# Installation of Mobile Communication Network Sites


KATHREIN

Antennen · Electronic

**Photo on title page:** Installation of a new antenna pole with a helicopter at the skiing area “Brauneck” Bavaria/Germany.

## Please note:

**As a result of more stringent legal regulations and judgements regarding product liability, we are obliged to point out certain risks that may arise when products are used under extraordinary operating conditions.**

The mechanical design is based on the environmental conditions as stipulated in ETS 300 019-1-4, which include the static mechanical load imposed on an antenna by wind at maximum velocity.

Extraordinary operating conditions, such as heavy icing or exceptional dynamic stress (e.g. strain caused by oscillating support structures), may result in the breakage of an antenna or even cause it to fall to the ground.

These facts must be considered during the site planning process.

**The details given in our data sheets have to be followed carefully when installing the antennas and accessories.**
**In addition, please use our information brochure about mounting configurations.**

**The installation team must be properly qualified and also be familiar with the relevant national safety regulations.**

TÜV MANAGEMENT SERVICE ISO 9001 ISO 14001

## “Quality leads the way”

Being the oldest and largest antenna manufacturer worldwide, we take on every day the challenge arising from our own motto. One of our basic principles is to look always for the best solution in order to satisfy our customers.
Our quality assurance system conforms to DIN EN ISO 9001 and applies to the product range of the company: Antenna systems, communication products as well as active and passive distribution equipment.

# Contents

# Planning

## 1. Technical Site Inspection

During preparations for a Technical Site Inspection, which includes recording the site dimensions as required for planning purposes, the main features of a site should already be determined by the mobile communication and fixed network planners. This includes selecting the antennas required for this site, whereby the main factors are the type (Omni or directional radiation), the radiation directions depending on the area to be covered and the desired antenna gain.

Similarly, any possible influences from neighbouring sites set up by other network operators, as well as reflections or shadows cast by neighbouring buildings or similar effects must also be taken into account.

The final planning of a site should be carried out in agreement with the country specific regulations and the site owner, whereby their wishes and ideas as regards the arrangement or the set-up of the individual components should, of course, be considered.

## 2. Basic planning

The antenna system must be designed in such a way that any subsequent work on site necessary, such as maintenance and repair work, can be carried out taking into consideration the relevant safety at work laws and accident prevention regulations. Above all, this affects the access facilities to the technical units and antennas.

The infrastructure of the antenna system should be dimensioned in such a way that any subsequent extensions or upgrades to the system

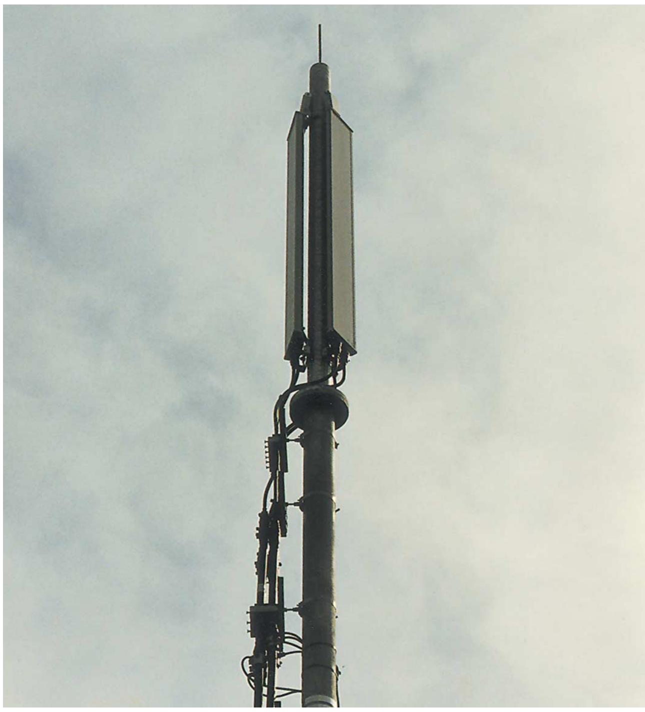


Photo 1: One antenna per sector.

Photo 2: Two antennas per sector. Installation of 2 F-Panels per sector using 2 x F-Panel Mounting Kits.

can be implemented without necessitating extensive alterations. This involves both the installation of additional technical units, as well as the number of antennas and cables. For example, if dual-polarized Kathrein F-Panel antennas are used, the capacity can be extended (2 antennas per sector) by installing a so-called 2 x F-Panel Mounting Kit, without having to greatly alter the mast set-up (Photos 1 and 2).

## 3. Environmental influences

The specific weather conditions at individual sites (e.g. the expected wind speeds or icing-up of antennas) should be considered when planning and dimensioning the system (Photo 3), as well as the influence of “aggressive” emissions on the installed components.  Above all, the main wind direction should be considered here, in order not to expose the antennas and the masts to dangerous emissions (Photo 4).

The development of all Kathrein antenna types, i.e. including those from our product families GSM 800 / 900 (MHz), GSM 1800 (MHz) as well as the UMTS range, is also carried out taking into consideration the requirements laid down

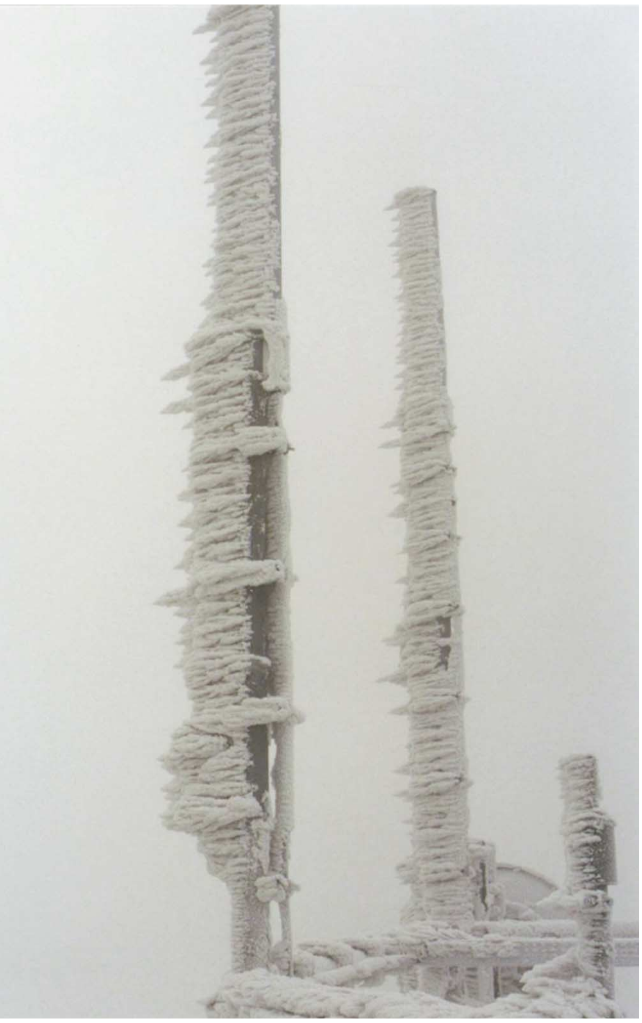


Photo 3: Iced up Kathrein omni-directional antennas – fully functional!

Photo 4: Corrosion due to chimney fumes.

in the so-called "European Telecommunication Standard (ETS) 300 019-1-4 class 4.1E and ETS 300 019-2-4".
The test values given in these standards prescribe, for example, what temperatures, air humidity, wind velocity or vibrations the antennas have to be able to withstand. However, Kathrein antennas not only achieve these values, they even partially exceed them. Please note, that strain caused by oscillating support structures must be avoided in any case.

## 4. Size of the system, extent of installation work

Depending on the site acquired and the desired antenna configuration, the extent of the installation work needed can of course differ considerably and therefore also the size of the finished antenna systems. The spectrum ranges from installation work carried out on already existing mobile communication masts (Photo 5) or on chimneys, through to the attachment of antenna masts to various roof structures (Photo 6) or facades, right up to the installation of complete steel frameworks or complicated steel constructions, which are then installed on e.g. flat roofs (Photo 7).

Photo 5


Photo 6

Photo 7

Photo 8: Two antennas per sector for space diversity.

The size of the finished antenna system is also influenced by the choice of "Antenna Family". Whereas at least 2 or 3 antennas per sector have to be mounted if standard vertically polarized antennas are used for space-diversity operation (Photo 8), only one antenna per sector is sufficient (Photo 9) if Kathrein Xpol antennas are used in connection with a diplexer, since in this case planners make use of so-called polarization diversity.

