Industriefunkuhren

hopf Elektronik GmbH

Technical Manual

General System Information

Antenna Equipment DCF77

ENGLISH

Version: 01.05 – 26.01.2005

hopf Elektronik GmbH
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Symbols and Characters

Operational Reliability

Disregard may cause damages to persons or material.

Functionality

Disregard may impact function of system/device.

Information

Notes and Information.

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Safety regulations

The safety regulations and observance of the technical data serve to ensure trouble-free operation of the device and protection of persons and material. It is therefore of utmost importance to observe and compliance with these regulations.

If these are not complied with, then no claims may be made under the terms of the warranty. No liability will be assumed for any ensuing damage.

Safety of the device

This device has been manufactured in accordance with the latest technological standards and approved safety regulations

The device should only be put into operation by trained and qualified staff. Care must be taken that all cable connections are laid and fixed in position correctly. The device should only be operated with the voltage supply indicated on the identification label.

The device should only be operated by qualified staff or employees who have received specific instruction.

If a device must be opened for repair, this should only be carried out by employees with appropriate qualifications or by ***hopf*** Elektronik GmbH.

Before a device is opened or a fuse is changed all power supplies must be disconnected.

If there are reasons to believe that the operational safety can no longer be guaranteed the device must be taken out of service and labelled accordingly.

The safety may be impaired when the device does not operate properly or if it is obviously damaged.

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1 DCF77 - General Information

The transmitter DCF77[1] is located in Mainflingen, about 25 kilometers south-east of Frankfurt/Main. It is run by the "Physikalisch-Technischen Bundesanstalt" (PTB) in Braunschweig.

The DCF77-signal transmits the central European time (CET) or the Central European Summertime (CEST) which is the same as UTC plus one or two hours with deviations smaller than 0.5 µs. This station transmits continuously except for short interruptions because of technical faults or maintenance. Longer breaks may be experienced during thunderstorms on the location of the transmitter.

Time Signals

The carrier is modulated by means of second markers with the exception of second marker 59 of each minute which signifies that the next marker will be the minute marker.

At the beginning of each second the signal amplitude is reduced to 25% for 100 ms or 200 ms. The start of the decrease of the signal amplitude marks the exact beginning of the second. The second markers are phase-synchronous with the DCF77-signal.

In general: the inaccuracy of the received DCF77-timesignal is large compared to the emitted time signal.

The reception depends largely on the limited bandwidth of the time signal transmitter and other natural interferences. At a distance of some 100 kilometers, a time signal uncertainty of less than 0.1 ms is achievable.

Time Code

The second marker duration of 100 and 200 msec. correspond to binary 0 or 1, respectively, in a BCD code used for the coded transmission of time and date.

There are three groups of time information, each followed by a parity check bit:

- P1 = number of the minutes
- P2 = number of the hours
- P3 = numbers of the calendar day, the day of the week, the month and the year

Counting the binary "ones" of the information group concerned and of the corresponding parity check bit completed to an even number.

In the case of the transmission of legal time in the form of CEST, second marker number 17 has a duration of 200 ms. During one hour before the change from CET to CEST or from CEST to CET, second marker 16 has a duration of 200 ms, thus announcing the approaching change.

[1] DCF77 : **D** = German, **C** = long_wave_signal, **F** = Frankfurt, **77** = frequency

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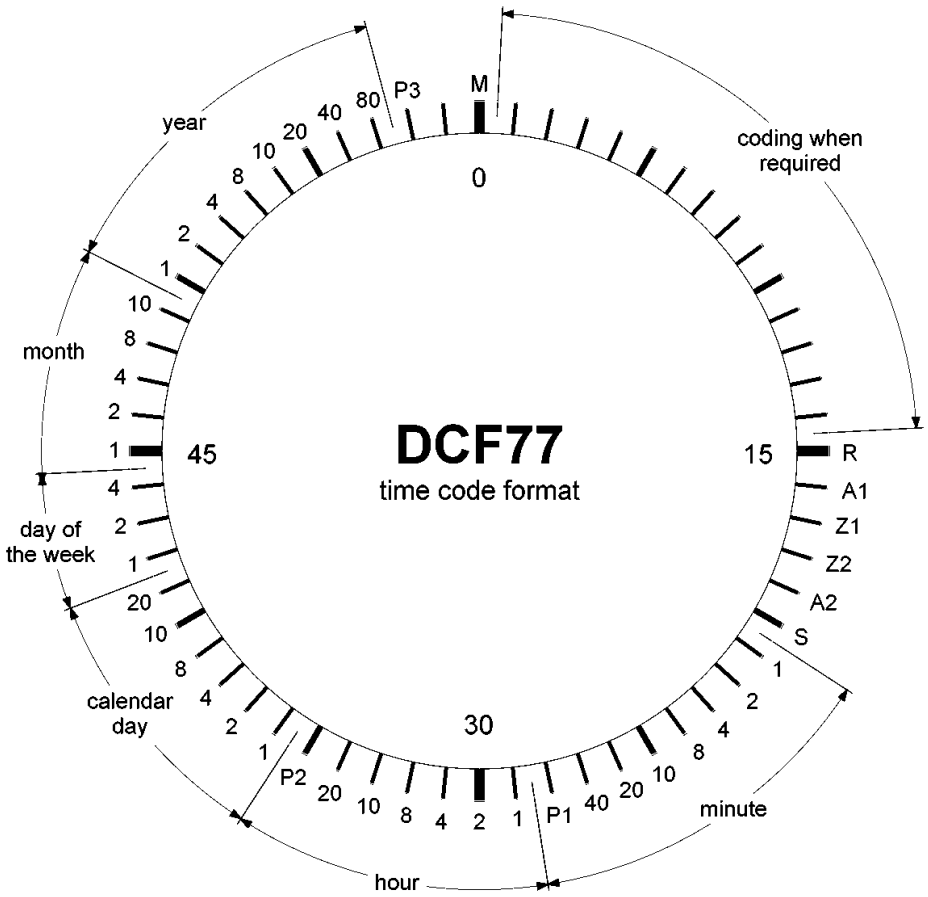
The coding is shown in the figure:



M	minute marker (0.1 s)
R	second marker no. 15 has a duration of 0.2 s if the signal is sent over the spare antenna
A1	announcement for a changeover from MEZ to MESZ or vice versa
Z1, Z2	time zone bits
A2	announcement for a switching second
S	start bit of the coding time information
P1, P2, P3	Parity check bits

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2 Antennas General

All ***hopf*** antennas are designed for operating with ***hopf*** radio controlled clocks and radio controlled clock systems. It is possible to use the antenna with strange makes if keeping to the limiting values.

2.1 Antenna Structure

All ***hopf*** antennas are directional active antennas and of the same electrical design.

