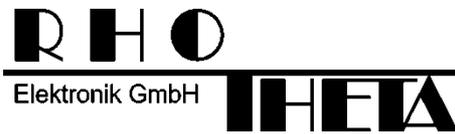


# Installation Manual

## RT-1000 Multichannel



Edited by:

RHOTHETA Elektronik GmbH  
Kemmelpark  
Dr.-Ingeborg-Haeckel-Str. 2  
82418 Murnau  
Germany

Tel.: +49 8841 4879 - 0  
Fax: +49 8841 4879 - 15

Internet: [www.rhotheta.de](http://www.rhotheta.de)  
E-Mail: [email@rhotheta.de](mailto:email@rhotheta.de)

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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 System Installation Procedure

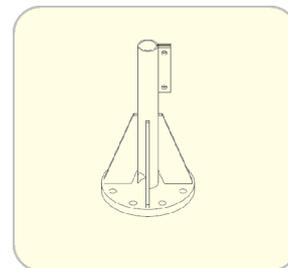
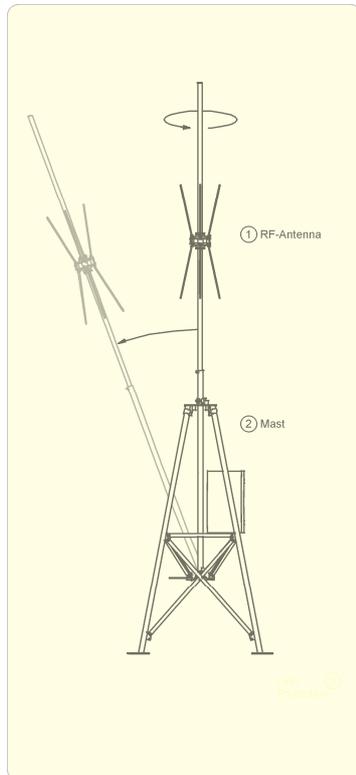
The following steps have to be done in sequence to use the direction finder system. In case of any problems during the installation procedure, do not continue the installation before the problem is eliminated.

## 1.1 Installation of the Antenna Mast

If an antenna mast is supplied, start the system installation with the mast construction. Detailed information described in the Antenna Mast User Manual.

Installation of the Antenna Mast		
Step	Description	Done
1	Choose the right position for your antenna installation. Good conditions are an open area, a position a few meters above the ground and several 100 meters away from reflecting obstacles.	<input type="checkbox"/>
2	Mount the antenna mast to the ground	<input type="checkbox"/>
3	Tilting the antenna mast	<input type="checkbox"/>
4	Mount the antenna cabinet to the antenna mast	<input type="checkbox"/>
5	Connect the grounding for lightning protection	<input type="checkbox"/>

If an antenna flange is supplied, start with the installation of the flange. Mount the flange to the ground or on a shelter, pull the antenna cable thru the flange in the same way as described for the antenna mast and connect the grounding.



