User Manual

RT-1000
Antenna

VHF Bearing-System

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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 General Information

DF-Systems are used to locate aircraft, ships, vehicles or persons who have a radio transmitter. All prevalent DF-Systems determine the direction from which the signal reaches the DF-Antenna. If this direction is the same as the direction to the aircraft, vessel or the vehicle, everything is fine. If the radio signal arrives, the DF-Antenna not in a direct way, because of shadowing or reflections, the direction finder shows in the direction to the reflector, where the signal (or the majority of the signal) comes from.
This direction can have a big difference to the direction of the source of the signal, the aircraft, the vessel or the vehicle where the transmitter is located. The operator will regard this as a malfunction of the direction finder. In the physical way, this is not true. The problem is that the bearing we get from the DF is not the information the operator desires.
This means for the praxis, that we have to find an antenna location, where the radio signals always arrive the antenna in the direct way.
The achievable bearing accuracy depends largely on the physical conditions at the antenna location.

The remote concept of the RT-1000 C DF-System separates the antenna and the high frequency components (RF-Antenna, Receiver Unit) from the controller side (Controller) with the signal processing. So it is easy to place the antenna somewhere in the open field where the physical conditions are good, while the Controller is located at the tower side.
The following information should help you, to find a physical convenient antenna location.

1.1 Reflections and their Influence to the Bearing Result.

The antenna of a DF-System can be seen as a sensor, which analyses the incoming electromagnetic wave field to find out where it comes from. As the waves on quiet water surface also radio waves in the free (unobstructed) field dispread circular from around the transmitter.

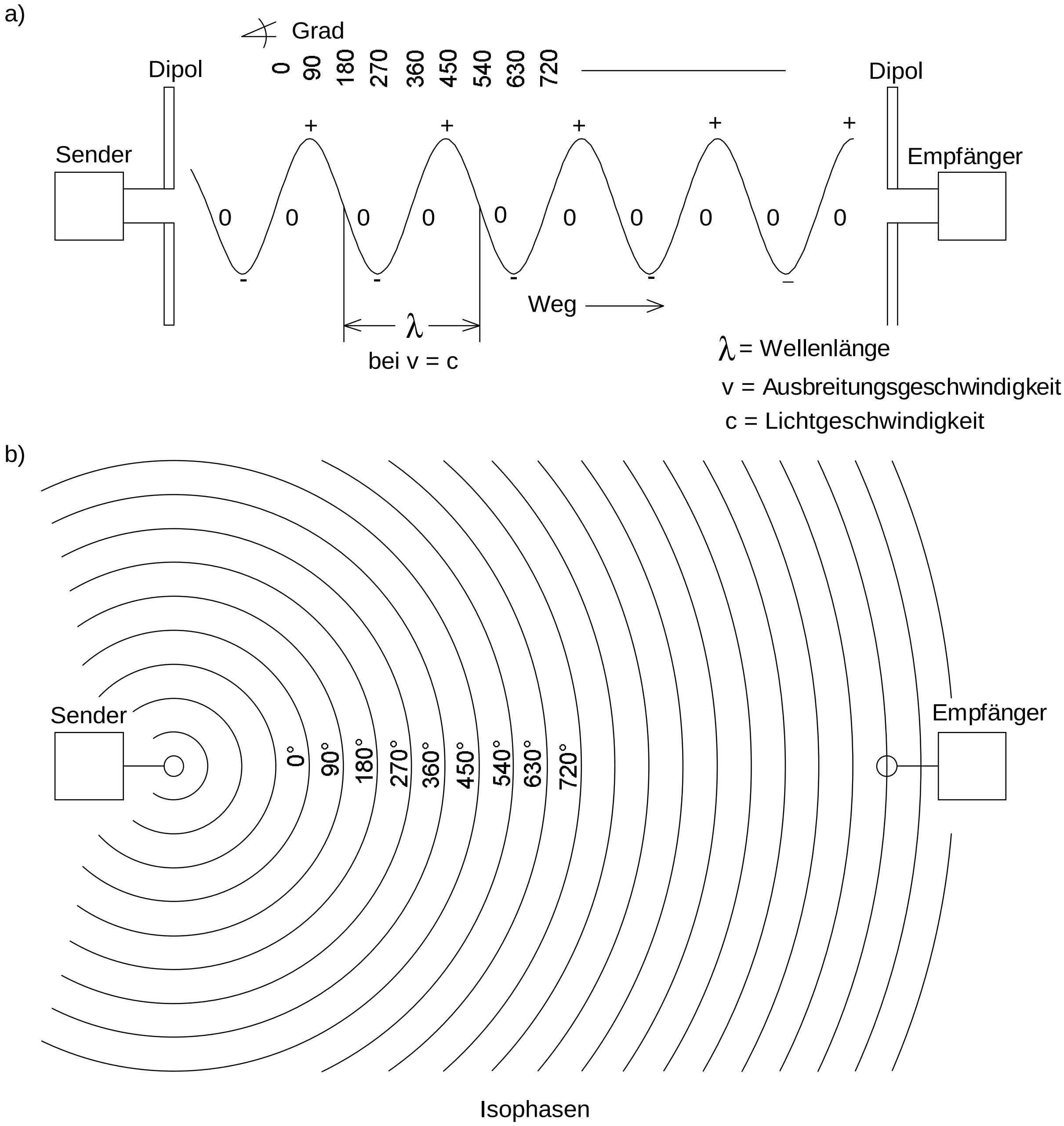


Fig. 1: Free-space propagation of radio waves

Fig. 1 gives an extremely simplified representation of even radio wave propagation in free space. The sine wave in part a) corresponds to the instantaneous value of the electric field on the plane path to the receiver. Part b) is the vertical projection of part a). The circles represent the lines of equal phase relations for even waves.

If the distance between transmitter and receiver is adequate, these are practically straight lines when they reach the receiver location. Such an idealized situation is not to be found in built-up areas, and especially not in mountainous regions. In such areas, the propagation path is obstructed by obstacles, mirror reflectors; diffuse reflectors with and without absorption characteristics, diffracting edges and resonators. Reflectors and conducting rods are effective as resonators if their size is approximately that of the wavelength to be received. Therefore, reflections increase as wavelengths become shorter, diffractions at edges however are reduced and so the effect of shadowing obstacles is more important.

Accordingly, the propagation characteristics of radio waves from approximately $\lambda < 10$ m increasingly resemble those of light.
At a wavelength of 1 m to 3 m, wave propagation requires a direct path and if this is not available, only reflected waves are received. In urban areas, these may come from several directions simultaneously. But that is not all: the mostly horizontal or vertical plane polarized waves propagated by the transmitter are also rotated to a certain degree due to diffuse reflectors and diffracting edges. When the wave arrives at the receiver, it may be oblique, elliptically, or even circular polarized. This fact becomes apparent by the often curious antenna positions which are necessary to obtain the best reception of radio or television waves.
These points are meant to indicate that in the VHF, UHF range, direction finding of a stationary transmitter using a stationary direction finder in a built-up area or even inside a building is practically impossible.

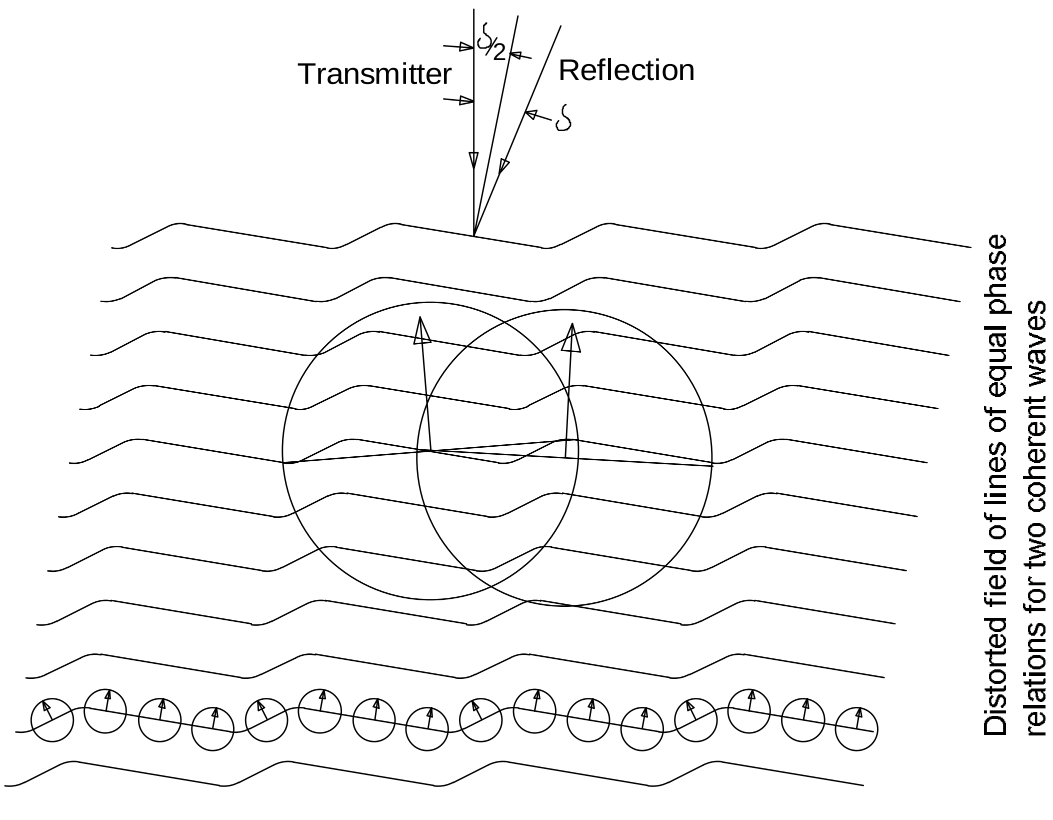


Fig. 2: Field of lines of equal phase relations for two coherent waves

Conditions at airports are much more favourable. These instructions are intended to allow the best positioning of the direction finder antenna.