By using Kathrein *dual-band antennas* (GSM 900 / GSM 1800 MHz) or *triple-band antennas* (GSM 900 / GSM 1800 / UMTS 2000 MHz) the various frequency ranges of one or several network operators can be combined together on one single antenna, which considerably reduces the amount of space needed for the antenna system.

Photo 9: One antenna per sector.

# Execution of the installation

## 1. Installation of the antenna system

We have to point out that with all the work that is necessary for the installation of an antenna system, the currently valid national standards, safety at work laws, regulations and accident prevention regulations, as well as the remarks in the individual planning manuals provided by each network operator must be observed and kept to. Any work that goes beyond the normal measure of steel installation work, such as e.g. bricklaying, roofing or plumbing work, must be carried out by specialist companies.

Photos 10 and 11: Installation of an antenna platform at a height of approx. 50 m with the help of two auxiliary platforms.

## 2. Antenna attachment

The attachment of Kathrein antennas and splitters may only be carried out by means of the attachment clamps and down-tilt brackets in the permissible combination(s) intended for this purpose!
In order to increase the distance between antenna and the surface of the mast, the use of Kathrein off-set clamps is also possible. Thereby cables for antennas that are mounted above panels can be lead directly upwards along the mast and behind the panels (Photo 12). Taking into consideration the permissible wind load and depending on the radiating direction, also 2 or 3 antennas can be installed at the same height, even to masts of smallish diameters, without the antennas interfering with the operation of each other.

Photo 12: Cable led upwards behind antennas mounted at a distance.

In Annex (1) you will find a summary of possible installation options for Kathrein antennas.

## Azimuth adjustment

Since antennas are usually installed on steel platforms or steel and concrete towers, the adjustment of the radiation direction using a commercially available compass is often not very precise or even impossible due to disturbing influences of metalic parts. In order to be able to adjust antennas to the desired radiating direction in spite of this, we recommend the use of the so-called Kathrein Azimuth Adjustment Tool (AAT) (Photo 13).

The procedure is as follows:

Use a map, and look for a prominent target. Find out the angle between the target (e.g. church, high-rise building, mountain, tower) and the radiating direction ......

→ ... Set this angle on the scale of the Azimuth Adjustment Tool ....

→ ... Attach the tool to the antenna ...

→ ... Aim at the target through the telescope and twist the antenna accordingly to set the correct radiating direction.

In Annex (2) you will find a schematic drawing showing the use of the AAT.

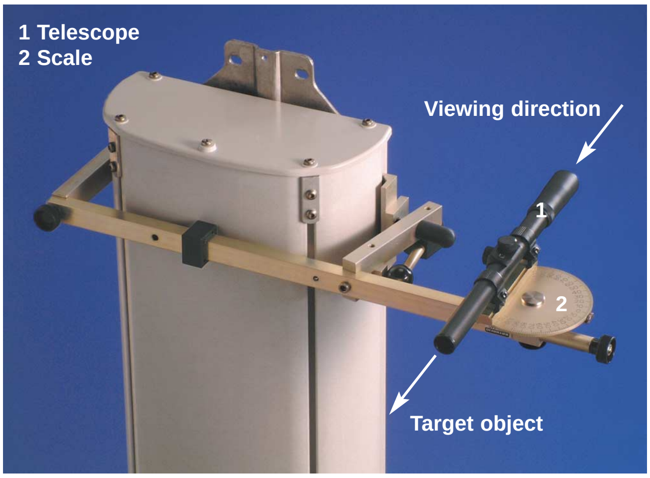



Photo 13: Azimuth Adjustment Tool for A-Panels.

If Kathrein 3-sector clamp kits are used, which are available for various mast diameters, a harmonious design can be achieved that takes up little space when installing Kathrein A-Panels or F-Panels. Even though there is only a relatively small distance between the antennas, sufficient isolation values of more than 40 dB are still achieved (Photo 14).

If, for certain network planning reasons or due to lack of available space at the mast top, omnidirectional antennas have to be mounted laterally to a mast, so-called Side-mounting-Brackets should be used.

Photo 14: 3-sector clamp kit with A-Panel dual-band antennas

Depending on the mast diameter and the distance of the omni-directional antenna from the mast surface (which is defined with reference to the wavelength), various horizontal radiation patterns can be produced.

In Annex (3) you will find a diagramme showing possible installation options with refering radiation patterns.

## Upside-down mounting

Due to lack of space it may become necessary to mount antennas hanging down from platforms or facades. In this case, we recommend the use of Kathrein antennas in the so-called upside-down version, i.e. the connector for the cable connection is on the top of the antennas, not on the bottomside.

This means that then the connecting cable can be lead directly upwards away from the antenna. This possibility of upside-down installation basically exists for all Kathrein antenna types in the A-Panels and F-Panel families without electrical downtilt. Upon request, the most commonly used antenna types with electrical down-tilt are also available in the upside-down version. The mounting instructions when the antennas are used as upside-down versions are to be found on the type-labels of the antennas and must be strictly followed, as the necessary procedure for exchanging the ventilation hole screw is described there in detail.

Photo 15: Installation of antennas: Upside-down.
Cable is led directly upwards to the platform.

## 3. Connecting cables (jumper cables)

The connection of the feeder cables to the antennas should be effected by means of highly flexible connecting cables (jumper cables). This has several advantages:

1. The antenna can be tilted downwards without damaging the feeder cable.
2. Various components e.g. tower mounted amplifiers (TMA) can be installed between feeder cable and antenna, without having to shorten the feeder cable at the mast.
3. In the course of optimization work, the radiating directions of the antennas can be re-set without any problem.

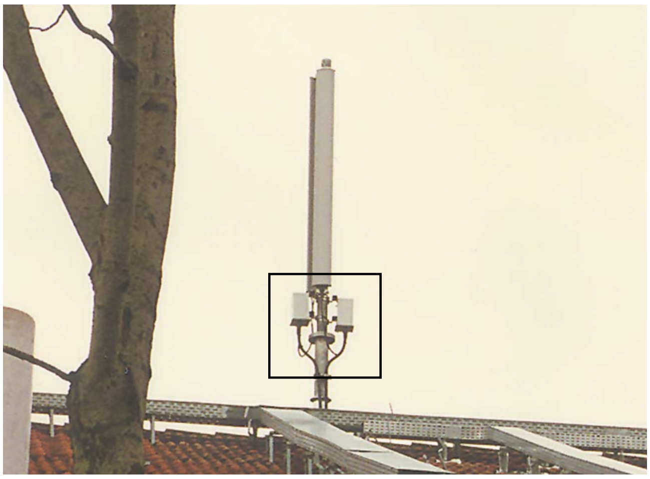


Photo 16: Subsequently installed tower mounted amplifier (TMA) between connecting cable and feeder cable

## 4. Connector installation

If connectors are expertly fitted, it is our opinion that additional protection by using self-vulcanizing adhesive tape, shrink tubes or similar is not necessary! Nor do we know of any connector manufacturer who prescribes additional protection against the penetration of water into the connector joint if their connectors are expertly fitted. Such additional sealing is very time-consuming and complicated to carry out on the attached connector.

## 5. Painting and disguising antennas

By painting the radome surfaces Kathrein base-station antennas can be matched in colour to their immediate surroundings. The instructions for painting Kathrein antennas, as given in Annex (4), must be strictly observed and adhered to.

If antennas are to be installed at “sensitive” sites in such a way that they are not recognisable by other people, then there is the possibility of completely disguising the antennas (Photos 17 and 18).

In our opinion, the complete disguise of antennas

Photo 17: Antennas matched in colour to their surroundings

must, however, always be viewed as a compromise solution that has certain big disadvantages. The intended materials to be used for the disguise must be chosen very carefully. If unsuitable materials are used, there is the danger that the radiating characteristics or the electrical values of the antennas will be altered so much that the parameters as required by the network operators cannot be kept to.

The most suitable material for disguising antennas is fibre-glass with only a few "mm" thickness. It has low insertion loss values and does not affect the electrical parameters of antennas as much as other materials.  In spite of this however, some specifications may be exceeded, depending on the antenna type involved. If there are poor values, then the distance of the antennas from the disguising material should be varied, in order to achieve an optimum solution. Examples showing the alteration of electrical values are given in Annex (5).

A mechanical downtilt fitted behind disguising material should be avoided. Due to the constantly altering distance between the antenna and the disguising material, the electrical parameters, such as VSWR and decoupling, can change. If a downtilt facility is required behind disguising material, then we recommend antennas with electrical downtilt, which have proved to be considerably less critical in this regard.

Photo 18

Photos 19 and 20: Antennas completely disguised (Source: NAUTICO-GFK-Produkte-GmbH, D-45869 Gelsenkirchen)

A further possibility of hiding antennas is to install them in such a way that they blend into the neighbouring surroundings of the antenna system in a harmonious way (Photos 21 and 22).