### **Caution:**

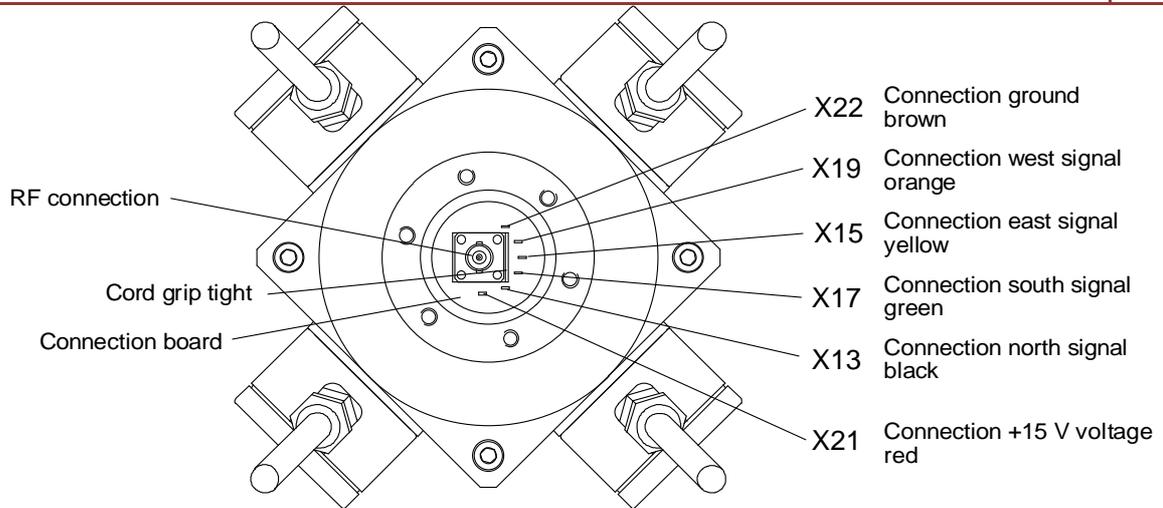
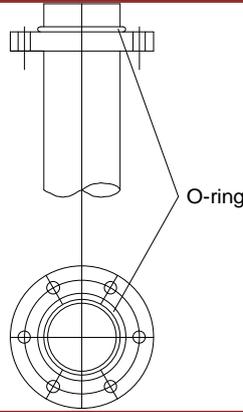
During installation, the antenna cable has to be pulled from the cabinet through the protection tube and the antenna tubes before it will be connected to the antenna. (Round plug does not fit through the protective tube)

## 1.2 Antenna installation

Detailed information is given in the Antenna User Manual and in the Figures below

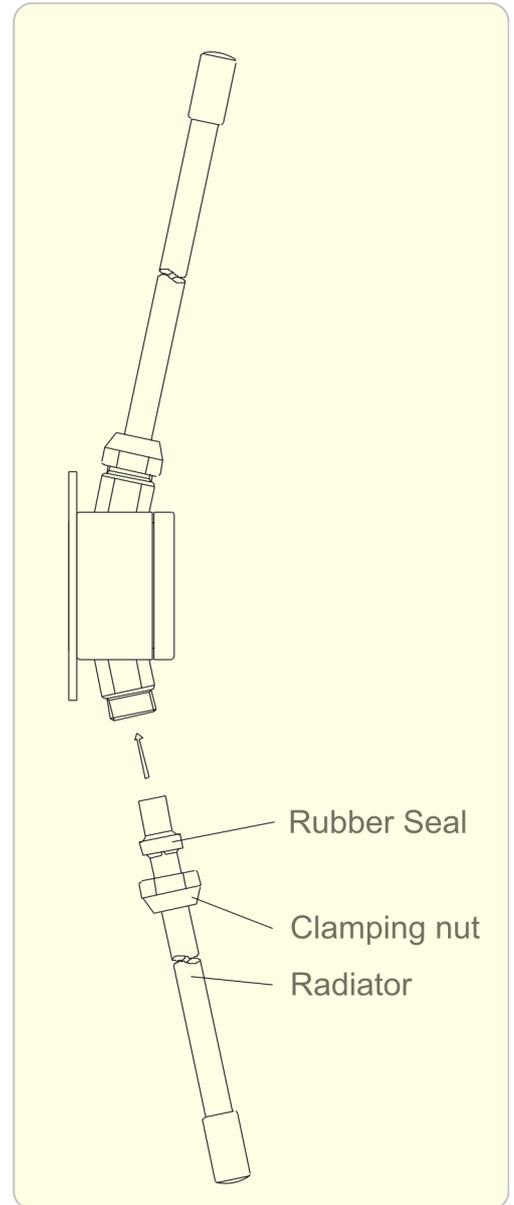
### Installation of the Antenna

Step	Description	Done
1	Fit the O-ring on mast tube	<input type="checkbox"/>
2	Pull the antenna cable through the mast tube	<input type="checkbox"/>
3	Connect RF cable to the BNC connector	<input type="checkbox"/>
4	Screw cord grip tight to clamp the RF cable	<input type="checkbox"/>
5	Plug the control cables into the connection board	<input type="checkbox"/>