Of course, airports are not without reflectors, but these do not normally cause noticeable problems. All direction finders with field probes calculate the angle of signal incidence by finding out the path direction (vector), at which the largest phase modification per unit of distance is present.

In Fig. 1 this vector is vertical to the lines of equal phase relations. Fig. 2 shows the distorted field of lines of equal phase relations for two coherent waves (reflection) from different directions with different field strengths.

Mainly 4 parameters influence the deviation of the bearing caused by reflections:

1. Position of the DF antenna
2. Position for the Transmitter antenna
3. Position of the reflector
4. Wave length of the signal (signal frequency)

The advantage of wide base direction finders is most noticeable in static conditions. Static conditions indicate that the position of the transmitter and direction finder as well as the transmitter frequency does not change with time. Should one of the three named items change (e.g. transmitter in aero-plane) the direction finder antenna and the field of lines of equal phase relations begin to move in relation to one another. This movement accelerates in proportion to the relationship between the reflected path distance and the direct path distance of the radio wave (Fig. 3).

As shown in Fig. 2, this movement in the case of wide base direction finders causes slight azimuth oscillation. In contrast, this oscillation is larger in the case of narrow base direction finders - the series of small circles in Fig. 2. When several values are averaged out however, both systems give the same azimuth.

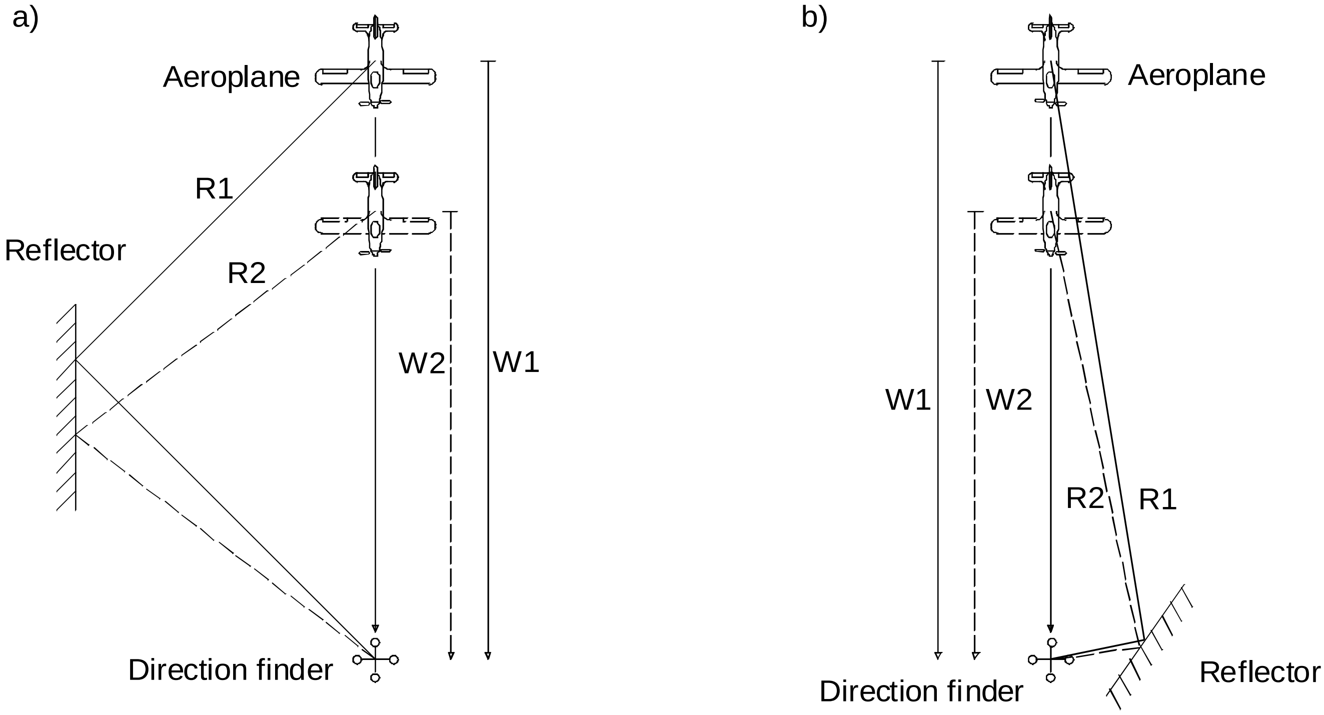


Fig. 3: Reflected path distance an direct path distance of the radio wave

favourable:

W1/W2 » R1/R2

unfavourable:

W1/W2 ≈ R1/R2

With moving transmitter:

Rapid phase shifting between W and R signal, therefore good bearing average.

Only very slow phase shifting between W and R signal, so no averaging possible. The possible displayed bearing oscillates slowly around the rated value.

The following conclusions can be drawn:

Vertical reflector surfaces e.g. buildings, hangars, metal fences, metal masts, overhead lines as well as bushes and trees should not be within 100 m of the direction finder antenna if possible.

1.2 Influence of the signal ground reflection to the DF accuracy

The signal out of an aircraft transmitter will reach the DF antenna on the direct way. In addition a part of the signal will be reflected on the ground and will reach the antenna as well. Depending on the angle of incidence and the height at which the DF antenna is located above the ground, the direct signal and the reflected signal have to go different distances.

a)