Ferrite antennas are used for the frequencies in the long-wave range to keep the antennas small. The oscillating circuit in the antenna, made of a wired ferrite rod and various capacitors, is tuned to 77.5 kHz.

The features of the oscillating circuit depend mainly on the ferrite rod. Temperature changes influence the permeability of the ferrite rod and thus the mid-frequency of the tuned oscillating circuit for the DCF77 signal.

The output voltage of the oscillating circuit is fed to an amplifier with definite input resistance. Behind the amplifier there is an adaptation to the antenna cable.

2.2 Types of Antennas

The following types of antennas for the different purposes are available:

- FG443600 Indoor antenna
- FG441700A Outdoor antenna for the flat roof installation
- FG441800A Outdoor antenna for the wall installation
- FG442000 Outdoor antenna for the pole installation
- FG443700 Outdoor antenna with non-directional reception for mobile operations

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2.2.1 Indoor Antenna FG443600

This antenna can be used in buildings away from sources of interference for the DCF77-reception. e.g. TVs, monitors, terminals, in-house-LAN, electrical engines etc..

Also the construction of the building has to be taken into consideration. Reinforced concrete buildings and fairing plates attenuate considerably the DCF77-signal and cause a bad signal/noise ratio.

The antenna, which can be turned by 360°, is screwed to a wall bracket made of zinc-coated steel.

2.2.2 Outdoor Antennas

Mostly radio controlled clock systems are running with an outdoor antenna.

Whereas the surroundings of the indoor antenna can change because of changing technical operations in the rooms, the conditions for the outdoor antenna remain nearly constant.

For rough weather conditions we supply a very robust outdoor antenna. It is housed in a round weatherproof plastic casing. The different antennas differ in their mechanical structure only.

The mechanical construction is made of a sturdy, anodised aluminum or die-cast aluminum designed to withstand strong wind. The antenna cable leaves the casing at the bottom.

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2.3 Place of Installation

The time code is transmitted in the long-wave range carried out by modulation of the amplitude. It can therefore be easily disturbed. There are many external sources of interference, e.g. corona discharge at high-voltage lines, atmospheric disturbances like thunderstorms near the location of the transmitter or between transmitter and receiver.

Internal disturbances are mainly caused by engines, computer screens, monitors, power relays, cladding etc..

For the purpose of industrial use outdoor antennas should be installed to avoid internal disturbances from the start. It also avoids possible interferences caused by devices installed at a later date.

Clocks for the home use have the narrowband design to achieve noise suppression. The short-term accuracy of these devices is +5 to +150 msec.. This accuracy suffices for home use where the long-term accuracy is of interest. After one year the second deviation is still only +5 to +150 msec..

For industrial purposes these deviations are often not acceptable. The antenna as well as the receiver must be of wider band design to reach more accurate second markers. Values between +5 to +15 msec. require bandwidths of about 4 kHz for the antenna. This can therefore mean that the antenna feeds a lot more noise signals to the electronics so that the receiving electronics cannot decode a minute cycle.

Basically we can say that:

Short-term accuracy and high noise immunity are incompatible in DCF77-system. The location of the antenna must be chosen with utmost care.

2.4 Antenna Installation

All ***hopf*** antennas are active, directional antennas, except for the non-directional antenna. They should therefore be directed to the maximum signal strength.

2.4.1 Indoor Antenna

The **indoor antenna** is to be placed near a window facing the direction Frankfurt. The antenna disk is turned so, that the arrow at the bottom side of the antenna plate points at Frankfurt a.M.

2.4.2 Outdoor antenna

The **Outdoor antenna** is fixed to the outside wall of the building facing Frankfurt. Then the antenna disc is turned (by loosening the screw) so that the arrow underneath the antenna disc also points to Frankfurt, thus reaching the optimal signal/noise ratio.

We supply our portable DCF77 signal analyser for our customers to solve difficult location problems.

All ***hopf*** radio controlled clocks have an integrated program to align antennas to the direction Frankfurt. Please refer to chapter "alignment of the antenna" in the individual manuals.

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3 Indirect Lightning Protection in General

When using outdoor antennas the antenna cables may experience high interference voltages caused by thunderstorms. This may destroy or damage not only the directly connected radio controlled clock systems but also other connected devices.

An indirect lightning protection should be connected between outdoor antenna and radio controlled clock board to avoid high cost and subsequent damages.

3.1 Causes of Over Voltage

A building can be protected directly by the lightning protector developed by Benjamin Franklin. But it does not protect the electronic devices inside from indirect consequences of the flash of lightning.

A flash is basically an oversized short-circuit between two lines of different potentials e.g. two layers of clouds or the clouds and the ground. A current of 1000 to 100 000 ampere circle between two clouds or between ground and cloud causing the below listed damages or destruction at open lines (antennas, antenna cables) and connected devices:

3.1.1 Electrostatic Field

The rise of this field up to 50 kV/m may be caused by a close thundercloud with potential load or by the static charging of the air. The field change happens suddenly, producing high-frequency electromagnetic micro-pulses.

3.1.2 Rise of the Earth Potential

A flash driving into the ground causes an instant rise of the earth potential which depends on the amperage and the local specific resistance of the ground. The ground reduces the over voltage in waves which leads to high voltage potential differences in unprotected devices.

3.1.3 Electromagnetic Radiation

A flash may be compared with and antenna being a few kilometers long. The pulse currency of some kilo amperes causes the radiation of a strong electromagnetic field. The radiation induces high voltages and currents in lines close by (1 to 2 km) which again leads to over voltages in connected devices.

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3.2 Indirect Lightning Protection FG444100

It is impossible to stop over voltages caused by effects of a flash of lightning, but it is possible to protect a device from the destructive powers.

To achieve this it is necessary to short-circuit all the lines with over voltages to reduce it as quickly as possible. Once the interference is over the device is to return to its previous specifications.

The ***hopf*** indirect lightning protection consists of a combination of different components. Fast absorber diodes keep the potential difference between antenna core and 0 constantly. The following gas arresters, once lit, short-circuit the line to the earthing point.

It is due to this combination that the potential separation of the antenna circuit from the other electronics is guaranteed even in undisturbed situations.

If the indirect lightning protection itself is destroyed by a flash of lightning the lines stay short-circuited. Therefore no DCF77 signal is received. We advise using the status bits in the connected devices to check.

3.3 Installation

When using the ***hopf*** indirect lightning protection we presume that a comprehensive lightning protection concept is in operation on location, including a direct protection of the building according to VDE and also that the voltage supply of the device is protected from lightning.

The indirect lightning protection is usually installed directly where the cable enters the building. Therefore in-house cables running parallel to the antenna cable are disturbed as little as possible.

The antenna is connected to the BNC input-connector of the indirect lightning protection - the extended line to the electronics is connected to the BNC-output connector.

A copper stranded wire is run from the earthing screw to the nearest earth connection point.

Thickness and length of the copper stranded wire is described in ***chapter 5 Technical Data***.