## Installation of the Antenna

Step	Description	Done
6	Screw antenna head onto mast tube	<input type="checkbox"/>
7	Fit O-ring to lightning conductor rod	<input type="checkbox"/>
8	Screw lightning conductor rod onto antenna head	<input type="checkbox"/>
9	Fix radiators <ul style="list-style-type: none"> <li>• Push clamping nut, clamping cone, washer and rubber seal onto radiator</li> <li>• Push radiator fully into recess for radiator</li> <li>• Carefully tighten clamping nuts</li> </ul>	<input type="checkbox"/>
10	Erect mast tube (if not already done)	<input type="checkbox"/>



Installation of the Antenna		
Step	Description	Done
11	Earth mast tube	<input type="checkbox"/>
12	Align antenna Point north dipole (marked by red point on radiator housing) northwards	<input type="checkbox"/>

### 1.3 Antenna Cabinet Installation

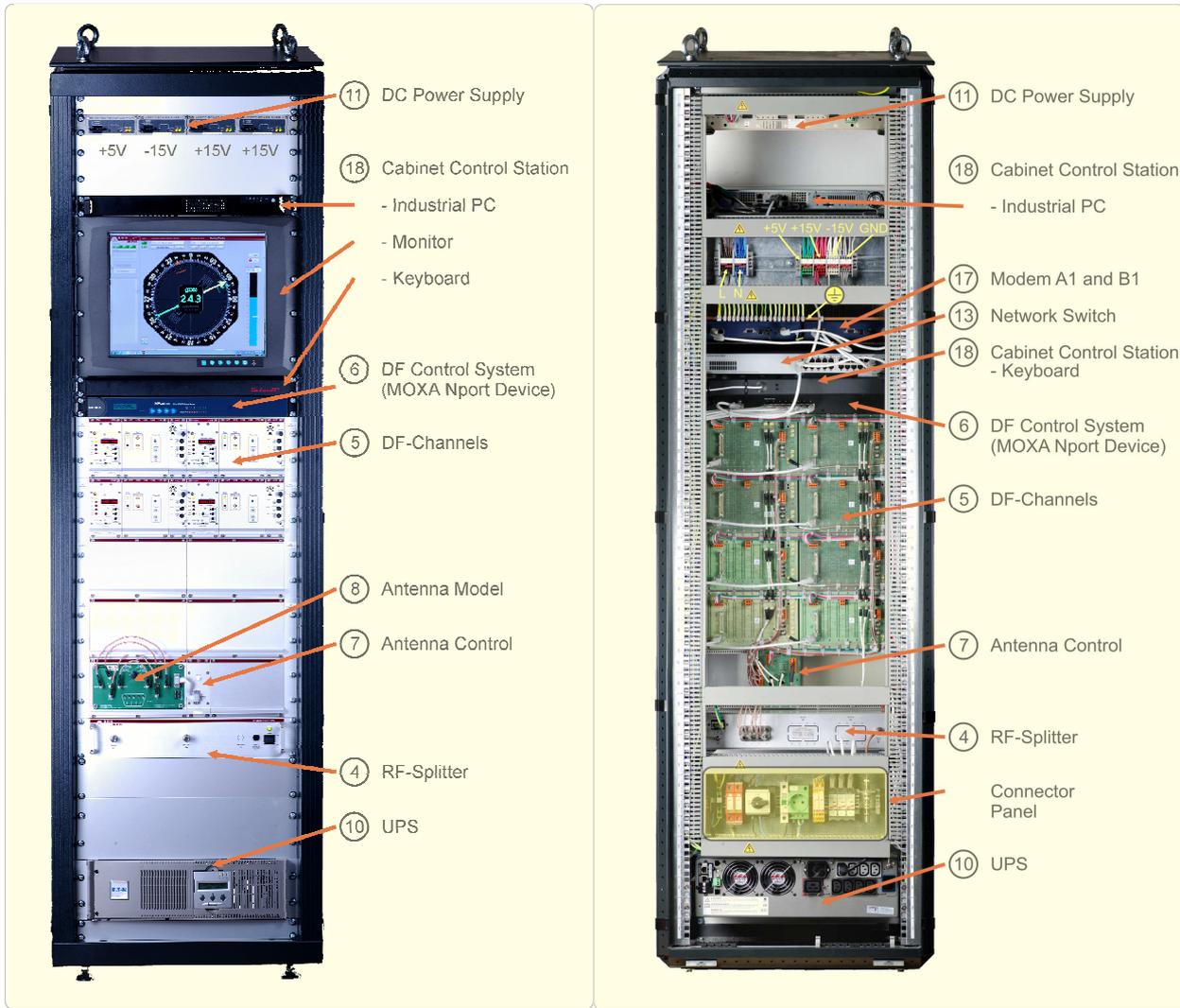
If an external lightning protection is supplied, install the antenna cabinet to the antenna mast. More information is given in the antenna mast user manual.