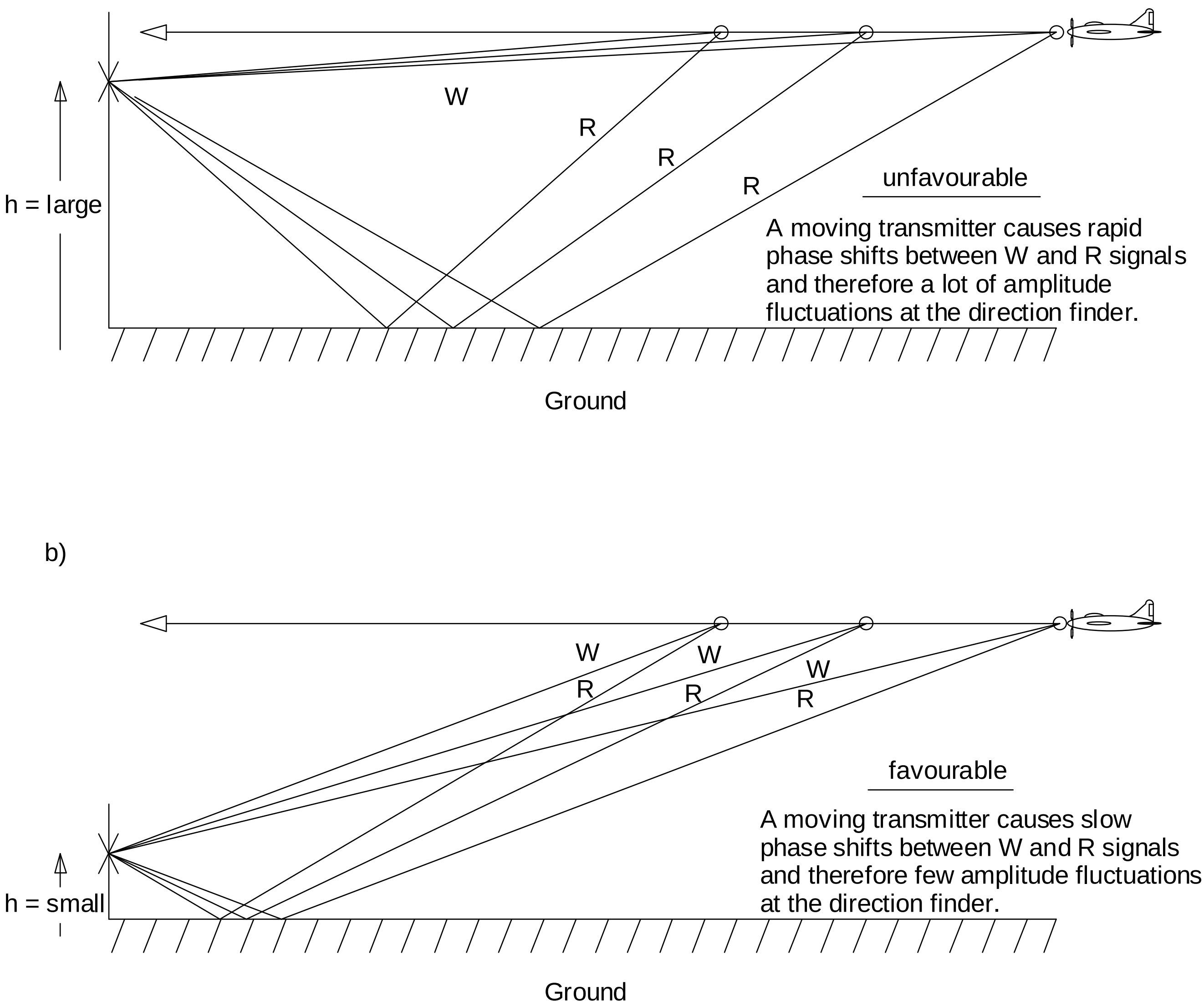
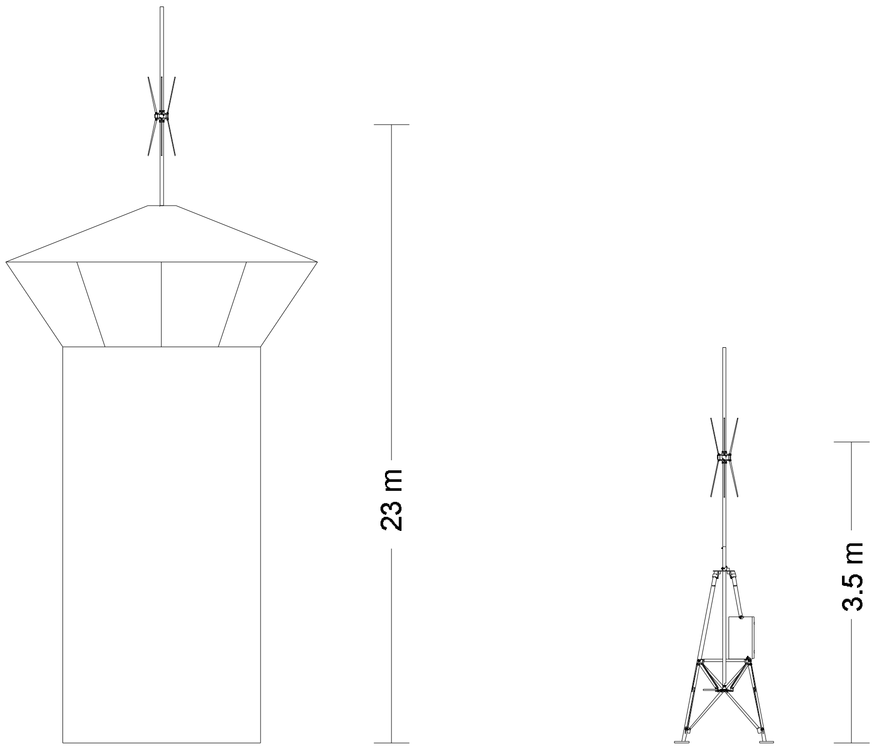
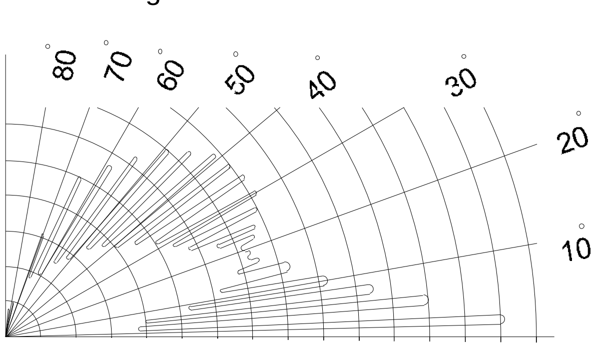


Fig. 4: The phases between a direct wave W and a reflected wave R

This is the reason why there are angles of the signal incidence, where the signals are in phase and there are angles where the signal arrive the antenna in opposite phase. On one case the direct and the ground signal add each other, on the other case the direct signal is compensated or reduced by the ground reflected signal. This is the reason why the vertical antenna diagram become more zero points as higher the antenna is placed (see Fig. 5).



Vertical diagram for h = 23 m



Vertical diagram for h = 3.5 m

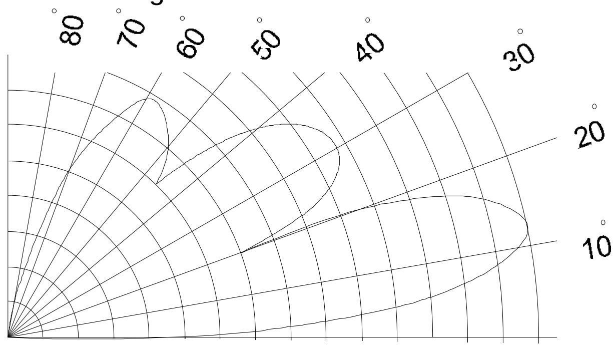


Fig. 5: Signal strength lobes plotted against angle of elevation

The zeros of the vertical diagram can be determined using the following formula:

$$\tan\alpha = \frac{\lambda}{2h} n \,; \qquad \lambda = \frac{c_0}{f} \,; \qquad c_0 = 299792458 \, {}^{m}\!/_{s}$$

c_0= light velocity [m/s]
λ= wave lengths of the signal [m]
h = height of the antenna head above the ground [m]
n = ordinal numeral of the zero point (1. 2. 3….)
f = signal frequency [Hz]

By itself, zero point in the vertical antenna diagram will not cause bearing failures. It will only cause a significant reduction of the signal field strength. The ground will absorb a part of the signal so not 100% will be reflected. In the praxis the direct incoming signal and the ground reflected signal will not compensate each other, so that even an attenuated signal is received. In the area of the zero points of the antenna diagram, the direct signal from the aircraft will be attenuated by the ground reflection. All other signals, which reach the antenna via horizontal reflectors, will be not attenuated and become now strong in relation to the direct signal. The DF is not able to distinguish between direct and reflected signals. It shows the direction to reflector where now the strongest signal comes from. If an aircraft fly through the maxima's and minima's of the DF antenna, while it approach the airport, significant bearing value fluctuations can occur. The cause is that alternately, the field strength of the direct, or of the reflected signal, will predominate (see Fig. 6).
If the antenna is mounted on the RHOTHETA antenna mast RT-1306, the antenna head is about 4 Meters above the ground. The 1^{st} zero point will be in an elevation of approx. 17°above the horizon.
In the areas which are relevant for the air traffic controller (report points, traffic pattern …), the aircrafts stay below of the first zero point.
The roof of the tower is in physical respect, the worst antenna position you can find on an airfield. The very high antenna position with it's the unfavourable vertical antenna diagram, in combination with a lot of building around it, as well as other antenna systems and reflectors on the tower roof will influence the DF results in the most applications in a not acceptable way. The full performance of the DF system, you will get here only in very rarely cases.

The following conclusion may be drawn:
The best position for a direction finder antenna is on a flat surface at a distance from vertical reflectors, only 3.5 to 4 m above the ground.

Summary we can say:
An antenna location in a free area, a few meters above the ground and in a ambit of some 100 meters free of reflecting obstacles, will give satisfying bearing results. An antenna position more than 10 meter above ground can be a problem and should be checked out by a flight test before final installation.