It is important that the earth line of the connected device has the same earth connecting point as the indirect lightning protection, to avoid destructive potential differences. If this cannot be guaranteed, the indirect lightning protection should be installed at a different place.

If the indirect lightning protection is installed near the device the earth cable can be connected to the earth of the device. In this case the antenna cable between antenna and indirect lightning protection should not run parallel to other cables.

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4 Antenna Amplifier 4x

If several DCF77-antennas are required in a building, the indirect lightning protection can be supplied with a 4x potential free antenna amplifier.

The lightning protection housing contains, apart from the indirect lightning protection, a power supply and several amplifier modules.

The antenna input is on one of the narrow sides of the housing, whereas the cableinlet for the voltage supply cable is on the other narrow side.

The DCF77 signal is fed to a pre-amplifier via the antenna input. The amplified signal is then fed to 4 potential free output steps, which carry the signal on to the insulated BNC antenna connectors on the broader sides of the housing.

To connect the supply voltage the lid of the housing has to be removed by undoing the screws and connecting the cable through the leading-in hole to the appropriate terminals.

Both the installation of the indirect lightning protection as well as the indirect lightning protection with amplifier must not be carried out by anyone but qualified personnel.

We supply 2 versions of the 4x antenna amplifier:

- FG444400 4x antenna amplifier with indirect lightning protection
- FG444600 4x antenna amplifier

4.1 Indirect Lightning Protector + Multi Aerial Amplifier FG444400

The 4x antenna amplifier consists of 4 units.

1. mains unit
2. pre-amplifier
3. 4x amplifier for the potential separation
4. indirect lightning protection

4.1.1 Mains Unit

The mains unit supplies the antenna and the single amplifier with voltage. The input transformer is equipped with a thermo fuse.

4.1.2 Pre-Amplifier

The pre-amplifier couples the modulated DCF77-signal from the supply voltage of the active antenna.

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4.1.3 Amplifier for the Potential Separation

The pre-amplified signal is led to 4 potential free amplifiers.

When outdoor antennas are connected to the amplifier we recommend using our version with indirect lightning protection. The indirect lightning protection block is connected in series with the pre-amplifier.

4.1.4 Indirect Lightning Protection

More about indirect lightning protection refer to ***chapter 3.2 Indirect Lightning Protection***.

The picture shows the device **FG444400** with integrated 4x antenna distributor.

4.2 Multi Aerial Amplifier FG444600

If several DCF77-clocks are wanted in the building the 4x antenna amplifier with potential separation can be used. The device is structured like the antenna amplifier FG444400, but without indirect lightning protection (picture above). The housing contains the mains unit and several amplifier modules.

The signal is fed via a pre-amplifier to 4 potential free output steps and put out via insulated BNC-connectors on the wider side of the housing.

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5 Technical Data

Antenna

Voltage supply via antenna cable:	+1.7 to + 5V DC
Differential output resistance:	50 Ω
Amplification:	26 (20) dB
Antenna cable:	RG59 compatible
• Cable length (delivery status):	indoor antenna: 10 m outdoor antenna: 20 m
• max. length of cable **without** multi aerial amplifier:	theoretical: 500 m recommended: 250 m
• max. length of cable **with** multi aerial amplifier:	theoretical: 1000 m recommended: 500 m
Plastic:	light proof
Wind stress outdoor antenna:	max. 180 km/h
Band width:	4 kHz

Indoor antenna 4436

Humidity:	95% not condensed
Protection class:	IP50
Temperature range 3 dB limit:	
• Operating:	0° C to +50° C
• Storage:	-50° C to +85° C

Outdoor antennas 4417, 4418, 4420, 4437

Humidity:	100%
Protection class:	IP65
Temperature range 3 dB limit:	
• Operating:	-30° C to +80° C
• Storage:	-50° C to +85° C

Indirect Lightning Protection 4441

Type of housing:	aluminium-die-cast housing
Measurements (W x H x D):	250 x 105 x 95 mm
Weight:	approx. 3.5 kg
Earth connection point:	
• Thickness of the copper stranded wire:	min. 10 mm^2
• Length of the copper stranded wire:	max. 10 m
Current stability:	10 kA (8/20 µsec. Wave)
Speed of response:	< 1 nsec.
Protection level at 6 kV 1,2/50 µsec. wave at input:	< 12 V
Insertion loss for DCF77 signal:	max. 3dB
Input / output:	BNC-connector (female / female)
Input / output impedance:	50 Ω
Temperature range:	
• Operating:	-20° C to +80° C
• Storage:	-40° C to +85° C
Humidity:	95% not condensed
Protection class:	IP40

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4x Multi Aerial Amplifier <u>with</u> Indirect Lightning Protection 4444

Type of housing:	aluminium-die-cast housing
Measurements (W x H x D):	250 x 105 x 95 mm
Weight:	approx. 3.5 kg
Earth connection point:	
• Thickness of the copper stranded wire:	min. 10 mm^2
• Length of the copper stranded wire:	max. 10 m
Voltage supply:	230 V AC +10%
Power consumption:	6 VA max.
Fuse:	thermal cutout
Current stability:	10 kA (8/20 µsec. Wave)
Speed of response:	< 1 nsec.
Protection level at 6 kV 1,2/50 µsec. wave at input:	< 12 V
Insertion loss for DCF77 signal:	max. 3dB
Input / output:	BNC-connector (female / female)
Input / output impedance:	50 Ω
Length of cable antenna - amplifier:	max. 500 m
Length of cable amplifier - clock:	max. 500 m
Amplification:	0 - 3 dB
Temperature range:	
• Operating:	-20° C to +80° C
• Storage:	-40° C to +85° C
Humidity:	95% not condensed
Protection class:	IP40

4x Multi Aerial Amplifier <u>without</u> Indirect Lightning Protection 4446

Type of housing:	aluminium-die-cast housing
Measurements (W x H x D):	250 x 105 x 95 mm
Weight:	approx. 3.5 kg
Earth connection point:	
• Thickness of the copper stranded wire:	min. 10 mm^2
• Length of the copper stranded wire:	max. 10 m
Voltage supply:	230 V AC +10%
Power consumption:	6 VA max.
Fuse:	thermal cutout
Input / output:	BNC-connector (female / female)
Input / output impedance:	50 Ω
Length of cable antenna to 4446:	max. 500 m
Length of cable 4446 to the clock:	max. 500 m
Amplification:	0 - 3 dB
Temperature range:	
• Operating:	-20° C to +80° C
• Storage:	-40° C to +85° C
Humidity:	95% not condensed
Protection class:	IP40

Outdoor antenna and indirect lightning protection can be destroyed by lightning bolts. Therefore we can give only a limited guarantee for those parts.