Installation of the Antenna cabinet		
Step	Description	Done
1	Mount the antenna cabinet to the antenna mast	<input type="checkbox"/>
2	Route the cables through the waterproof flange	<input type="checkbox"/>
3	Connect the Control cables (given in the cable plan for the antenna cabinet)	<input type="checkbox"/>
4	Connect the RF cables (given in the cable plan for the antenna cabinet)	<input type="checkbox"/>
5	Mount the cable anchorage for the four cables in the antenna cabinet	<input type="checkbox"/>

#### **Caution:**

All cables should be installed with protection tubes. It is important that no water will stay in the protection tubes permanent.

### 1.4 DF Main Unit Installation



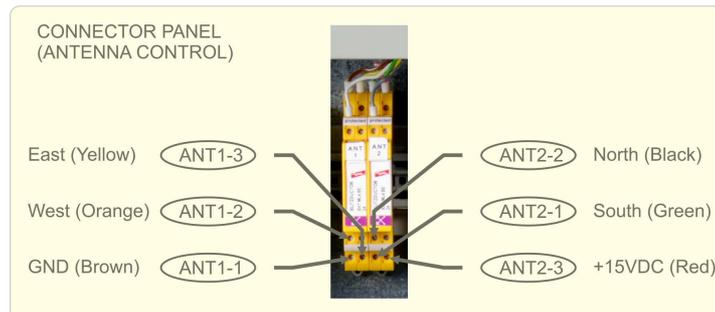
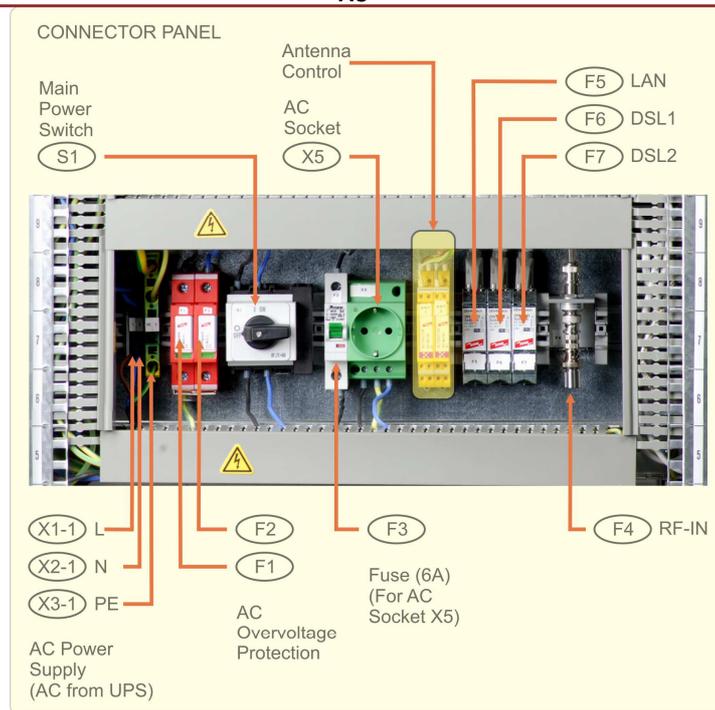
More information is given in the user manual, General System Description.