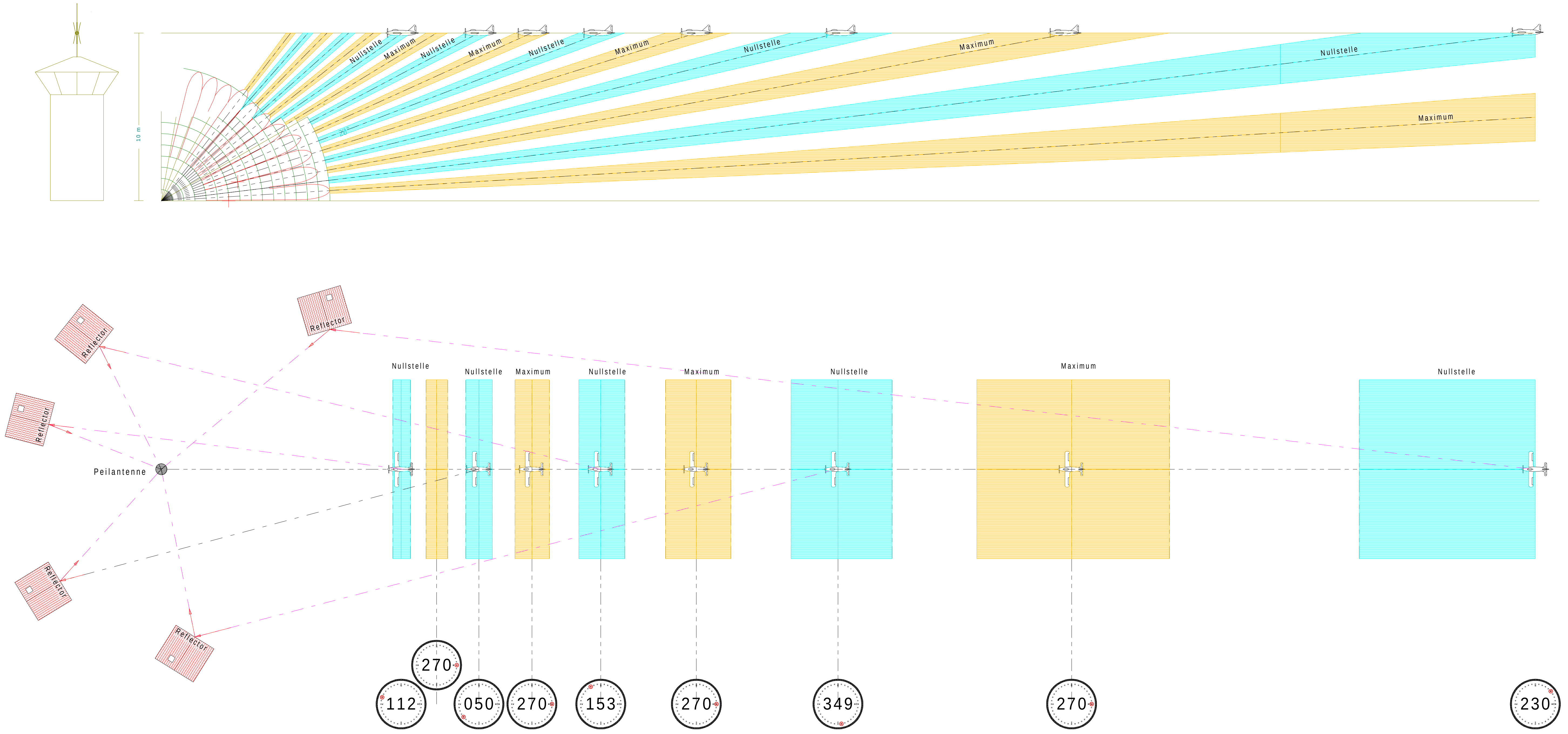


Fig. 6: Influence of ground reflection to the bearing result

In order to carry out checking and acceptance, the direction finder is subjected to a "flight test" (Fig.7). By means of circular flights approx. 5 to 10 km away, the angular accuracy and influences due to vertical reflectors are calculated. These circular flights should be carried out in both directions in order to eliminate any possible "lag error" in the direction finder display. The aeroplane is tracked using a theodolite erected next to the direction finder antenna and angle values from this are compared with those from the direction finder display. It is also possible to do it with a GPS based procedure. Here the exact DF antenna position is stored as a way point in the GPS of the aircraft or vessel. While the test flight the pilot gives the GPS bearing to the DF side. Here it both bearings can be compared. RHOTHETA can support you in this matter with an automatic test recording system.
During the radial flights, the aeroplane flies across the direction finder from various directions to find out detrimental ground reflections and the cone of silence, the area above the direction finder where no usable information can be gained from the direction finder. These over-flight measurements are especially important for testing the usefulness of a direction finder antenna set-up on the tower.

