer their customers the highest possible level of safety. RHOTHETA products are designed and tested in accordance with valid safety regulations. The compliance with these standards is continuously monitored by our quality assurance system.

This product is tested and left the factory in perfect technical and safety-relevant condition. To maintain this condition and to ensure safe operation, the user must pay attention to all instructions and warnings given. For any questions regarding these safety instructions, RHOTHETA Elektronik GmbH can be contacted at any time.

The observance of the safety instructions will help to prevent personal injury and damage caused by all kinds of dangers. This requires that the following safety instructions must be read carefully and understood before using the product, as well as observed when using the product. The additional safety instructions, such as for protecting persons, appear in relevant parts of the product documentation and must also be paid attention to.

The use of this product for other than its designated purpose or in disregard for the manufacturer’s instructions is the responsibility of the user. The manufacturer takes no responsibility for the misuse of the product.

The manufacturer is not liable beyond the scope of legal rules.

This guide is part of the product RT-400 and must be kept with the product throughout its lifetime.

## 2.2 Basic Safety Instructions

**Caution / Warning**
**Read and observe the following instructions, warnings and safety instructions of the manufacturer!**

- During all work, the local and national safety and accident prevention regulations must be observed.
- When installing or operating the product always follow the manufacturer's instructions.
- Always place the product on appropriate locations.
- Do not expose the product to environmental conditions (heat, humidity, wind load etc.) that exceed the specified acceptable conditions in the manuals.
- Use only the manufacturer’s prescribed components and/or use only recommended materials and do not modify them. Any other use or unauthorized modifications to the product will void the authorization to operate it.
- Connect only approved accessories kits or additional equipment.
- Ensure that the connections with information technology equipment, e.g. industrial computers, comply with the IEC 60950-1/EN 60950-1 or similar standards that apply in each case.
- The product may only be opened by authorized personnel. The connector must always be disconnected before opening.

# 3 Legal Information

## 3.1 EU Declaration of Conformity

RHOTHETA Elektronik GmbH hereby declares that the product RT-400 is in compliance with the essential requirements and other relevant provisions of:

- Directive 2014/53/EU relating to radio equipment
- Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment

The full text of the Declaration of Conformity can be found at:
https://www.rhotheta.com/products/rt_400

## 3.2 FCC Information (USA)

Changes or modifications not expressly approved by the party responsible for compliance (RHOTHETA) could void the user's authority to operate the equipment.

**Note**
RT-400 AU has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

## 3.3 FCC information (USA) regarding the included WiFi module

For WiFi connectivity, this product includes a FCC-certified single-modular transmitter TI CC3220MODASF. The module is an FCC certified radio module that carries a modular grant.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.
- This device must accept any interference received including interference that may cause undesired operation of the device.

**CAUTION**

**FCC RF Radiation Exposure Statement:**
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

The WiFi device has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio / TV technician for help.

## 3.4 ISED Information (Canada)

This device contains license-exempt transmitter(s) / receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s). Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

A radio license must be obtained prior to possession and use of this scanner receiver.
Une licence radio doit être obtenue avant la possession et l'utilisation de ce récepteur de scanner.

## 3.5 ISED Information (Canada) regarding the included WiFi module

This product includes a TI CC3220MODASF module certified for IC / ISED as a single-modular transmitter.
This device complies with ISED licence-exempt RSS standards.

Operation is subject to the following two conditions:
(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- L'appareil ne doit pas produire de brouillage
- L'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

**CAUTION**

**ISED RF Radiaton Exposure Statement:**
This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.
**Declaration d'exposition aux radiations:**
Cet equipment est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet equipment doit être installé et utilize avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

# 4 General Description

The RHOTHETA direction finder system RT-400 is designed to receive and locate emergency signals and special application signals on the international distress and application specific frequencies in the VHF / UHF frequency range.
The system consists of an RT-400 Antenna Unit (AU), which is designed light and robust for typical portable use, a RT-400 Carrying Frame, a RT-400 Power Pack, and the control software RT-400 DF Scout. The Power Pack can be charged using the RT-400 Battery Charger.
The Antenna Unit can be installed on the optionally available RT-400 Car Mounting Kit.
Besides the standard RT-400 Carrying Frame, the RT-400 Carrying Frame with lift can be used in cases where an easy reconfiguration from transport position to operational position is desired.
The control software RT-400 DF Scout operates under Android operating systems on a tablet computer, which is connected to the Antenna Unit through a Wi-Fi connection.
The RT-400 DF Scout is described in a separate User Manual.

