The Synchronization Experts.

MANUAL

GPS183D(A)HS

DIN Rail GPS Receiver

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint & Legal Information

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You may also write to **techsupport@meinberg.de** to request an updated version at any time or provide feedback on errors or suggested improvements, which we are grateful to receive.

Meinberg reserves the right to make changes of any type to this document at any time as is necessary for the purpose of improving its products and services and ensuring compliance with applicable standards, laws & regulations.

3 Presentation Conventions in this Manual

3.1 Conventions for the Presentation of Critical Safety Warnings

Warnings are indicated with the following warning boxes, using the following signal words, colors, and symbols:

Caution!

This signal word indicates a hazard with a **low risk level**. Such a notice refers to a procedure or other action that may result in **minor injury** if not observed or if improperly performed.

Warning!

This signal word indicates a hazard with a **medium risk level**. Such a notice refers to a procedure or other action that may result in **serious injury** or even **death** if not observed or if improperly performed.

Danger!

This signal word indicates a hazard with a **high risk level**. Such a notice refers to a procedure or other action that will very likely result in **serious injury** or even **death** if not observed or if improperly performed.

3.2 Secondary Symbols Used in Safety Warnings

Some warning boxes may feature a secondary symbol that emphasizes the defining nature of a hazard or risk.

The presence of an “electrical hazard” symbol is indicative of a risk of electric shock or lightning strike.

The presence of a “fall hazard” symbol is indicative of a risk of falling when performing work at height.

This “laser hazard” symbol is indicative of a risk relating to laser radiation.

3.3 Conventions for the Presentation of Other Important Information

Beyond the above safety-related warning boxes, the following warning and information boxes are also used to indicate risks of product damage, data loss, and information security breaches, and also to provide general information for the sake of clarity, convenience, and optimum operation:

Important!

Warnings of risks of product damage, data loss, and also information security risks are indicated with this type of warning box.

Information:

Additional information that may be relevant for improving efficiency or avoiding confusion or misunderstandings is provided in this form.

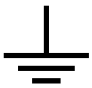
3.4 Generally Applicable Symbols

The following symbols and pictograms are also used in a broader context in this manual and on the product.

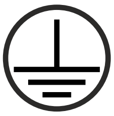
The presence of the “ESD” symbol is indicative of a risk of product damage caused by electrostatic discharge.

Direct Current (DC) *(symbol definition IEC 60417-5031)*

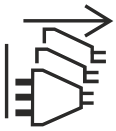
Alternating Current (AC) *(symbol definition IEC 60417-5032)*



Grounding Terminal *(symbol definition IEC 60417-5017)*



Protective Earth Connection *(symbol definition IEC 60417-5019)*



Disconnect All Power Connectors *(symbol definition IEC 60417-6172)*

4 Important Safety Information

The safety information provided in this chapter as well as specific safety warnings provided at relevant points in this manual must be observed during every installation, set-up, and operation procedure of the device, as well as its removal from service.

Any safety warnings affixed to the device itself must also be observed.

Any failure to observe this safety information, these safety warnings, and other safety-critical operating instructions in the product documentation, or any other improper usage of the device may result in unpredictable behavior from the product, and may result in injury or death.

Depending on your specific device configuration and installed options, some safety information may not be applicable to your device.

Meinberg accepts no responsibility for injury or death arising from a failure to observe the safety information, warnings, and safety-critical instructions provided in the product documentation.

It is the responsibility of the operator to ensure that the product is safely and properly used.

Should you require additional assistance or advice on safety-related matters for your product, Meinberg's Technical Support team will be happy to assist you at any time. Simply send a mail to **techsupport@meinberg.de**.

4.1 Appropriate Usage

The device must only be used appropriately in accordance with the specifications of the product documentation! Appropriate usage is defined exclusively by this manual as well as any other relevant documentation provided directly by Meinberg.

Appropriate usage includes in particular compliance with specified limits! The device's operating parameters must never exceed or fall below these limits!

4.2 Product Documentation

The information in this manual is intended for readers with an appropriate degree of safety awareness.

The following are deemed to possess such an appropriate degree of safety awareness:

- **skilled personnel** with a familiarity with relevant national safety standards and regulations,
- **instructed personnel** having received suitable instruction from skilled personnel on relevant national safety standards and regulations.

Read the product manual carefully and completely before you set the product up for use.

If any of the safety information in the product documentation is unclear for you, do **not** continue with the set-up or operation of the device!

Safety standards and regulations change on a regular basis and Meinberg updates the corresponding safety information and warnings to reflect these changes. It is therefore recommended to regularly visit the Meinberg website at https://www.meinbergglobal.com or the Meinberg Customer Portal at https://meinberg.support to download up-to-date manuals.

Please keep all product documentation, including this manual, in a safe place in a digital or printed format to ensure that it is always easily accessible.

Meinberg's Technical Support team is also always available at techsupport@meinberg.de if you require additional assistance or advice on safety aspects of your Meinberg product.

4.3 Safety During Installation

This rack-mounted device has been designed and tested in accordance with the requirements of the standard IEC 62368-1 (*Audio/Video, Information and Communication Technology Equipment—Part 1: Safety Requirements*). Where the rack-mounted device is to be installed in a larger unit (such as an electrical enclosure), additional requirements in the IEC 62368-1 standard may apply that must be observed and complied with. General requirements regarding the safety of electrical equipment (such as IEC, VDE, DIN, ANSI) and applicable national standards must be observed in particular.

The device has been developed for use in industrial or commercial environments and may only be used in such environments. In environments at risk of high environmental conductivity ("high pollution degree" according to IEC 60664-1), additional measures such as installation of the device in an air-conditioned electrical enclosure may be necessary.

If the appliance has been brought into the usage area from a cold environment, moisture may develop as a result of condensation; in this case, wait until the appliance has adjusted to the temperature and is completely dry before setting it up.

When unpacking & setting up the equipment, and before operating it, be sure to read the information on installing the hardware and the specifications of the device. These include in particular dimensions, electrical characteristics, and necessary environmental conditions.

Fire safety standards must be upheld with the device in its installed state—never block or obstruct ventilation openings and/or the intakes or openings of active cooling solutions.

The device with the highest mass should be installed at the lowest position in the rack in order to position the center of gravity of the rack as a whole as low as possible and minimize the risk of the rack tipping over. Further devices should be installed from the bottom, working your way up.

The device must be protected against mechanical & physical stresses such as vibration or shock.

Never drill holes into the device to mount it! If you are experiencing difficulties with rack installation, contact Meinberg's Technical Support team for assistance!

Inspect the device housing before installation. The device housing must be free of any damage when it is installed.

4.4 Grounding the Device

In order to ensure that the device can be operated safely and to meet the requirements of IEC 62368-1, the device must be correctly connected to the protective grounding conductor via the protective grounding terminal.

If an external grounding terminal is provided on the chassis, it must be connected to the grounding busbar for safety reasons before connecting the power supply. This ensures that any possible leakage current on the chassis is safely discharged to earth.

The screw, washer, and toothed lock washer necessary for mounting the grounding cable are provided on the grounding terminal of the chassis. A grounding cable is not included with the device.

Please ensure that your grounding cable has a thickness of 1.5 mm^2 or greater, that you use a suitable grounding terminal or lug, and that the cable is properly crimped!

4.5 Electrical Safety

This Meinberg product is operated at a hazardous voltage.

This system may only be set up and connected by skilled personnel, or by instructed personnel who have received appropriate technical & safety training from skilled personnel.

Custom cables may only be assembled by a qualified electrician.

Never work on cables carrying a live current!

Never use cables or connectors that are visibly damaged or known to be defective! Faulty, defective, or improperly connected shielding, connectors, or cables present a risk of injury or death due to electric shock and may also constitute a fire hazard!

Before operating the device, check that all cables are in good order. Ensure in particular that the cables are undamaged (for example, kinks), that they are not wound too tightly around corners, and that no objects are placed on the cables.

Cables must be laid in such a way that they do not present a tripping hazard.

The power supply should be connected using a short, low-inductance cable. Avoid the use of power strips or extension cables if possible. If the use of such a device is unavoidable, ensure that it is expressly rated for the rated currents of all connected devices.

Never connect or disconnect power, data, or signal cables during a thunderstorm! Doing so presents a risk of injury or death, as cables and connectors may conduct very high voltages in the event of a lightning strike!

Device cables must be connected or disconnected in the order specified in the user documentation for the device. Connect all cables only while the device is de-energized before you connect the power supply.

Always pull cable connectors out at **both** ends before performing work on connectors! Improperly connecting or disconnecting this Meinberg system may result in electric shock, possibly resulting in injury or death!

When pulling out a connector, **never** pull on the cable itself! Pulling on the cable may cause the plug to become detached from the connector or cause damage to the connector itself. This presents a risk of direct contact with energized components.

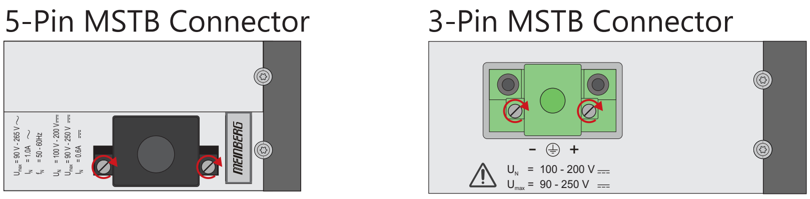


Illustration: Lock screws on an MSTB plug connector; in this case on a LANTIME M320

Ensure that all plug connections are secure. In particular, when using plug connectors with lock screws, ensure that the lock screws are securely tightened. This is especially important for power supply connectors where 3-pin or 5-pin MSTB connectors with lock screws are used (see illustration).

Before the device is connected to the power supply, the device housing must be grounded by connecting a grounding cable to the grounding terminal of the device.

When installing the device in an electrical enclosure, it must be ensured that adequate clearance is provided, minimum creepage distances to adjacent conductors are maintained, and that there is no risk of short circuits.

Protect the device from the ingress of objects or liquids!

If the device malfunctions or requires servicing (for example, due to damage to the housing, power supply cable, or the ingress of liquids or objects), the power supply may be cut off. In this case, the device must be isolated immediately and physically from all power supplies! The following procedure must be followed in order to correctly and reliably isolate the device:

- Pull the power supply plug from the power source.
- Loosen the locking screws of the MSTB power supply plug on the device and pull it out of the device.
- Contact the person responsible for your electrical infrastructure.
- If your device is connected to one or more uninterruptible power supplies (UPS), the direct power supply connection between the device and the UPS solution must be first be disconnected.

4.5.1 Special Information for Devices with AC Power Supply

This device is a Protection Class 1 device and may only be connected to a grounded outlet (TN system).

For safe operation, the installation must be protected by a fuse rated for currents not exceeding 20 A and equipped with a residual-current circuit breaker in accordance with applicable national standards.

The appliance must only ever be disconnected from the mains power supply via the mains socket and not from the appliance itself.

Make sure that the power connector on the appliance or the mains socket is readily accessible for the user so that the mains cable can be pulled out of the socket in an emergency.

Non-compliant cabling or improperly grounded sockets are an electrical hazard!

Only connect the appliance to a grounded shockproof outlet using a safety-tested mains cable designed for use in the country of operation.

4.5.2 Special Information for Devices with DC Power Supply

In accordance with IEC 62368-1, it must be possible to disconnect the appliance from the supply voltage from a point other than the appliance itself (e.g., from the primary circuit breaker).

The power supply plug may only be fitted or dismantled while the appliance is isolated from the power supply (e.g., disconnected via the primary circuit breaker).

Power supply cables must have adequate fuse protection and have an adequate wire gauge size (1 mm^2 – 2.5 mm^2 / 17 AWG – 13 AWG).

The power supply of the device must have a suitable on-demand disconnection mechanism (i.e., a switch). This disconnection mechanism must be readily accessible in the vicinity of the appliance and marked accordingly as a disconnection mechanism for the appliance.

4.6 Safety when Maintaining and Cleaning the Device

Only use a soft, dry cloth to clean the device.

Never use liquids such as detergents or solvents to clean the device! The ingress of liquids into the device housing may cause short circuits in the electronic circuitry, which in turn can cause a fire or electric shock!

Neither the device nor its individual components may be opened. The device or its components may only be repaired by the manufacturer or by authorized personnel. Improperly performed repairs can put the user at significant risk!

In particular, **never** open a power supply unit or module, as hazardous voltages may be present within the power supply device even after it is isolated from the upstream voltage. If a power supply unit or module is no longer functional (for example due to a defect), it can be returned to Meinberg for repair.

Some components of the device may become very hot during operation. Do not touch these surfaces!

If maintenance work is to be performed on the device and the device housing is still hot, switch off the device beforehand and allow it to cool.

4.7 Battery Safety

The integrated CR2032 lithium battery has a service life of at least ten years.

Should it be necessary to replace the battery, please note the following:

- The battery may only be replaced by the same type or a comparable type recommended by the manufacturer.
- The battery may only be replaced by the manufacturer or authorized personnel.
- The battery must not be exposed to air pressure levels outside of the limits specified by the manufacturer.

Improper handling of the battery may result in the battery exploding or in leakages of flammable or corrosive liquids or gases.

- **Never** short-circuit the battery!
- **Never** attempt to recharge the battery!
- **Never** throw the battery in a fire or dispose of it in an oven!
- **Never** dispose of the battery in a mechanical shredder!

5 Important Product Information

5.1 CE Marking

This product bears the CE mark as is required to introduce the product into the EU Single Market.

The use of this mark is a declaration that the product is compliant with all requirements of the EU directives effective and applicable as at the time of manufacture of the product.

These directives are listed in the EU Declaration of Conformity, appended to this manual as → Chapter 12.

5.2 UKCA Marking

This product bears the British UKCA mark as is required to introduce the product into the United Kingdom (excluding Northern Ireland, where the CE marking remains valid).

The use of this mark is a declaration that the product is in conformity with all requirements of the UK statutory instruments applicable and effective as at the time of manufacture of the product.

These statutory instruments are listed in the UK Declaration of Conformity, appended to this manual as → Chapter 13.

5.3 Ensuring the Optimum Operation of Your Device

- Ensure that ventilation slots are not obscured or blocked by dust, or else heat may build up inside the device. While the system is designed to shut down safely and automatically in the event of temperature limits being exceeded, the risk of malfunctions and product damage following overheating cannot be entirely eliminated.
- The device is only deemed to be appropriately used and EMC limits (electromagnetic compatibility) are only deemed to be complied with while the device housing is fully assembled in order to ensure that requirements pertaining to cooling, fire safety, electrical shielding and (electro)magnetic shielding are upheld.

5.4 Maintenance and Modifications

Important!

Before performing any maintenance work on or authorized modification to your Meinberg system, we recommend making a backup of any stored configuration data (e.g., to a USB flash drive from the Web Interface).

5.4.1 Replacing the Battery

Your device's clock module is fitted with a lithium battery (type CR2032) that is used to locally storage almanac data and sustain operation of the real-time clock (RTC) in the reference clock.

This battery has a life of at least ten years. However, if the device exhibits the following unexpected behaviors, the voltage of the battery may have dropped below 3 V, and the battery will need to be replaced:

- The reference clock has the wrong date or wrong time when the system is started.
- The reference clock repeatedly starts in Cold Boot mode (i.e., upon starting, the system has no ephemeris data saved whatsoever, resulting in the synchronization process taking a very long time due to the need to rediscover all of the visible satellites).
- Some configuration options relating to the reference clock are lost every time the system is restarted.

In this case, you should not replace the battery on your own. Please contact the Meinberg Technical Support team, who will provide you with precise guidance on how to perform the replacement.

5.4.2 Replacing the Fuse

Danger!

This equipment is operated at a hazardous voltage.

Danger of death from electric shock!

- The device must be disconnected from the mains! This is done using the physical power switch.
- Once the power switch is OFF, release the lock screws of the power connector (if applicable) and detach the connector.

Meinberg recommends keeping a spare fuse to hand at all times to ensure that a triggering of the integrated fuse does not disrupt the operation of your system for any longer than absolutely necessary. Ensure that it is of the proper type, and that it has the appropriate current and voltage ratings and blow curve. The rated voltage and current values are marked on the device itself next to the fuse compartment.

Fuses are marked with standardized designations in accordance with IEC 60127 to provide information about their specifications. For example, if a fuse is marked *T 2.5 A H 250 V*, it has the following meaning:

- *T*: The blow curve type, in this case *timelag*
- *2.5 A*: The current rating, in this case *2.5 Ampere*
- *H*: The breaking capacity, in this case *high*
- *250 V*: The voltage rating, in this case *250 Volt*

Ensure that the new fuse meets the following requirements and satisfies the specifications printed on the device itself:

Current Type	Labeling Standard	Extinguishing Agent	Blow Curve Type	Dimensions
AC	IEC 60127-compliant	With/without	T (Timelag)	5 x 20 mm
DC	IEC 60127-compliant	With	T (Timelag)	5 x 20 mm

Replacement Process

1. Cut the power supply to the device before disconnecting all signal, antenna, error relay, and serial interface connections from the device. Check that the device is actually de-energized and ensure that it cannot be switched back on!
2. Remove the fuse bracket from the fuse compartment by rotating it anticlockwise using a slotted screwdriver. Replace the fuse and insert the fuse bracket with the new fuse into the fuse compartment. Push it in with the screwdriver and rotate it clockwise until the fuse bracket is securely seated again.
3. Reconnect all cables in the reverse order to how they were disconnected. The power can now be switched back on if appropriate.

5.5 Disposal

Disposal of Packaging Materials

The packaging materials that we use are fully recyclable:

Material	Use for	Disposal
Polystyrene	Packaging frame/filling material	Recycling Depot
PE-LD (Low-density polyethylene)	Accessories packaging, bubble wrap	Recycling Depot
Cardboard	Shipping packaging, accessories packaging	Paper Recycling

For information on the proper disposal of packaging materials in your specific country, please inquire with your local waste disposal company or authority.

Disposal of the Device

This product falls under the labeling obligations of the Waste Electrical and Electronic Equipment Directive 2012/19/EU ("*WEEE Directive*") and thus bears this WEEE symbol. The presence of this symbol indicates that this electronic product may only be disposed of in accordance with the following provisions.

Important!

Do not dispose of the product or batteries via the household waste. Inquire with your local waste disposal company or authority on how to best dispose of the product or battery if necessary.