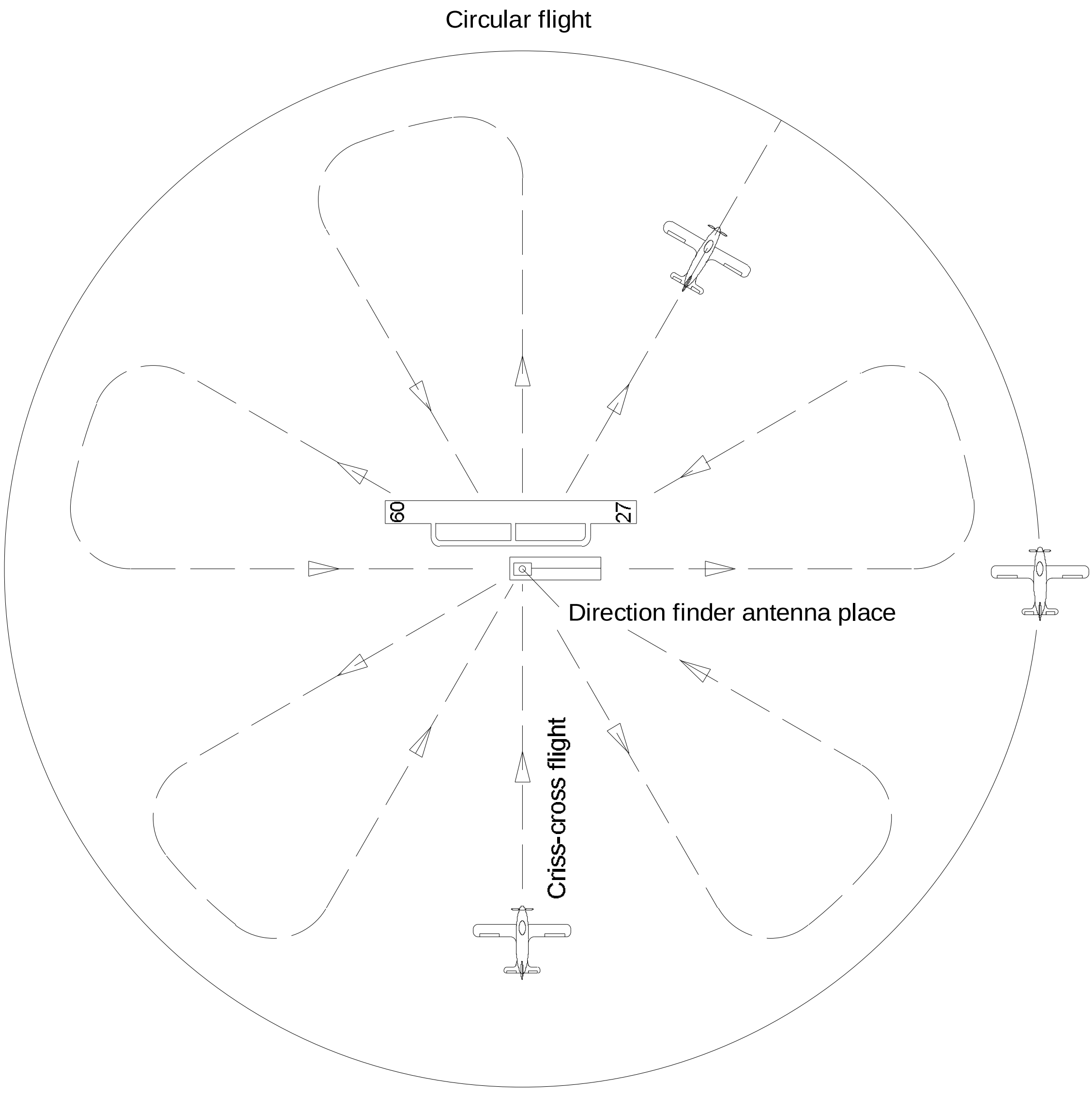


Fig. 7: Surveying the direction finder using radial and circular flights

2 Antenna Construction

2.1 Side View

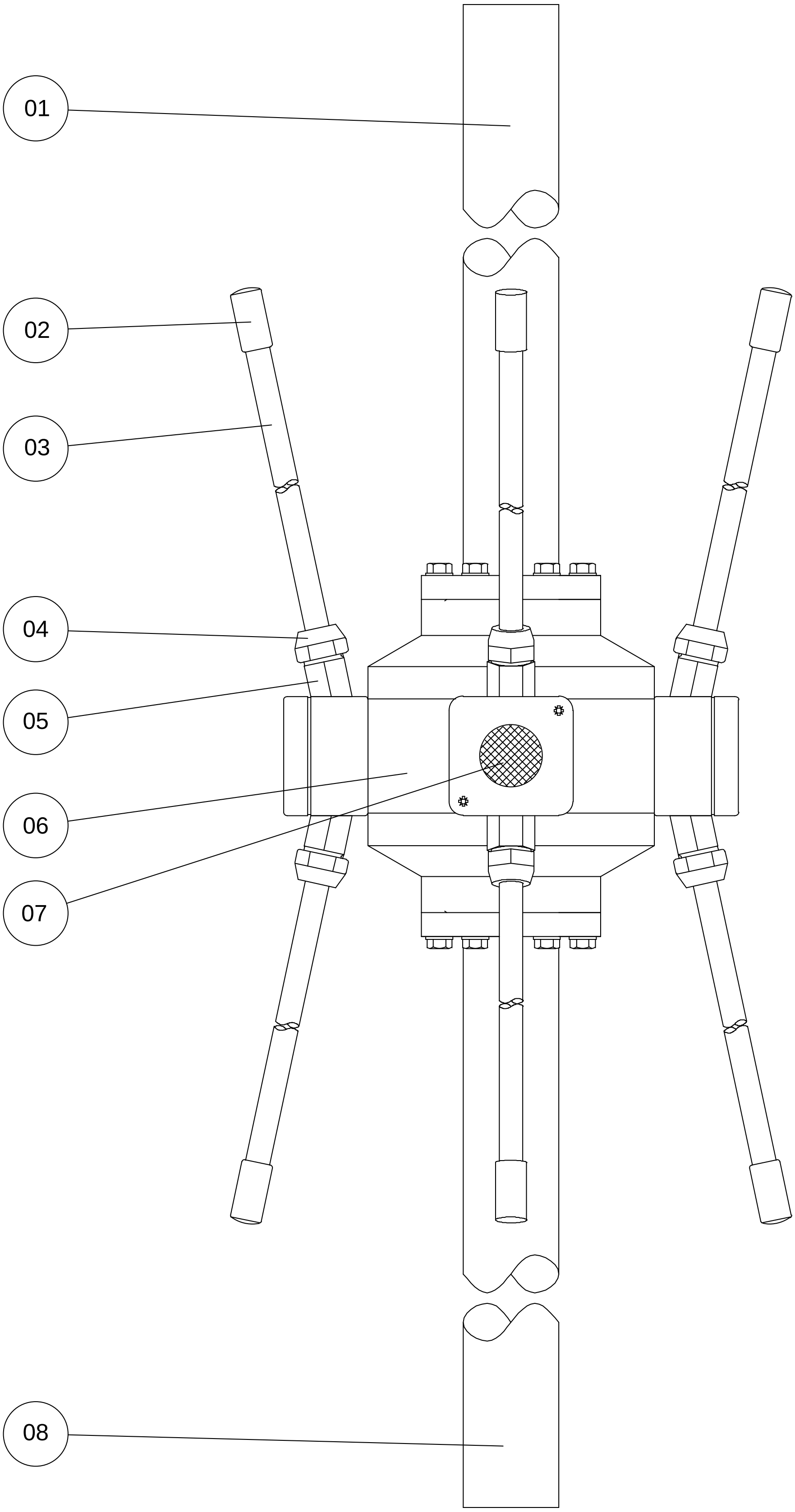


Fig. 8: RTA 1300.A Direction Finder Antenna

2.2 Bottom View

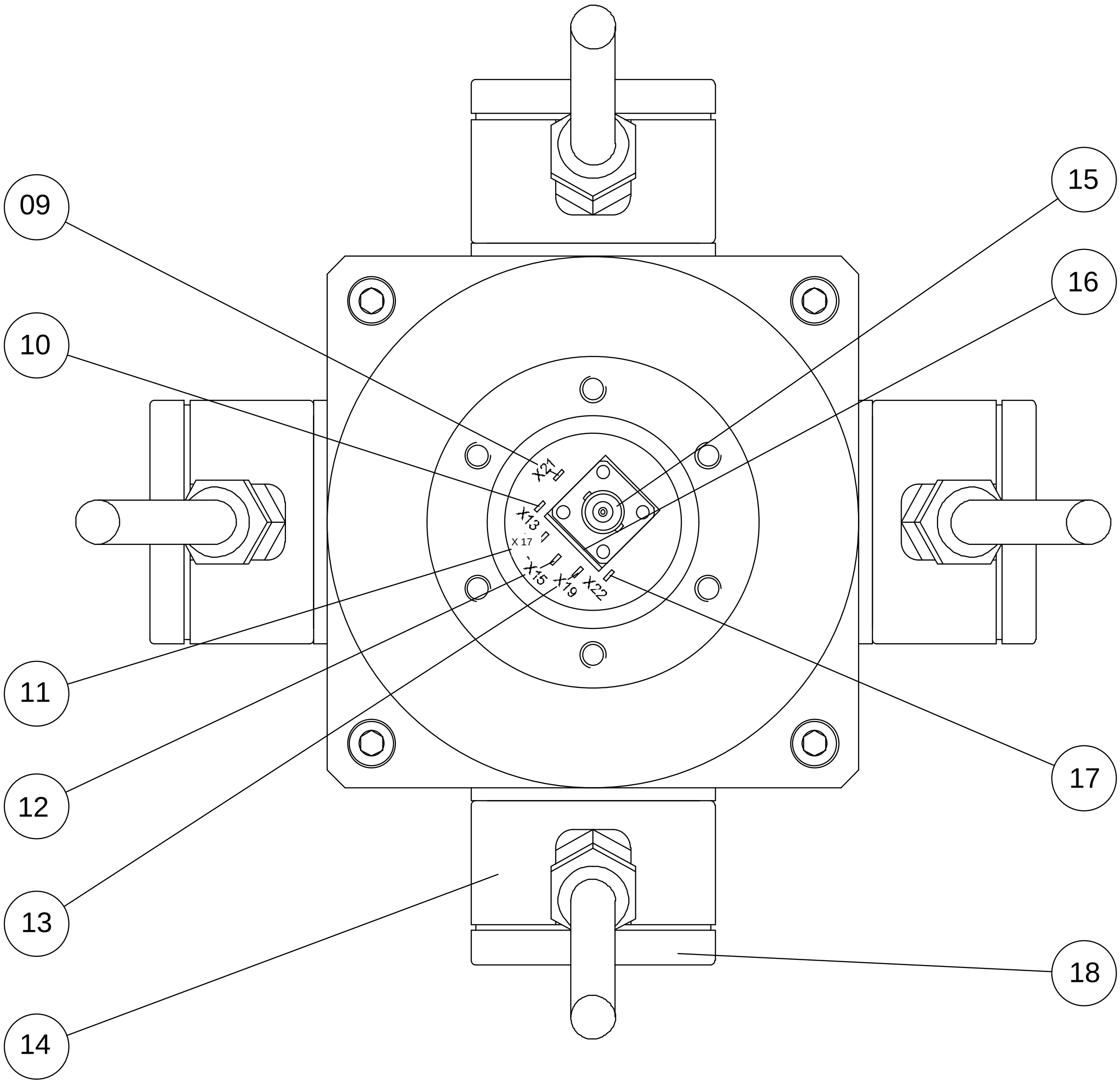


Fig. 9: RTA 1300.A Direction Finder Antenna (Bottom View)