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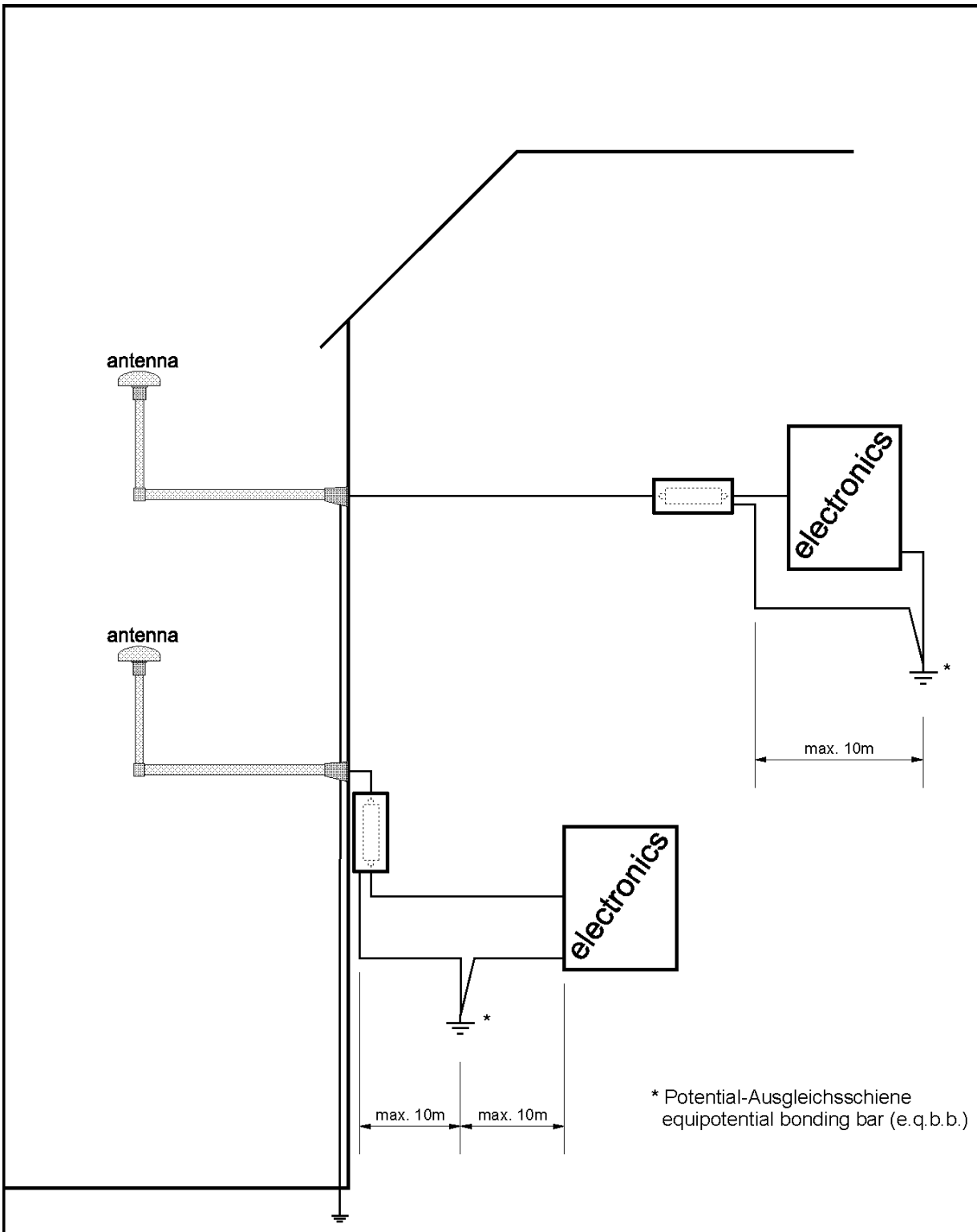

The lightning protection and the electronic must be connected on the same earth potential!
The line between lightning protection and ground must be closer than 10m.

Der Blitzschutz und die Elektronik müssen auf dem gleichen Erdpotential liegen!
Die Verbindung vom Blitzschutz zum Erdpotential darf eine Länge von 10m nicht überschreiten!

date	name	size	no.	page
10.03.98	Vollmer	A4	ZC98031002	1/1

indirect lightning protection
Indirekter Blitzschutz

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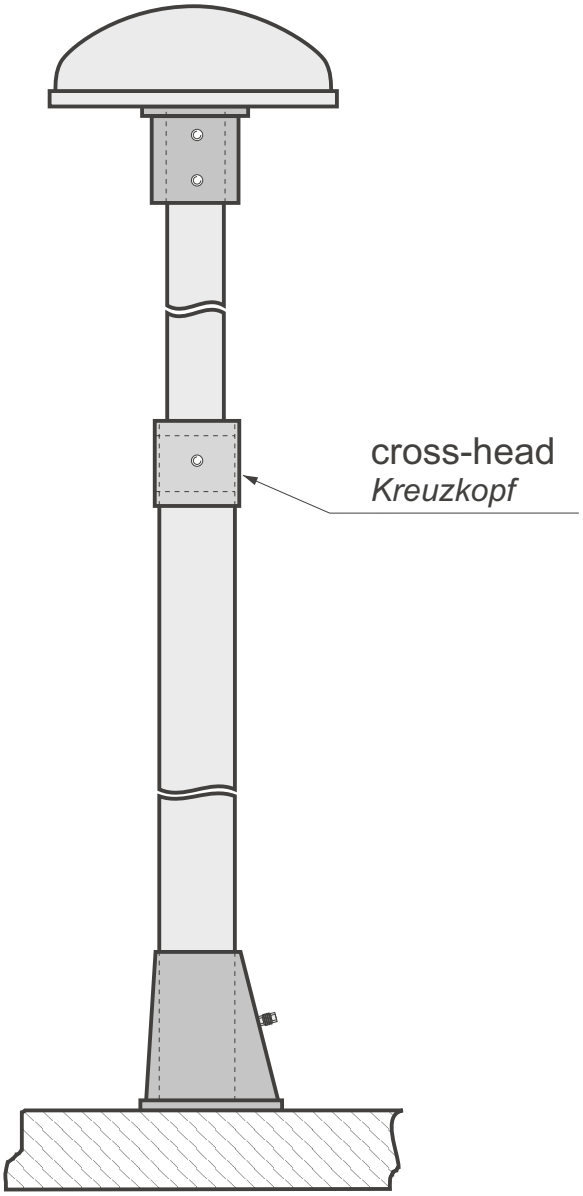
Mounting of Antenna 4490G10 / 4418A