The RT-400 is a modern precision direction finder intended for professional SAR (search and rescue) purposes.
It receives and locates signals on all international VHF-UHF emergency frequencies, including marine channel 16 and all COSPAS-SARSAT channels.

The excellent performance of the RT-400 is possible due to our revolutionary patented wide band antenna and its sophisticated bearing analyzing algorithms, which deliver quick and steady information.

**Note**
In general, the RT-400 system is optimized for mobile and portable operation, where the heading of the control tablet computer and the antenna are identical. If the antenna is to be used in a fixed installation, make sure that the direction / north marking (marking on the Antenna Unit) points towards north. Refer to the DF Scout manual for setting up the software to operate without GPS and compass correction of the bearing rose.

# 5 Back Pack Operation without lift option

## 5.1 Installation in Transport Position

For easy back pack transportation, the Antenna Unit may be installed upside-down on the carrying frame. The antenna is fixed using two quick clamps, with the antenna casing itself being resting on the padded platform.
This carrying position, due to its low center of gravity, allows easier back-packed transportation of the system.
The Power Pack is to be installed on the carrying frame.

## 5.2 Installation in Operating Position

Place the Antenna Unit in Top-Up position. Make sure the direction marking (marking on the Antenna Unit) points into forward direction. The Antenna Unit should be placed as high as possible, or at least as high as needed so that the bottom part of the antenna cylinder is higher than the head of the person carrying the system.

Connect the power cable from the Power Pack rack of the carrying frame to the connector at the bottom of the antenna mast.

## 5.3 Activation and use of the Antenna Unit

The system is activated by toggling the POWER switch on the Power Pack to the ON position. Details on how to use the Tablet Software (RT-400 DF Scout) can be found in the RT-400 DF Scout User Manual.

## 5.4 Deactivation of the Antenna Unit

The system is deactivated by toggling the POWER switch on the Power Pack to the OFF position.

# 6 Back Pack Operation with lift option

## 6.1 Installation

Place the Antenna Unit in the Top-Up position and as low as possible (antenna part just above the padded ring, foot of the mast pressed in the lower ring) and fix it using the quick clamp. Make sure the direction marking (marking on the Antenna Unit) points into forward direction.
Connect the power cable from the Power Pack rack of the carrying frame to the connector at the bottom of the antenna mast.

**Note**
Upside-down mounting of the Antenna Unit is only possible in the version without the lift option, and it is not possible in the lift version of the RT-400.

## 6.2 Activation and use of the Antenna Unit

Drive the antenna to its operating position using the Up/Down switch on the Power Pack. The lift automatically stops when the maximum height is reached. The Antenna Unit should be placed as high as possible, or at least as high as needed so that the bottom part of the antenna cylinder is higher than the head of the person carrying the system.
The system is activated by toggling the POWER switch on the Power Pack to the ON position.
Details on how to use the Tablet Software (RT-400 DF Scout) can be found in the DF Scout User Manual.

## 6.3 Deactivation of the Antenna Unit

The system is deactivated by toggling the POWER switch on the Power Pack to the OFF position.
The Antenna Unit can be driven back to the transport position by pushing the Up / Down switch on the Power Pack DOWN. The lift automatically stops when the minimum height is reached.

# 7 Mobile Use

## 7.1 Car Installation and Transport Position of the Antenna Unit

The optional RT-400 Car Mounting Kit must be installed on the roof railing of the car first. The car mounting kit is prepared to be attached on standard roof luggage racks using tapped T-heads

**Note**
Mounting technology might vary for some roof luggage racks.

In the next step, fix the RT-400 Antenna Unit using the quick clamp. Make sure the direction marking (marking on the Antenna Unit) points towards the front side of the car.
Pull the detent pin and move the antenna to the horizontal transport position and fix it with the included hook-and-loop tape. For non-operational road transport, the antenna should always be in this position.
Connect the antenna to the power supply. The antenna may be powered through the external DC power cable connected to a car DC outlet (e.g. cigarette lighter connection).
If using the DC power cable and feeding it through a door or window into the car, make sure not to crush the cable.
The Tablet computer may be installed on the windshield using a car windshield tablet mount, or on any other position the operator finds appropriate. Connection to the Antenna Unit is through Wi-Fi, so no cable is needed.