This product is considered to be a "**B2B**" product for the purposes of the WEEE Directive and is also classified as "**IT and Telecommunications Equipment**" in accordance with Annex I of the Directive.

It can be returned to Meinberg for disposal. Any transportation expenses for returning this product (at end-of-life) must be covered by the end user, while Meinberg will bear the costs for the waste disposal itself. If you wish for Meinberg to handle disposal for you, please get in touch with us. Otherwise, please use the return and collection systems provided within your country to ensure that your device is disposed of in a compliant fashion to protect the environment and conserve valuable resources.

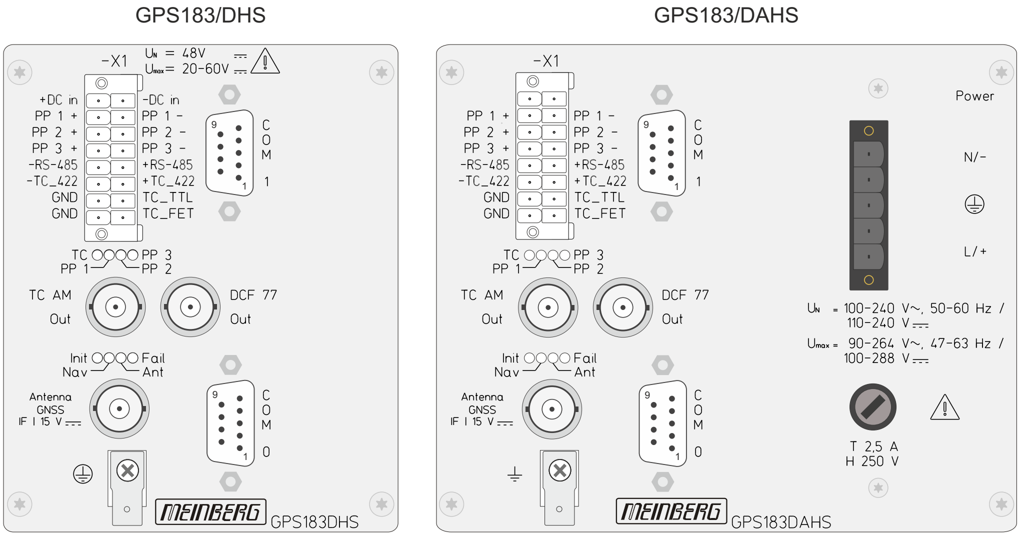
Disposal of Batteries

Please consult your local waste disposal regulations for information on the correct disposal of batteries as hazardous waste.

6 General information about GPS183/D(A)HS

The Meinberg satellite receiver clocks of the GPS183/D(A)HS series are available with several options. This manual describes the following models:

	20-60 V DC	100-240 V AC	110-240 V DC	Optocoupler outputs	PhotoMos relay outputs
GPS183/DHS	x			x	
GPS183/DAHS		x	x	x	
GPS183/MOS/DHS	x				x
GPS183/MOS/DAHS		x	x		x



The variants differ in power supply and the type of DC-isolation of the programmable pulse outputs. The differences are described in the relevant chapters, the name GPS183/D(A)HS is used whenever common features of all types of clocks are specified.

The satellite receiver clock GPS183/D(A)HS has been designed to provide an extremly precise time reference for the generation of programmable pulses. High precision available 24 hours a day around the whole world is the main feature of the new system which receives it's information from the satellites of the Global Positioning System.

The Global Positioning System (GPS) is a satellite-based radio-positioning, navigation, and time-transfer system. It was installed by the United States Departement of Defense and provides two levels of accuracy: The Standard Positioning Service (SPS) and the Precise Positioning Service (PPS). While PPS is encrypted and only available for authorized (military) users, SPS has been made available to the general public.

GPS is based on accurately measuring the propagation time of signals transmitted from satellites to the user´s receiver. A nominal constellation of 24 active satellites together with 6 spares in six orbital planes 20,000 km over ground provides a minimum of four satellites to be in view 24 hours a day at every point of the globe. Four satellites need to be received simultaneously if both receiver position (x, y, z) and receiver clock offset from GPS system time must be computed. All the satellites are monitored by control stations which determine the exact orbit parameters as well as the clock offset of the satellites´ on-board atomic clocks. These parameters are uploaded to the satellites and become part of a navigation message which is retransmitted by the satellites in order to pass that information to the user´s receiver.

The high precision orbit parameters of a satellite are called ephemeris parameters whereas a reduced precision subset of the ephemeris parameters is called a satellite´s almanac. While ephemeris parameters must be evaluated to compute the receiver´s position and clock offset, almanac parameters are used to check which satellites are in view from a given receiver position at a given time. Each satellite transmits its own set of ephemeris parameters and almanac parameters of all existing satellites.

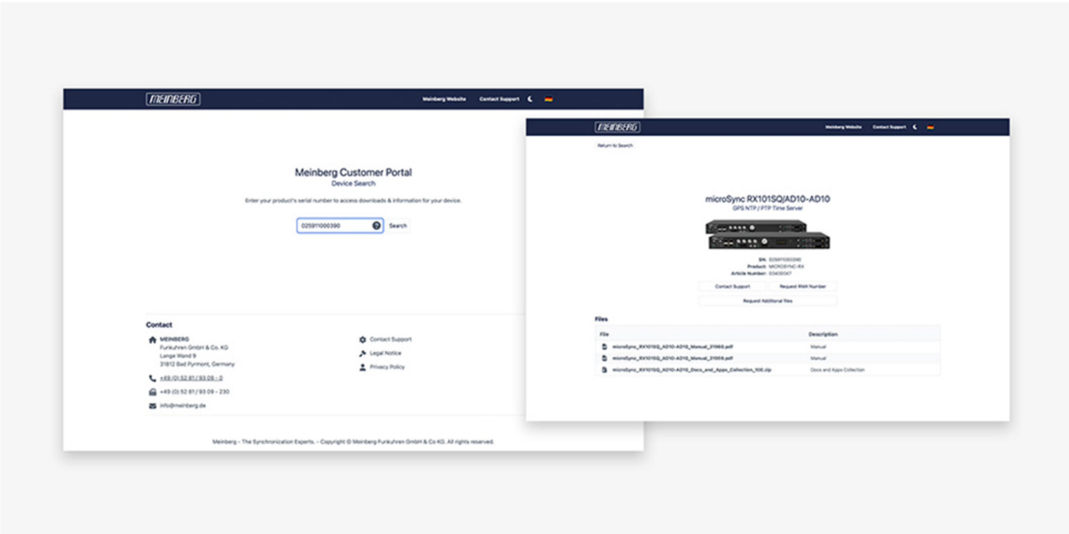
6.1 GPS183/D(A)HS Features

The GPS183/D(A)HS is designed for mounting on a DIN rail. The front panel integrates eight LED indicators, an terminal block, two DSUB and three BNC-connectors. The receiver is connected to the antenna by a 50 Ohm coaxial cable with length up to 300 m (when using a GPS receiver and standard RG58 coax cable). It is possible to connect up to four receivers to one antenna by using an optional antenna diplexer.

The navigation message coming from the satellites is decoded by GPS183/D(A)HS's microprocessor in order to track the GPS system time with an accuracy of better than +- 100 nsec. Compensation of the RF signal's propagation delay is done by automatical determination of the receiver's position on the globe. A correction value computed from the satellites navigation messages increases the accuracy of the board's TCXO to $\pm 5x10^{-9}$ and automatically compensates the oscillators aging. The last recent value is restored from the battery memory at power-up.

7 Meinberg Customer Portal - Software and Documentation

End users of Meinberg products are provided with technical support, full documentation and software downloads through our Support Centre - all in one place: https://meinberg.support



No Registration required
There's no need to register; simply enter your product's serial number at https://www.meinberg.support and you'll have everything you need to get your Meinberg system up and running—or perhaps back up and running, as the case may be—with up-to-date installation and reference manuals, downloads for drivers, remote monitoring, configuration tools, and SNMP MIB files, direct links to contact Meinberg's Technical Support team, and the ability to easily request additional files.

The Meinberg Customer Portal vastly simplifies how you access support, software, and documentation, and ensures that you always have the latest versions of downloadable tools and manuals at your disposal.

The installation program for the monitor software "Meinberg Device Manager".
With the help of this programme, Meinberg receivers can be configured via the serial interface and status information of the module can be displayed.

The Meinberg Device Manager software is executable under the following operating systems:

Windows	Windows 10, Windows 8.1, Windows 8, Windows 7
Linux	Ubuntu, Mint Linux, Debian, SUSE Linux, CentOS

The installation programme can also be downloaded at any time via an internet connection:
https://www.meinbergglobal.com/english/sw/mbg-devman.htm

A detailed documentation in PDF format can be found here:
https://www.meinbergglobal.com/download/docs/manuals/english/meinberg-device-manager.pdf

8 Installation

8.1 Installation of the GNSS Antenna

8.1.1 Planning the Installation of the Antenna

The following conditions should be met as closely as possible when selecting the best place to install your antenna:

- a clear 360° view around the antenna (to maximize exposure to the live sky), prioritizing in particular a clear view to the northern horizon (if antenna located in the southern hemisphere) or the southern horizon (if antenna is located in the northern hemisphere) to maximize the number of GNSS satellites visible at any given time;
- the highest elevation possible (to limit exposure to reflections from the ground and from other buildings);
- at least 10 m (∼ 30 ft) distance to any electrical equipment prone to emitting significant electrical interference, such as HVAC units and cameras;
- at least 50 cm (∼ 2 ft) distance to other GNSS antennas;
- at least 10 m – 30 m (∼ 30 ft – 100 ft) distance to other transmission antennas, depending on transmission power;
- sufficient distance from other metallic objects, which can reflect radio signals capable of interfering with GNSS signals; the necessary distance will depend on the size, orientation, and relative position of the objects.

For more information on the background to the above requirements and recommendations, please refer to ➜ Chapter 10.2, "The Importance of Good Antenna Positioning".

Important!

The specified accuracy levels for your GPS183/D(A)HS are specified for clear-sky conditions and can only be guaranteed if the above conditions for the installation of the antenna are met fully.

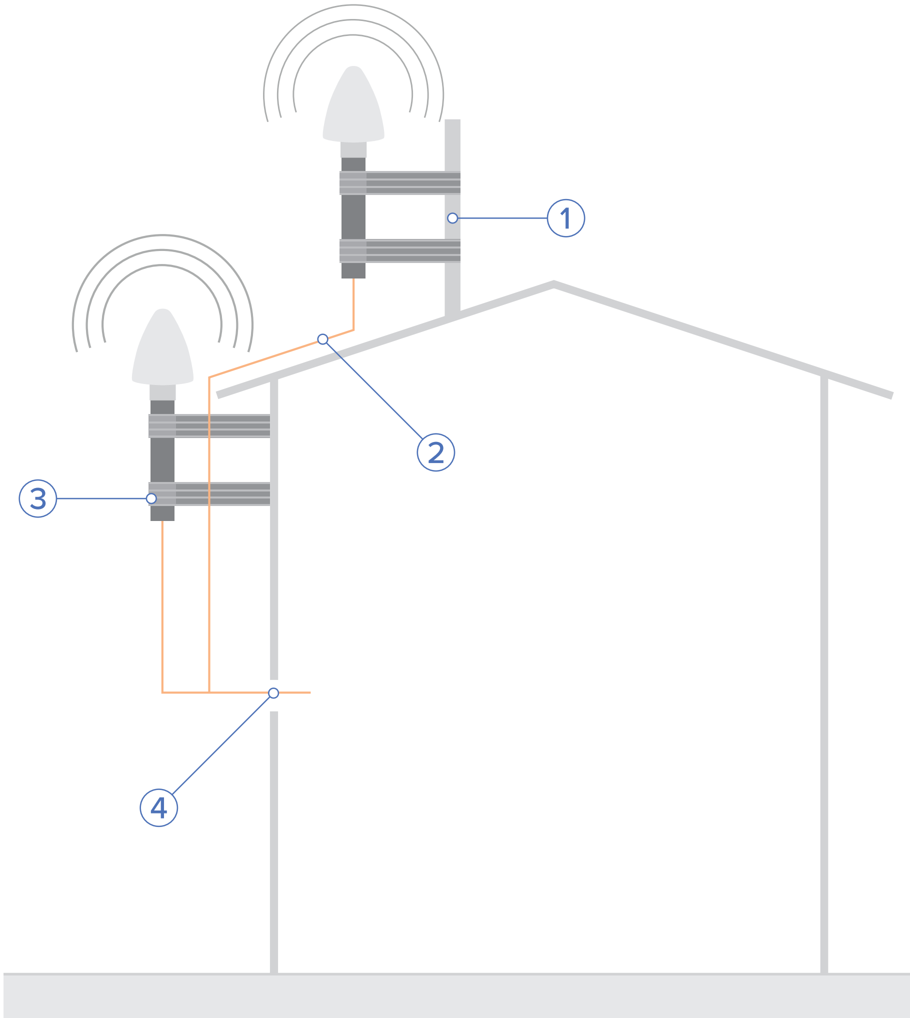


Figure 8.1: Effective Positioning of a GNSS Antenna

1. Mast Mounting
2. Antenna Cable
3. Wall Mounting
4. House Entry

Typically, these conditions can be met by installing the antenna on top of a roof as shown by the antenna on the **right** in Fig. 8.1.

However, if you do not have access to a roof to install the antenna, or if your roof conditions are such that significant radio interference is to be expected, you may consider mounting the antenna on a wall as high as possible, ensuring that a 360° view is observed with a view above the edge of the roof, as shown by the antenna on the **left** in Fig. 8.1. Mounting accessories are provided with your antenna for this purpose.

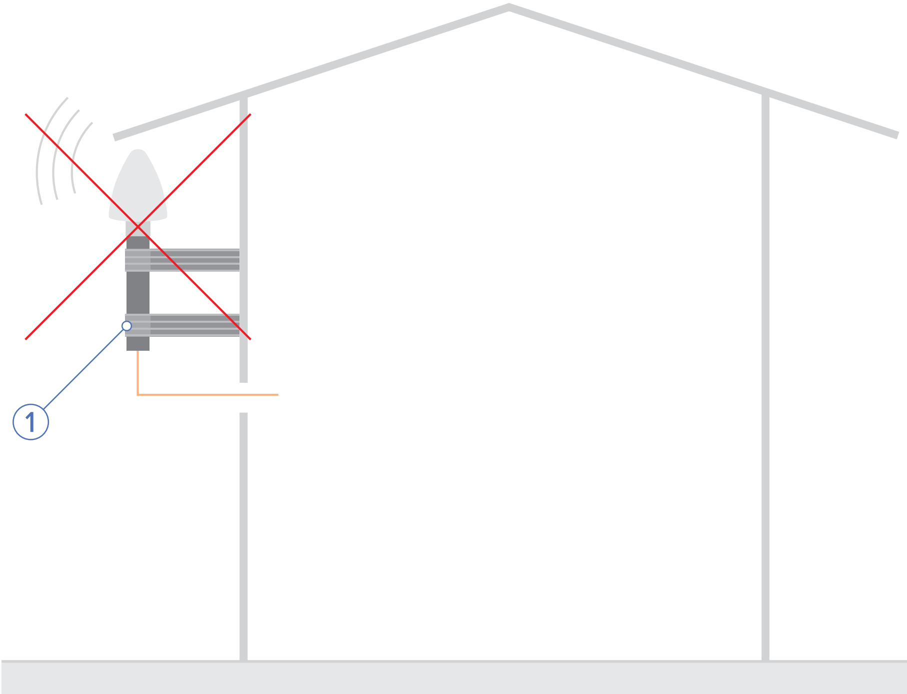


Figure 8.2: Poor Positioning of a GNSS Antenna

Please avoid mounting your antenna on a wall in such a way that the wall obscures the antenna's signal cone, as shown by the **upper antenna** in Fig. 8.2. This not only essentially halves the antenna's exposure to live-sky signals by halving the signal cone, but also exposes the antenna to signal reflections from the wall that the antenna is mounted on.

Under no circumstances should you install the antenna in a horizontal position! Doing so not only essentially halves the antenna's live-sky exposure in the same way as shown by the **lower antenna** in Fig. 8.2, but also maximizes the antenna's exposure to signals reflected from the ground and to other spurious transmissions from ground level.

8.1.2 Assembly and Fixture of the Antenna

8.1.2.1 Pole Assembly and Fixture of the Antenna

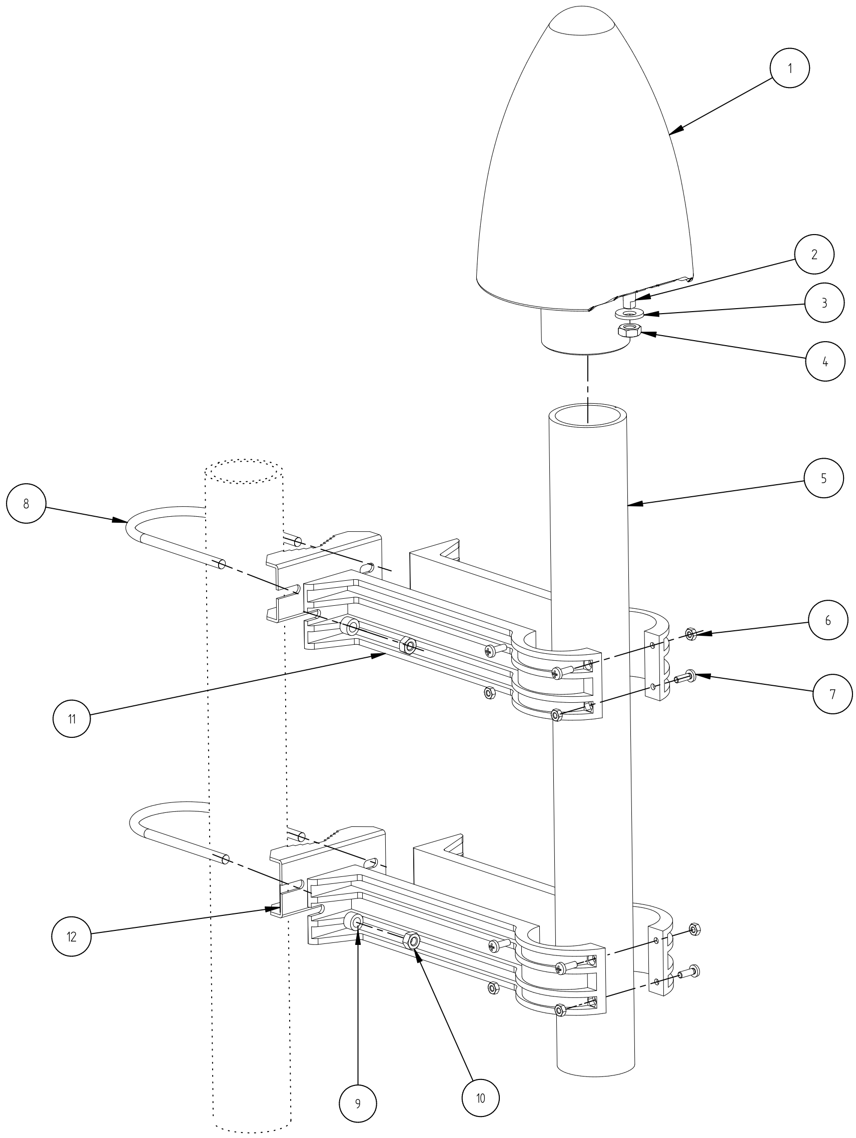


Figure 8.3: Mounting a GPSANTv2 Antenna onto a Mast

Fig. 8.4 illustrates how to assemble and mount a Meinberg GPSANTv2 Antenna on a mast by way of example.