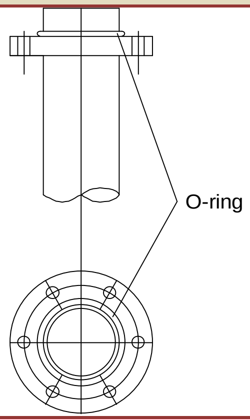
2.3 Component List

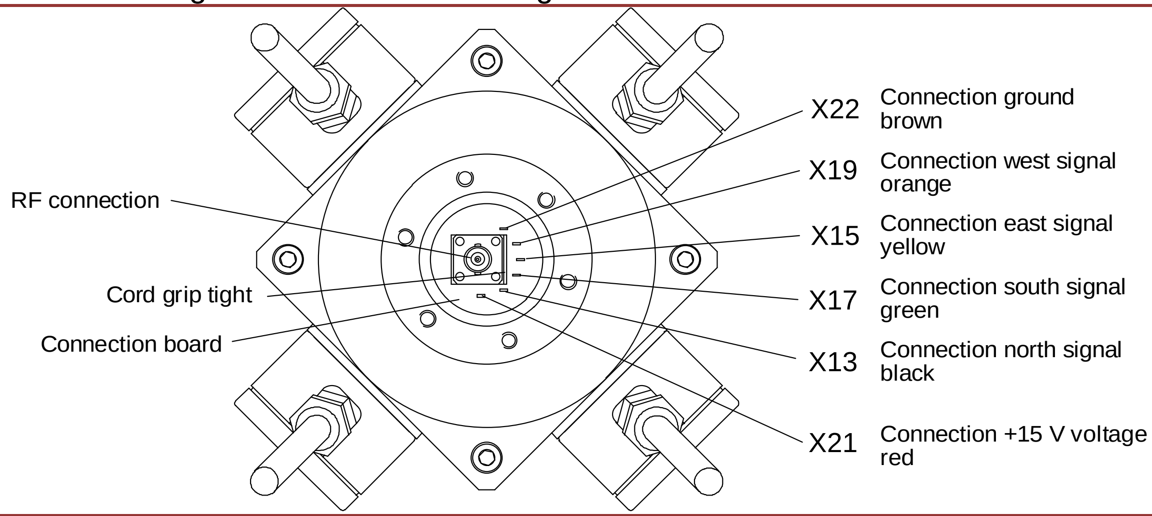
Installation of the Antenna		
Pos.	**Connector**	**Function**
1		Lightning conductor rod
2		Radiator cover
3		Radiator
4		Clamping nut
5		Radiator flange
6		Antenna head
7		North dipole label
8		Mast tube
9	X 21	Flat plug for control cable connection
10	X 13	Flat plug for control cable connection
11	X 17	Flat plug for control cable connection
12	X 15	Flat plug for control cable connection
13	X 19	Flat plug for control cable connection
14		Radiator housing
15		BNC jack for antenna cable
16		Cord grip
17	X 22	Flat plug for control cable connection
18		Radiator housing cover

3 Assembly Instructions

Installation of the Antenna

Step	Description
1	Fit the O-ring on mast tube
2	Pull the antenna cable through the mast tube
3	Connect RF cable to the BNC connector
4	Screw cord grid tight to clamp the RF cable
5	Plug the control cables into the connection board • Push back guard sockets • Using pointed flat-nose pliers, grip the flat plug covers and push fully onto the flat plugs. • Push guard sockets back on again.



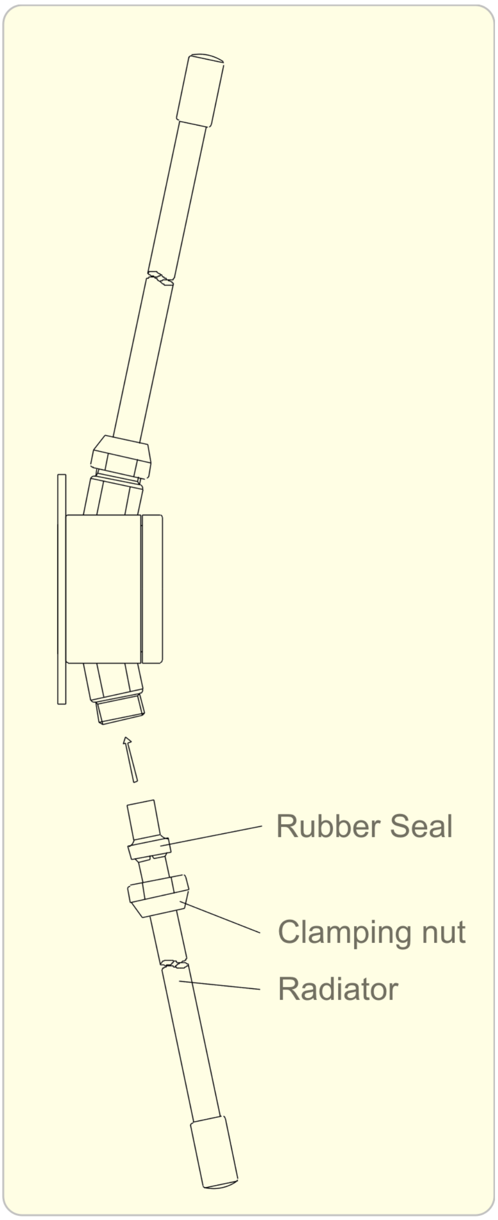


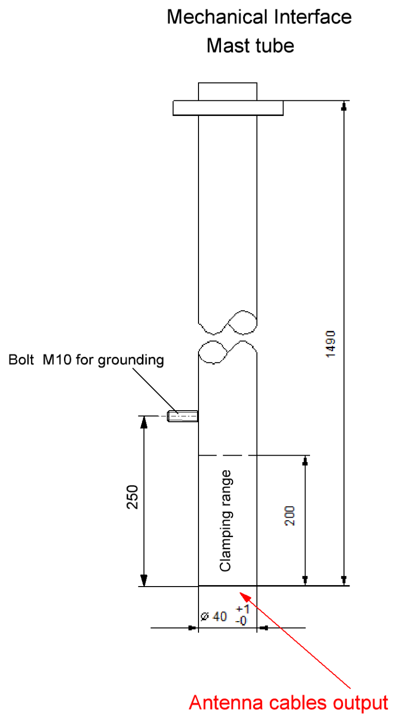
Allocations of Connections

Connector (Name)	Control Cable Colour	Signal
X22 (GND)	brown	Earth
X13 (NORTH)	black	North dipole control current
X17 (SOUTH)	green	South dipole control current
X15 (EAST)	yellow	East dipole control current
X19 (WEST)	orange	West dipole control current
X21 (+15 V)	red	15-V supply voltage

Installation of the Antenna

Step	Description
6	Apply a thin coat of grease to the antenna head/mast tube contact faces.
7	Screw antenna head onto mast tube.
8	Fit O-ring to lightning conductor rod
9	Apply thin coat of grease to antenna head/lightning conductor rod contact faces.
10	Screw lightning conductor rod onto antenna head.
11	Fix radiators • Push clamping nut, clamping cone, washer and rubber seal onto radiator. • Push radiator fully into recess for radiator. • Carefully tighten clamping nuts
12	Erect mast tube (if not already done)



<table>
<tr><th colspan="3">Installation of the Antenna</th></tr>
<tr><th>Step</th><th colspan="2">Description</th></tr>
<tr><td>13</td><td>Earth mast tube</td><td>
</td></tr>
<tr><td>14</td><td colspan="2">Align antenna
Point north dipole (marked by red point on radiator housing) northwards</td></tr>
</table>

Warning

Observe all appropriate guidelines, especially VDE regulations when conducting all building work, installation of electrical equipment and lightning protection measures.

Caution

LED-based obstacle lights should not be used. LED-based obstacle lights may disturb the reception of the DF system due to the integrated power supply.
The use of the RHOTHETA obstacle light as defined in the options list will prevent such problems.

4 North Alignment of the Direction Finder Antenna and Determining the System Accuracy at the Installation Site

The north alignment is used to harmonize the angle determined by the direction finder with the actual (magnetic) north-related azimuth values.

4.1 North Alignment Using a Ground Transmitter (Pre-setting)

Pre-setting, which requires further correction by the north adjustment on the DF Channel in the ±90 range (resolution 0.5°) as described in DF Channel user manual, is achieved by the mechanical alignment of the direction finder antenna.

Nevertheless, the setting of the antenna should be carried out as accurately as possible since this makes subsequent measurements easier.

Procedure:

1. Mount the direction finder antenna on the antenna mast so that it is free to rotate. Point the marked dipole to the north. For the RTA 1306 Antenna Mast, loosen the clamping screws provided for the purpose.

2. Switch on the direction finding system. Set the north adjustment to zero. Carry out a phase adjustment.

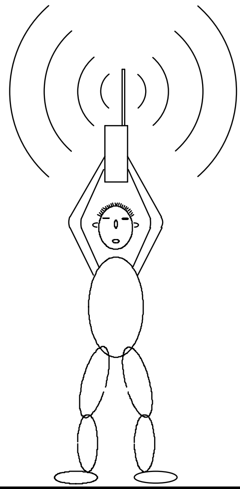
3. Set up a transmitter at an adequate distance (at least 100 m). From there, use a compass to determine the direction to the direction finder antenna.

Caution
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.

Caution
While doing measurements with a compass, be sure that nothing is around which can influence the magnetic field. This can cause a big failure in you measurement

4. Activate the transmitter and transmit a continuous signal.
   For hand held radio units it is advisable to hold the unit above your head. In this case, the antenna points vertically upwards.

Caution
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.



5. 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.

Caution
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.

Caution
When carrying out the above measurements there must be no objects (vehicles, parking aircraft, buildings…) in the vicinity of the transmitter or the direction finder which could disturb the wave propagation.

4.2 Flight Checking for Exact North Alignment and Determining the System Accuracy at the Antenna Installation Site

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 around the site of the direction finder.
Note:
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°/s.

In the case of all flight checking measurements, it must be ensured that an 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.

4.2.1 Determining the Position Using a Theodolite

- Set up the theodolite in the immediate vicinity of the direction finder antenna, aligned with magnetic north.
- The calibration aircraft then flies a circular flight path around the direction finder antenna and transmits a continuous signal.
- Track the aircraft using a theodolite.
- If the aircraft flies through a 10° mark, report this from the theodolite to the controller (e.g. by radio).
- Record the instantaneous bearing at the controller.