Photo 21: Omnidirectional antennas mounted on the roof of a municipal building.

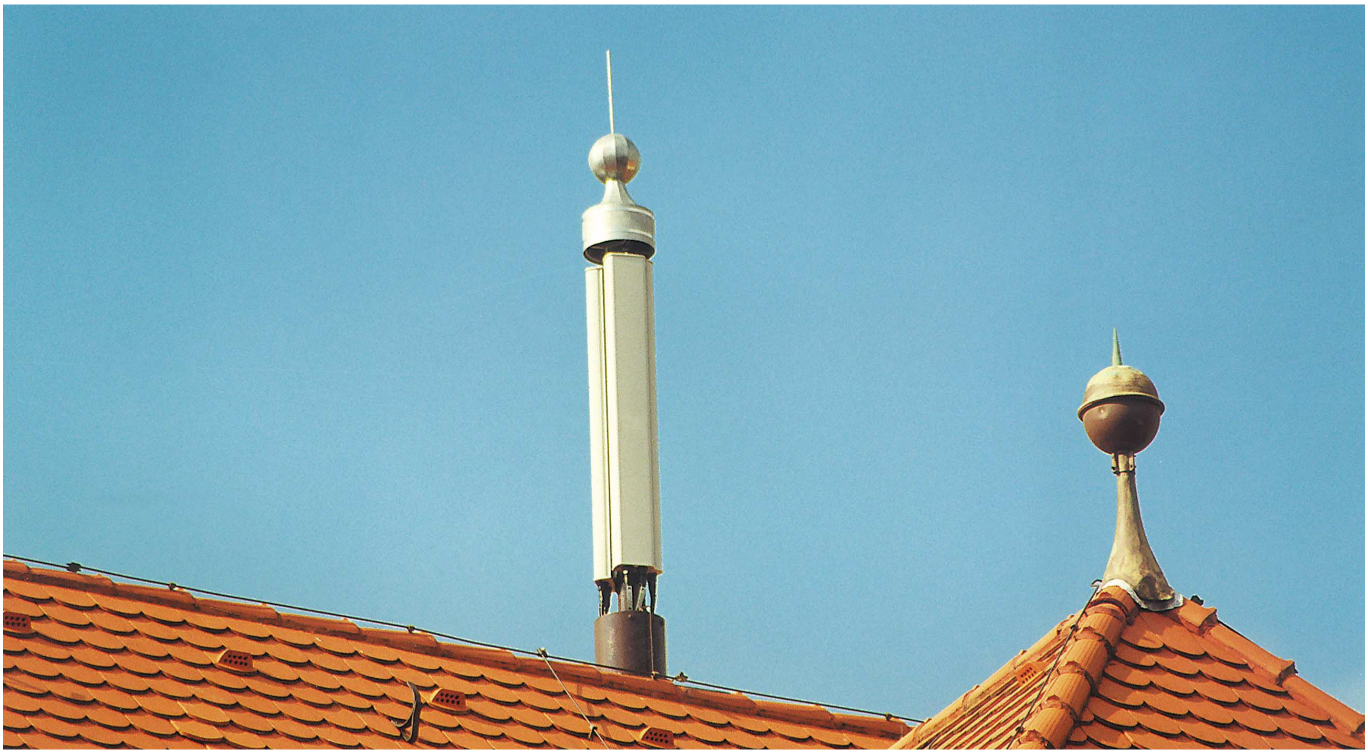


Photo 22: Antenna configuration adapted to suit the surroundings

## 6. Cable installation

When installing feeder cables, the maximum bending radii prescribed by the cable manufacturers must be kept to. These radii may vary for the same cable diameters from one manufacturer to another. When attaching the feeder cables by using cable clamps, the valid torques as prescribed by the clamp manufacturers must be kept to and/or the remarks in the planning manuals of the network operators be observed and adhered to, in order not to damage the cables. Following the most common world-wide standards, it is not permissible to lead antenna feeder cables or grounding cables through such places that are used for storing easily flammable materials, e.g. hay, straw, paper and so on, or in which highly explosive gas-air mixtures can build up or accumulate. If cables have to be led through such places, then suitable protective measures must be taken.

This also applies in a certain sense to antenna masts, if there is a danger that the mast can charge itself up with static electricity due to oscillations and can discharge itself again by giving off sparks.

Photo 23: Disguised antenna mast in a shed barn.

Photo 24: Fire protection of a cable path rinne in a shed barn, in accordance with fire protection class F90.

## 7. Earthing, lightning protection

The requirements concerning lightning protection of the antenna system should be taken from the individual manuals or installation regulations provided by the network operators. In all cases the individually applicable standards and regulations must be observed, as well as any regulations provided by the electricity companies responsible. We have to point out that the earthing of an antenna system should be considered only as system protection and not as building protection. Our antennas, including our omni-directional antennas, may not be used as a part of a building's lightning protection system!

Kathrein antennas and splitters are grounded in accordance with the Euro-Norm EN 50083-1. High voltages after a stroke of lightning can thus be discharged via the clamps and downtilt brackets. However, it must be ensured that the metal fixtures, clamps, brackets and also the antenna mast provide a proper electrical contact, in order to guarantee an unhindered discharge of the current (see also painting instructions for Kathrein antennas).
If antennas are installed directly onto a house wall, it must be clarified on a case-by-case basis whether the antennas should be provided with a separate earthing system.
When earthing the feeder cables, the instructions from the network operators should be followed. The following earthing locations/points have proved themselves to be useful:
At the beginning and at the end of the feeder cables, before cables enter into a building, at the change from horizontally-led to vertically-led cables or vice versa, as well as for straight vertical cable (e.g. on masts or chimneys) approx. every 20 m.

## 8. Electrical measurements

The minimum values to be achieved (VSWR and permissible cable insertion loss) when measuring the system Antenna-Jumper-Feeder depend on the values prescribed by the network operators. A consideration of the test values achieved must be made from various points of view.
Of course, one obtains the clearest test value for an antenna, if one measures the antenna alone, i.e. without the feeder cable. This type of measurement is therefore recommended by Kathrein.
With a complete Antenna-Jumper-Feeder system the value of the return-loss attenuation is purely theoretically the value smaller than or equal to twice the cable attenuation (Feeder and Jumper) plus the VSWR value of the antenna given in the data-sheet in dB.

VSWR of the antenna is = 1.5 → Return loss = –14 dB
Attenuation of the feeder including Jumper = 3 dB
Twice the cable attenuation (forwards and backwards) = –6 dB
Results in a calculated total value of –20 dB
This corresponds to a VSWR value of 1.21

In practice however, it is often the case that the actually measured value diverges from the calculated total value, since the above sample calcuation only applies to an ideal cable with a VSWR value of 1.
The measured value achieved depends on several factors. It is affected by the kind of cable path and the resulting cable length, the number of bends and changes of direction of the feeder cables, the appropriate use of cable clamps, the expertly carried out installation of connectors and earthing muffs, as well as the influence of reflections from neighbouring sites or transmitting signals received from other network services.

To check the feeder cable and to find out the correct length, we recommend using the so-called Time-Domain-Reflexion-Measurement. With this TDR measurement one can localize and document damaged parts of the cable (caused by e.g. inexpert installation of the cable clamps or too extreme bends) or too great miss match at the connectors. This kind of measurement will provide extremely precise conclusions about the whole Feeder-Jumper-Antenna system.

The very commonly used so-called Distance-To-Fault (DTF) type of measurement is only suitable in a very limited way for these purposes, since this kind of measurement is based on other preconditions with regards to the measuring instrument, and the values documented do not necessarily reflect anything about the actual condition of the cable.

Recommended measurements to be carried out for checking the whole system are:

1. VSWR of the whole system
2. TDR measurement of the cables

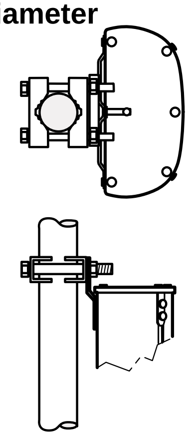
If the required values are not adhered to, we recommend performing the VSWR measurement on the antenna alone and checking the return-loss attenuation of the feeder and the jumper cable using a 50 Ohm termination, as well as measuring the cable attenuation in order to find the fault. When measuring the cable attenuation, proceed as follows:

- Close off the cable with a short circuit
- Measure the return-loss attenuation
- The test result halved is the actual cable attenuation, since the transmitted measuring signal runs through the cable twice: Network analyser – Short circuit – Network analyser

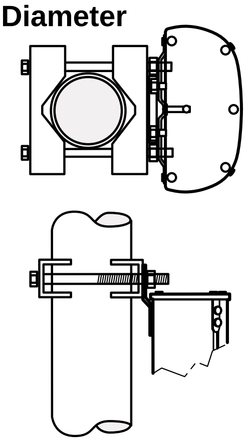
Mounting configurations and possible combinations of antenna types and clamps as well as clamps and downtilt kits.