The antenna may be mounted onto an existing mast (maximum pole diameter 60 cm / 2.3 inches) or directly onto a wall, provided that the installation conditions specified in → Chapter 8.1.1, "Planning the Installation of the Antenna" and → Chapter 10.2, "The Importance of Good Antenna Positioning" are met, in particular those regarding the maintenance of distances from sources of electromagnetic interference, signal reflections, and signal obstructions.

Danger!

Do not mount the antenna without an effective fall arrester!

Danger of death from falling!

- Ensure that you work safely when installing antennas!
- Never work at height without a suitable and effective fall arrester!

Danger!

Do not work on the antenna system during thunderstorms!

Danger of death from electric shock!

- Do not carry out any work on the antenna installation or the antenna cable if there is a risk of lightning strike.
- Do not perform any work on the antenna installation if it is not possible to maintain the prescribed safety distance from exposed power lines or electrical substations.

Mounting the Antenna onto a Mast

1. Assemble the two pairs of pole clamp halves (Item 8 in Fig. 8.4) with the mounting tube (Item 2 in Fig. 8.4) in the clamps. Secure the tube inside each of the two clamps using four M4x12 Phillips screws and corresponding M4 hex nuts (Items 3 and 4 in Fig. 8.4). To ensure that the clamp is secure as possible, the top and bottom screws of each clamp should be inserted from opposing directions as shown in Fig. 8.4.

2. Place the threaded bolts (Item 5 in Fig. 8.4) around the designated mast pole and feed the two prongs into the holes of the pole bracket (Item 9 in Fig. 8.4). Secure each of the clamps to each of the pole brackets using two spacers and two M6 hex nuts (Item 7 in Fig. 8.4) and tighten until the pole bracket and U-bolt are secure.

3. Once you have verified that the clamps are securely mounted to the mast, that they exhibit no movement without significant force, and that the tube is securely held by the clamps, you may insert the antenna into the top of the mounting tube.

8.1.2.2 Wall Assembly and Fixture of the Antenna

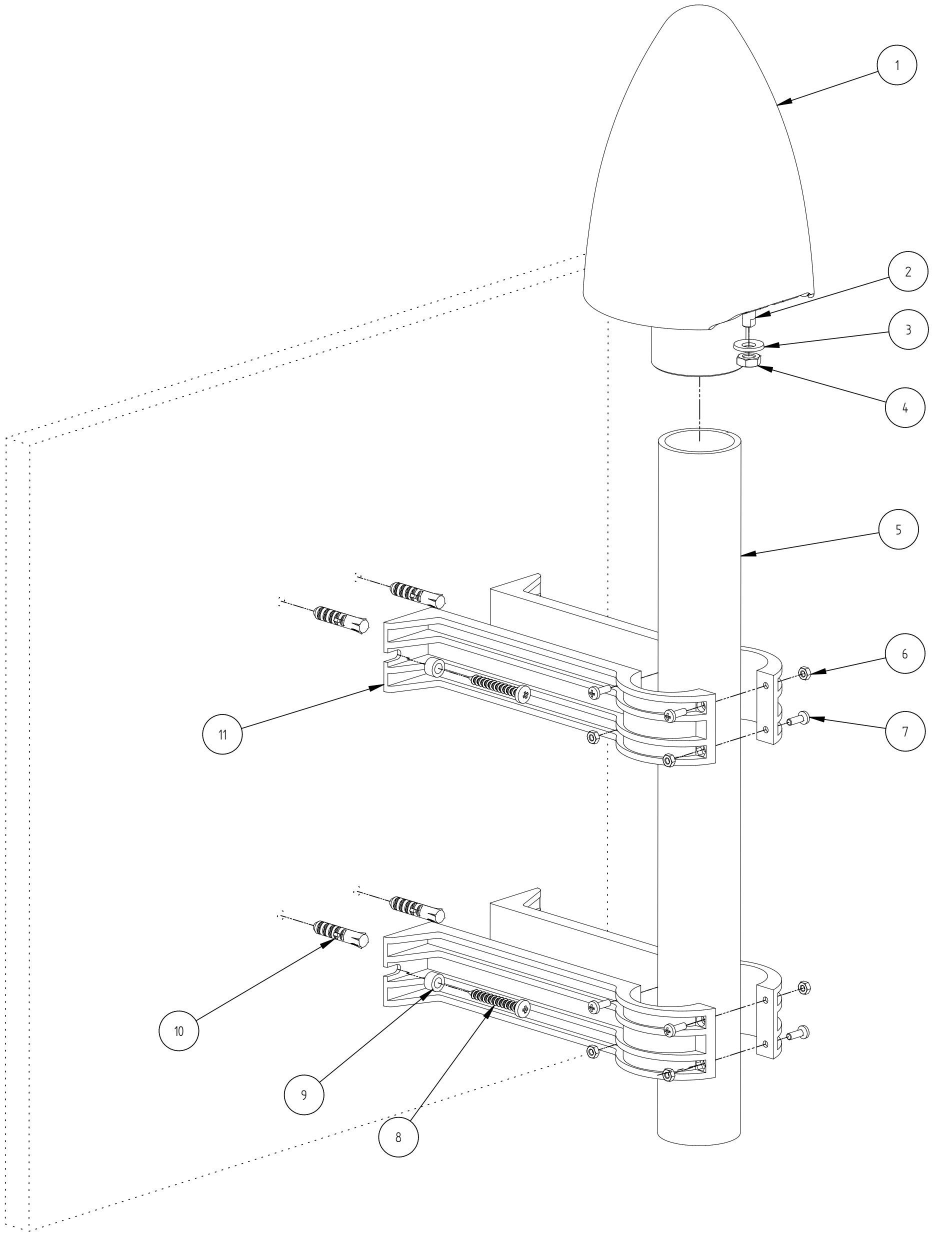


Figure 8.4: Mounting a GPSANTv2 Antenna onto a Mast

Fig. 8.4 illustrates how to assemble and mount a Meinberg GPSANTv2 Antenna on a mast by way of example.

The antenna may be mounted onto an existing mast (maximum pole diameter 60 cm / 2.3 inches) or directly onto a wall, provided that the installation conditions specified in → Chapter 8.1.1, "Planning the Installation of the Antenna" and → Chapter 10.2, "The Importance of Good Antenna Positioning" are met, in particular those regarding the maintenance of distances from sources of electromagnetic interference, signal reflections, and signal obstructions.

Danger!

Do not mount the antenna without an effective fall arrester!

Danger of death from falling!

- Ensure that you work safely when installing antennas!
- Never work at height without a suitable and effective fall arrester!

Danger!

Do not work on the antenna system during thunderstorms!

Danger of death from electric shock!

- Do not carry out any work on the antenna installation or the antenna cable if there is a risk of lightning strike.
- Do not perform any work on the antenna installation if it is not possible to maintain the prescribed safety distance from exposed power lines or electrical substations.

Mounting the Antenna onto a Wall

1. Assemble the two pairs of pole clamp halves (Item 8 in Fig. 8.4) with the mounting tube (Item 2 in Fig. 8.4) in the clamps. Secure the tube inside each of the two clamps using four M4x12 Phillips screws and corresponding M4 hex nuts (Items 3 and 4 in Fig. 8.4). To ensure that the clamp is secure as possible, the top and bottom screws of each clamp should be inserted from opposing directions as shown in Fig. 8.4.

2. Drill four holes for M6x45 screws in the underlying wall to match the two screw slits on each of the clamps. Insert two wallplugs into these holes.

3. Use four spacers and four M6x45 screws to mount the clamps onto the wall using the slits on each of the clamps.

4. Once you have verified that the clamps are securely mounted to the wall and the tube is securely held by the clamps, you may insert the antenna into the tube.

8.1.3 Laying the Antenna Cable

Your GPS183/D(A)HS is typically shipped with a suitable antenna cable. However, if it is not, or if you must procure a replacement for an old or damaged cable, please consult ➜ Chapter 10.4, "Antenna Cable" for information on the required specifications.

When laying the antenna cable, ensure that the specified maximum cable length is not exceeded. This length will depend on the selected cable type and its attenuation factor. If the specified maximum length is exceeded, correct transmission of the synchronization data and thus proper synchronization of the reference clock can no longer be guaranteed.

Important!

Please avoid using a mixture of different cable types for your antenna installation. This should be taken into consideration in particular when purchasing additional cable, for example in order to extend an existing cable installation.

Like any other metallic object in the antenna installation (antenna and master), the antenna cable must be integrated into the grounding infrastructure of the building and also connected to the other metallic objects. Refer to ➜ Chapter 8.1.4, "Grounding the Antenna" for more information.

Meinberg also strongly recommends implementing in-line surge protection using the MBG S-PRO surge protector, which should be mounted as closely to the point of entry into the building itself. Refer to ➜ Chapter 8.1.5, "In-Line Surge Protection" for more information.

Caution!

When laying the antenna cable, ensure that sufficient distance is maintained from live cables (such as high-voltage power lines), as these can cause severe interference and compromise the quality of the antenna signal significantly. Surges in power lines (caused, for example, by lightning strike) can generate induced voltages in a nearby antenna cable and damage your system.

Any kinking, crushing, or other damage to the external insulation must be avoided. In particular, the bend radius of the cable, which is the radius at which a cable can be bent without sustaining damage such as kinks, must be considered when laying the cable around corners or turns.

The coaxial connectors must be protected from damage and from exposure to water jets or corrosive substances.

8.1.4 Grounding the Antenna

Danger!

Surge protection and lightning protection systems may only be installed by persons with suitable electrical installation expertise.

Risk of fire and danger of death from electric shock!

- **Do not** attempt to implement surge protection or lightning protection systems if you do not have suitable professional electrical qualifications.

If the antenna is not properly grounded, exposure to high induced voltages from indirect lightning strikes can generate significant surge voltages in the coaxial cable, potentially causing significant damage to or even destroying both your antenna and any connected receivers or signal distributors.

Accordingly, antennas and antenna cables must always be professionally integrated into a building's equipotential bonding infrastructure as part of an effective lightning protection strategy to ensure that voltages induced by lightning strikes directly on or indirectly near the antenna are redirected safely to ground.

Meinberg antennas feature integrated surge protection in accordance with IEC 61000-4-5 Level 4 to reliably shield the antenna against surge voltages. The antenna also has a grounding terminal to allow it to be connected as directly as possible to a bonding conductor using a grounding cable. Please refer to the standards regarding antenna installations (e.g., DIN EN 60728-11) for more information.

In order to enhance the safety of the building and the protection of your Meinberg system, Meinberg also recommends the additional use of the MBG S-PRO surge protector, which is addressed in → Chapter 8.1.5, "In-Line Surge Protection".

VDE 0185-305 (IEC 62305) (relating to buildings with lightning protection systems) and VDE 0855-1 (IEC 60728-11) (addressing bonding strategies and the grounding of antenna installations in buildings with no external lightning protection system) are the lightning protection standards applicable to antenna installations on a building. Antennas must generally be integrated into a building's lightning protection system or bonding infrastructure.

If the antenna represents the highest point of a building or pole, the lightning protection strategy should incorporate a safe zone (e.g., formed by a lightning rod) positioned above the antenna. This increases the likelihood of lightning being 'caught' by the lightning rod, allowing surge currents to be safely passed from the lightning rod along a grounding conductor to ground.

Electrical bonding is the connection of all metallic, electrically conductive elements of the antenna installation in order to limit the risk of dangerous voltages for people and connected devices.

To this end, the following elements should be connected and integrated into a bonding system:

- the antenna cable shielding using cable shield bonding connectors*
- the core conductor of the antenna cable using surge protection devices
- antennas, antenna poles
- ground electrodes (e.g., foundation electrode)

** Minimum IP rating IP X4 when using bonding connectors outdoors.*

Connecting the Grounding Terminal of the Antenna

As mentioned previously, the antenna must be connected to a grounding busbar using a grounding cable (not included). A grounding cable must be assembled for this purpose; the recommended conductor thickness is 4 mm^2 – 6 mm^2 and a ring terminal fitting the M8 (0.315 inch) grounding bolt must be used.

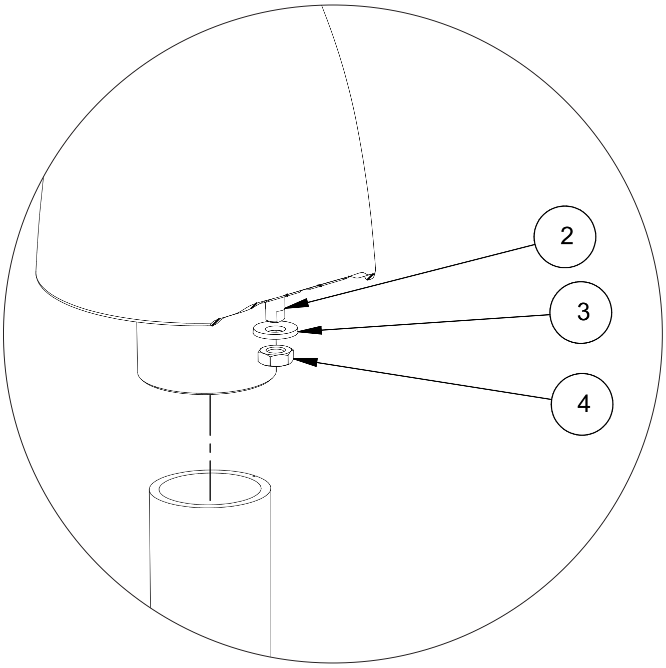


Figure 8.5: Grounding Terminal Assembly

Grounding Cable Installation Procedure

1. Remove the nut (Item 4 in Fig. 8.5) and the safety washer (Item 3 in Fig. 8.5).

2. Place the ring terminal onto the grounding bolt (Item 2 in Fig. 8.5).

3. First place the safety washer (Item 3 in Fig. 8.5) onto the grounding bolt (Item 2 in Fig. 8.5), then screw the M8 nut (Item 4 in Fig. 8.5) onto the thread of the grounding bolt.

4. Tighten the nut (Item 4 in Fig. 8.5) with a max. torque of **6 Nm**.

Once the antenna has been correctly installed with the grounding cable, connect the grounding cable to the bonding bar (see Fig. 8.6 and Fig. 8.7).

Antenna Installation without Insulated Lightning Rod System

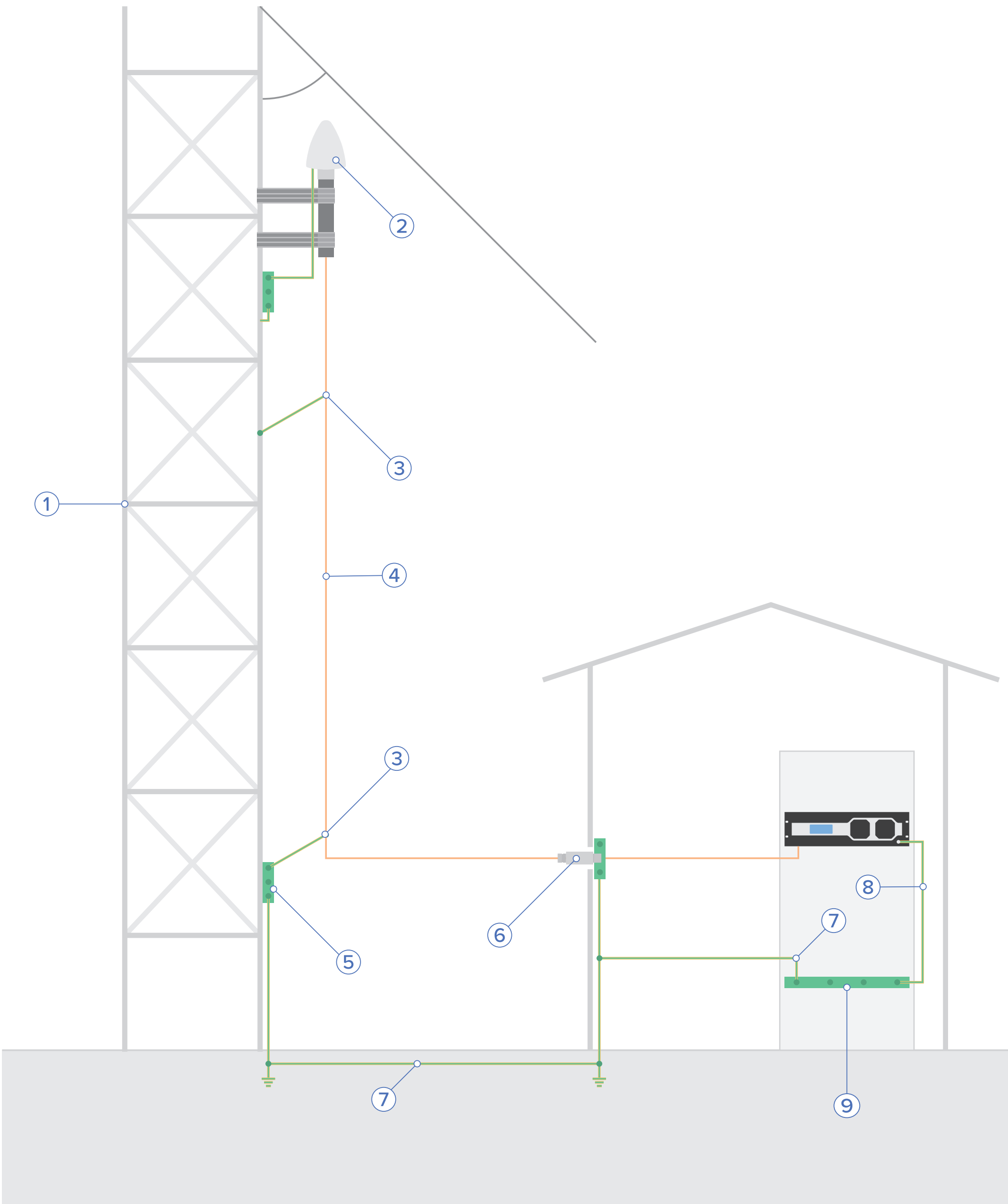


Figure 8.6: Grounding of a Mast-Mounted Antenna

1	Antenna Pole
2	Antenna
3	Shield Grounding Clamp
4	Antenna Cable
5	Equipotential Bonding Bar
6	Surge Protector (MGB-S-PRO)
7	Bonding Conductor
8	Ground Connection Device
9	Main Earthing Busbar
α	Safety Zone