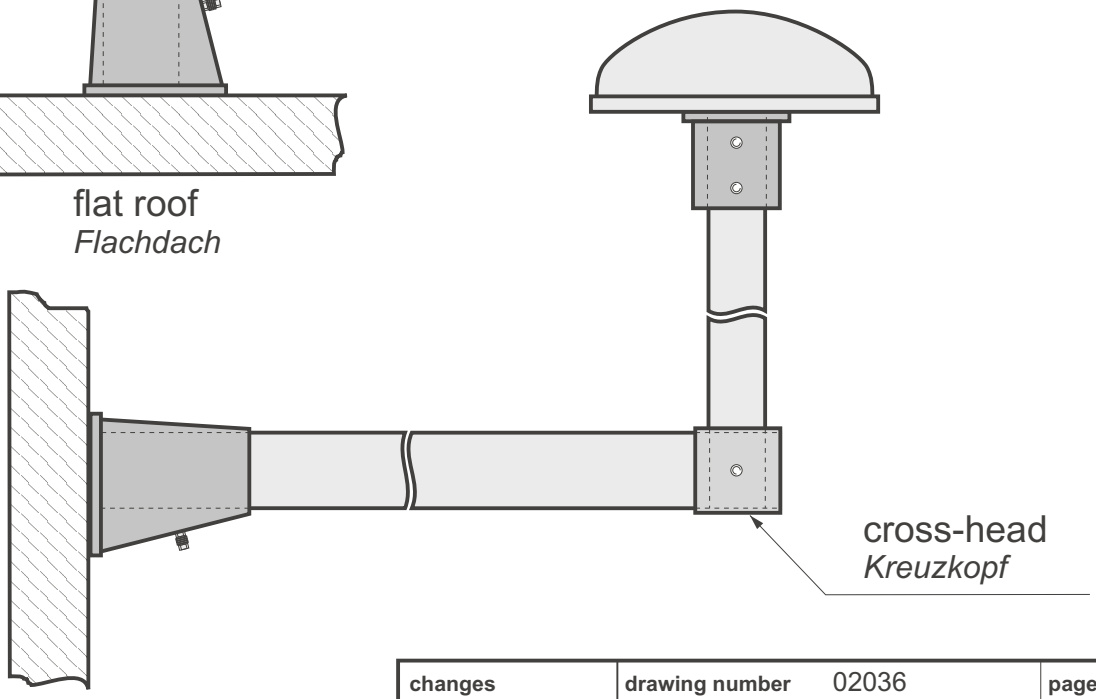
Montage Antennen 4490G10 / 4418A



flat roof
Flachdach

The tube with the antenna will be supplied unmountedly. The cross-head will be pluged according to mounting for wall or flat roof.

Das Rohr mit dem Antennenteller wird unmontiert geliefert. Der Kreuzkopf wird je nach Motagebedarf für Hauswand oder Flachdach gesteckt.



vertical wall
Senkrechte Hauswand

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			name	Vollmer	
			check		
date	changes	name	size	A4	

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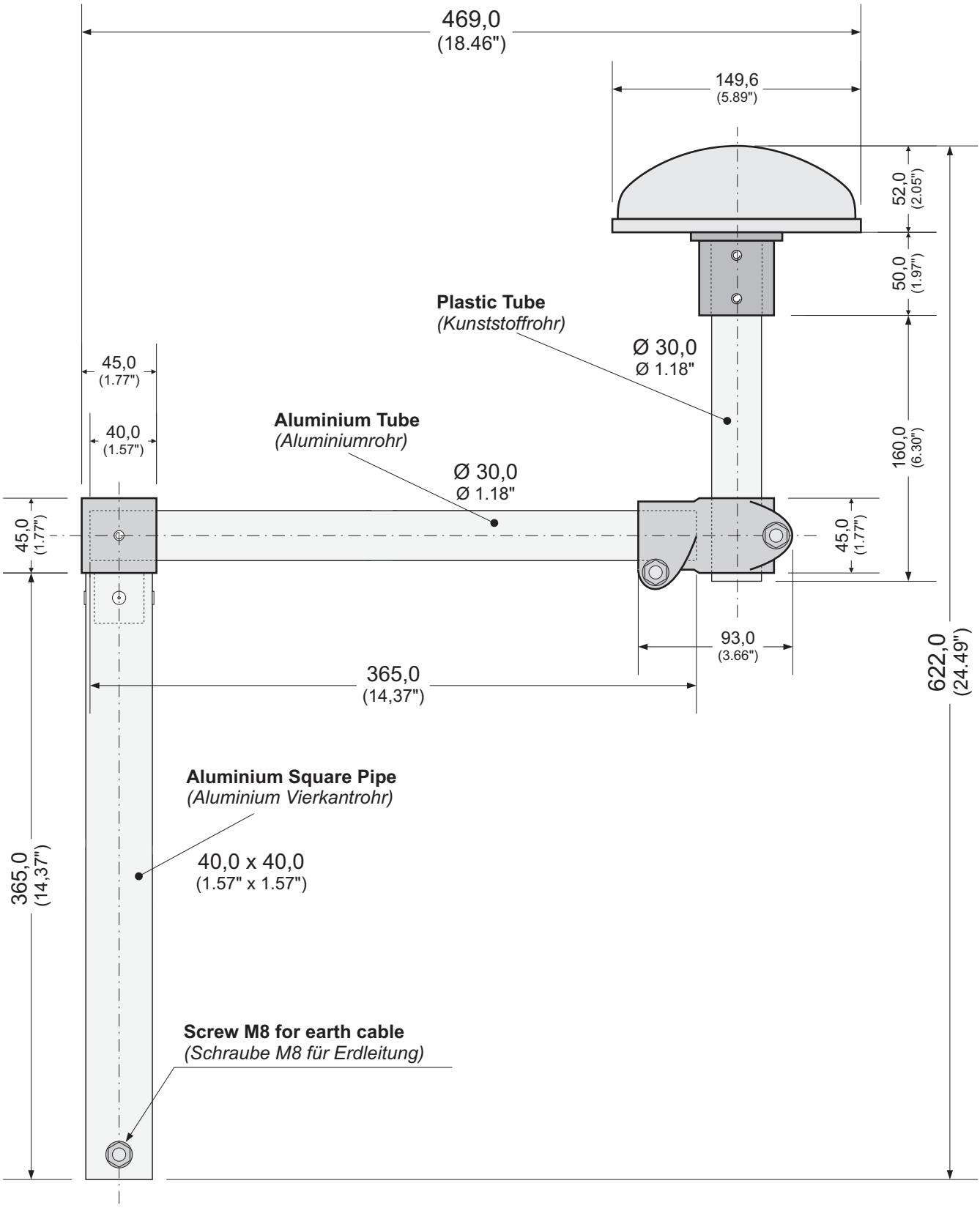
Dimensions of Antenna 4490G11 / 441700A

Abmessungen Antennen 4490G11 / 441700A



All dimensions in mm (inch)

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			name	Vollmer	
			check		
date	changes	name	size	A4	