# Mounting Configurations

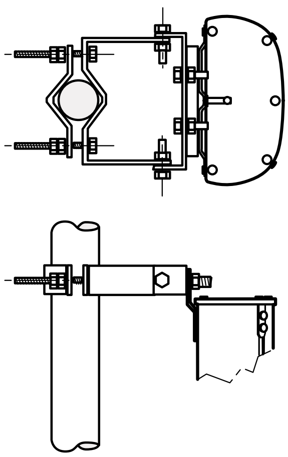
**Small Pipe Diameter**



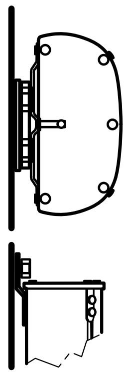
**Large Pipe Diameter**



**Off-set**

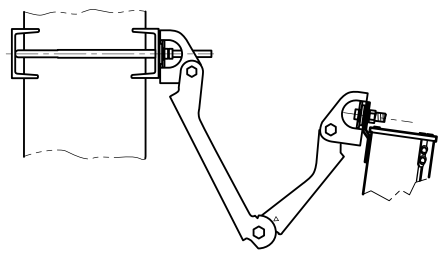


**Flat Surface**

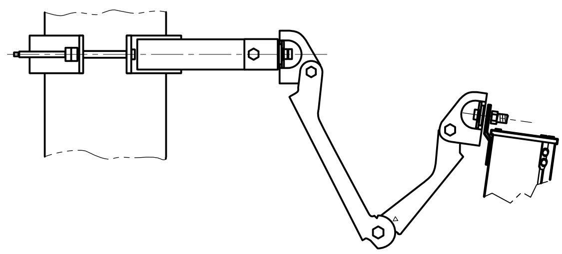


Not applicable to Eurocell Panels with connector position at rear.

**Standard Tilt**

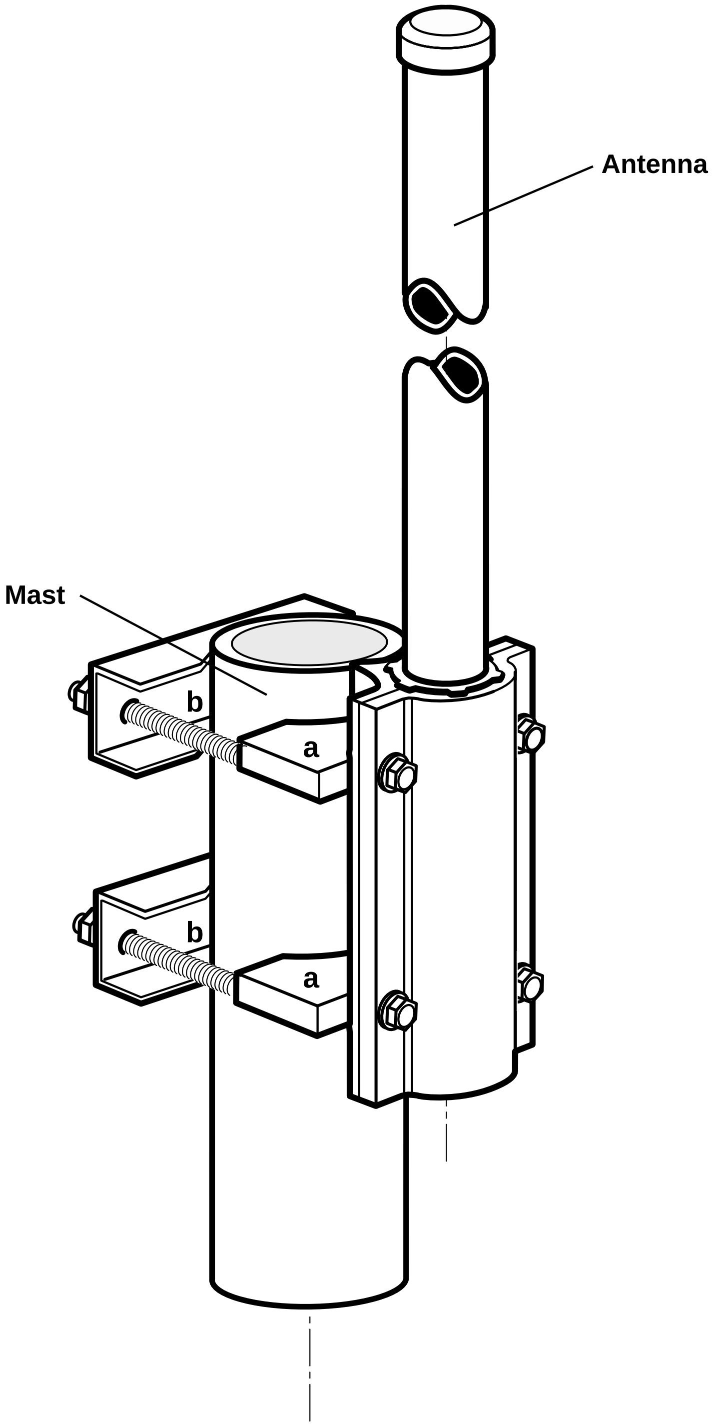


**Off-set Tilt**



# Mounting Instructions
# Side-mounted Clamp
# 738 908

**For masts of 94 – 125 mm diameter**




**Mounting:**

1) Screw the clamps [a] to the antenna.

2) Attach the antenna (including the [a] clamps) to the mast using the counter-clamps [b].

## Possible combinations of Kathrein antennas with various clamps

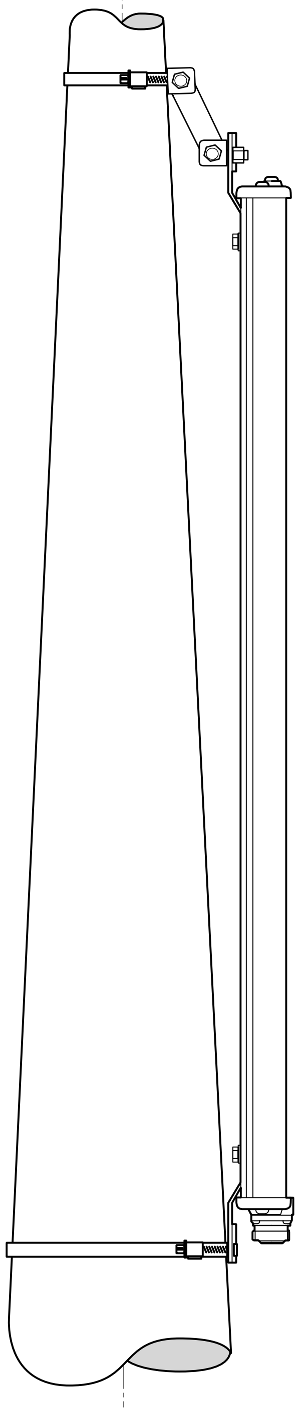
| Clamp | Mast diameter in mm | A-Panel 30° | A-Panel 65°/90° Eurocell Panels | F-Panel 33° | F-Panel 60°–105° | Packing unit Quantity per delivery unit |
|---|---|---|---|---|---|---|
| 731 651 (small pipe ∅) | 28 – 64 | | x | x | x | 1 pce. |
| 738 546 (large pipe ∅) | 50 – 115 | | x | x | x | 1 pce. |
| 733 677 (off-set) | 60 – 115 | | x | x | x | 1 pce. |
| 733 678 (off-set) | 115 – 210 | | x | x | x | 1 pce. |
| 733 679 (off-set) | 210 – 380 | | x | x | x | 1 pce. |
| 733 680 (off-set) | 380 – 521 | | x | x | x | 1 pce. |
| 733 736 (clamps) | 50 – 125 | x | | | | 2 pcs. |
| K 61 14 03 (clamps) | 116 – 210 | x | | | | 2 pcs. |
| K 61 14 04 (clamps) | 210 – 380 | x | | | | 2 pcs. |
| K 61 14 05 (clamps) | 380 – 521 | x | | | | 2 pcs. |
| 734 360 (clamps) | 34 – 60 | | | | x | 2 pcs. |
| 735 361 (clamps) | 60 – 80 | | | | x | 2 pcs. |
| 736 362 (clamps) | 80 – 100 | | | | x | 2 pcs. |
| 736 363 (clamps) | 100 – 120 | | | | x | 2 pcs. |
| 738 364 (clamps) | 120 – 140 | | | | x | 2 pcs. |
| 739 365 (clamps) | 45 – 125 | | | | x | 2 pcs. |
| 742 033 (3-Sector Clamp) | 114.3 | | x | x | x | 2 pcs. |
| 742 034 (3-Sector Clamp) | 139.7 | | x | x | x | 2 pcs. |
| 742 263 (3-Sector Clamp) | 88.9 | | | | x | 2 pcs. |