Antenna Installation with Insulated Lightning Rod System

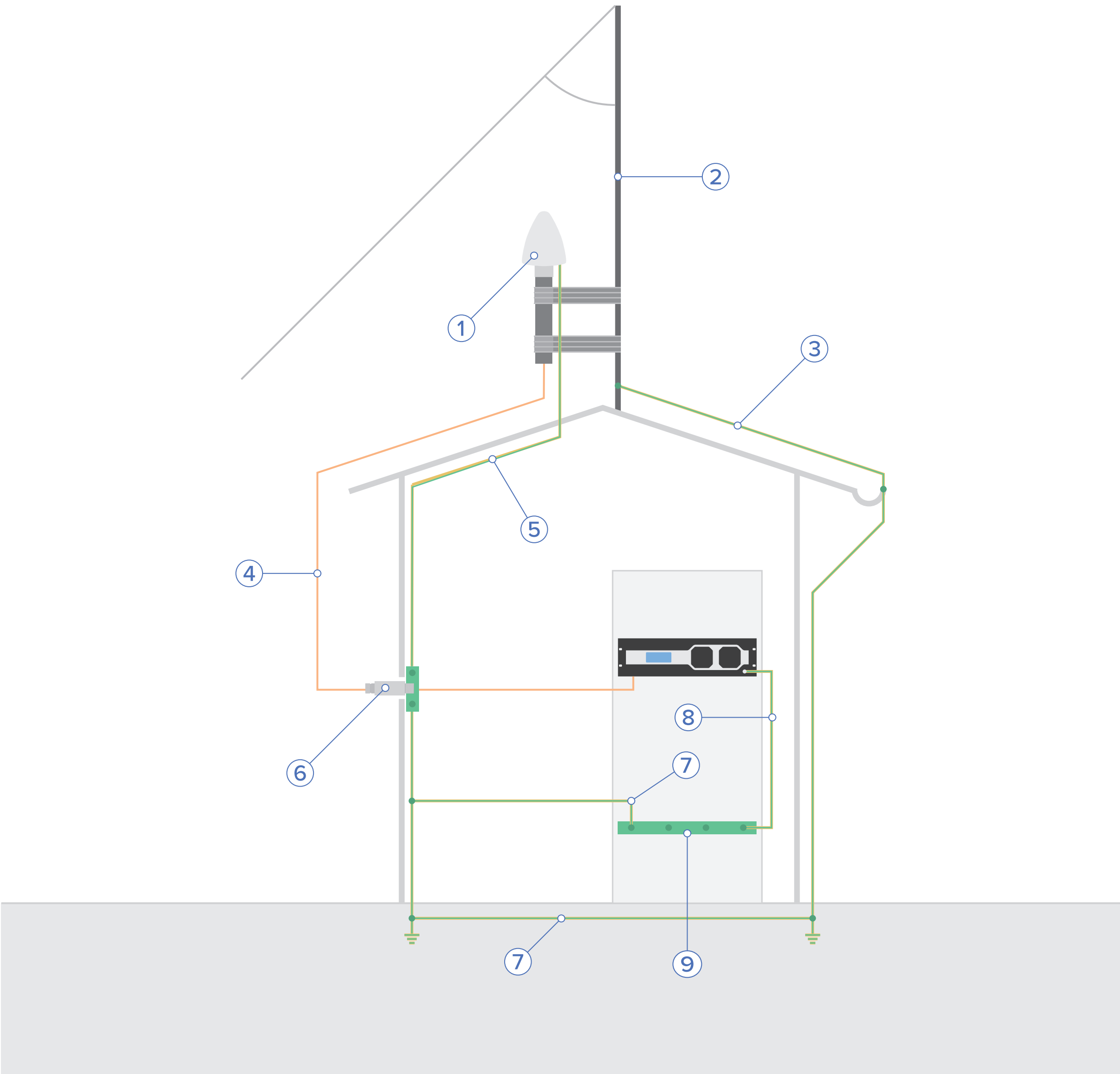


Figure 8.7: Grounding of a Roof or Wall-Mounted Antenna

1	Antenna
2	Lightning Rod
3	Lightning Rod Conductor
4	Antenna Cable
5	Antenna Ground Connection
6	Surge Protector (MGB-S-PRO)
7	Bonding Conductor
8	Ground Connection Device
9	Main Earthing Busbar
α	Safety Zone

8.1.5 In-Line Surge Protection

Information:

The MBG S-PRO surge protector and suitable coaxial cable are not included as standard with a Meinberg antenna, but can be ordered as an optional accessory.

The MBG S-PRO is a surge protector manufactured by Phoenix Contact (Type Designation CN-UB-280DC-BB) that is designed to protect devices connected via coaxial cable. Its use is optional but strongly recommended by Meinberg.

The MBG S-PRO is patched directly into the antenna line and consists of a replaceable gas discharge tube that redirects the energy from the cable shielding to the ground potential when ignited, protecting the building from a risk of fire and connected devices from possible surge voltages and likely damage or destruction. The surge protector is installed at the point of entry of the antenna cable into the building.

The MBG S-PRO must be shielded against water spray and water jets, either by means of a suitable enclosure (IP65) or a protected location.

Installation and Connection

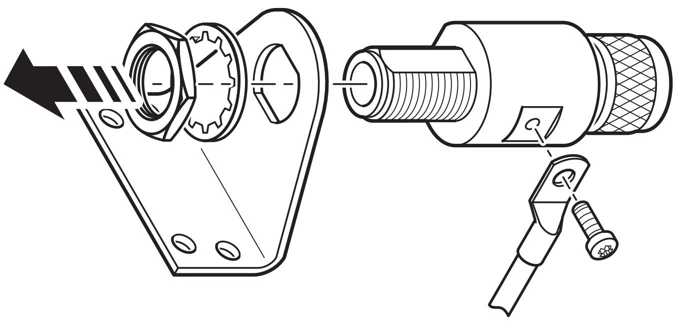


Figure 8.8: Assembly of the MBG S-PRO surge protector

1. Select a location for the installation of the MBG S-PRO. This location must be as close as possible to the point of entry into the building in order to limit the length of unprotected cable exposed to lightning strikes. The route from the ground terminal on the MBG S-PRO to the building's grounding busbar must also be as short as possible.

2. Mount the supplied mounting bracket as shown in Fig. 8.8, then fit the MBG S-PRO to the bracket.

3. Connect the MBG S-PRO to a grounding busbar using a ground conductor cable that is as short as possible. It is also important for the ground terminal of the surge protector to be connected to the same bonding bar as the connected Meinberg system in order to prevent destructive potential differences.

4. Connect the coaxial cable from the antenna to one of the surge protector connectors, then connect the other surge protector connector to the coaxial cable leading to the Meinberg reference clock.

Caution!

For safety reasons, the antenna cable must not exceed a certain length if there are no other devices such as a power distributor between the surge protector and the downstream electronic device with integrated surge protection at the mains connector level.

Please refer to the document "Technical Specifications: MBG S-PRO Surge Protector" in the appendix detailed technical specifications and a link to the data sheet.

8.2 Powering Up the System

If both the antenna and the power supply have been connected the system is ready to operate. About 10 seconds to 3 minutes after power-up the receiver has warmed up and operates with the required accuracy. If the receiver finds valid almanac and ephemeris data in its battery buffered memory and the receiver´s position has not changed significantly since its last operation the receiver can find out which satellites are in view now. Only a single satellite needs to be received to synchronize and generate output pulses, so synchronization can be achieved maximally one to 10 minutes after power-up. After 20 minutes of operation the OCXO is full adjusted and the generated frequencies are within the spezified tolerances.

If the receiver position has changed by some hundred kilometers since last operation, the satellites' real elevation and doppler might not match those values expected by the receiver thus forcing the receiver to start scanning for satellites. This mode is called Warm Boot because the receiver can obtain ID numbers of existing satellites from the valid almanac. When the receiver has found four satellites in view it can update its new position and switch to Normal Operation. If the almanac has been lost because the battery had been disconnected the receiver has to scan for a satellite and read in the current almanacs. This mode is called Cold Boot. It takes 12 minutes until the new almanac is complete and the system switches to Warm Boot mode scanning for other satellites.

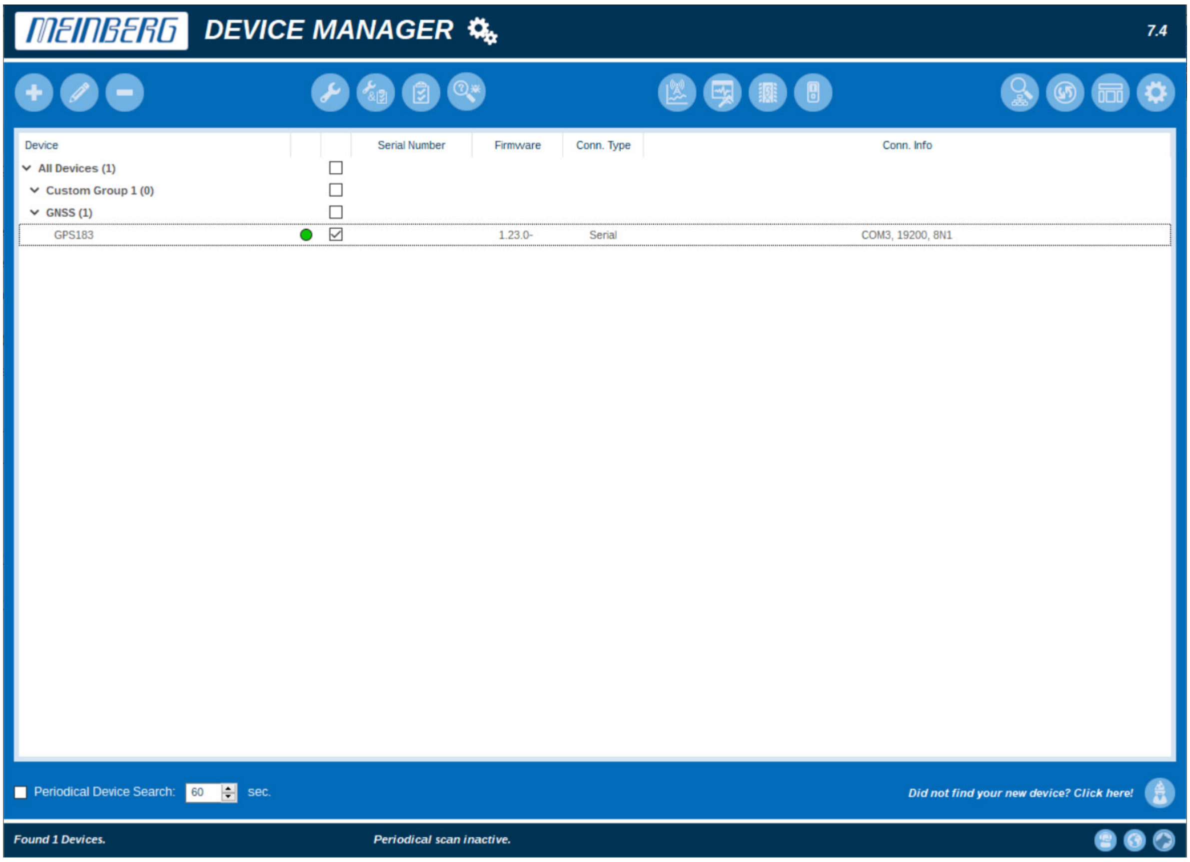
In the default mode of operation, neither pulse and synthesizer outputs nor the serial ports will be enabled after power-up until synchronization has been achieved. However, it is possible to configure some or all of those outputs to be enabled immediately after power-up. If the system starts up in a new environment (e. g. receiver position has changed or new power supply) it can take some minutes until the OCXO´s output frequency has been adjusted. Up to that time accuracy of frequency drops to 10^{-8} reducing the accuracy of pulses to $+$-3 μs.

8.3 Configuration and Monitoring with Meinberg Device Manager

The program serves the configuration of Meinberg Radio Clocks. The software can be run on the operating systems Windows 7 or higher.

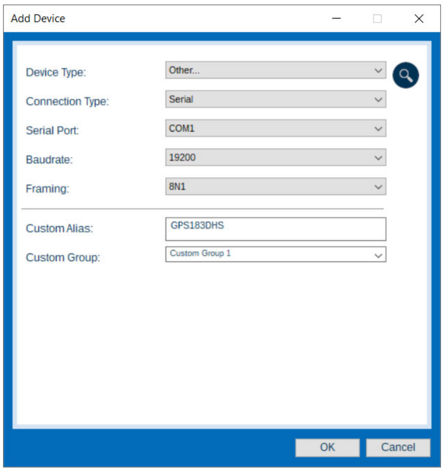
Documentation:
https://www.meinbergglobal.com/download/docs/manuals/english/meinberg-device-manager.pdf

Download:
https://www.meinbergglobal.com/english/sw/mbg-devman.htm



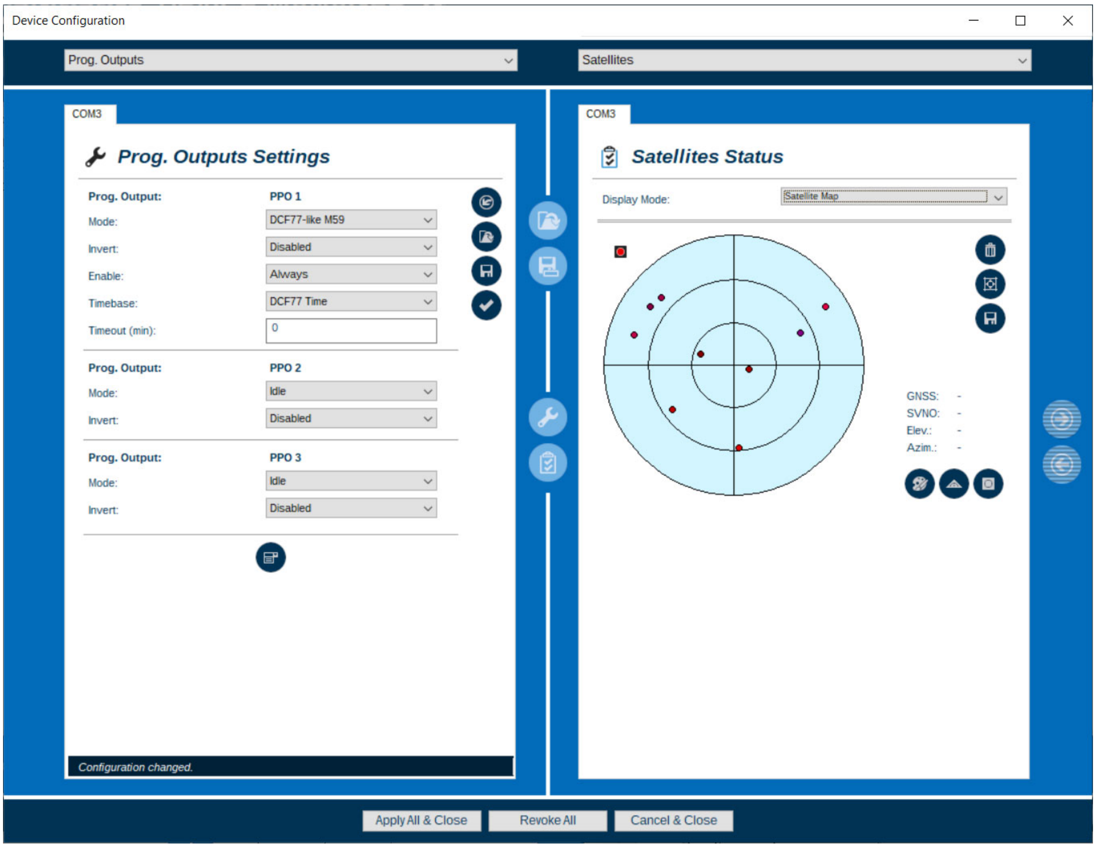
A connection between the system and the program can be done by the serial port. All possible configurations are described in the "Meinberg Device Manager" documentation.

Connection



The PC should have generated an automatic connection to the clock, select the tab "Search Device". Alternatively, you can use the button "Add Device" to generate a connection to the clock by using the same configure (Port / Baud / Framing).