#### Installation of the DF Main Unit

Step	Description	Done
1	Install the DF Main Unit cabinet in the shelter. (The unit should not be moved when the direction finder is working.) The floor should be flat and stable to handle the weight of the direction finder system.	<input type="checkbox"/>
2	Remove all transport locks	<input type="checkbox"/>
3	Install the additional served component <ul style="list-style-type: none"> <li>• UPS</li> </ul>	<input type="checkbox"/>

Installation of the DF Main Unit		
Step	Description	Done
4	Connect the installed component described in the connection plan: <ul style="list-style-type: none"> <li>Start with the AC Power-IN and AC-Out of the UPS (the two cables are fit at the connection panel)</li> </ul>	<input type="checkbox"/>
5	Be sure that all components are switched off: <ul style="list-style-type: none"> <li>Main Power Switch (S1, connection panel)</li> <li>DF Channels</li> <li>RF-Splitter</li> <li>DC Power Supply (+5V, -15V, +15V, +15V)</li> </ul>	<input type="checkbox"/>
6	Connect the RF cable from the antenna to the connection panel (The cable has to be put through the cable bushing in the bottom of the cabinet.)	<input type="checkbox"/>
7	Connect the antenna control signals to the connection panel (The cable has to be put through the cable bushing in the bottom of the cabinet.)	<input type="checkbox"/>
8	Measure the AC Supply voltage $230 V_{rms} \pm 10 V$	<input type="checkbox"/>
9	Connect the DF Main unit to the AC Power Supply grid. Described in the connection plan.	<input type="checkbox"/>

**Attention: 230 V<sub>AC</sub>**



### Installation of the DF Main Unit

Step	Description	Done
10	Switch ON the UPS The UPS displays "Power ON"	<input type="checkbox"/>
11	Switch ON the Main Power Switch	<input type="checkbox"/>
12	Switch ON the DC power supplies. (from left to right) <ul style="list-style-type: none"> <li>• + 5 V</li> <li>• - 15 V</li> <li>• + 15 V one</li> <li>• + 15 V two</li> </ul> The Power-ON LEDs must light up (green and orange)	<input type="checkbox"/>
13	Switch on the RF-Splitter (described in the user manual of the RF-Splitter) The green Power-ON LED must light up	<input type="checkbox"/>
14	Switch ON the DF Channels successively If there is a problem in one channel, do not switch on the other channels. Solve the problem before. <ul style="list-style-type: none"> <li>• The 3 Power-ON LEDs must light up green If a Power-ON LED is Red, control the DC fuses of the DF Channel If a Power-ON LED do not light up, control the particular Power supply.</li> <li>• The Receiver Power LED must light up green.</li> <li>• Behave the receiver start up sequence described in the DF Channel user manual. The frequency display started with "88888888", followed by the system identification "RT-1000 A" and the actual software revision.</li> </ul>	<input type="checkbox"/>
15	Switch ON the DF Control System, the MOXA NPort device. The actual IP address should be displayed in the MOXA display.	<input type="checkbox"/>
16	Control the Power On LED of the network switch	<input type="checkbox"/>
17	Control the Power On LED of the DSL Modems	<input type="checkbox"/>
18	Switch on the IPC and the Monitor	<input type="checkbox"/>

## 1.5 Start Up the DF Commander Software

The IPC is delivered with a Windows 7 licence. A local user is configured and the DF Commander software is installed. Detailed information about the software and the configuration are given in the DF Commander User Manual.

### Start Up the DF Commander

Step	Description	Done
1	After booting the IPC, start the DF Commander software with the desktop icon.	<input type="checkbox"/>
2	Configure the Network devices (if supplied) to the local requirements.	<input type="checkbox"/>
	<b>Device</b>	<b>IP Address</b>
	Modem a1	
	Modem b1	
	UPS	
	DF Control System/MOXA	
	Network Switch	
	IPC	
3	The DF Commander should be licenced and a system should be pre-configured. If Not, follow the description for licencing and system configuration in the DF Commander Manual.	<input type="checkbox"/>
4	Establish the network connection to the DF Channels	<input type="checkbox"/>
5	After starting up the software, no error or warning notifications should be present.	<input type="checkbox"/>
6	Configure the DF Commander to your individual requirements	<input type="checkbox"/>
7	Configure the bearing system	<input type="checkbox"/>
8	Set the Administrator password	<input type="checkbox"/>
9	Set the Technician password	<input type="checkbox"/>

## 1.6 Phase Adjustment

There are two alternative methods for the phase adjustment. If an antenna model is supplied use method 1 if not, the second method is necessary. The Phase adjustment must be done for every DF Channel separately.