## Possible combinations of Kathrein downtilt brackets with various clamps

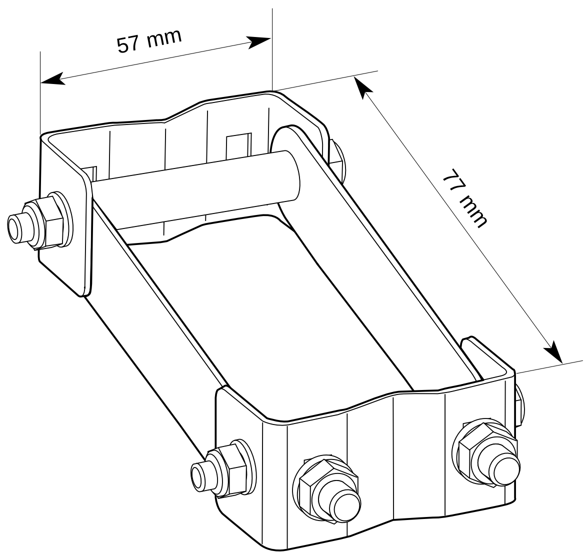
| | Downtilt Brackets | | |
|---|---|---|---|
| Clamps | 733 695 | 737 971 – 737 978 | 732 317, -318, -321, -322, -327<br>**Only for F-Panels (60°–105°) up to 1.3 m length** |
| 731 651 (small pipe ∅) | | x | |
| 738 546 (large pipe ∅) | | x | x |
| 733 677 (off-set) | | x | |
| 733 678 (off-set) | | x | |
| 733 679 (off-set) | | x | |
| 733 680 (off-set) | | x | |
| 733 736 | x | | |
| K 61 14 03 | x | | |
| K 61 14 04 | x | | |
| K 61 14 05 | x | | |
| 734 360 | | | x |
| 734 361 | | | x |
| 734 362 | | | x |
| 734 363 | | | x |
| 734 364 | | | x |
| 734 365 | | | x |
| 742 033 | | x | |
| 742 034 | | x | |
| 742 263 | | | |

# F-Panel Accessories
# Slant Compensation Kit for F-Panels with 60° – 160° Half-power Beam Width

**Type No. 732 319**



**Use the slant compensation kit type no. 732 319 together with the clamps 734 360 … 734 365**




Weight: approx. 200 g

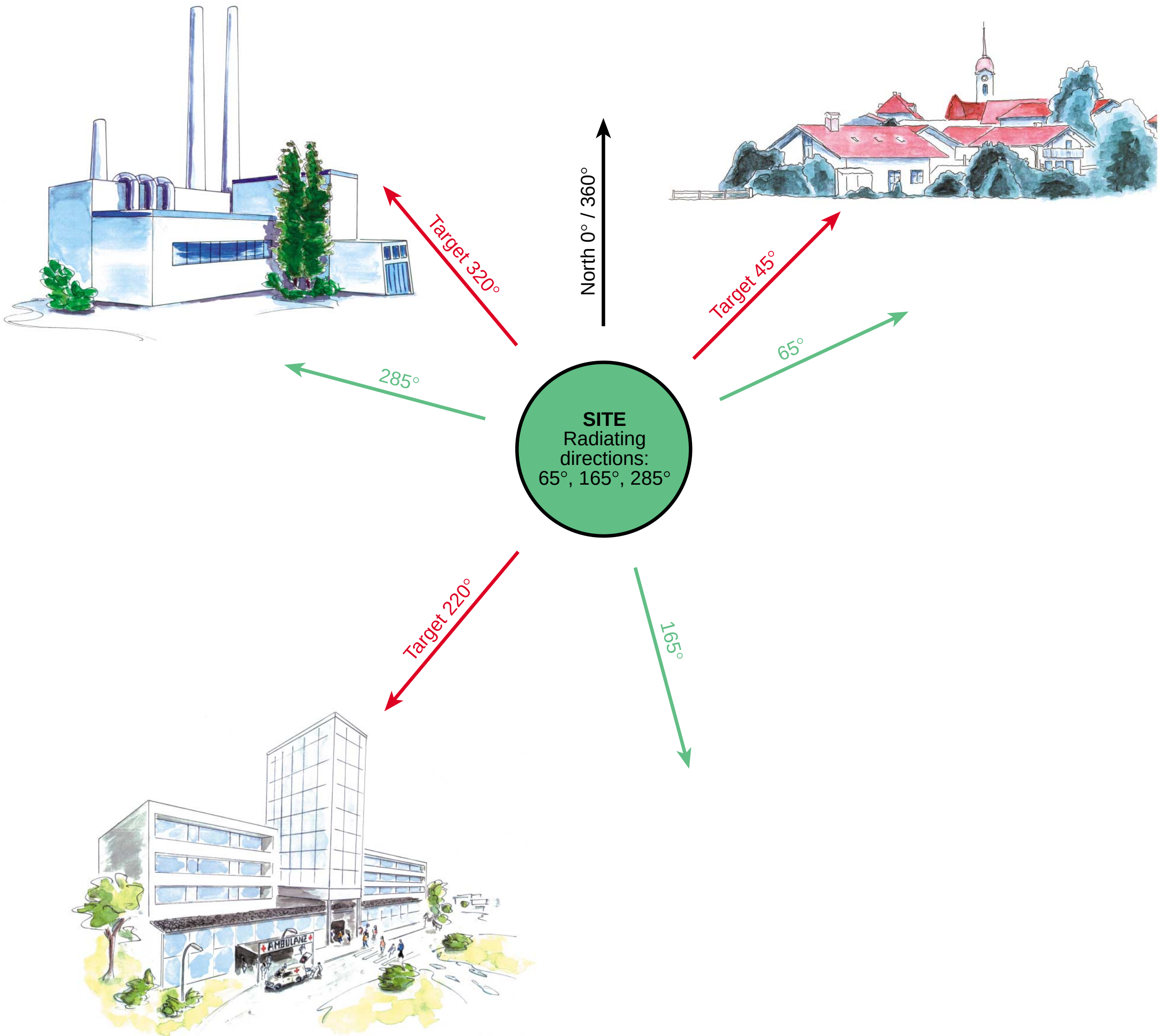
## Adjustment of the scale for the respective radiating direction

**Alignment 65°:**
45° – 65° = –20°
The telescope must be set to –20° on the scale, i.e. to 20° anti-clockwise.

**Alignment 165°:**
220° – 165° = +55°
The telescope must be set to +55° clockwise on the scale.

**Alignment 285°:**
320° – 285° = +35°
The telescope must be set to +35° clockwise on the scale.

**Formula for adjusting the scale:**
Angle of target – Angle of radiating direction
= Angle to be set on the scale



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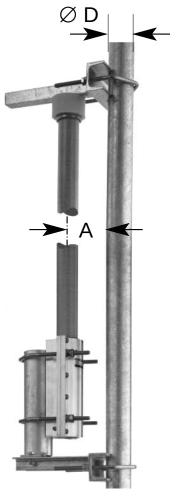
Mounting configurations for side-mounted brackets and examples showing the resulting influences on radiation patterns.