**Warning**
Make sure the driver's visibility through the car's windshield and windows, and their access to control elements, are not obstructed.

**Note**
If using a car DC outlet to supply the Antenna Unit, depending on your vehicle's electrical circuitry, the DC outlet might be interrupted under different conditions (ignition deactivated, etc.). Every interruption of the DC outlet will interrupt the operation of the Antenna Unit including the embedded Wi-Fi module. A later Wi-Fi reconnect to your Tablet computer might be delayed up to one minute or more, which is a normal behavior of Android operating systems.

## 7.2 Mobile Operation

For bringing the Antenna to the operational position and operating the system while mounted on a car, release the hook-and-loop tape, pull the detent pin, and reposition the antenna unit vertically. Make sure that the detent pin has snapped in. Also, make sure that the NORTH marking on the antenna points towards the front of your car, otherwise, wrong bearings will be indicated in your RT-400 DF Scout application.
Switch the power ON (Power switch on the RT-400 Power Pack or connecting the DC cable to the car DC outlet).
Details on how to use the Tablet Software (RT-400 DF Scout) can be found in the DF Scout User Manual.

# 8 Service and Maintenance of the RT-400 Power Pack

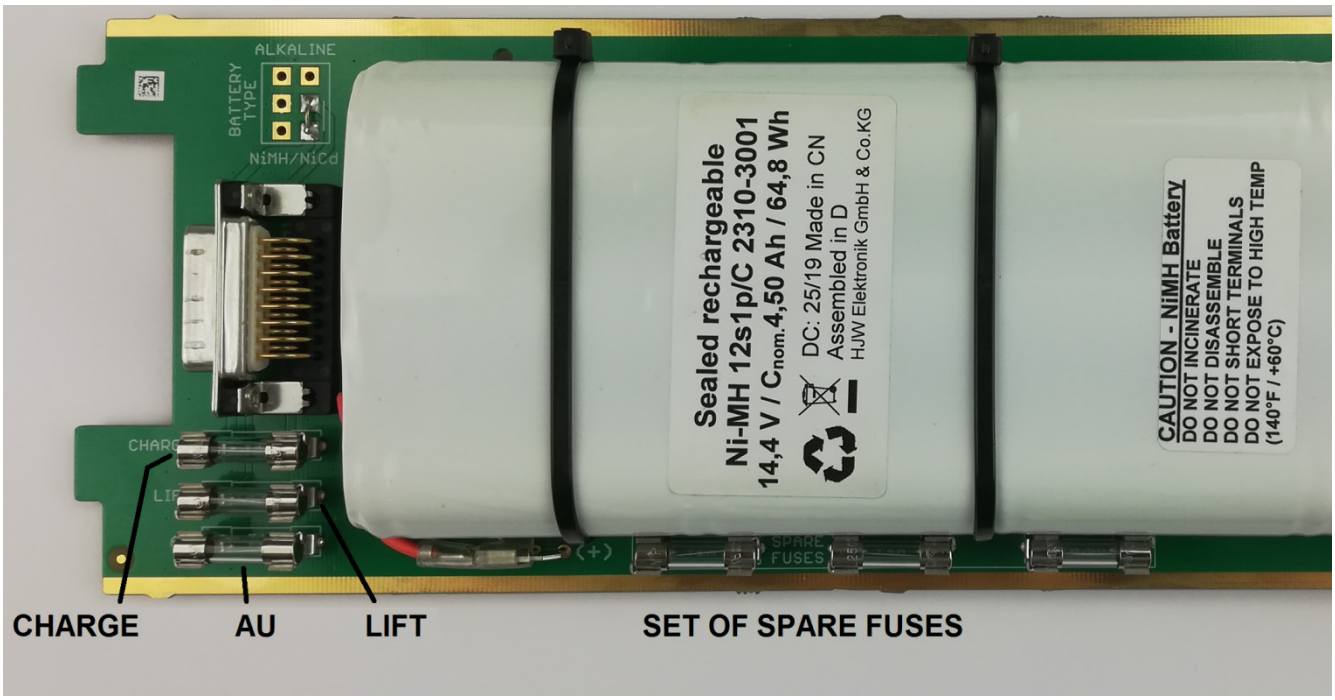
## 8.1 Installation of the Power Pack

The power pack can be plugged into, and removed from, the power pack rack of the carrying frame.