### Phase Adjustment Method 1 with Antenna Model

Step	Description	Done
1	Connect the antenna model to the TEST-IN port of the RF-Splitter	<input type="checkbox"/>
2	Feed in a RF-Signal in the ATC band range with a signal level of approx. -7 dBm at the antenna model RF input	<input type="checkbox"/>
3	The north adjustment on the controller should be set to 0°.	<input type="checkbox"/>
4	Adjust the receiver to the appropriate frequency.	<input type="checkbox"/>
5	Move the antenna signal switch on the antenna model to the 000° (QDM 180°) position	<input type="checkbox"/>
6	Turn the two rotary switches till the middle of the Phase Adjust LED light up are is reached. (Detailed description in the DF Channel manual)	<input type="checkbox"/>

### Phase Adjustment Method 2 without Antenna Model

Step	Description	Done
1	Position a test transmitter (e.g. walkie-talkie) approx. 100 m away, exactly to the north of the direction finder antenna (dipole north with label pointing towards the transmitter).	<input type="checkbox"/>
2	The bearing display should show QDM 180° and QDR 0°.	<input type="checkbox"/>
3	The north adjustment on the controller should be set to 0°.	<input type="checkbox"/>
4	Turn the two rotary switches till the middle of the Phase Adjust LED light up is reached. (Detailed description in the DF Channel manual)	<input type="checkbox"/>

#### Note:

The transmitter has to be exactly in the north of the Antenna. The bearing display has to show QDM 180° / QDR 000°. A deviation of more than  $\pm 1^\circ$  will make it impossible to execute the phase adjustment. The receiving level should be greater > 80%.

### Phase Adjustment

Step	Description	Done		
1	Do the phase adjustment for every DF Channel described in the DF Channel user manual.	<input type="checkbox"/>		
2	Note the phase adjustment values in connection to the DF Channel numbers			
	Channel Number	Coarse	Fine	<input type="checkbox"/>
3				<input type="checkbox"/>
4				<input type="checkbox"/>
5				<input type="checkbox"/>
6				<input type="checkbox"/>
7				<input type="checkbox"/>
8				<input type="checkbox"/>
9				<input type="checkbox"/>
10				<input type="checkbox"/>

## 1.7 North Alignment of the Direction Finder Antenna

Start Up the DF Commander		
Step	Description	Done
1	<p>Set up a transmitter at an adequate distance (at least 100 m). From there, use a compass to determine the direction to the direction finder antenna.</p> <p><b>Caution:</b> When measuring using the compass, ensure that during the measurement there are no objects (transmitters, cars...) in the vicinity of the compass which could affect the magnetic field.</p>	<input type="checkbox"/>
2	<p>Activate the transmitter and transmit a continuous signal.</p> <p><b>Caution:</b> When transmitting with a monopole antenna (e.g. a hand held unit), care must be taken due to undefinable radiation conditions to ensure that the antenna is as free as possible from disturbance, i.e. vertically installed.</p> <p><b>Note:</b> For hand held radio units it is advisable to hold the unit above your head. In this case the antenna points vertically upwards</p>	<input type="checkbox"/>
3	<p>Rotate the direction finder antenna in the mast mounting until the controller, which is set to the transmitter frequency, indicates the QDM value determined by the compass (set the north adjustment to zero). In this case correcting the antenna setting by rotating clockwise (viewed from above the single dipole moves in the north -- east -- south -- west direction) reduces the indicated QDM value, a counter-clockwise rotation causes an increase.</p> <p><b>Note:</b> The direction finder antenna should be rotated slowly with pauses because a considerable lag error occurs in the determination in the direction finding unit. For the final adjustment, the person rotating the antenna must move away from the antenna after each correction so as not to disturb the near field of the antenna and therefore influence the direction finding.</p> <p><b>Caution:</b> When carrying out the above measurements there must be no objects (vehicles, parking aircraft, buildings etc.) in the vicinity of the transmitter or the direction finder which could disturb the wave propagation.</p>	<input type="checkbox"/>

## 1.8 Network Integration

To use a remote control PC, it is necessary to integrate the DF-System into the local network. RHOTHETA recommended doing this with the local network administrator using the Network Configuration manual.