## Type No. 737 398

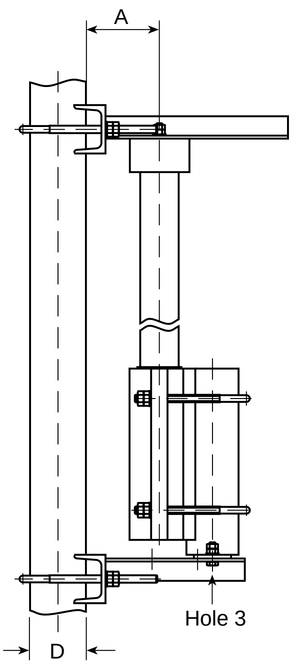
### Side-mounted bracket
### (for mast diameters of 40 – 105 mm)

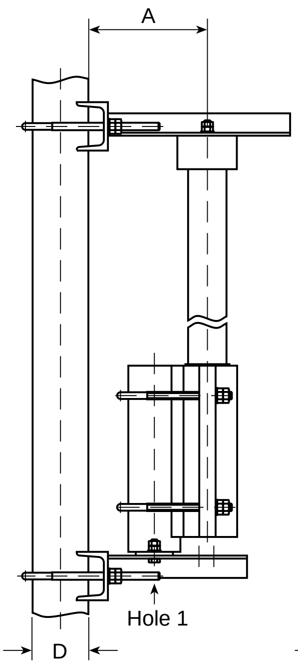
| Type No. | 737 398 | |
|---|---|---|
| Bracket | At the top and at the bottom | |
| Fits antenna type no: | **900 MHz** | **1800 MHz** |
| | 736 347 | 739 785 |
| | 736 348 | 738 187 |
| | 736 349 | 739 404 |
| | 736 350 | 737 190 |
| | 736 351 | |
| | 738 664 | |

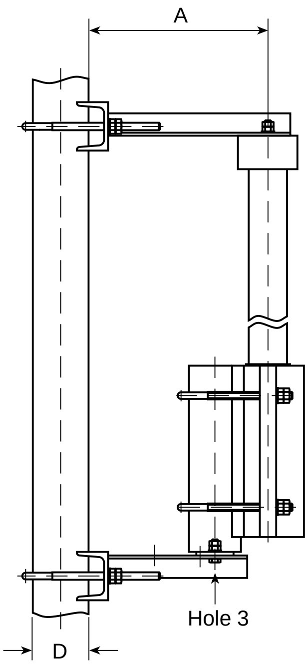


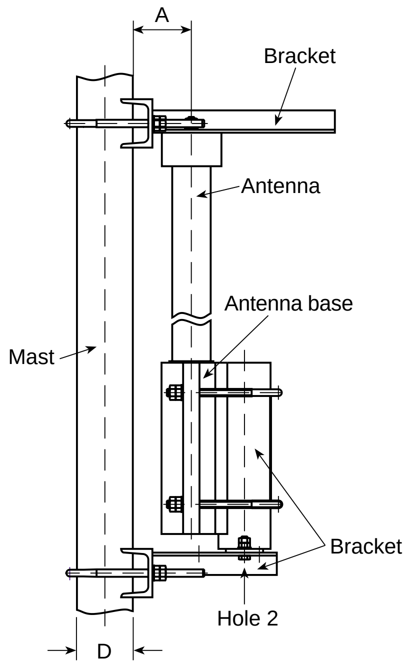

**Side-mounting is possible for four fixed distances between the tubular mast and the antenna:**

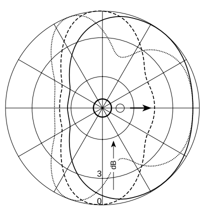
| 900 MHz (Holes 1 and 3) | | | 1800 MHz (Hole 2) |
|---|---|---|---|
| A = 100 mm = 0.3 λ | A = 160 mm = 0.5 λ | A = 240 mm = 0.75 λ | A = 80 mm = 0.5 λ |

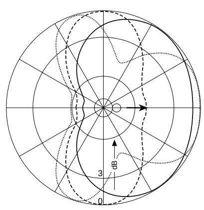


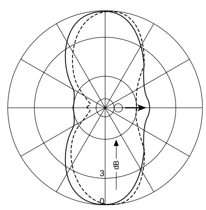




| Pipe Diameter | Horizontal Radiation Pattern | Spacing A Curve |
|---|---|---|
| 40 mm |  Direction from mast to antenna → | 100 mm |
| | | 160 mm |
| | | 240 mm |

| Pipe Diameter | Horizontal Radiation Pattern | Spacing A Curve |
|---|---|---|
| 100 mm |  Direction from mast to antenna → | 100 mm |
| | | 160 mm |
| | | 240 mm |

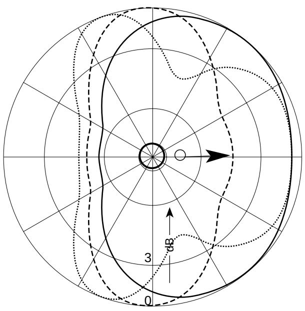
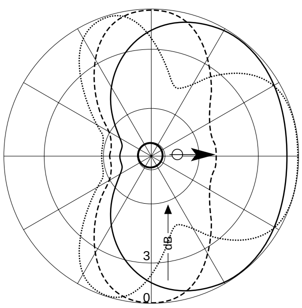
| Pipe Diameter Curve | Horizontal Radiation Pattern | Spacing A |
|---|---|---|
| 40 mm |  Direction from mast to antenna → | 80 mm |
| 100 mm | | |

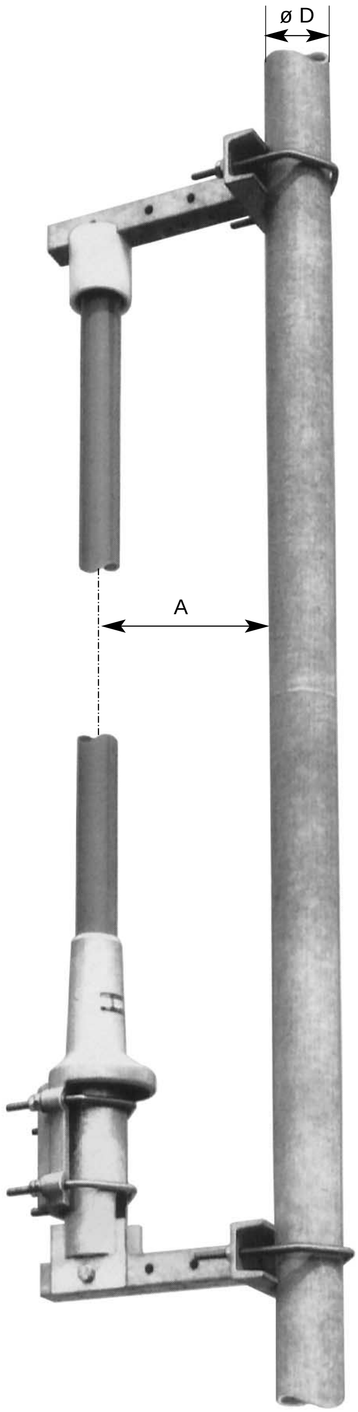
## Side-mounted bracket
## (for mast diameters of 40 – 105 mm)

| Type No. | K 61 33 5 | K 61 33 6 |
|---|---|---|
| Bracket | At the bottom only | At both the top and the bottom |
| Fits for antenna type no. | K 75 11 6 ..<br>K 75 15 6 .. | 738 779<br>741 558 |

Side mounting is possible for three fixed distances between the tubular mast and the antenna:

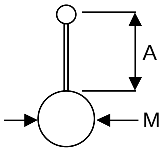
100 mm = 0.3 λ
160 mm = 0.5 λ
240 mm = 0.75 λ