The power pack must be plugged into its rack as shown in the pictures above. As soon as the power pack is locked by the locking spring, it is automatically connected to the backward connector on the carrying frame and ready for use.
To remove the power pack, pull the locking spring and unplug the power pack by pulling it forward.

## 8.2 Battery / Accumulator Replacement and Protection

The Power Pack operates with an internal 14,4 V NiMH accumulator package.
Use a Torx (size TX10) screw driver to remove the two screws on the back side of the Power Pack. The whole Battery Pack board can be removed from the housing and the accumulator may be replaced.




All input- and output connections are fused: Charge Input (CHARGE, 4 A slow-blow), Antenna Unit Output (AU, 1 A slow-blow) and Lift Output (LIFT, 0,5 A slow-blow).
Additionally, spare fuses are provided.

## 8.3 Charging Accumulators

Connecting the RT-400 Battery Charger directly to the Power Pack, instead of the Antenna Unit using the Power Cable, allows charging the accumulators.
Charging is done automatically, so no further user interaction is required.

# 9 Technical Data

## 9.1 Electrical Characteristics

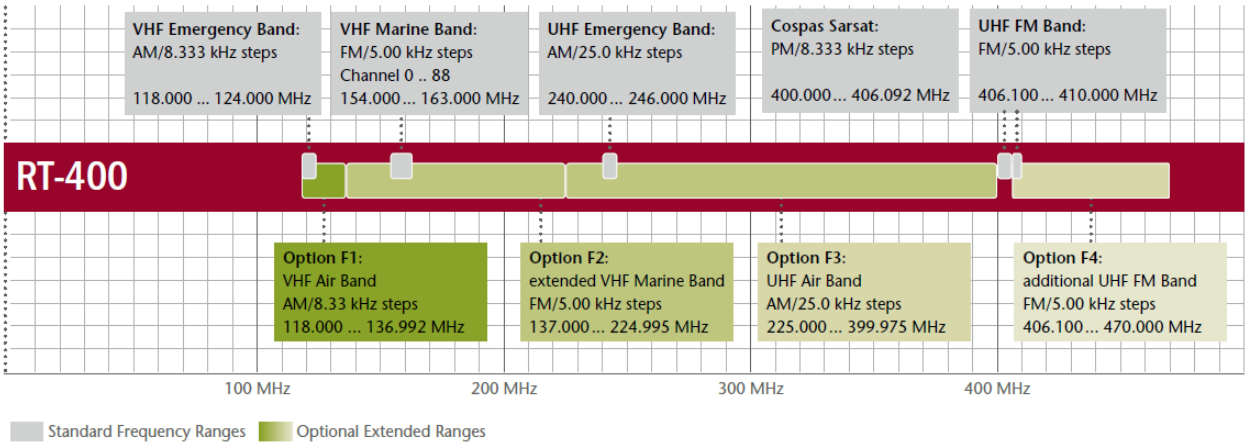
| System Characteristics | | |
|---|---|---|
| **Parameter** | **Condition** | **Data** |
| DF Method | - | Doppler (3 kHz rotation frequency) |
| Bearing Accuracy | | 5° RMS[1] |
| Display Resolution | | 1° |
| Minimum Signal Duration | | 100 ms |
| Frequency Range | VHF Air Band | 118.000 – 124.000 MHz<br>118.000 – 136.992 MHz (Option) |
| | Marine Band | 154.000 – 163.000 MHz<br>137.000 – 224.995 MHz (Option) |
| | UHF Air Band | 240.000 – 246.000 MHz<br>225.000 – 399.975 MHz (Option) |
| | COSPAS-SARSAT | 400.000 – 406.092 MHz |
| | UHF FM-Band | 406.100 – 410.000 MHz<br>406.100 – 470.000 MHz (Option) |
| Receive Frequency Tuning Steps | VHF Air Band | 8.33 kHz |
| | Marine Band | 5 kHz |
| | UHF Air Band | 25 kHz |
| | COSPAS-SARSAT | 8.33 kHz |
| | UHF FM-Band | 5 kHz |
| Bearing Sensitivity Continuous signal | VHF Air Band,<br>±5° bearing fluctuation | ≤ 4 µV/m / 2.5 µV/m typical |
| | Marine Band,<br>±5° bearing fluctuation | ≤ 3 µV/m / 2 µV/m typical |
| | Extended Marine Band above 174 MHz,<br>±5° bearing fluctuation | ≤ 5 µV/m / 3 µV/m typical |
| | UHF Air Band,<br>±5° bearing fluctuation | ≤ 6 µV/m / 4 µV/m typical |
| | COSPAS-SARSAT<br>±5° bearing fluctuation | ≤ 6 µV/m / 4 µV/m typical |
| | UHF FM-Band<br>±5° bearing fluctuation | ≤ 6 µV/m / 4 µV/m typical |