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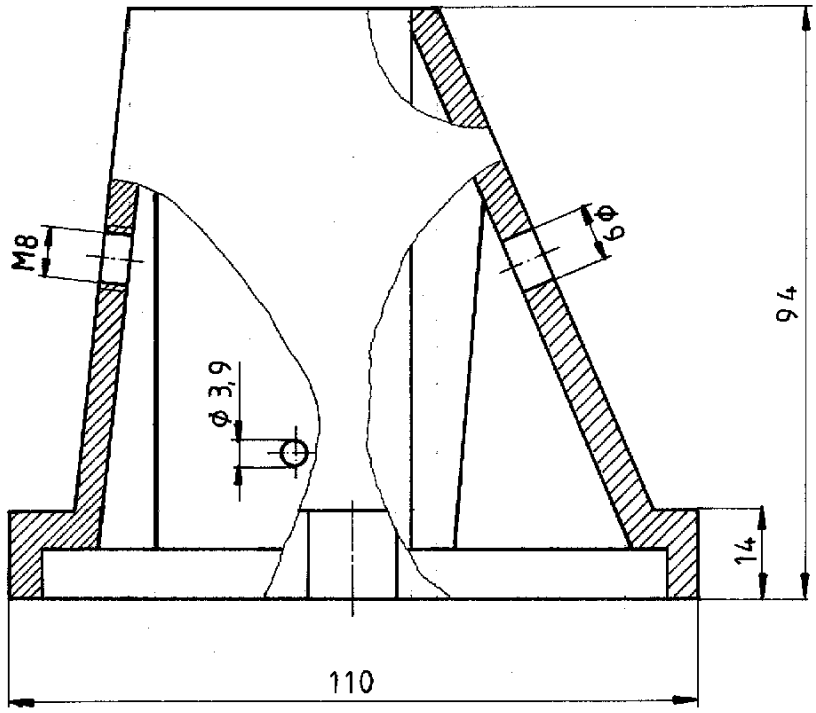
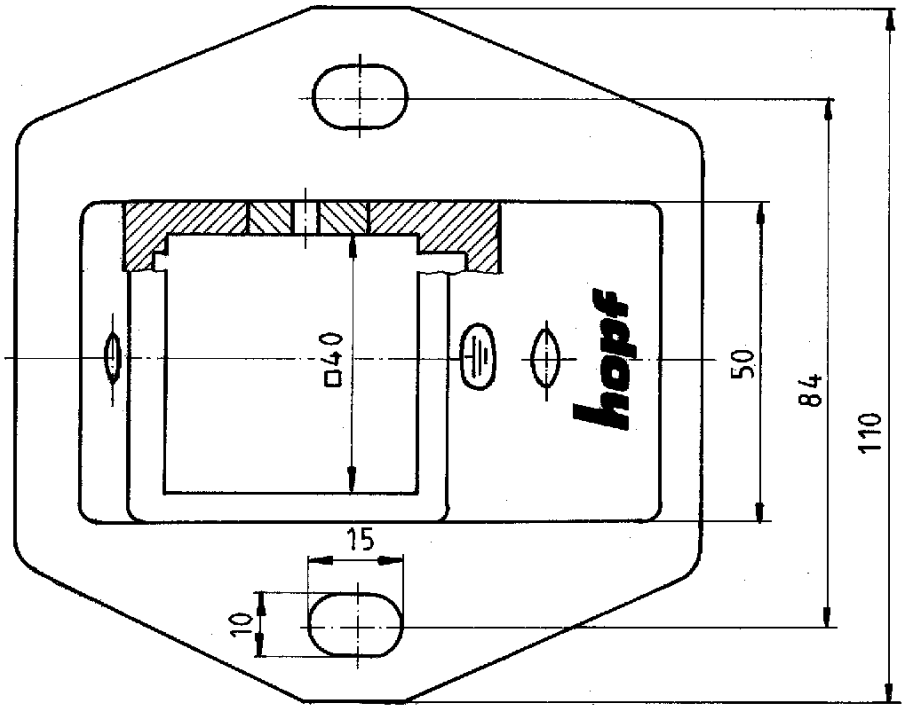
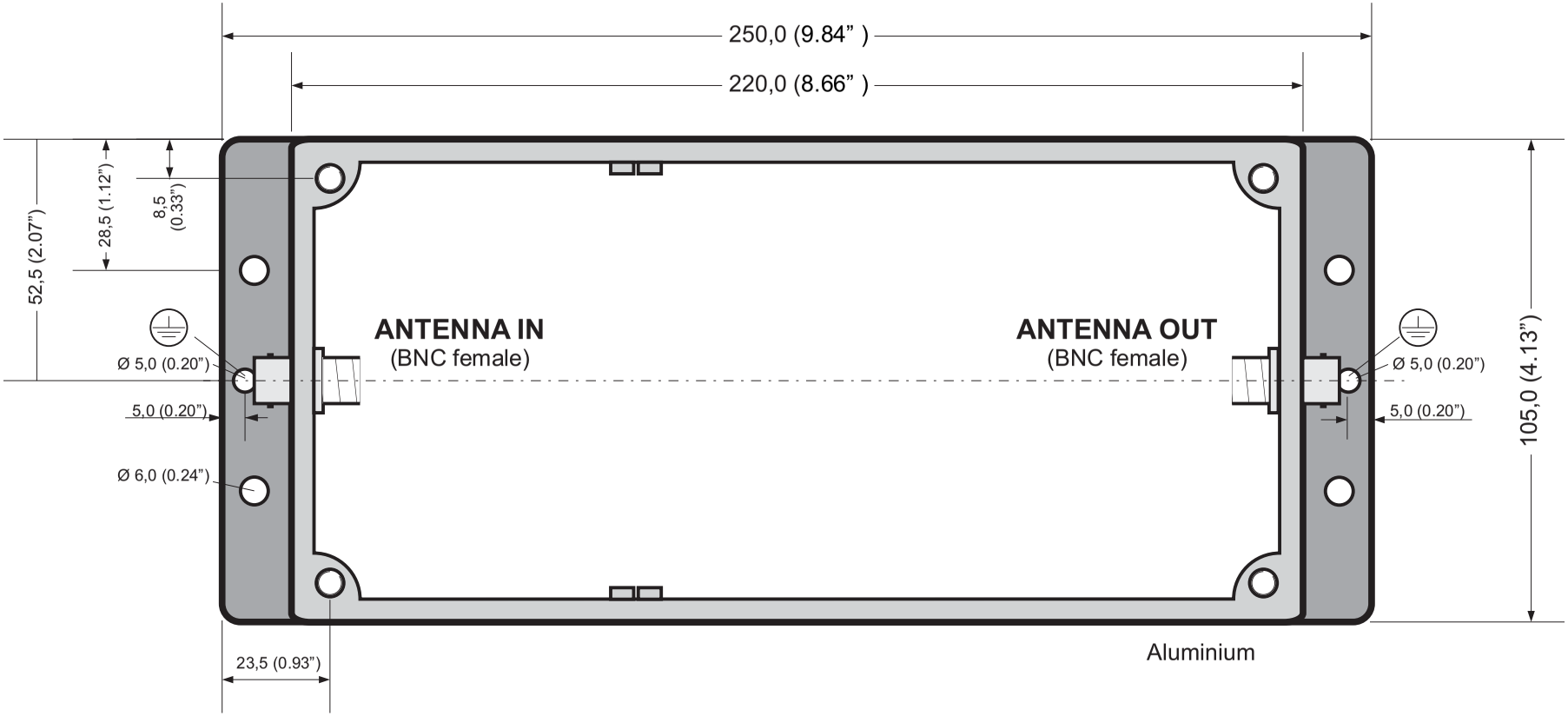