Configuration and Monitoring



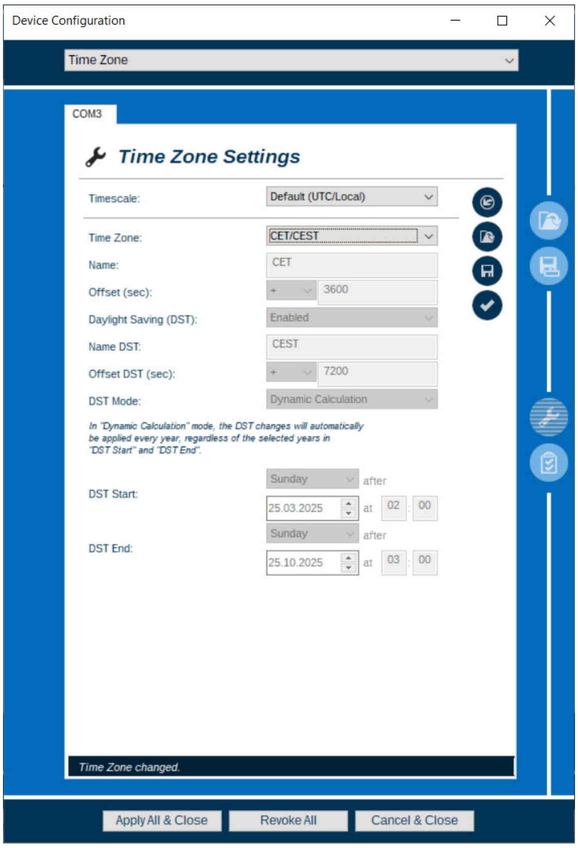
With "Configure Device" various configurations can be carried out on the system. Please note that any changes you make in the settings must always be confirmed with the "Apply Configuration" button. Use the "Restore Configuration" button to reset all settings back to their default values. For more information, please refer to the Meinberg Device Manager manual.

8.4 GPS183/D(A)HS Settings

8.4.1 Time Zone and Daylight Saving

The time zone and the switchover times for daylight saving time can be set using the "Meinberg Device Manager" software. By default, the switchover times are set to those currently applicable in the European Union (Central Europe – CET/CEST). It is also possible to disable the automatic summer/winter time changeover.

The Meinberg Device Manager manual describes how to set the parameters for other locations.



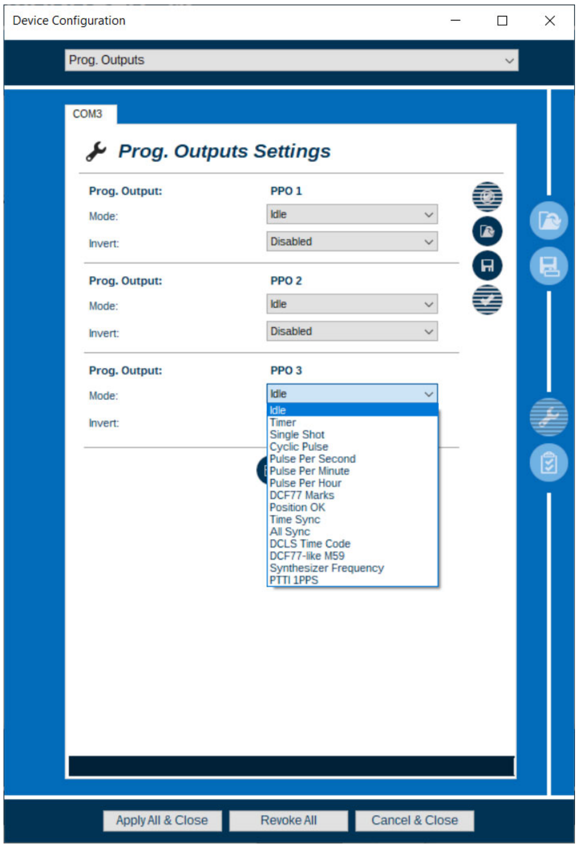
You can find more information about summer and winter time in
→ Chapter 10.1.1, "Time Zones and Daylight Saving Time"

8.4.2 Pulse Outputs

The pulse generator of the satellite controlled clock GPS containes three independant channels and is able to generate a multitude of different pulses, which are configured with the software "Meinberg Device Manager". The active state of each channel is invertible, the pulse duration settable between 10 msec and 10sec in steps of 10 msec. In the default mode of operation the pulse outputs are disabled unti the the receiver has synchronized after power-up. However, you can configure the assembly group to enable the ports immediately after switching on. The pulse outputs are electrically insulated by optocouplers or PhotoMOS relays and are available at the -X1-Interface (DMC-Connector).

The following modes can be configured for each channel independently:

- Idle
- Timer
- Single Shot
- Cyclic
- Pulse Per Sec.
- Pulse Per Min.
- Pulse Per Hour.
- DCF77-Marks
- Position OK
- Time Sync
- All Sync
- DCLS Time Code
- DCF77 like M59
- Synthesizer Frequency
- PTTI 1PPS

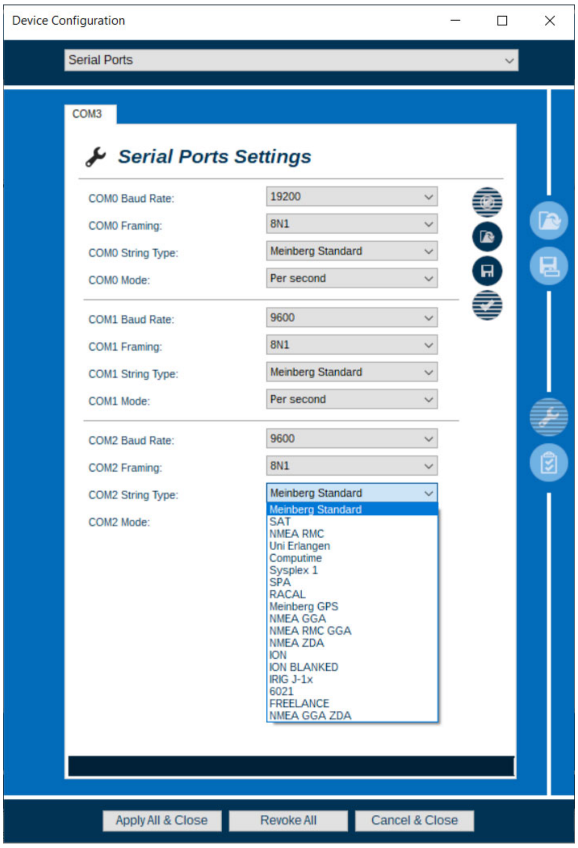


A detailed description of programmable pulse outputs can be found in
→ Chapter 10.9, “Overview of Programmable Signals”

8.4.3 Asynchronous Serial Ports

One RS-485 serial interface and two asynchronous serial interfaces (RS-232) are available to the user. By default, automatic transmission of a time string via the serial ports is disabled until the receiver has synchronized. However, it is possible to change the device configuration so that serial time strings are always transmitted immediately after power-up.

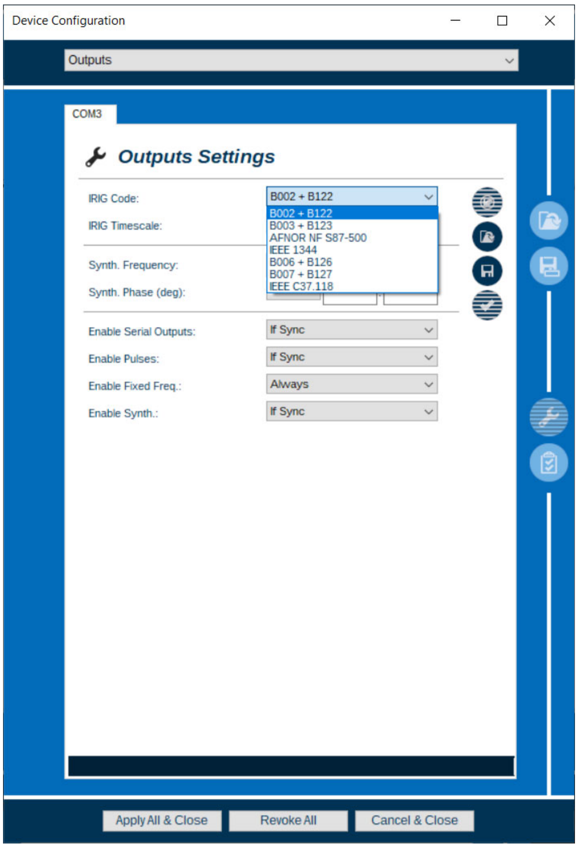
Transmission speeds, framings and the kind of the time string can be configured separately. The serial ports are sending a time string either once per second, once per minute or on request with ASCII "?" only. The format of the output strings is ASCII, see the technical specifications for details. The corresponding parameters can be set up by the program "Meinberg Device Manager" using serial port COM 0.



Detailed information about the selectable time telegrams can be found in
→ Chapter 10.8, "Time Strings"

8.4.4 Time Code Outputs

The GPS183/D(A)HS receiver provides amplitude-modulated timecode (AM) and DCLS timecode (DC Level Shift) via a BNC female connector and via the 16-pin terminal block (as programmable pulse outputs). The time code format is selected using the Meinberg "Device Manager Software". The time code format is always selected for all outputs (AM and DCLS) simultaneously.

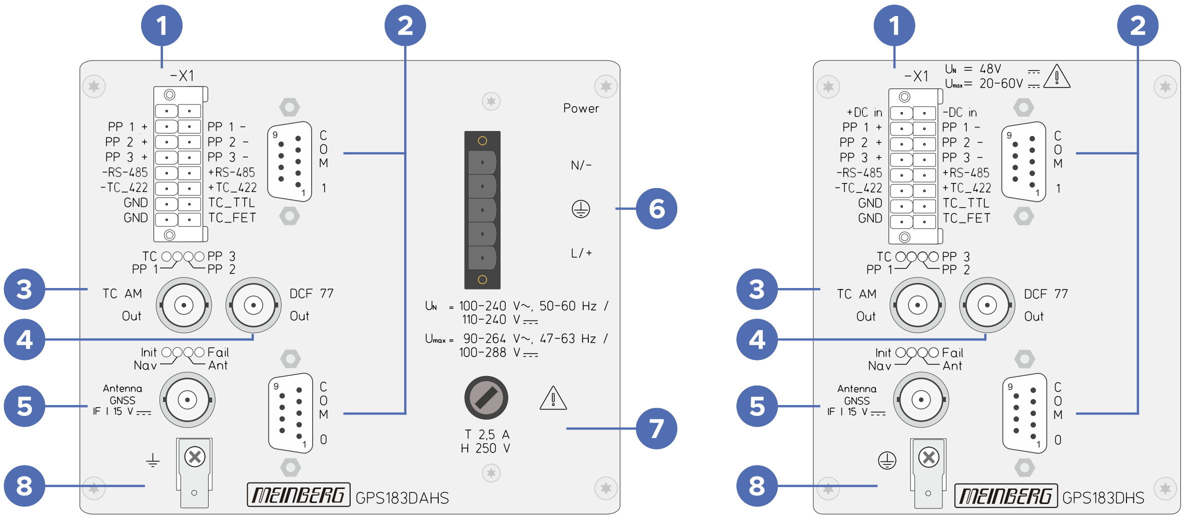


Timecode Generation

By default, timecode signals are not output until the GPS183/D(A)HS is synchronized. However, if the timecode signal needs to be output immediately after a reset regardless of the GNSS synchronization state, the "Pulses" enable flag can be set to "Always" in the Meinberg Device Manager software. In this case, the generated timecode cannot be considered to be locked to the official UTC second until the GNSS is synchronized.

For further information on time codes, please refer to → Chapter 10.10, "General Information about Timecode".

9 The Front Panel Layout



Front Panel Connectors GPS183/D(A)HS

Name	Type	Signal	Cable
COM 0, COM 1	9pin D-SUB	RS-232	shielded data line
COM 2	16pin Terminal	RS-485	data line
Optoc. Out	16pin Terminal		
DCF Out	BNC female	77.5 kHz	shielded coaxial line
Time Code			
AM Out	BNC female	3 V_{pp} into 50 Ohm	shielded coaxial line
DCLS Out	16pin Terminal	RS-422, TTL	data line
Antenna	BNC female		shielded coaxial line
Power Supply	over 16pin Terminal (DHS) over 5pin Screwterminal (DAHS)		

9.1 AC/DC Power Supply

Danger!

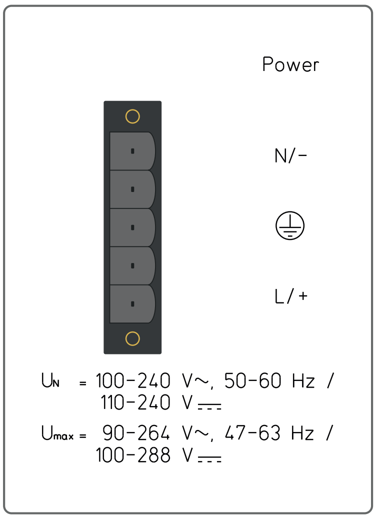
This equipment is operated at a hazardous voltage.

Danger of death from electric shock!

- This device must be connected by skilled personnel or instructed personnel only.
- **Never** handle exposed terminals or plugs while the power is on.
- All connectors must provide protection against contact with live parts in the form of a suitable plug body!
- Always ensure that wiring is safe!
- The device must be grounded by means of a connection with a correctly installed protective earth conductor (PE).

Connector Type: 5-Pin MSTB

Pin Assignment:
1: N/-
2: Not Connected
3: PE (Protective Earth)
4: Not Connected
5: L/+



Power Supply Specifications

Nominal Voltage Range:	U_N	=	100 – 240 V ~ 110 – 240 V ⎓
Rated Voltage Range:	U_{max}	=	90 V – 264 V ~ 100 V – 288 V ⎓
Nominal Current:	I_N	=	0.15 A
Rated Current:	I_{max}	=	0.6 A
Inrush current:	I_C	=	30 A @ 115 V ~ 60 A @ 230 V ~
Nominal Frequency Range:	f_N	=	50 Hz – 60 Hz
Rated Frequency Range:	f_{max}	=	47 – 63 Hz

Output Specifications

Typical Heat Output*:	E_{therm}	=	28.8 kJ/h (27.3 BTU/h)

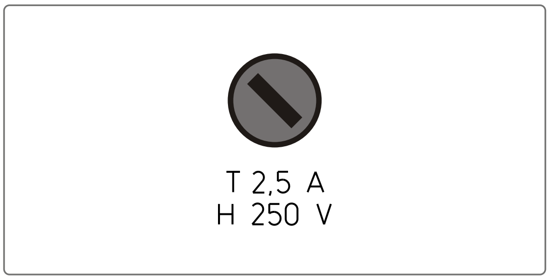
* Heat loss is calculated based on the assumption of a typical 8 W (DC) / 25 VA (AC) power draw.

9.2 Fuse

The fuse provides protection against voltage surges and short circuits and limits the risk of damage to the integrated power supply. The fuse is accessible externally and can be replaced if necessary.

Technical Specifications

Rated Voltage:	250 V
Trigger Delay:	Timelag
Rated Current:	2.5 A



Danger!

This equipment is operated at a hazardous voltage.

Danger of death from electric shock!

- The device must be disconnected from the mains! This is done using the physical power switch. Once the power switch is OFF, release the lock screws of the power connector (if applicable) and detach the connector.
- Disconnect all signal cables from the device, including antenna, fault message relay contact cables, and serial interfaces.
- Heed the safety information in → Chapter 5.4.2, "Replacing the Fuse".

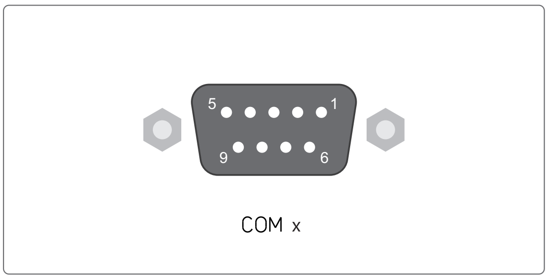
9.3 Assignment of the DSUB connectors

The serial ports COM 0 and COM 1 are accessible via 9pin DSUB connectors in the frontpanel. These RS-232 interfaces can be connected to a computer by using a standard modem cable. TxD describes the sending, RxD the receiving line of the GPS183/D(A)HS.

Connector: D-SUB female 9pin

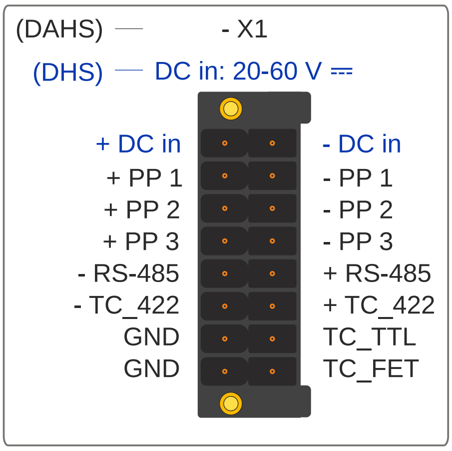
Cable: shielded data line

Assignment:
Pin 2: TxD (transmit)
Pin 3: RxD (receive)
Pin 5: GND (ground)

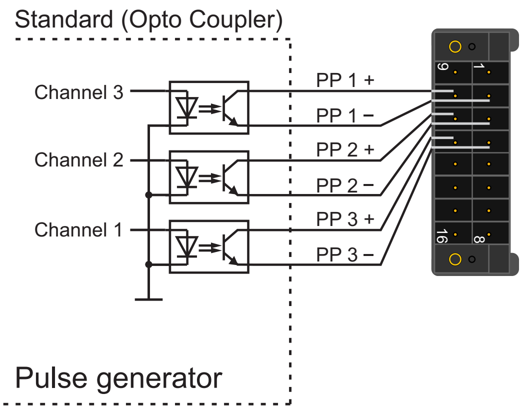


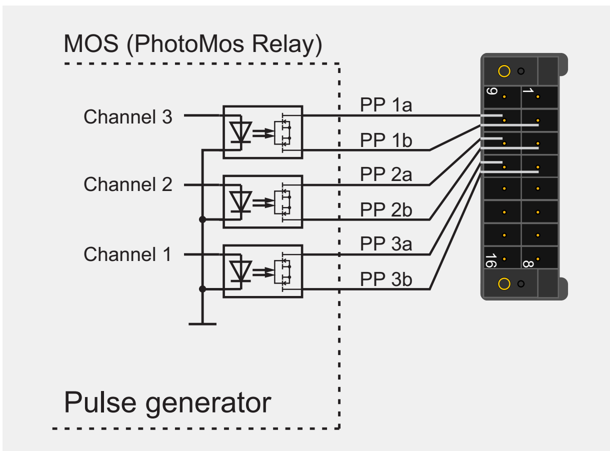
9.4 Assignment of the Terminal Block

The pulse outputs are accessible through the terminal block in the front panel. In addition, the power supply of DHS variants of the GPS183/D(A)HS is connected using two pins of this terminal block. The marking besides the terminal has the following meaning:



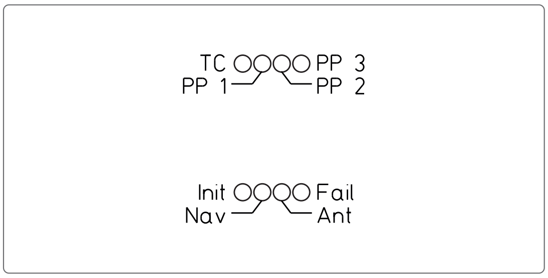
+	DC in	positive potential of power supply (.../DHS only)
-	DC in	reference potential of power supply (.../DHS only)
+	PP x	Programmable Pulse (positiv)
-	PP x	Programmable Pulse (negativ)
+	RS-485	Serial Time string (positiv)
-	RS-485	Serial Time string (negativ)
+	TC_422	Time Code (DCLS) with RS-422 level (positiv)
-	TC_422	Time Code (DCLS) with RS-422 level (negativ)
	TC_TTL	Time Code (DCLS), TTL into 50 Ω
	TC_FET	Time Code (DCLS), field-effect transistor (470 Ω to +5V)
	GND	Ground





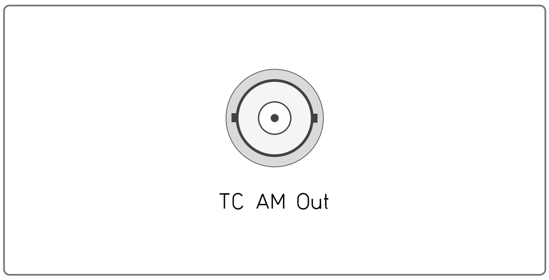
9.5 Status LEDs DMC Connector

LED Indicators



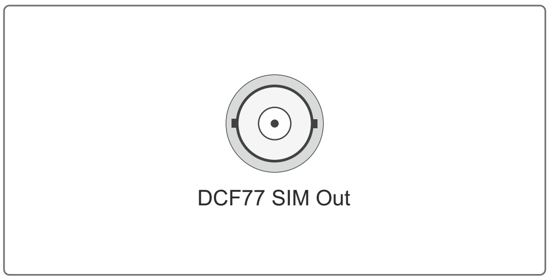
TC:	green blinking: time code signal
PP 1:	off: no signal configured green blinking: prog pulse signal
PP 2:	off: no signal configured green blinking: prog pulse signal
PP 3:	off: no signal configured green blinking: prog pulse signal
Init:	blue: while the receiver passes through the initialization phase green: the oscillator has warmed up
Nav.	green: positioning successfully
Ant:	red: antenna faulty or not connected
Fail:	red: time has not synchronized

9.6 Time Code AM Output



Carrier frequency:	1 kHz (IRIG-B)
Signal outputs:	Unbalanced sine wave-signal: 3 V_{pp} (MARK) 1 V_{pp} (SPACE) into 50 Ohm
Connector:	BNC, female
Cable:	shielded coax line

9.7 DCF77 Simulation output (-62 dBm)



Output signal:	77.5 kHz frequency
Signal level:	-62 dBm
Connection type:	BNC, female
Cable:	shielded coax line

9.8 Antenna Input: GPS Receiver

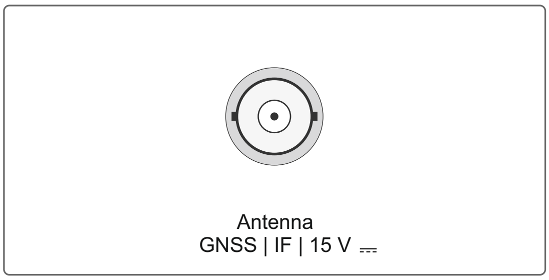
Danger!

Do not work on the antenna installation during thunderstorms!

Danger of death from electric shock!

- **Do not** carry out any work on the antenna installation or the antenna cable if there is a risk of lightning strike.
- **Do not** perform any work on the antenna installation if it is not possible to maintain the prescribed safety distance from exposed power lines or electrical substations.

Connector Type: (on device)	BNC, Female
Receiver Type:	12-Channel GPS Receiver
Signal Support:	GPS: L1 C/A (1575.42 MHz)
Mixing Frequency: (Reference Clock to Antenna)	10 MHz [1]
Intermediate Frequency: (Antenna to Reference Clock)	35.4 MHz [1]
	1) These frequencies are transferred via the antenna cable
Voltage Draw of Antenna:	15 V (via antenna cable)
Power Consumption of Antenna:	100 mA (via antenna cable)
Cable Type:	Coaxial Cable, Shielded
Cable Length:	Max. 300 m (RG58) Max. 700 m (RG213) Max. 1100 m (H2010 Ultraflex)



10 Technical Specifications GPS Receiver

Receiver:	12 channel C/A code receiver
Antenna:	GPS Antenna with remote power supply refer to → Chapter 10.3, “Technical Specifications: GPSANTv2 Antenna”
Antenna Input:	Antenna circuit dc-insulated; dielectric strength: 1000 V ⎓ Length of cable: refer to chapter "Mounting the antenna"
Time to Synchronization:	one minute with known receiver position and valid almanac 12 minutes if invalid battery buffered memory
Battery Backup:	storage of pulse configuration and important GPS-system data in the internal RAM, backed-up by lithium battery lifetime of battery 10 years min.
Pulse Outputs:	three programmable outputs

GPS183/DHS, GPS183/DAHS
DC-insulated by optocouplers
U_{CEmax} = 55 V, I_{Cmax} = 50 mA, P_{tot} = 150 mW, V_{iso} = 5000 V

pulse delay:	t_{on} e.g. 20 μsec (I_C = 10 mA) t_{off} e.g. 3 μsec (I_C = 10 mA)

GPS183/MOS/DHS, GPS183/MOS/DAHS
DC-insulated by PhotoMOS relays
U_{max} = 250 V AC/DC peak, I_{max} = 150 mA, P_{tot} = 360 mW, V_{iso} = 1500 V

pulse delay:	t_{on} e.g. 0,18 msec (I_{load} = 150 mA) t_{off} e.g. 0,07 msec (I_{load} = 150 mA)
default settings:	all pulse outputs inactive mode of operation: ’if sync’

Accuracy of Pulses:	better than +-100nsec after synchronization and 20 minutes of operation better than +-3 μsec during the first 20 minutes of operation
Serial Ports:	3 independant asynchronous serial ports

COM 0 (RS-232)

Baud Rate:	300 up to 19200
Framing:	7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 801

COM 1 (RS-232)
Baud Rate: 300 up to 19200
Framing: 7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 801

COM 2 (RS-485)

Baud Rate:	300 up to 19200
Framing:	7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 801

time string selectable for COM 0, COM 1 and COM 2
possible string types in chapter: Time Stings

	default settings:	COM 0: 19200, 8N1 COM 1, COM 2: 9600, 8N1 'Standard Meinberg' time string per second mode of operation 'if sync'

Time Code Outputs:

modulated via BNC-connector:
3 V_{pp} (MARK), 1 V_{pp} (SPACE) into 50Ω

unmodulated via 16-pin terminal:
Field effect transistor with internal pull-up (1 kΩ) to +5 V

Data of transistor:
Uds_{max} = 100 V, Id_{max} = 150 mA, P_{max} = 250 mW

TTL into 50Ω
RS422

DCF77 Emulation:

AM-modulated 77.5 kHz carrier frequency
usable as replacement for a DCF77 antenna
output level approximately -55 dBm (unmodulated)

Power Requirements:

GPS183DHS
20-60 V DC
DC-isolation 1.5 kV DC

GPS183DAHS
100-240 V DC
100-240 V AC, 50-60 Hz
Fuse: 250 V, 2.5 A, SB

Dimension:

GPS183/DHS
105 mm x 85 mm x 104 mm (height x width x depth)

GPS183/DAHS
105 mm x 125.5 mm x 104 mm (height x width x depth)

Connectors:

coaxial BNC connectors for antenna/converter unit, AM modulated DCF77 output and modulated time code output
16-pole terminal block for connection of:
- pulse outputs
- power supply (GPS183DHS and GPS183/MOS/DHS only)

DAHS, MOS/DAHS: 5pol. Screwterminal

Ambient Temperature:

0 ... 50°C

Humidity:

85% max.

10.1 How Satellite Navigation Works

The use of a receiver for location tracking and time synchronization relies on the ability to measure the satellite-to-receiver propagation delay as precisely as possible. It is necessary to have simultaneous reception from at least four satellites so that the receiver can determine its relative spatial position in three dimensions (x, y, z) and measure the deviation of its clock against the system clock. Monitoring stations around the planet track the orbital trajectory of the satellites and detect deviations between the local atomic clocks and the system time. The collected data is transmitted up to the satellites, which then send navigation data back to Earth.

The high-precision trajectory data of each satellite, known as the satellite's ephemeris, is needed by the receiver to continuously calculate the precise location of the satellites in space. A roughly defined ephemeridal schedule based on empirical data, referred to as an almanac, is used by a receiver to identify which satellites are visible above the horizon given a known approximate location and time. Each satellite transmits its own ephemeridal schedule as well as the almanacs of all existing satellites.

Satellite Systems

GPS was installed by the United States Department of Defense (US DoD) and operates at two performance levels: the Standard Positioning Service, or SPS, and the Precise Positioning Service, or PPS. The structure of the messages transmitted by the SPS has been openly published and reception is provided for public use. The timing and navigation data of the more precise PPS is encrypted and is thus only accessible to certain (usually military) users.

GLONASS was originally developed by the Russian military for real-time navigation and ballistic missile guidance systems. GLONASS satellites also send two types of signal: a Standard Precision Signal (SP) and an encrypted High Precision Signal (HP).

BeiDou is a Chinese satellite navigation system. The second-generation system, officially referred to as the BeiDou Navigation Satellite System (BDS) and also known as "COMPASS", consists of 35 satellites. BeiDou entered service in December 2011 with ten satellites and was made available to users in the Asia-Pacific region. The system was completed in June 2020 with the launch of the final satellite.

Galileo is an in-development global European satellite navigation and time reference system controlled by a civilian authority (European Union Agency for the Space Programme, EUSPA). Its purpose is the worldwide delivery of high-precision navigation data and is similarly structured to the American GPS, Russian GLONASS and Chinese BeiDou systems. The main differences in the systems lie in their approaches to frequency usage & modulation and the satellite constellation.

10.1.1 Time Zones and Daylight Saving Time

GPS System Time is a linear timescale that was synchronized with the international UTC timescale (Coordinated Universal Time) when the satellite system became operational in 1980. Since it has entered service, however, several leap seconds have been introduced to the UTC timescale to adjust UTC time to irregularities in the Earth's rotation. While GPS System Time deviates from UTC time by several seconds for this very reason, satellite messages do incorporate the number of seconds by which these timescales deviate from one another, allowing GPS receivers to be synchronized internally with the international UTC timescale.

The receiver's microprocessor can identify any time zone based on UTC time and automatically apply Daylight Saving Time adjustments over several years if so configured by the user.

10.2 The Importance of Good Antenna Positioning

This chapter aims to provide some basic technical background as to the factors that influence good GNSS antenna positioning.

GNSS Receiver Basics

A GNSS antenna captures signals from satellites visible in the sky (referred to as *live-sky signals*). These signals are transmitted by constellations of satellites (also known as *space vehicles* or SVs) in a medium Earth orbit of generally between 20,000 and 30,000 km above sea level.

GNSS antennas used by Meinberg receivers are directional antennas designed to be installed vertically in order to receive live-sky signals within their *signal cone*, which is a reception field spreading out from the antenna up to the sky.

In the case of the GNSS Multi-Band Antenna, this signal cone is approximately 120° relative to the zenith (straight up) to ensure that the antenna can capture a strong a signal as possible even at the horizontal extremes (90° from the zenith). This signal cone can be disrupted by solid objects or other radio signals in its path.

There is a certain margin of error involved in calculating a position based on the distance between an antenna and the satellites visible within the signal cone. Because of this margin of error (known as *dilution of precision*), the position calculated between two measurements can vary even though the antenna and receiver are physically in exactly the same place. Dilution of precision can be influenced by factors outside of the influence of the receiver, such as ionospheric interference, but some factors can be affected by well-considered antenna positioning that maximizes the visible sky while minimizing potential sources of interference.

Impact of GNSS Lock Count on Clock Accuracy

An antenna used for a Meinberg GNSS receiver requires a lock on the live-sky signals from at least four satellites within the antenna's (ideally undisrupted) signal cone for the receiver to properly, accurately, and consistently determine its position, which it does by generating a *navigation solution*. The more satellites that are visible, the more options the receiver has to generate a *strong solution*, in which the satellites are far apart and the dilution of precision is lower, resulting in a more accurate position fix. This improves the stablility of the position that is measured from solution to solution.

The specified accuracy of synchronized Meinberg systems assume clear-sky conditions for GNSS receivers, such that any obstructions antithetical to clear-sky conditions may reduce clock accuracy accordingly.

It is therefore important for an antenna to have as much direct exposure to the sky as possible, as this increases the chances of more live-sky signals being correctly detected and improves the quality of the position detection. Obstructions such as buildings or trees reduce or eliminate the chance of live-sky signals being correctly received from that direction, limit the strength of the navigation solution, and can also produce *multipath interference* (see below).

In locations between the 55th parallels, a clear view to the northern and/or southern horizons is especially important in increasing the number of GNSS satellites visible at any given time, because the *ground tracks* of the GPS and Galileo satellite orbits converge with greater frequency around the 55th parallels and the equator of the Earth.

In locations **north** of the **55th north parallel** (e.g., much of Canada, Scandinavia, Greenland, Alaska) GNSS reception is less reliable, as the further north the receiver is located, the less likely GNSS reception at the zenith becomes. As such, a clear view to the north is *less* beneficial and a clear, unobstructed view to the south becomes *more* important.

Conversely, in locations **south** of the **55th south parallel** (principally Antarctica, but also small parts of Brazil, Chile, and Argentina), GNSS reception at the zenith becomes more problematic the further south the receiver is located. As such, a clear view to the **south** is *less* beneficial here, while a clear, unobstructed view to the

north becomes *more* important.

Radio-Frequency Interference

GNSS signals are conventionally very weak—typically as low as –120 to –130 dBm at ground level. For a common point of reference, the signal strength of a 2.4 GHz wi-fi router at the extremes of its range must be –80 dBm to maintain a stable connection.

With this in mind, radio-frequency interference plays a significant role in GNSS signal reception and must therefore factor into your choice of installation location. Even minor electromagnetic and other radio-frequency interference from other antennas, overhead power lines, and electrical equipment such as HVAC units and cameras can introduce errors, as can a general proximity to metallic surfaces.

Further information on RF emissions from other devices may be obtainable from the documentation of those devices, but as a general rule, a distance of 50 cm from other GNSS antennas, at least 10 m from camera systems (regardless of radio or cable transmission) or HVAC units, and at least 30 m from transmission antennas should be maintained.

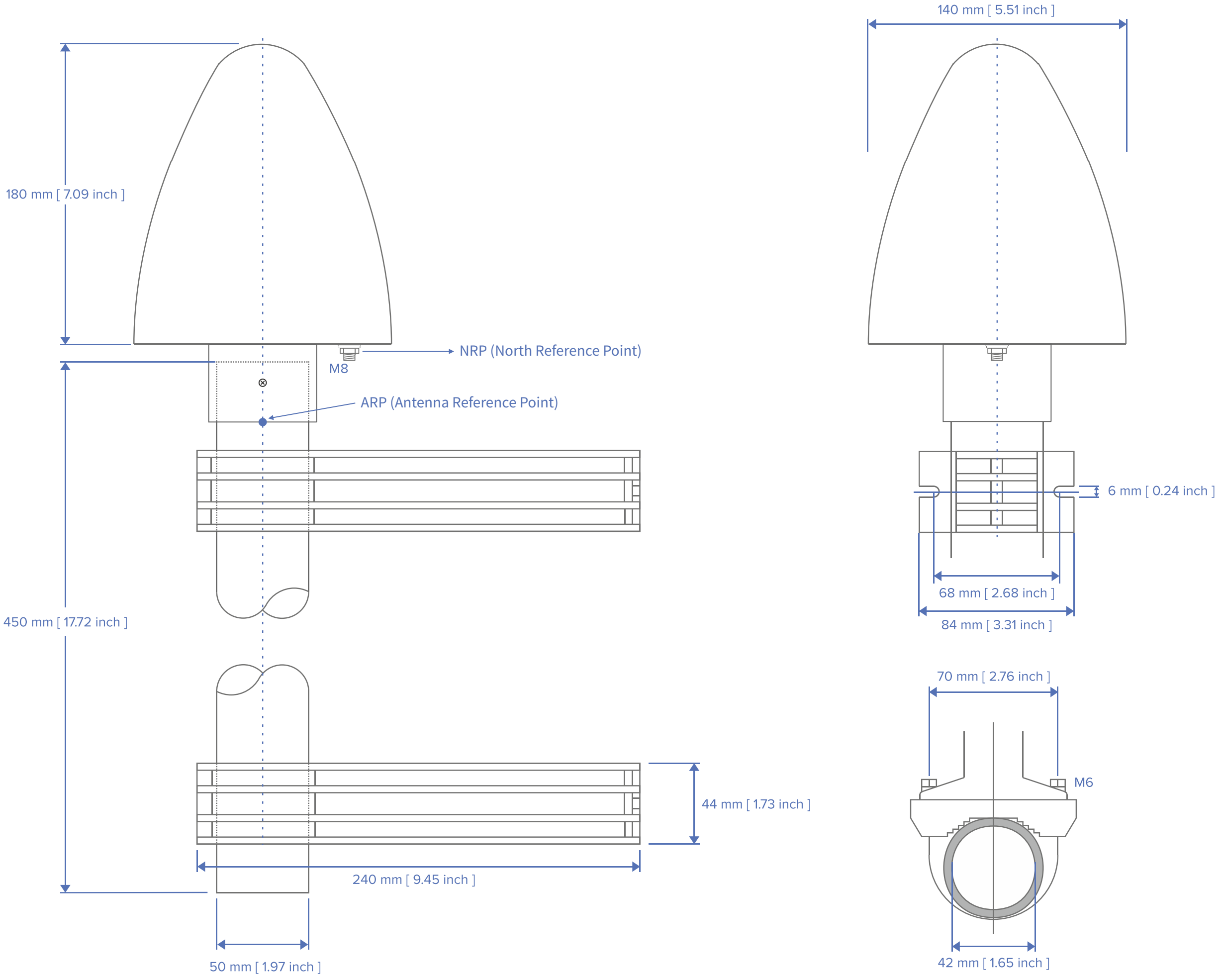
Multipath Interference

To enable GNSS antennas to receive sky signals reliably even at horizon level, the signal cone of an antenna typically encompasses the ground to a certain degree. This can be problematic in that GNSS signals can be 'reflected' from terrestrial surfaces such as the ground (as well as other buildings or other vertical surfaces) and are essentially an 'echo' of an otherwise directly received GNSS signal. These signals are referred to as 'multipath interference' and can significantly disrupt a Meinberg receiver's ability not only to determine its position but also acquire the time from the GNSS signal.