| System Characteristics | | |
|---|---|---|
| **Parameter** | **Condition** | **Data** |
| Bearable Types of Modulation | | A3E, F3E, A3X (distress signal modulation) |
| Polarization | | Vertical |
| Scanning | | Multiple scanning and monitoring functions available |
| COSPAS-SARSAT Functionality | | Decoding of COSPAS-SARSA-Message: Shows beacon ID, GPS position[2)] and whole message string (short and long message) Displays direction and distance[2)] to beacon. |
| Power Supply Antenna Unit | Input Voltage | 12 … 30 V DC |
| Power Pack | Accumulator Batteries | 14.4 V NiMH, 4500 mAh |
| Operational Time (Antenna Unit), 20°C | With 14.4 V NiMH, 4500 mAh | > 8 h |
| Data Interface | Tablet – Antenna Unit | Wi-Fi |

[1] Measured with un-modulated, undisturbed wave field at field strength ≥ 20 dB above sensitivity level by changing the angle of incidence with the antenna rotating on a revolving table to eliminate environmental influences on the results.

[2] If GPS position available.

## 9.2 Frequency Options



## 9.3 Environmental and Mechanical Characteristics

| Typical Mechanical and Environmental Characteristics | | | | |
|---|---|---|---|---|
| **Parameter** | **Carrying Frame [1)]** | **Antenna Unit** | **Power Pack** | **Car Mounting Kit[2)]** |
| Weight | 5.6 kg | 2.3 kg | 1.8 kg | 5.6 kg |
| Operating Temperature | -40°C to +60°C | -40°C to +60°C | -20°C to +55°C[3)] | -40°C to +80°C |
| Storage Temperature | | -55°C to +80°C | -20°C to +50°C[4)] | |
| Ingress Protection | IP 67 [6)] | IP 67 | IP 67 | |
| Dimensions | Approx. W x H x D: 350 mm x 820 mm x 295 mm [5)] | ∅ 270 mm x 185 mm | Approx. W x H x D: 111 mm x 45 mm x 320 mm | 750 mm x 450 mm x 220 mm |

[1] Version with lift, without Power Pack, without Antenna Unit, including tablet frame for Samsung Galaxy Tab S3, without Tablet.

[2] Without antenna, retracted

[3] Temperature Range for discharge operation. During standard charge, ambient temperature should be between 0 and +45°C, for fast charge, it should be between 10 and 40°C.

[4] For 3 months of storage duration. If stored for more than 3 and up to 6 months, upper temperature should not exceed 40°C. For storage duration of up to two years, upper temperature limit is 30°C.

[5] Backpack section only

[6] Version without lift. Version with lift option IP 50.

| Typical Mechanical and Environmental Characteristics, Complete System | |
|---|---|
| **Parameter** | **Complete System with lift option [7)]** |
| Weight | 10.6 kg |

[7] Includes Carrying Frame, Antenna Unit, Power Pack, Samsung Galaxy Tab S3. Does not include car mounting kit.

# 10 Disposal within the European Union

**Product Recycling**

Product labeling in accordance with EN 50419

At the end of the life of the product, this product may not be disposed of with normal household waste. Even disposal via the municipal collection points for electrical and electronic equipment is not allowed.

The correct disposal of this product will help to conserve resources and prevent potential negative effects on the environment and human health which may occur due to improper handling of the product.

- Therefore, carry out the inoperative device, an electronics recycling.
  or
- The RHOTHETA Elektronik GmbH takes back all its products, subject to redemption, in accordance with the requirements of the WEEE Directive (2002/96 / EC) of the European Union to deliver it to a professional disposal.

# 11 Disposal outside the European Union

For proper disposal of used electronic equipment in accordance with the respective national regulations in countries outside the European Union please check it with your dealer or the local authorities.

# 12 Notes