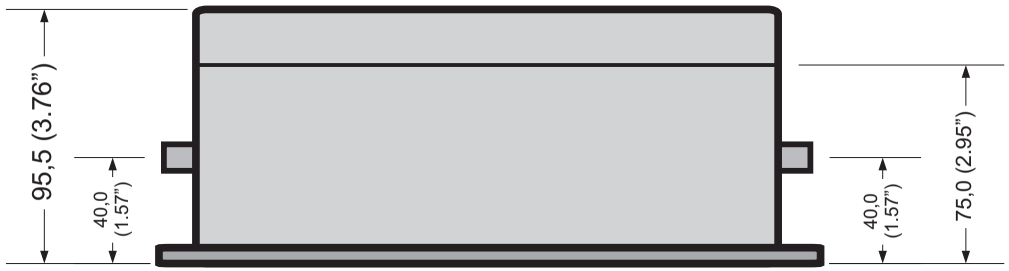


no. ZC97041001		page 1/1
	antenna mounting	
	date 10.04.97	System
	name Vollmer	hopf Elektronik GmbH
	size A4	post box 1847 D-58468 Lüdenscheid fon: (02351) 938686 fax: (02351) 459590

Dimensions of Indirect Lightning Protector (article no. for GPS: FG4495G0 / for DCF77: FG444100)

Abmessungen Gehäuse Indirekter Blitschutz





All dimensions in mm (inch)

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date	changes	name	size	A4	

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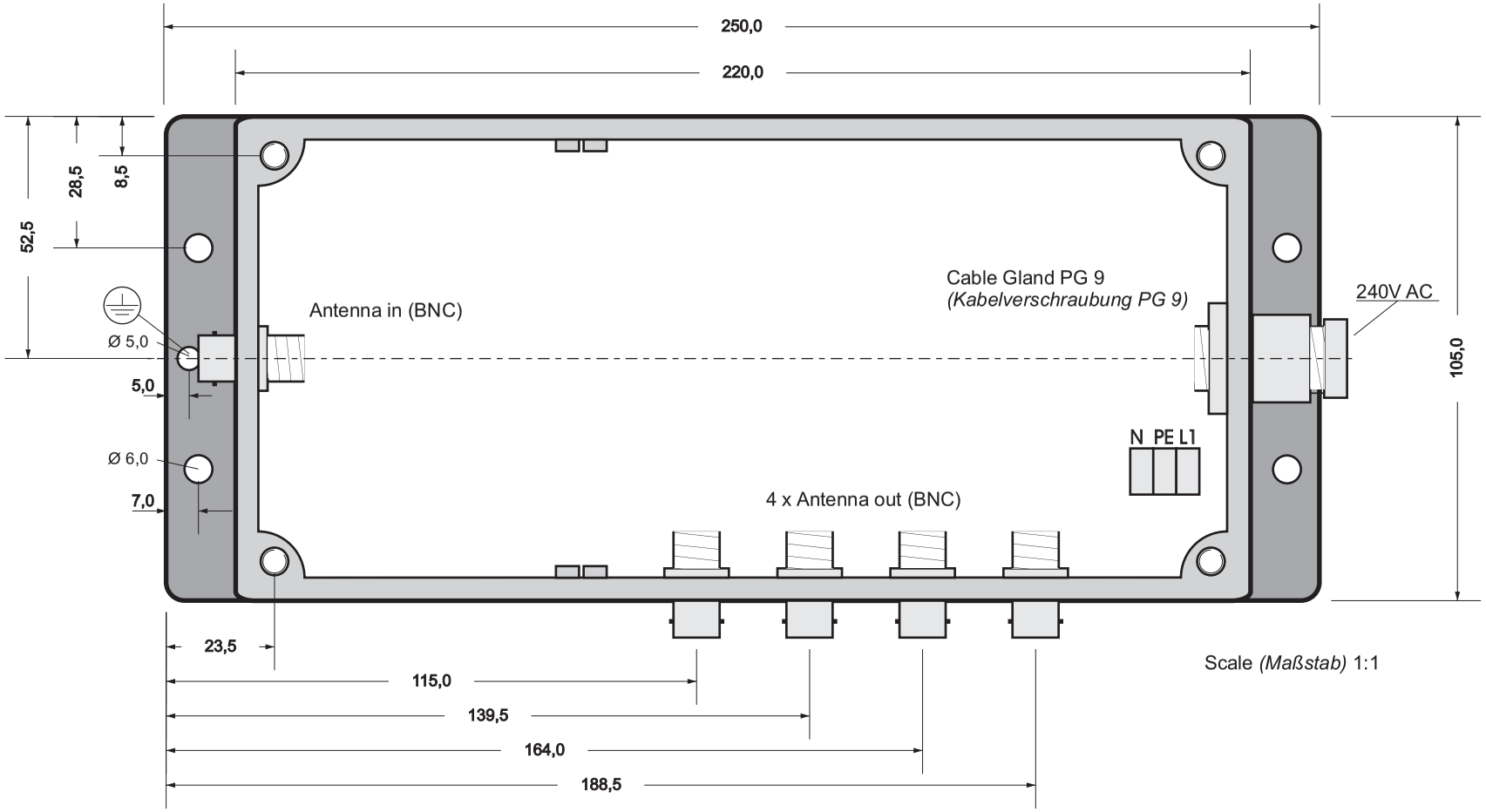
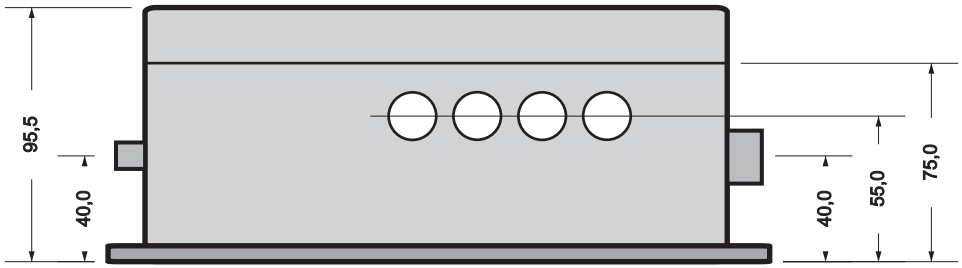