The mitigation of multipath interference relies first and foremost on the directional antenna being mounted vertically, so that the center of the signal cone is directed towards the zenith and is perpendicular to the horizon to ensure that as little of the signal cone is facing the ground as possible. Maximizing the elevation of the antenna above any vertical faces of surrounding architecture and landscape features also plays a significant role in mitigating the impact of multipath interference.

10.3 Technical Specifications: GPSANTv2 Antenna

Physical Dimensions



Electrical Specifications

Power Supply: (via Antenna Cable)	15 V ± 3 V
Nominal Current Draw: (via Antenna Cable)	Approx. 100 mA at 15 V, max. 115 mA

Signal Reception & Processing

Reception Frequency:	1575.42 MHz (GPS L1/Galileo E1 Band)
Axial Ratio:	≤ 3 dB at zenith
Element Gain:	Typically 5.0 dBic at zenith
Mixing Frequency:	10 MHz
Intermediate Frequency:	35.4 MHz
Out-of-Band Rejection:	≥ 70 dB @ 1555 MHz ≥ 55 dB @ 1595 MHz
Conversion Gain: Antenna Input to IF Output	59 dB ± 3 dB
Noise Figure:	Typically 1.8 dB, maximum 3 dB at +25 °C
Input Filter Survival Capacity:	Exposure to > 13 dBm for 24 h without destruction
Conversion Delay: (Patch Connector to IF Output)	Typically 152 ns ± 5 ns
Group Delay Ripple within 2.4 MHz System Bandwidth:	Max. 15 ns
Polarization:	Right-Hand Circular Polarization
ETSI-Compliant Frequency Blocking:	Blocked frequency range further extended to 6 GHz
	–40 dBm
P1dB Input:	
Antenna Pattern:	Vertical 3 dB Angle Width: 100° centered around azimuth

Connection

Connector Type:	Type-N, Female
Nominal Impedance:	50 Ω
Voltage Standing Wave Ratio (VSWR):	≤ 1.5 : 1
Grounding Terminal:	M8 threaded bolt and hexagon nut for use with corresponding ring lug

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Specifications for Interference Immunity

Surge Protection:	Level 4 (per IEC 61000-4-5) Test Voltage: 4000 V Max. Peak Current @ 2 Ω: 2000 A
ESD Protection:	Level 4 (per IEC 61000-4-2) Contact Discharge: 8 kV Air Discharge: 15 kV

Mechanical and Environmental Specifications

Housing Material:	ABS Plastic Case for Outdoor Installation
Specified Environment:	Outdoor Environments
IP Rating:	IP65
Temperature Range (Operation):	–60 °C to +80 °C (–76°C to +176 °F)
Temperature Range (Storage):	–20 °C to +70 °C (–4°C to +158 °F)
Relative Humidity (Operation):	5 % to 95 % (non-condensing)
Weight:	1.4 kg (3.09 lbs), including mounting kit

10.4 Antenna Cable

Meinberg provides suitable cable types with its antennas and these are ordered together with the antenna to match the length you need from your antenna to your Meinberg reference clock. The route to be covered for your antenna installation should be determined and the appropriate cable type selected accordingly before confirming your order.

Important!

Please avoid using a mixture of different cable types for your antenna installation. This should be taken into consideration in particular when purchasing additional cable, for example in order to extend an existing cable installation.

The cable is shipped with both ends fitted with the appropriate connectors as standard, although the cable can also be shipped without any pre-fitted connectors if so requested.

The table below shows the specifications of the supported cable types for the transmission of the 35 MHz intermediate frequency for cables supplied by Meinberg. For cables from sources other than Meinberg, please refer to the data sheet of that cable.

Cable Type	RG58C/U	RG213	H2010 (Ultraflex)
Signal Propagation Time at 35 MHz*	503 ns/100 m	509 ns/100 m	387 ns/100 m
Attenuation at 35 MHz	8.48 dB/100 m	3.46 dB/100 m	2.29 dB/100 m
DC Resistance	5.3 Ω/100 m	1.0 Ω/100 m	1.24 Ω/100 m
Cable Diameter	5 mm	10.3 mm	10.2 mm
Max. Cable Length	300 m	700 m	1100 m

Table: Specifications of cable types recommended by Meinberg

* The propagation times are specified on the basis of 100 m cable; these values can be used as a reference to calculate the propagation time of any other arbitrary length of cable. Please note that these values are based on real measurements performed by Meinberg engineers on available cable. When performing your own measurements or calculating propagation delay based on the specifications provided in the data sheet for your cable, the results may vary slightly from this table.

Compensating for Signal Propagation Time

The signal propagation time can be compensated for in Meinberg Device Manager by entering the length of the antenna cable under "**Settings** → **Clock**".

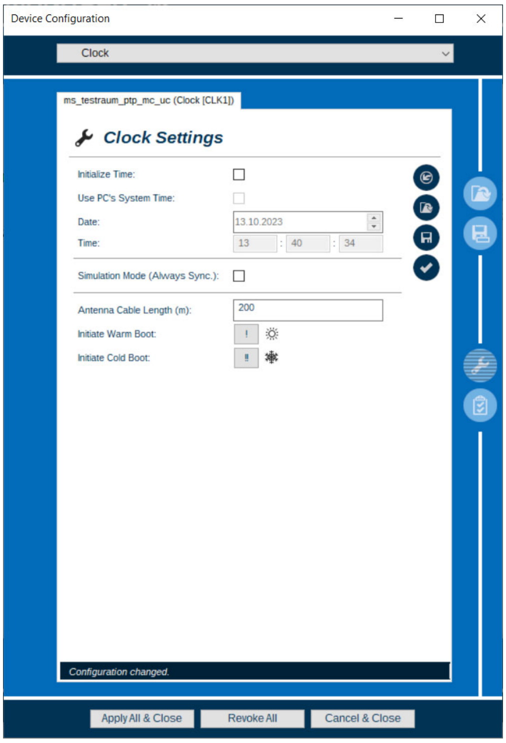


Illustration: "Clock" menu in Meinberg Device Manager

10.5 Technical Specifications: MBG S-PRO Surge Protector

The MBG S-PRO is a surge protector manufactured by Phoenix Contact (Type Designation CN-UB-280DC-BB) and designed to protect coaxial connections. It is patched directly into the antenna line and consists of a replaceable gas discharge tube that redirects the energy from the cable shielding to the ground potential when ignited. Connect the MBG S-PRO using a ground conductor cable that is as short as possible.

The MBG S-PRO has no dedicated input/output polarity and no preferred installation orientation.

Figure 10.1: MBG S-PRO Surge Protector (Phoenix CN-UB-280DC-BB)

Features

- Excellent RF Performance
- Multiple Strike Capability
- 20 kA Surge Protection
- Bidirectional Protection

Contents of Package:	Surge Protector with Mounting Bracket and Accessories
Product Type:	Surge Protector for Transmission and Receiver Devices
Construction Type:	In-Line Breaker
Connector Types:	Type-N, Female/Type-N, Female

The original product page of the supplier (see link) of the CN-UB-280DC-BB surge protector provides detailed specifications, as well as a variety of product-specific documents under the link below:

Data Sheet (Download):

https://www.meinbergglobal.com/download/docs/shortinfo/english/cn-ub-280dc-bb_pc.pdf

10.6 Connection Data DFMC-connector

Conductor cross section solid min.	0.2 mm^2
Conductor cross section solid max.	1.5 mm^2
Conductor cross section flexibel min.	0.2 mm^2
Conductor cross section flexibel max.	1.5 mm^2
Conductor cross section flexible, with ferrule, without plastic sleeve min.	0.25 mm^2
Conductor cross section flexible, with ferrule, without plastic sleeve max.	1.5 mm^2
Conductor cross section flexible, with ferrule, with plastic sleeve min.	0.25 mm^2
Conductor cross section flexible with ferrule, with plastic sleeve max.	0.75 mm^2
Conductor cross section AWG min.	24
Conductor cross section AWG max.	16
AWG according to UL/CUL min.	16
AWG according to UL/CUL max.	24

Specifications for ferrules

Ferrules without insulating collar, according to DIN 46228-1	Cross-section: 0.25 mm^2;	length: 5 mm ... 7 mm
	Cross-section: 0.34 mm^2;	length: 7 mm
	Cross-section: 0.5 mm^2;	length: 8 mm ... 10 mm
	Cross-section: 0.75 mm^2;	length: 8 mm ... 10 mm
	Cross-section: 1 mm^2;	length: 8 mm ... 10 mm
	Cross-section: 1.5 mm^2;	length: 10 mm
Ferrules with insulating collar, according to DIN 46228-4	Cross-section: 0.14 mm^2;	length: 8 mm
	Cross-section: 0.25 mm^2;	length: 8 mm ... 10 mm
	Cross-section: 0.34 mm^2;	length: 8 mm ... 10 mm
	Cross-section: 0.5 mm^2;	length: 8 mm ... 10 mm
	Cross-section: 0,75 mrn^2;	length: 8 mm ... 10 mm

10.7 Oscillator Specifications

	TCXO	OCXO-SQ	OCXO-HQ	OCXO-DHQ
Short-Term Stability (where t = 1 second)	2×10^{-9}	5×10^{-10}	5×10^{-12}	2×10^{-12}
Pulse-per-Second Accuracy	< ± 100 ns	< ± 50 ns	< ± 50 ns	< ± 50 ns
Phase Noise	1 Hz: -60 dBc/Hz 10 Hz: -90 dBc/Hz 100 Hz: -120 dBc/Hz 1kHz: -130 dBc/Hz	1 Hz: -70 dBc/Hz 10 Hz: -105 dBc/Hz 100 Hz: -125 dBc/Hz 1kHz: -140 dBc/Hz	1 Hz: -85 dBc/Hz 10 Hz: -115 dBc/Hz 100 Hz: -130 dBc/Hz 1kHz: -140 dBc/Hz	1 Hz: -80 dBc/Hz 10 Hz: -110 dBc/Hz 100 Hz: -125 dBc/Hz 1kHz: -135 dBc/Hz
Frequency Accuracy in Free-Run Mode (1 Day)	$\pm 1 \times 10^{-7}$ ± 1 Hz	$\pm 5 \times 10^{-9}$ ± 50 mHz	$\pm 5 \times 10^{-10}$ ± 5 mHz	$\pm 1 \times 10^{-10}$ ± 1 mHz
Frequency Accuracy in Free-Run Mode (1 Year)	$\pm 1 \times 10^{-6}$ ± 10 Hz	$\pm 2 \times 10^{-7}$ ± 2 Hz	$\pm 5 \times 10^{-8}$ ± 0.5 Hz	$\pm 1 \times 10^{-8}$ ± 0.1 Hz
Frequency Accuracy with GPS Synchronization	$\pm 1 \times 10^{-11}$	$\pm 1 \times 10^{-11}$	$\pm 1 \times 10^{-12}$	$\pm 1 \times 10^{-12}$
Time-of-Day Accuracy in Free-Run Mode (1 Day)	± 4.3 ms	± 65 µs	± 10 µs	± 4.5 µs
Time-of-Day Accuracy in Free-Run Mode (7 Days)	± 128 ms	± 9.2 ms	± 1.0 ms	± 204 µs
Time-of-Day Accuracy in Free-Run Mode (30 Days)	± 1.1 s	± 120 ms	± 16 ms	± 3.3 ms
Time-of-Day Accuracy in Free-Run Mode (1 Year)	± 16 s	± 4.7 s	± 788 ms	± 158 ms
Temperature-Dependent Drift in Free-Run Mode	$\pm 1 \times 10^{-6}$ (–20 to 70 °C)	$\pm 1 \times 10^{-7}$ (–10 to 70 °C)	$\pm 1 \times 10^{-8}$ (5 to 70 °C)	$\pm 2 \times 10^{-10}$ (5 to 70 °C)

10.8 Time Strings

10.8.1 Meinberg Standard Time String

The Meinberg Standard time string is a sequence of 32 ASCII characters, starting with the character <STX> (Start of Text, ASCII code 02h) and terminated with the character <ETX> (End of Text, ASCII code 03h). The format is as follows:

<STX>D:*dd.mm.yy*;T:*w*;U:*hh.mm.ss*;*uvxy*<ETX>

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

<STX>	Start of Text, ASCII code 02h sent with one-bit accuracy at the change of each second		
dd.mm.yy	The date:		
	dd	Day of the month	(01–31)
	mm	Month	(01–12)
	yy	Year of the Century	(00–99)
w	The day of the week		(1–7, 1 = Monday)
hh.mm.ss	The time:		
	hh	Hours	(00–23)
	mm	Minutes	(00–59)
	ss	Seconds	(00–59, or 60 during leap second)
uv	Clock status characters (depending on clock type):		
	u:	"#"	GPS: Clock is in free-run mode (no exact synchronization) PZF: Time frame not synchronized DCF77: Clock has not synchronized since last reset
	" "	(Space, 20h) GPS: Clock is synchronized (base accuracy is reached) PZF: Time pattern synchronized DCF77: Clock has synchronized since last reset	
	v:	"*" GPS: Receiver has not yet verified its position PZF/DCF77: Clock currently in free-run mode	
	" "	(Space, 20h) GPS: Receiver has determined its position PZF/DCF77: Clock is synchronized with transmitter	
x	Time zone indicator:		
	"U"	UTC	Universal Time Coordinated, formerly GMT
	" "	CET	European Standard Time, Daylight Saving Time active
	"S"	(CEST) Central European Summer Time, Daylight Saving Time inactive	
y	Announcement of clock jump during last hour before jump enters effect:		
		"!"	Announcement of start or end of Daylight Saving Time
		'A'	Announcement of leap second insertion
		" "	(Space, 20h) nothing announced
<ETX>	End of Text, ASCII code 03h		

10.8.2 SAT Time String

The SAT time string is a sequence of 29 ASCII characters, starting with the character `<STX>` (Start of Text, ASCII code 02h) and terminated with the character `<ETX>` (End of Text, ASCII code 03h). The format is as follows:

<STX>*dd.mm.yy/w/hh:mm:ssxxxxuv*<ETX>

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

`<STX>` Start of Text, ASCII code 02h sent with one-bit accuracy at the change of each second

`dd.mm.yy` The date:

dd	Day of the month	(01–31)
mm	Month	(01–12)
yy	Year without century	(00–99)

`w` The day of the week (1–7, 1 = Monday)

`hh:mm:ss` The current time:

hh	Hours	(00–23)
mm	Minutes	(00–59)
ss	Seconds	(00–59, or 60 during leap second)

`xxxx` Time zone identifier:

"UTC"	Universal Time Coordinated, formerly GMT
"CET"	European Standard Time, daylight saving disabled
"CEST"	Central European Summer Time, Daylight Saving Time active

`u` Clock status characters:

"#"	Clock has not synchronized since last reset
" "	(Space, ASCII code 20h) Clock has synchronized since last reset

`v` Announcement for time jump during last hour before event:

"!" Announcement of start or end of Daylight Saving Time

" "(Space, ASCII code 20h) nothing announced

`<CR>` Carriage Return, ASCII code 0Dh

`<LF>` Line Feed, ASCII code 0Ah

`<ETX>` End of Text, ASCII code 03h

10.8.3 NMEA 0183 String (RMC)

The NMEA 0183 RMC time string is a sequence of 65 ASCII characters, starting with the string "$GPRMC" and terminated with the sequence <CR> (Carriage Return, ASCII code 0Dh) und <LF> (Line Feed, ASCII code 0Ah). The format is as follows:

`$GPRMC,hhmmss.ff,A,bbbb.bb,n,lllll.ll,e,0.0,0.0,ddmmyy,0.0,a*hh<CR><LF>`

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

`$`	Start character, ASCII code 24h sent with one-bit accuracy at the change of each second		
`GP`	Device ID, in this case "GP" for GPS		
`RMC`	Message type ID, in this case "RMC"		
`hhmmss.ss`	The current time:		
	`hh`	Hours	(00–23)
	`mm`	Minutes	(00–59)
	`ss`	Seconds	(00–59, or 60 during leap second)
	`ff`	Fractional seconds	(1/10 ; 1/100)
`A`	Status (A = Time data valid, V = Time data not valid)		
`bbbb.bb`	Geographical latitude of the receiver position in degrees Leading zeroes are padded with spaces (ASCII code 20h)		
`n`	Geographical hemisphere, possible characters are:		
	"`N`"	North of Equator	
	"`S`"	South of Equator	
`lllll.ll`	Geographical longitude of the receiver position in degrees Leading zeroes are padded with spaces (ASCII code 20h)		
`e`	Prime meridian hemisphere, possible characters are:		
	"`E`"	East of Greenwich Meridian	
	"`W`"	West of Greenwich Meridian	
`0.0,0.0`	Speed over the ground in knots and track angle in degrees. With a Meinberg GPS clock, these values are always 0.0, with GNS clocks, the values are calculated by the receiver for mobile applications.		
`ddmmyy`	Current Date:		
	`dd`	Day of the month	(01–31)
	`mm`	Month	(01–12)
	`yy`	Year of Century	(00–99)
`a`	Magnetic variation E/W		
`hh`	Checksum (XOR sum of all characters except "$" and "*")		
`<CR>`	Carriage Return, ASCII code 0Dh		
`<LF>`	Line Feed, ASCII code 0Ah		

10.8.4 NMEA 0183 Time String (GGA)

The NMEA 0183 GGA string is a sequence of characters starting with the string “$GPGGA” and ending with the characters <CR> (Carriage Return) and <LF> (Line Feed). The format is as follows:

$GPGGA,*hhmmss.ff*,*bbbb.bbbbb*,*n*,*lllll.ll*,*e*,*A*,*vv*,*hhh.h*,*aaa.a*,M,
ggg.g,M,,0*cs<CR><LF>

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

$	Start character, ASCII code 24h sent with one-bit accuracy at the change of each second
GP	Device ID, in this case “GP” for GPS
GGA	Message type ID, in this case “GGA”
hhmmss.ss	The current time: *hh* Hours (00–23) *mm* Minutes (00–59) *ss* Seconds (00–59, or 60 while leap second) *ff* Fractional seconds (1/10 ; 1/100)
bbbb.bbbbb	Geographical latitude of receiver position in degrees Leading zeroes are padded with spaces (ASCII code 20h)
n	Geographical hemisphere, possible characters are: “N” North of Equator “S” South of Equator
lllll.lllll	Geographical longitude of the receiver position in degrees Leading zeroes are padded with spaces (ASCII code 20h)
e	Prime meridian hemisphere, possible characters are: “E” East of Greenwich Meridian “W” West of Greenwich Meridian
A	Position determined (1 = yes, 0 = no)
vv	Number of satellites used (0–12)
hhh.h	HDOP (Horizontal Dilution of Precision)
aaa.h	Mean Sea Level Altitude (MSL Altitude = WGS84 Altitude - Geoid Separation)
M	Meters (unit as fixed value)
ggg.g	Geoid Separation (WGS84 Altitude - MSL Altitude)
M	Meters (unit as fixed value)
cs	Checksum (XOR sum of all characters except "$" and "*")
<CR>	Carriage Return, ASCII code 0Dh
<LF>	Line Feed, ASCII code 0Ah

10.8.5 NMEA 0183 Time String (ZDA)

The NMEA 0183 ZDA time string is a sequence of 38 ASCII characters starting with the string "$GPZDA" and ending with the characters <CR> (Carriage Return) and <LF> (Line Feed). The format is:

`$GPZDA,`*`hhmmss.ss,dd,mm,yyyy,HH,II*cs`*`<CR><LF>`

ZDA - Time and Date: UTC, day, month, year, and local time zone.