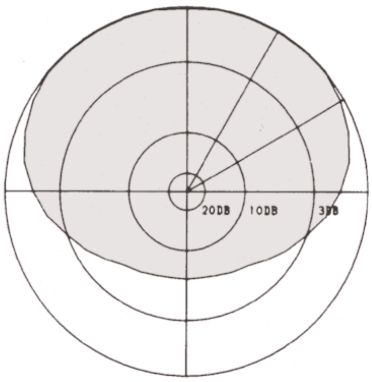
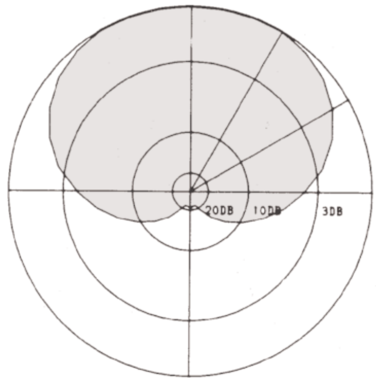
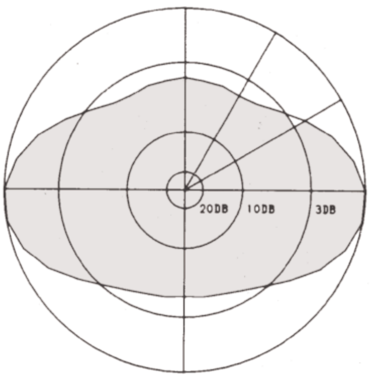
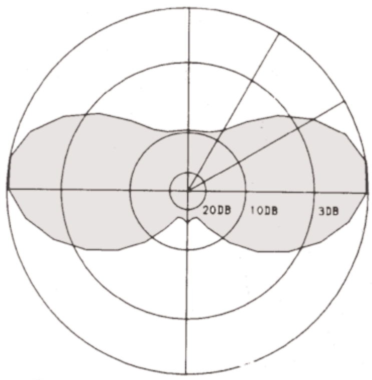
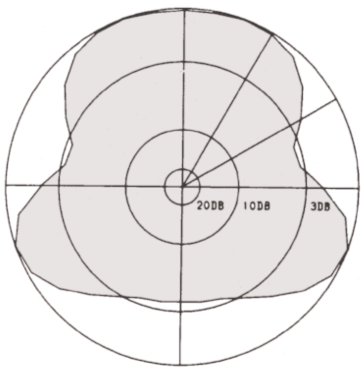
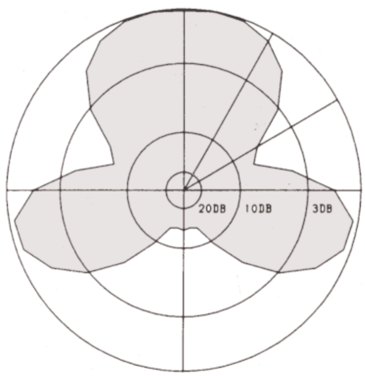
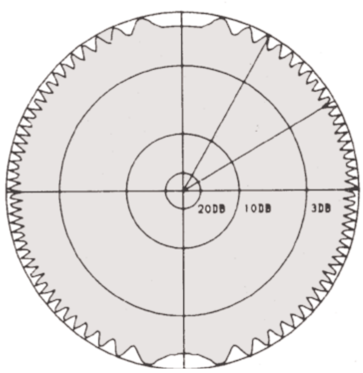
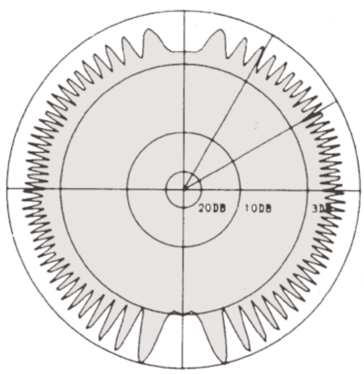
| Pipe Diameter | Horizontal Radiation Pattern | Spacing A / Curve | Additional gain to the nominal value of the antenna gain |
|---|---|---|---|
| 40 mm |   Direction from mast to antenna → | 100 mm | 2 dB |
| | | 160 mm | 3 dB |
| | | 240 mm | 2 dB |
| 100 mm |   Direction from mast to antenna → | 100 mm | 2.5 dB |
| | | 160 mm | 3.5 dB |
| | | 240 mm | 2.5 dB |



K 61 33 6

## Diagrammes
## antenna in front of mast




| Distance **(A)** | Mast diameter **0.04** λ | Mast diameter **0.6** λ |
|---|---|---|
| **0.25** λ |  |  |
| **0.5** λ |  |  |
| **0.75** λ |  |  |
| **20** λ |  |  |

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## Painting Instructions for Mobile Communication Base Station Antennas

**ATTENTION:**
**The guarantee conditions applicable for the antenna only remain valid if the following painting instructions are abserved.**
**The quality of the painting is at the customer's own risk.**

For optical reasons the colour of base station antennas often has to be adapted to the surroundings. Kathrein antennas are particularly suitable for subsequent, long-lasting painting since the visible parts (radomes) are generally made of fibre-glass (polyester), to which paint adheres very well. A thin layer of paint has only a negligible influence on the electrical characteristics.

### General remarks:

- Antennas must be treated as highly sensitive equipment. They require very careful treatment during processing and transport (see instructions on the packaging).

- We recommend that painting is only carried out by a qualified professional painting company, but painting on site is also possible (and permissible).

- We recommend that painting is only carried out on the visible surfaces, i.e.
  - The fibre glass radomes of Eurocell panels
  - The front and side surfaces of A-Panels and F-Panels made up of extruded fibre glass profiles

  Thus the painting process is limited to the basic fibre-glass material.

- Normally available commercial paints consisting of one or two components are suitable. The manufacturer's instructions for use and processing must be observed. Paints with metallic effects or metallic components are not permissible.

### Preparation and implementation of the painting process

- Cover those surfaces that are not to be painted, i.e.:
  - The complete fitted end cap of the antenna and the ventilation hole ("fitted": RF connectors, downtilt adjustment screw, instruction labels)
  - Mounting plates
  - Rear side of the antenna, at least all labels.
- Preliminary treatment of the surfaces according to the paint manufacturer's instructions.
- Paint according to the paint manufacturer's instructions.
- Maximum permissible hardening temperature is 70 °C.
- Remove the masking from the paint-free surfaces.

### Optical check after the painting procedure

- Are the ventilation hole, the RF connectors, the mounting plates and the adjustment screw (if such screw exists) free of paint?
- Are all labels legible?

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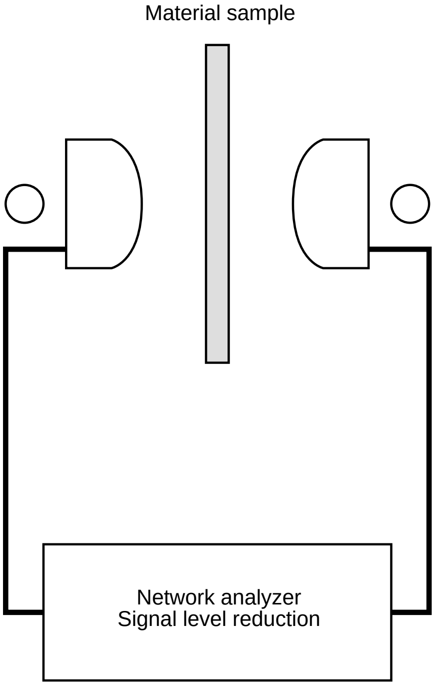
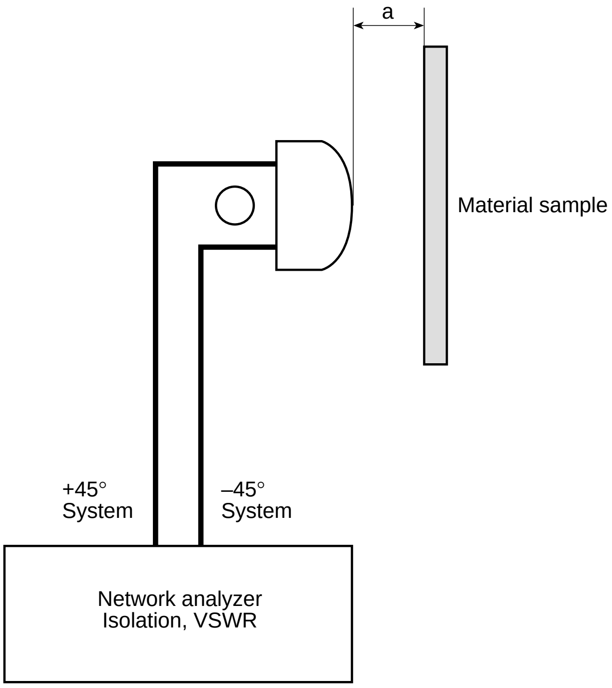
Measurements of influences on various electrical values if antennas are additionally covered