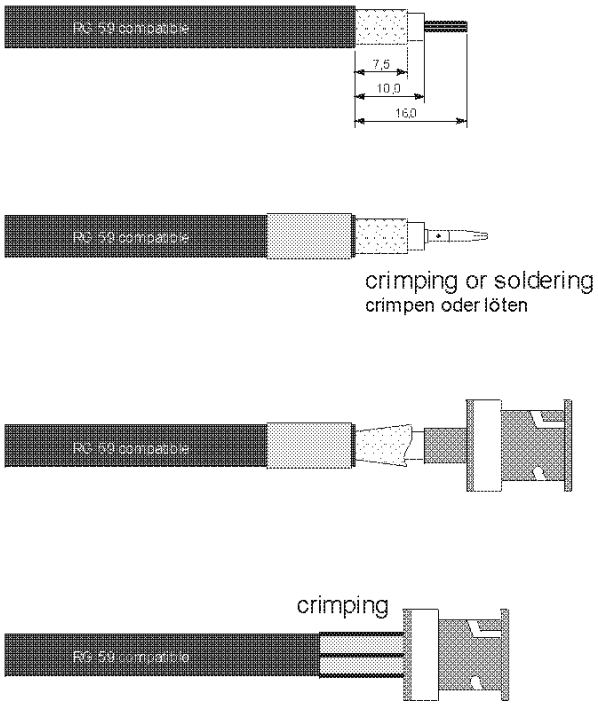
Scale *(Maßstab)* 1:1



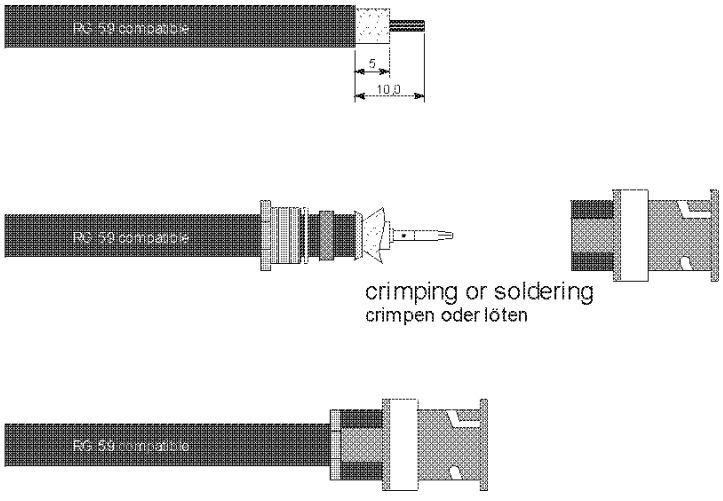
Scale *(Maßstab)* 1:2

no. ZC97091603a		page 1/1
	Multi Aerial Amplifier ***Multiantennenverstärker***	
	date 16.09.97	System
	name Vollmer	hopf Elektronik GmbH
24.02.05 engl.	size A3	post box 1847 D-58468 Lüdenscheid fon: (02351) 938686 fax: (02351) 459590

Mounting the BNC-plug with crimping technique
Montage für BNC-Stecker mit Crimpmontage



Mounting the BNC-plug with screw technique
Montage für BNC-Stecker mit Schraubmontage



max. Diameter of connector: 15 mm

changes			drawing number	Zc01010401	page 1/1
			BNC Mounting		
			date	04.01.01	System
			name	Vollmer	
			check		
date	changes	name	size	A4	

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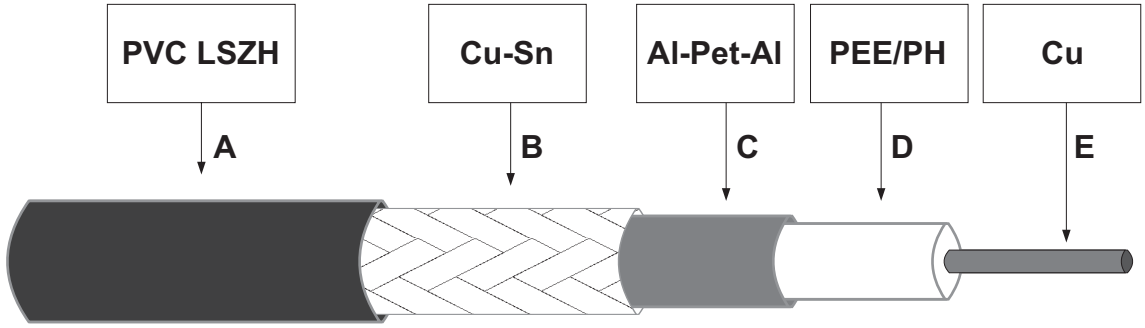
hopf Low Loss Cable (article-no: KA110109)

Low Smoke Zero Halogen



Construction Data

A	Sheath:	PVC Low Smoke Zero Halogen	Ø = 6.9 ±0.1 mm
B	Braid:	Cu-Sn	coverage = 80%
C	Outer Foil:	TRIPLEX	H 18 mm
		(Al/PET/AL)	Sp = [9 x 23 x 9] µm
			100% coverage
D	Dielectric:	PEE/PH	Ø = 4.8 ±0.1 mm
E	Inner conductor:	Cu	Ø = 1.13 ±0.01 mm

Electrical Characteristics

Characteristic Impedance:	75 ±3 Ohm
Capacitance:	52 pF/m
Velocity Ratio:	84%

Mechanical Characteristics

Min. bending radius:	50 mm
Weight:	approx. 32 kg/km
Temperature range:	-25°C ... +75°C
Handling Temperature:	min. 0°C

DC resistance max. (T=20°C)

inner conductor = 16.8 Ohm/km
outer conductor = 12.8 Ohm/km

Attenuation (T=20°C)

MHz	dB/100m
10	1.8
47	4.1
100	5.7
230	8.6
300	10
400	11.7
600	14.6
800	16.9
1000	19.3
1350	22.9
1750	26.4
2050	28.9
2150	29.6
2400	31.6

Return Loss

MHz	dB
[310-460]	> 26
[460-585]	> 24
[585-860]	> 23
[860-1750]	> 21
[1750-2400]	> 18

Screening Efficiency

MHz	dB
[47-200]	> 90
[200-470]	> 90
[470-1000]	> 90
[1000-2400]	> 90

Free from halogen (acc. To VDE 0472 part 813 and 815)
flame resistante (acc. To VDE 0472 part 804 test method B)

changes			drawing number 02107	page 1/1
			***hopf* Low Loss Cable - KA110109**	
			date 25.03.03	System
			name Vollmer	
			check	
date	changes	name	size A4	

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