### Integration in the Local Network

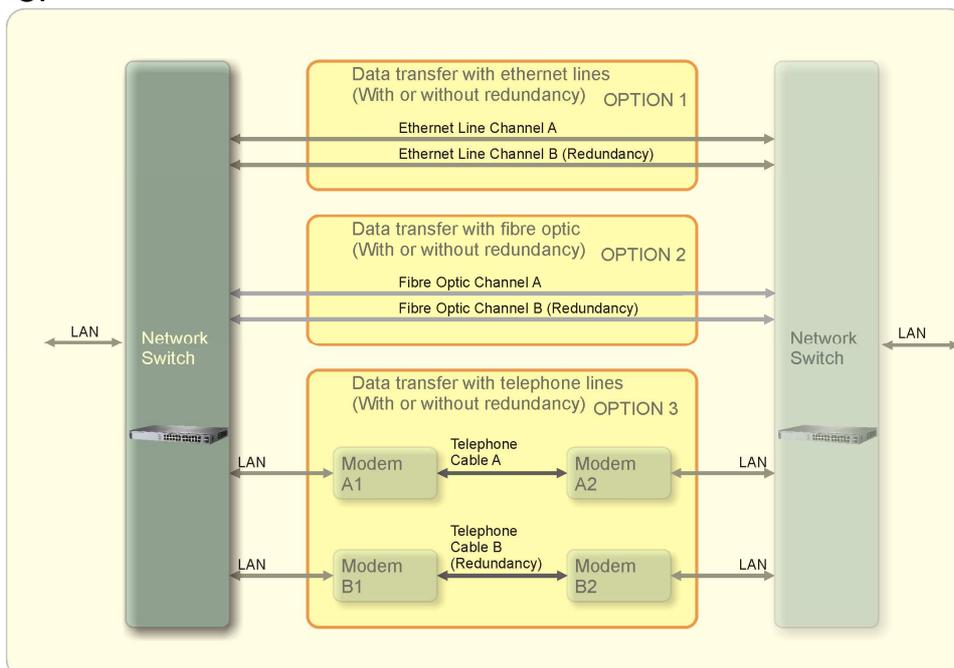
Step	Description	Done	
1	Connect the supplied Network interface <ul style="list-style-type: none"> <li>• LAN</li> <li>• DSL</li> <li>• Optical Fibre</li> </ul>	<input type="checkbox"/>	
2	Configure the Tower IP-Address	<input type="checkbox"/>	
3	Set the Network Switch User Name	<input type="checkbox"/>	
4	Set the Network Switch PW	<input type="checkbox"/>	
5	Configure the Network Switch IP-Address	<input type="checkbox"/>	
6	Configure the IP-Addresses of the DSL modems (if supplied)	<input type="checkbox"/>	
	Modem		IP-Address
	Modem A2 (Tower)		
	Modem B2 (Tower)		

**Caution:**

If you change, the DF Control System IP-Address has to be set in the DF Commander in the IPC in the DF Main Unit.

**Caution:**

All steps must be done for the components in the DF Main unit and for the equipment next to the Remote PC.



## 1.9 Remote PC Installation

The installation, licencing and configuration of the DF-Commander software for the remote PC are described in the user manual of the DF Commander.