4.2.2 Determining the Position Using a GPS Receiver

- Store the site coordinates of the direction finder antenna in the GPS receiver.
- During the circular flight around the direction finder antenna record the QDM values determined by the GPS receiver and transmit them by radio to the direction finder where they are then compared with the bearing.

4.2.3 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 there-fore 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.

4.3 Evaluation

The actual values measured by the direction finder (QDM bearings) are entered in a record for comparison with the desired values (theodolite bearings, GPS bearings, route points from the map).

4.3.1 Evaluation of Direction Finding Signal

To assess the suitability of the antenna site as accurately as possible and therefore assess the functioning of the direction finder system, the direction finding signal (DF signal) relevant for determining the bearing should be observed on an oscilloscope during the measurements. The signal can be taken from the "DF signal 2" test output on the rear of the controller. The right / left rotation signal at the "R/L" test output is used to trigger the oscilloscope. It is taken from the "R/L" test output on the rear of the controller. The connecting cables for the test outputs are contained in the RTM 1500 Service Kit or can be ordered from your dealer.

1. If there is correct reception without reflections the bearing signal appears as shown in Fig. 10.

   - Both blocks, clockwise and counter-clockwise rotation, have the same amplitudes. The envelope curve of the oscillation increases steadily (in accordance with e function) and has no "dips".
   - The blocks also experience no amplitude fluctuations over a long time period (5 seconds).
   - ➔ If the bearing signal has the above shape, it can be assumed that the bearing indicated by the controller is correct.

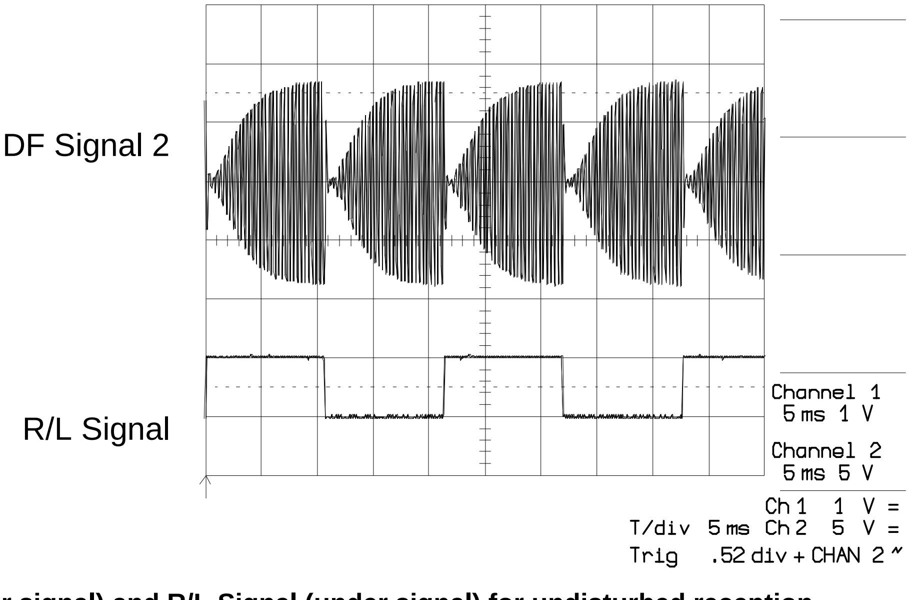


Fig. 10: DF Signal 2 (upper signal) and R/L Signal (under signal) for undisturbed reception

2. The amplitude of the bearing signal fluctuates within the individual blocks (refer to Fig 10). The fluctuation coincides with the rhythm of the audio signal.

   Possible causes:
   - The carrier is modulated (e.g. by speech)
   - ➔ Has no influence on the bearing accuracy

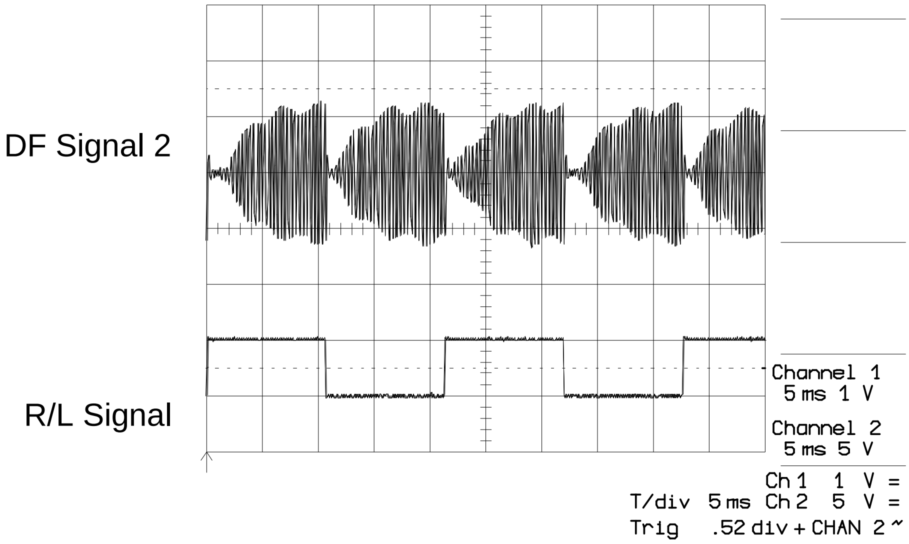


Fig. 11: DF Signal 2 and R/L Signal with a modulated reception signal

3. The direction finding signal is very noisy
   Possible causes:
   - The field strength of the transmission signal is too low.
   - The transmitter is masked by hills, buildings, forests etc. There is no "theoretical" line of sight to the transmitter.
   - ➔ The direction finding loses accuracy or is distorted by the masking

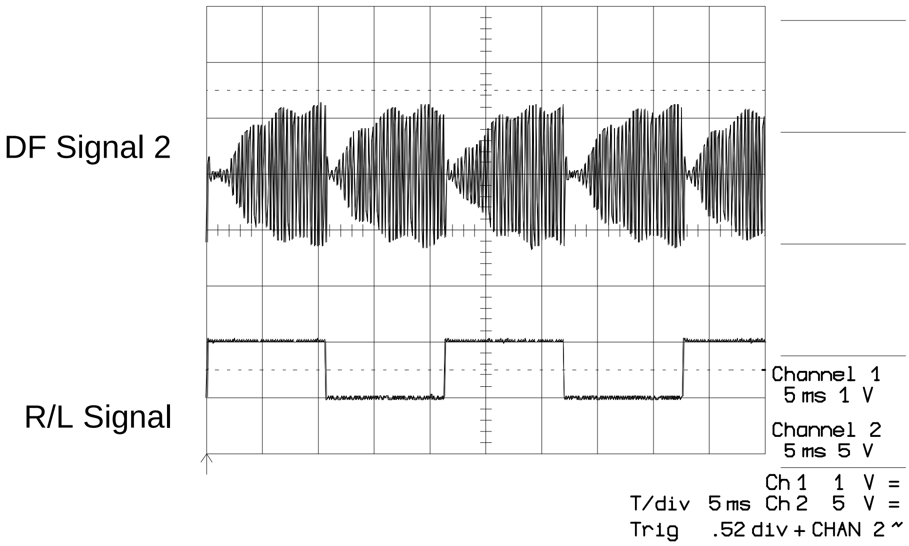


Fig. 12: DF Signal 2 and R/L Signal with noise reception signal

4. Amplitudes of clockwise rotation blocks or counter-clockwise rotation blocks "pump"

   The amplitudes of the clockwise rotation blocks and counter-clockwise rotation blocks are different

   Possible causes:
   - Effect of reflection
   - Extreme flight manoeuvres of the calibration aircraft
   - Jamming transmitter on same channel

5. Amplitude of R/L blocks is very large

- Effect of reflection

It is not possible to list all the possible disturbances and influences of direction finding signals here. As a rule it is assumed that if the direction finding signal is undisturbed the bearing shown by the controller is correct.
If the direction finding signal is observed during the complete circular flight, this provides a very good indication of the quality of the direction finding. This applies also for the azimuths at which no measuring points were recorded.

4.3.2 Evaluation of QDR Live Display (Green Light Dot Circle)

The QDR live display (green light dot circle) serves as a further criterion of the quality of the direction finding (including during every day operation).
During a circular flight the green light dot circle should "wander" steadily around the compass-card corresponding to the direction of movement of the aircraft. The green light dot circle display, because it is not averaged, precedes that of the red. The display jumps backwards and forwards between a maximum of two light dots.

Malfunctions which can be detected by the green light dot circle:

1. Rapid jumping backwards and forwards (spreading out) of the light dots around the aver-aged value.

   Possible causes:
   ➔ Received power too low due to the long distance from the transmitter.
   ➔ The transmitter is masked.