## Measurement of the maximum signal level reduction




## Measurement of isolation and VSWR

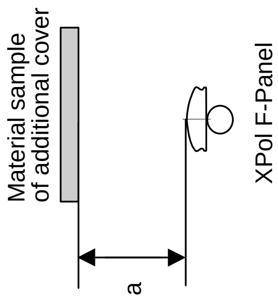


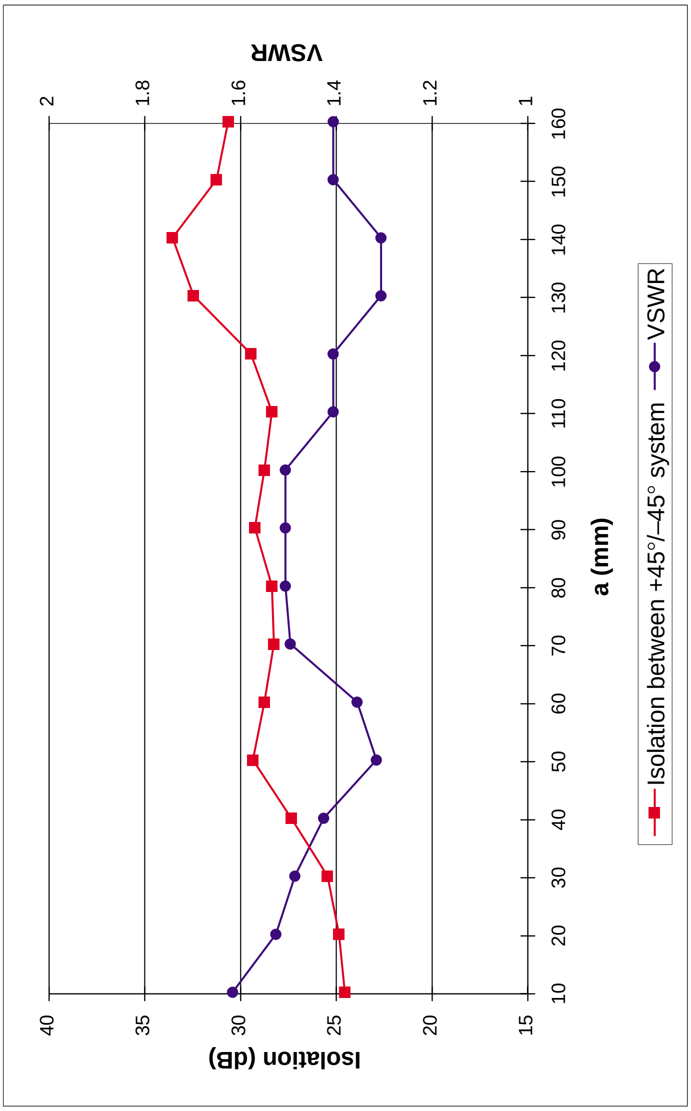

## Examples of max. signal level reduction at 1800 MHz

| Material | Signal Level Reduction |
|---|---|
| KÖMACELL 5 mm | 0.3 dB |
| KÖMACELL 10 mm | 0.5 dB |
| Plexiglass 4 mm | 0.5 dB |
| Plexiglass 10 mm | 1.0 dB |
| Glass 5 mm | 2.8 dB |
| Fibre-glass 2.5 mm | 0.4 dB |
| Wood 5 mm | 0.5 dB |
| Wood 20 mm | 2.5 dB |
| Rigips (Plasterboard) 12 mm | 1.1 dB |

## VSWR and isolation: Plasterboard

Measurement without additional cover:
Isolation: 38.4 dB
VSWR: 1.28



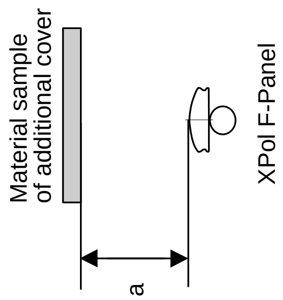




| | | | |
|---|---|---|---|
| KATHREIN | Date | Isolation and VSWR measurement<br>with material sample: 12 mm plasterboard (rigips)<br>1710 – 1880 MHz | Type No.:<br>739 495 |
| | Name | | Sh. No. |

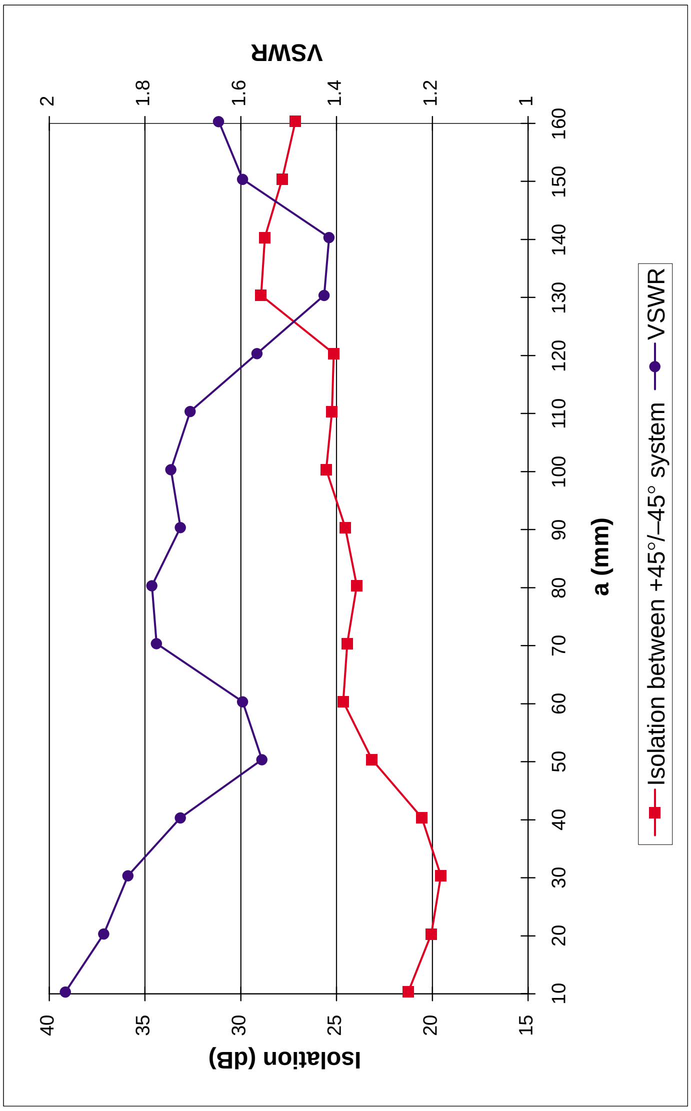
XPol F-Panel 1800/1900 65° 18 dBi 2°T

## VSWR and isolation: Glass

Measurement without additional cover:
Isolation: 38.4 dB
VSWR: 1.28




XPol F-Panel 1800/1900 65° 18 dBi 2°T




KATHREIN

Date

Name

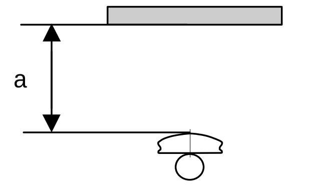
Isolation and VSWR measurement
with material sample: 5 mm glass
1710 – 1880 MHz

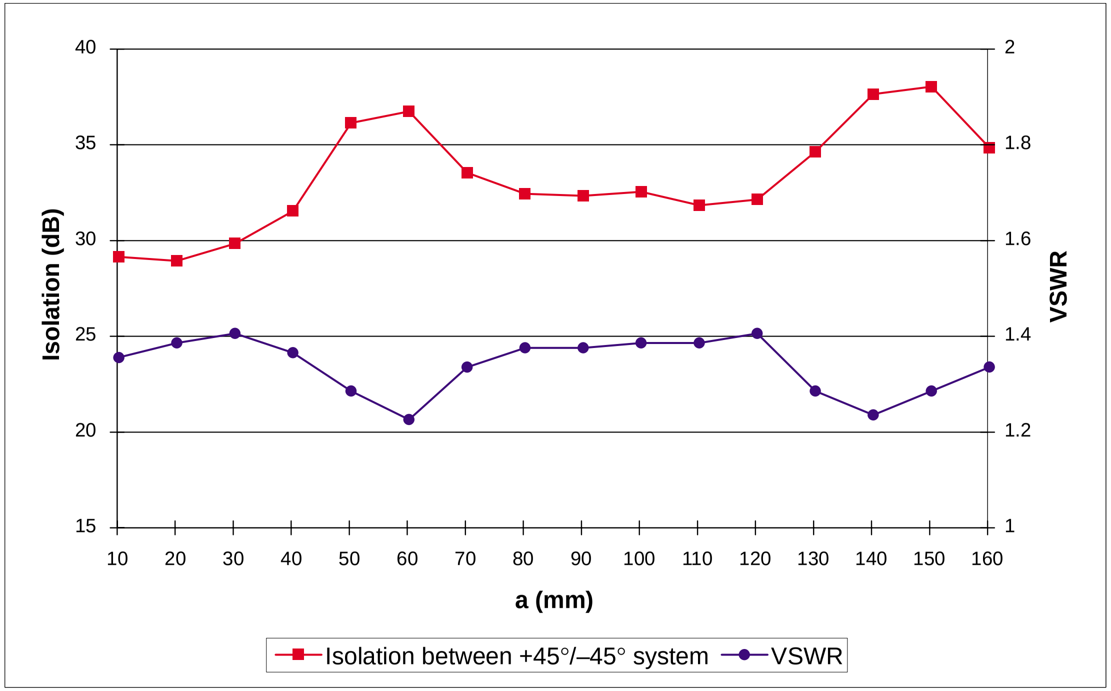
Type No.:
739 495

Sh. No.

## VSWR and isolation: Fiberglass

Measurement without additional cover:
Isolation: 38.4 dB
VSWR: 1.28




| | | | |
|---|---|---|---|
| KATHREIN | Date | Isolation and VSWR measurement with material sample: 2.5 mm fiberglass 1710 – 1880 MHz | Type No.: 739 495 |
| | Name | | Sh. No. |

XPol F-Panel 1800/1900 65° 18 dBi 2°T

9986.415/0202/10/ZW/PF Subject to alteration.

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