### Installation of the DF Commander on a Remote PC

Step	Description	Done	
1	Install the DF Commander software execute the "setup.exe" file	<input type="checkbox"/>	
2	Licencing the software	<input type="checkbox"/>	
3	Configure the DF Commander software	<input type="checkbox"/>	
4	Create a System	System Name	<input type="checkbox"/>
5	Create an Setup DF Channels	Number of Channels	<input type="checkbox"/>
6	Connect the DF Channels to the DF Control System	<input type="checkbox"/>	
	Channel	Socket (IP::Port)	
7	No Error or Warning should be displayed	<input type="checkbox"/>	
8	Change the frequency in all Channels	<input type="checkbox"/>	
9	Individualization of the Display	<input type="checkbox"/>	
10	Set Password for Administrator	<input type="checkbox"/>	
11	Set Password for Technician	<input type="checkbox"/>	

## 1.10 Integration of UPS

Integrate the UPS in the local network. RHOTHETA recommended doing this with the local network administrator and the UPS manual.

### Integration of the Uninterruptable Power Supply

Step	Description	Done
1	Configure the UPS IP-Address	<input type="checkbox"/>
2	Configure the individual error management	<input type="checkbox"/>

## 2 Flight Check

For exact north alignment under operating conditions and for determining the system accuracy at the actual installation site, a flight check should be carried out.

To do this, a continuous-signal transmitter is fitted in the aircraft, which then performs circular flights about the site of the direction finder. If the communication system of the aircraft is used as a transmitter, check beforehand whether this is suitable for continuous operation.

The radius of the circle and the flight speed shall be selected such that the "lag error" effect when determining the bearing is negligibly low. It must therefore be ensured that the angular velocity does not exceed  $0.3^\circ/\text{s}$ .

In the case of all flight checking measurements, it must be ensured that adequate reception field strength is present at the site of the direction finder antenna. Because of the quasi-optical wave propagation characteristic of VHF signals, there must also be a theoretical sight contact to the transmitter. If the transmitter is masked by hills, mountains, buildings or woods, the direction finder antenna cannot evaluate the directly transmitted signal, but instead assesses a signal which reaches the direction finder antenna via reflections. This normally leads to considerable bearing errors.

The instantaneous position of the aircraft can be determined by tracking with a theodolite or using a GPS receiver on the aircraft.

### 2.1 Determining the Position Using a Theodolite

Determining the Position Using a Theodolite		
Step	Description	Done
1	Set up the theodolite in the immediate vicinity of the direction finder antenna, aligned with magnetic north.	<input type="checkbox"/>
2	The calibration aircraft then flies a circular flight path around the direction finder antenna and transmits a continuous signal.	<input type="checkbox"/>
3	Track the aircraft using a theodolite.	<input type="checkbox"/>
4	If the aircraft flies through a $10^\circ$ mark, report this from the theodolite to the controller (e.g. by radio).	<input type="checkbox"/>
5	Record the instantaneous bearing at the controller.	<input type="checkbox"/>

### 2.2 Determining the Position Using a GPS Receiver

Determining the Position Using a GPS Receiver		
Step	Description	Done
1	Store the site coordinates of the direction finder antenna in the GPS receiver.	<input type="checkbox"/>
2	During the circular flight around the direction finder antenna record the QDM values determined by the GPS receiver	<input type="checkbox"/>
3	Transmit the positions by radio to the direction finder	<input type="checkbox"/>
4	Compared the GPS data with the bearing.	<input type="checkbox"/>

## 2.3 Simplified Method

If no theodolite or GPS receiver is available, a simplified measuring procedure must be used at the actual antenna installation site to precisely north align the system and determine its accuracy.

Route points:

With this method, the calibration aircraft overflies prominent landmarks (route points) the position of which has been previously determined from conformal maps (scale approximately 1: 200000). Note that the angular values determined using the map are relative to geographical north and must therefore be corrected with the magnetic declination.

As the aircraft overflies the route point this is transmitted to the direction finder. At the direction finder the instantaneous bearing is recorded and compared with the desired value from the map. To achieve a constant bearing during the over-flight, the aircraft must fly radially relative to the direction finder antenna, i.e. must fly either towards the direction finder antenna or away from it.

Due to the unavoidable errors when overflying, the route points chosen should be at least 10 km from the direction finder antenna (at a distance of 10 km a lateral offset of 175 m, with regard to the direction finder, when overflying the route point produces an error of 1°).

The PTT button should be pressed and held for at least 10 seconds before and after the over-flight, to enable the "before" and "after" history of the direction finding to be evaluated

### 3 Notes