2. During circular flight the light dots do not "wander" steadily around the compass-card, corresponding to the movement of the aircraft.

   Possible causes:
   ➔ Influence of reflections
   ➔ Aircraft performs extreme flight manoeuvres
   ➔ Jamming transmitter on same channel

3. Light dots jump (spontaneously) backwards and forwards in large areas of the compass-card.

   Possible cause:
   ➔ Reflections

4. Light dots jump backwards and forwards around the averaged value (red light dot) (spreading out).

   Possible cause:
   ➔ Reception signal is modulated. The spreading out area depends on the type and strength of the modulation.

4.3.3 Evaluation of Measuring Results

The deviations between the desired and actual values are entered in the test record compiled with the aid of the flight check. If in the case of a calibration aircraft the direction finding signal or the green light dot indication is evaluated, the observations made at the corresponding measured values are to be annotated. Bearing errors can be easily interpreted in this way. A test record of the following kind is obtained.

Example:
Test record

Installation of the Antenna			
Desired	**Act**	**Deviation**	**Remarks**
000°	000°	0°	
010°	011°	+1°	
020°	025°	+5°	Direction finding signal is noisy, indication fluctuates
030°	032°	+2°	
040°	041°	+1°	
050°	049°	-1°	
060°	060°	±0°	
070°	072°	+2°	
080°	083°	+3°	
090°	091°	+1°	
100°	099°	-1°	
110°	104°	-6°	Direction finding signal has amplitude fluctuations, display fluctuates by ±5°
120°	120°	±0°	
130°	131°	+1°	
140°	142°	+2°	
150°	150°	±0°	
160°	158°	-2°	
170°	170°	±0°	
180°	181°	+1°	
190°	189°	-1°	
200°	200°	±0°	
210°	217°	+7°	Direction finding signal "pumps", green light dot circle ±20°
220°	222°	+2°	
230°	231°	+1°	
240°	240°	±0°	
250°	251°	+1°	

Installation of the Antenna			
Desired	**Act**	**Deviation**	**Remarks**
260°	259°	-1°	
270°	270°	±0°	
280°	280°	±0°	
290°	290°	±0°	
300°	302°	+2°	
310°	311°	+1°	
320°	319°	-1°	
330°	330°	±0°	
340°	343°	+3°	
350°	351°	-1°	

In the example, larger deviations occur when measuring for the 20°, 110° and 210° desired values. As can be seen by the evaluation of the direction finding signal and the green light dot circle, they are due to masking of the transmitter and reflections. The measurements are no longer taken into account in further assessment. If interference of this kind occurs, the site of the antenna is to be changed.
In the example, the deviations are in the -2° to +3° range. In practice, the deviations can be greater due to measuring uncertainties or reflections at the antenna site. The details of the system accuracy given in the section 1 technical data "System Accuracy" apply to reflection-free reception conditions at the antenna site but in practice such conditions are never found. Whether an antenna site is suitable must therefore be assessed in the light of the requirements of everyday operation.

4.4 Determining the North Correction

To determine the final north adjustment, the average value of the deviation is determined from the test record. To do this, the sum of all the different values (the signs must be taken into account) are added and divided by the number of measurements.

$$average\_deviation = \frac{Sum\_of\_all\_deviations}{Number\_of\_measurements}$$

Example:

$$+0.55^\circ = \frac{+18^\circ}{33}$$

In the example the direction finder has a bearing which is on average 0.55° too great. This can now be corrected with the aid of the north adjustment in steps of 0.5°. The correction value to be set is obtained as follows:

$$correction\_value = average\_deviation * (-1)$$

Example:

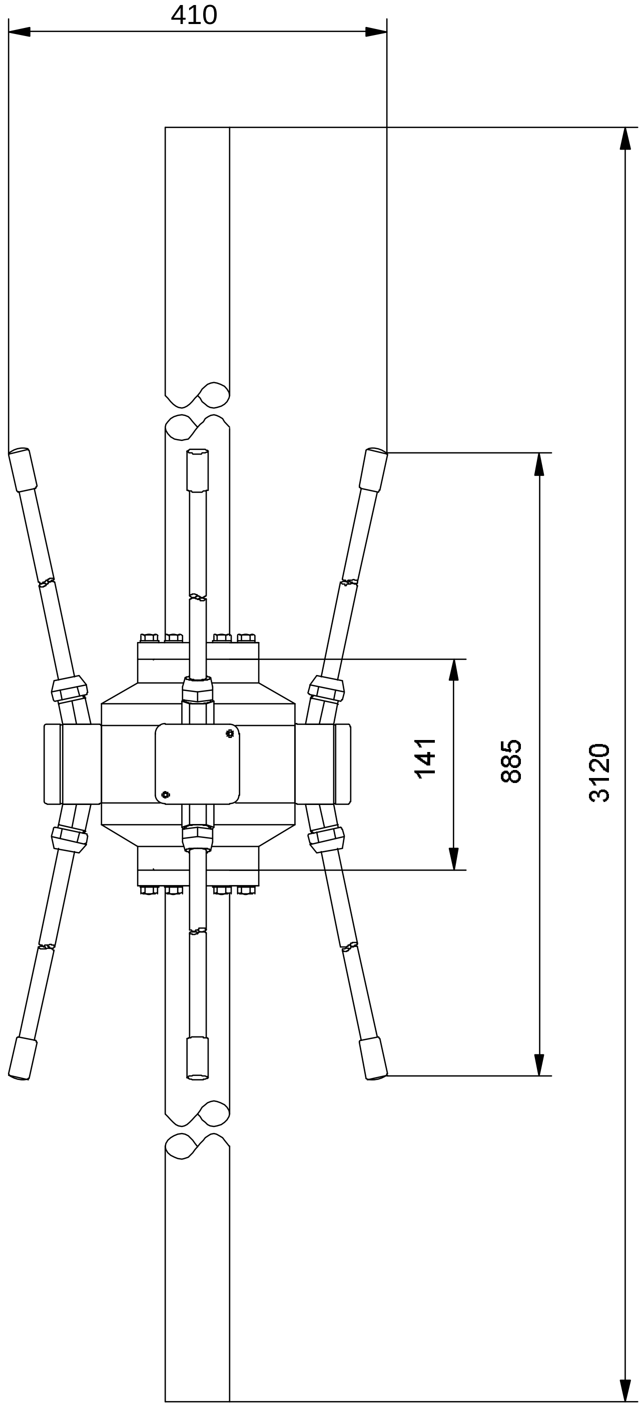
$$-0.55 = 0.55 * (-1)$$

➔ The value -0.5 is used as the correction value.

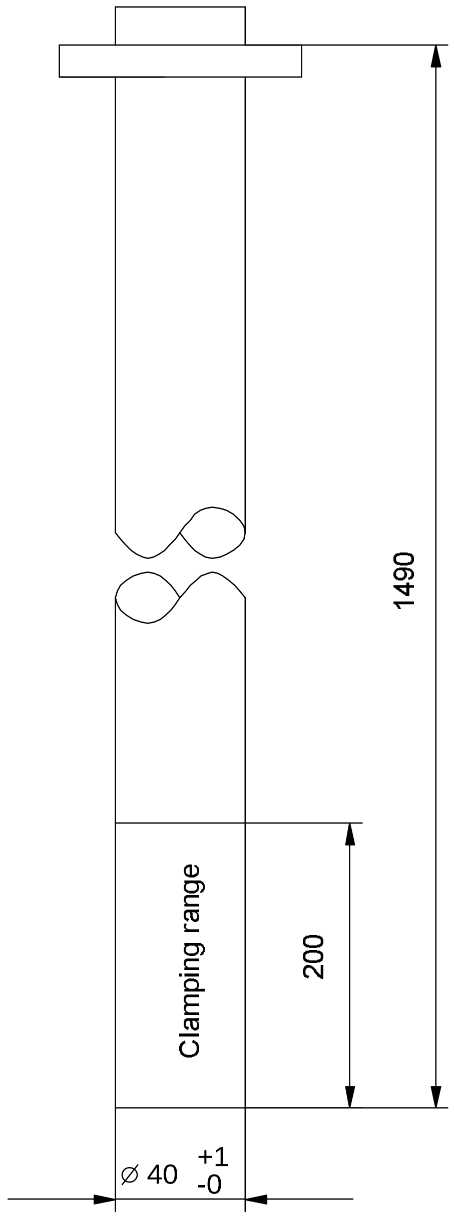
The direction finder system is now ready for operation but before the bearings can be transmitted to the aircraft approval by the relevant authorities in the respective country is necessary.

5 Mechanical Dimensions

RTA 1300 Direction Finding Antenna
with mast pole and lightning conductor rod



Mast pole



All dimensions in mm

6 Notes