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters are as defined below:

$	Start character, ASCII code 24h sent with one-bit accuracy at change of second		
hhmmss.ss	UTC time:		
	hh	Hours	(00–23)
	mm	Minutes	(00–59)
	ss	Seconds	(00–59, or 60 during leap second)
HH,II	The local time zone (offset to UTC):		
	HH	Hours	(00–±13)
	II	Minutes	(00–59)
dd,mm,yy	The date:		
	dd	Day of Month	(01–31)
	mm	Month	(01–12)
	yyyy	Year	(0000–9999)
cs	Checksum (XOR of all characters except "$" and "*")		
<CR>	Carriage Return (ASCII code 0Dh)		
<LF>	Line Feed (ASCII code 0Ah)		

10.8.6 Uni Erlangen Time String (NTP)

The Uni Erlangen time string (NTP) is a sequence of 66 ASCII characters, starting with the character `<STX>` (Start of Text, ASCII code 02h) and terminated with the character `<ETX>` (End of Text, ASCII code 03h). The format is as follows:

`<STX>`*`dd.mm.yy; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.lllle hhhhm`*`<ETX>`

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

`<STX>` Start of Text, ASCII code 02h sent with one-bit accuracy at the change of each second

`dd.mm.yy` The date:

dd	Day of the month	(01–31)
mm	Month	(01–12)
yy	Year (without century)	(00–99)

`w` The day of the week (1–7, 1 = Monday)

`hh.mm.ss` The time:

hh	Hours	(00–23)
mm	Minutes	(00–59)
ss	Seconds	(00–59, or 60 during leap second)

`v` Positive/negative sign for offset of local time zone relative to UTC

`oo:oo` Offset of local time zone relative to UTC in hours and minutes

`ac` Clock status:

a:	"#"	Clock has not synchronized since reset
	" "	(Space, ASCII code 20h) Clock has synchronized since reset
c:	"*"	GPS receiver has not verified its position
	" "	(Space, ASCII code 20h) GPS receiver has determined its position

`d` Time zone identifier:

"S"	CEST	Central European Summer Time
" "	CET	Central European Time

`f` Announcement of clock jump during last hour before discontinuity comes into effect:

"!"	Announcement of start or end of Daylight Saving Time
" "	(Space, ASCII code 20h) nothing announced

`g` Announcement of clock jump during last hour before discontinuity comes into effect:

"A'"	Announcement of leap second
" "	(Space, ASCII code 20h) nothing announced

`i` Leap second

"L"	Leap second is currently to be inserted (only active in 60th second)
" "	(Space, ASCII code 20h) No leap second announced

`bbb.bbbb` Geographical latitude of the receiver position in degrees
Leading zeroes are padded with spaces (ASCII code 20h)

`n`	Geographical hemisphere, possible characters are: "N" North of Equator "S" South of Equator
`lll.llll`	Geographical longitude of the receiver position in degrees Leading zeroes are padded with spaces (ASCII code 20h)
`e`	Prime meridian hemisphere, possible characters are: "E" East of Greenwich Meridian "W" West of Greenwich Meridian
`hhhh`	Altitude in meters of receiver position above WGS84 ellispoid Leading zeroes are padded with spaces (ASCII code 20h)
`<ETX>`	End of Text, ASCII code 03h

10.8.7 Computime Time String

The Computime time string is a sequence of 24 ASCII characters, starting with the character `T` and terminated with the character `<LF>` (Line Feed, ASCII code 0Ah). The format is as follows:

`T:`*`yy:mm:dd:ww:hh:mm:ss`*`<CR><LF>`

The letters printed in italics are replaced by ASCII numbers whereas the other characters are unalterable parts of the time string. The groups of characters as defined below:

`T`	Start character Sent with one-bit accuracy at the change of each second		
`yy:mm:dd`	The current date:		
	`yy`	Year without century	(00–99)
	`mm`	Month	(01–12)
	`dd`	Day of the month	(01–31)
	`ww`	Day of the week	(01–07, 01 = Monday)
`hh:mm:ss`	The current time:		
	`hh`	Hours	(00–23)
	`mm`	Minutes	(00–59)
	`ss`	Seconds	(00–59, or 60 during leap second)
`<CR>`	Carriage Return, ASCII code 0Dh		
`<LF>`	Line Feed, ASCII code 0Ah		

10.8.8 SYSPLEX-1 Time String

The SYSPLEX 1 time string is a sequence of 16 ASCII characters, starting with the character `<SOH>` (Start of Header, ASCII code 01h) and terminated with the character `<LF>` (Line Feed, ASCII code 0Ah).

> **Important!**
>
> To ensure that the time string can be correctly output and displayed through your terminal software of choice, a "C" must be sent (once, without quotes).

The format is as follows:

`<SOH>`*`ddd:hh:mm:ssq`*`<CR><LF>`

The letters printed in italics are replaced by ASCII numbers whereas the other characters are unalterable parts of the time string. The groups of characters as defined below:

`<SOH>`	Start of Header (ASCII code 01h) sent with one-bit accuracy at the change of each second			
`ddd`	Day of the Year		(001–366)	
`hh:mm:ss`	The current time:			
	`hh`	Hours	(00–23)	
	`mm`	Minutes	(00–59)	
	`ss`	Seconds	(00–59, or 60 during leap second)	
	`q`	Clock Status:	Space (ASCII code 20h)	Time Sync (GPS Lock)
			"`?`" (ASCII code 3Fh)	No Time Sync (GPS Fail)
`<CR>`	Carriage Return, ASCII code 0Dh			
`<LF>`	Line Feed, ASCII code 0Ah			

10.8.9 SPA Time String

The SPA time string is a sequence of 32 ASCII characters, starting with the string "`>900WD:`" and terminated with the character `<CR>` (Carriage Return). The format is as follows:

`>900WD:`*`yy-mm-dd_hh.mm;ss.fff:cc`*`<CR>`

The letters printed in italics are replaced by ASCII numbers whereas the other characters are unalterable parts of the time string. The groups of characters are as defined below:

`yy-mm-dd`	Current Date:		
	`yy`	Year without century	(00–99)
	`mm`	Month	(01–12)
	`dd`	Day of the month	(01–31)
	" "	(Space, ASCII code 20h)	
`hh.mm;ss.fff`	Current Time:		
	`hh`	Hours	(00–23)
	`mm`	Minutes	(00–59)
	`ss`	Seconds	(00–59, or 60 during leap second)
	`fff`	Milliseconds	(000–999)
`cc`	Checksum This is calculated as the XOR sum of the preceding characters. The resultant 8-bit value is reported as a hex value in the form of two ASCII characters (`0-9` or `A-F`)		
`<CR>`	Carriage Return		ASCII code 0Dh

10.8.10 RACAL Time String

The RACAL time string is a sequence of 16 ASCII characters started by a X character and terminated by the <CR> (Carriage Return, ASCII code 0Dh) character. The format is as follows:

XGU*yymmddhhmmss*<CR>

The letters printed in *italics* are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters are as defined below:

X	Start character (ASCII code 58h) Sent with one-bit accuracy at the change of each second		
G	Control character (ASCII code 47h)		
U	Control character (ASCII code 55h)		
yymmdd	Current date:		
	yy	Year of Century	(00–99)
	mm	Month	(01–12)
	dd	Day of Month	(01–31)
hh:mm:ss	Current time:		
	hh	Hours	(00–23)
	mm	Minutes	(00–59)
	ss	Seconds	(00–59, or 60 during leap second)
<CR>	Carriage Return (ASCII code 0Dh)		

10.8.11 Meinberg GPS Time String

The Meinberg GPS time string is a sequence of 36 ASCII characters, starting with the `<STX>` (Start of Text) character and ending with the `<ETX>` (End of Text) character. Unlike the Meinberg Standard time string, it does not contain UTC time or time adjusted to any local time zone. Instead, it contains GPS time without the UTC adjustments. The format is as follows:

```
<STX>D:dd.mm.yy;T:w;U:hh.mm.ss;uvGy;lll<ETX>
```

The letters printed in *italics* are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

`<STX>`	Start of Text, ASCII code 02h		
`dd.mm.yy`		The date:	
	dd	Day of the month	(01–31)
	mm	Month	(01–12)
	yy	Year of the Century	(00–99)
`w`	The day of the week		(1–7, 1 = Monday)
`hh.mm.ss`	The time:		
	hh	Hours	(00–23)
	mm	Minutes	(00–59)
	ss	Seconds	(00–59, or 60 while leap second)
`uv`	Clock status characters:		
	u:	"#"	Clock is in free-run mode (no exact synchronization)
		" "	(Space, ASCII code 20h) Clock is synchronized (base accuracy is achieved)
	v:	"*"	Receiver has not yet verified its position
		" "	(Space, ASCII code 20h) Receiver has determined its position
`G`	Time zone identifier "GPS Time"		
`y`	Announcement of clock jump during last hour before discontinuity comes into effect: "A'" Announcement of leap second insertion " " (Space, ASCII code 20h) nothing announced		
`lll`	Number of leap seconds between GPS time and UTC (UTC = GPS time + number of leap seconds)		
`<ETX>`	End of Text, ASCII code 03h		

10.8.12 ION Time String

The ION time string is a sequence of 16 ASCII characters, starting with the character <SOH> (Start of Header, ASCII code 01h) and terminated with the character <LF> (Line Feed, ASCII code 0Ah). The format is as follows:

<SOH>*ddd:hh:mm:ssq*<CR><LF>

The letters printed in italics are replaced by ASCII-formatted numbers, whereas the other characters are directly part of the time string. The groups of characters as defined below:

<SOH>	Start of Header (ASCII code 01h) sent with one-bit accuracy at the change of each second			
ddd	Day of Year		(001–366)	
hh:mm:ss	Current time:			
	hh	Hours	(00–23)	
	mm	Minutes	(00–59)	
	ss	Seconds	(00–59, or 60 while leap second)	
	q	Quality Indicator	Space (ASCII code 20h)	Time Sync (GPS Lock)
			"?" (ASCII code 3Fh)	No Time Sync (GPS Fail)
<CR>	Carriage Return (ASCII code 0Dh)			
<LF>	Line Feed (ASCII code 0Ah)			

10.8.13 ION Blanked Time String

The ION time string is a sequence of 16 ASCII characters, starting with the character `<SOH>` (Start of Header, ASCII code 01h) and terminated with the character `<LF>` (Line Feed, ASCII code 0Ah). The format is as follows:

`<SOH>`*ttt:hh:mm:ssq*`<CR><LF>`

Important!

The blanking interval lasts for 2 minutes and 30 seconds and is inserted every five minutes.

The letters printed in italics are replaced by ASCII numbers whereas the other characters are unalterable parts of the time string. The groups of characters as defined below:

`<SOH>`	Start of Header (ASCII code 01h) sent with one-bit accuracy at the change of each second			
`ddd`	Day of the year		(001–366)	
`hh:mm:ss`	The current time:			
	`hh`	Hours	(00–23)	
	`mm`	Minutes	(00–59)	
	`ss`	Seconds	(00–59, or 60 during leap second)	
	`q`	Clock Status:	Space (ASCII code 20h)	Time Sync (GPS Lock)
			"?" (ASCII code 3Fh)	No Time Sync (GPS Fail)
`<CR>`	Carriage Return, ASCII code 0Dh			
`<LF>`	Line Feed, ASCII code 0Ah			

10.8.14 IRIG-J Timecode

The IRIG-J timecode consists of a string of ASCII characters sent in “701” format, i.e.,:

- 1 start bit
- 7 data bits
- 1 parity bit (odd)
- 1 stop bit

The start of the second is marked by the leading edge of the start bit of the string. The string is 15 characters long and is sent once a second at a baud rate of 300 or greater. The format is as follows:

`<SOH>`*`DDD:HH:MM:SS`*`<CR><LF>`

The letters printed in italics are replaced by ASCII numbers whereas the other characters are unalterable elements of the string. The groups of characters as defined below:

`<SOH>`	Start of Header (ASCII code 01h)
`DDD`	Day of the year (ordinal date, 1–366)
`HH`, `MM`, `SS`	Time of the start bit in hours (`HH`), minutes (`MM`), seconds (`SS`)
`<CR>`	Carriage Return, ASCII code 0Dh
`<LF>`	Line Feed, ASCII code 0Ah

10.9 Overview of Programmable Signals

Meinberg systems with programmable pulse outputs provide the following signal options; the actual range of available signal options will vary from system to system:

Idle

Selecting “**Idle**” allows individual programmable outputs to be disabled individually.

Timer

In “**Timer**” mode, the output simulates a timer with a fixed daily schedule. It is possible to configure three switch-on and three switch-off times for each day and each output. In order to set a timer, both the switch-on time (“**ON**”) and the corresponding switch-off time (“**OFF**”) must be set. If the switch-on time is later than the switch-off time, the switching scheduler will interpret this to mean that the switch-off time is on the next day, which will keep the signal enabled through midnight.

Thus, if a program was set with a switch-on time of *23:45:00* and a switch-off time of *0:30:00*, this would cause the output to be enabled on day *n* at 11:45 p.m., and then to be disabled on day *n+1* at 12:30 a.m. If any of these three programs are to be left disabled, simply enter the same times into the “**ON**” and “**OFF**” fields. The “**Signal**” selector specifies the active state for the timer periods. Selecting “*Normal*” will put the output in a low state outside of switch-on periods and in a high state during switch-on periods (“active high”). Conversely, selecting “*Inverted*” will place the output in a high state outside of switch-on periods and in a low state during switch-on periods (“active low”).

Single Shot

“**Single Shot**” mode generates a single pulse of defined length once per day. The time of day when the pulse is to be generated can be set via the “**Time**” value. The value “**Length**” allows the pulse length to be set in 10 ms increments and may be any value in the range of *10 ms* to *10000 ms* (10 seconds). Entries that are not multiples of 10 ms will be rounded down.

Cyclic Pulse

“**Cyclic Pulse**” mode is used to generate cyclically repeating pulses. The time between two pulses is defined, and this value must always be provided in hours, minutes, and seconds. It is important to note that the pulse train is always synchronized with 0:00.00 local time, so that the first pulse on any given day will always be output at midnight, and is repeated at the specified cycle interval henceforth. Thus, if a cycle duration of *2 s* is specified, this will result in pulses being triggered at 0:00.00, 0:00.02, 0:00.04 and so on. While it is possible to set any cycle time between 0 and 24 hours, these repetitions are usually only useful if the time between pulses is always the same. For example, if a cycle time of *1:45.00* is set, this will output pulses at intervals of 6300 seconds. However, between the last pulse of any given day and the pulse at midnight on the following day, there will be an interval of just 4500 seconds.

Pulse-per-Second, Pulse-per-Minute, Pulse-per-Hour

These three modes generate pulses of defined length once per second, once per minute, or once per hour respectively. The configuration options for all three modes are the same. The value “**Pulse Length**” specifies the length of the pulse and can be between *10 ms* and *10000 ms* (10 seconds).

DCF77 Marks

In “**DCF77 Marks**” mode the selected output simulates the time string transmitted by the German DCF77 time code transmitter. The output pulses are the 100 ms and 200 ms pulses (logical 0/1) typical for the DCF77 code. The absence of the 59-second mark is used to signal that the next minute will begin with the following second mark.

DCF77-like M59

Sends a 500 ms pulse at the 59-second mark.

The “**Timeout**” field can be used to enter how many minutes the system should wait while in free-run mode before DCF77 simulation is suspended. Entering *0* here will disable the timeout function, so that the DCF77 simulation will continue running perpetually until manually disabled.

Position OK, Time Sync, All Sync

There are three different modes available for outputting the synchronization status of the clock. The “**Position OK**” mode outputs a signal whenever the GNSS receiver is receiving enough satellites to determine its position.

In “**Time Sync**” mode, a signal is only output as long as the clock’s internal timebase is synchronized to the GNSS reference. The “**All Sync**” mode requires both of the above states to be true—for a signal to be passed through the output, there must be sufficient satellites for positioning, **and** the internal timebase must be synchronized to the reference constellation’s timebase.

DCLS Timecode

DC level shift timecode. The timecode output here is configured in the “**Clock**” → “**IRIG Settings**” section of the Web Interface.

1 MHz Frequency, 5 MHz Frequency, 10 MHz Frequency

These modes are used to output a fixed frequency of 1, 5, or 10 MHz respectively, using a PPS signal as an absolute phase reference (i.e., the falling edge of the signal is synchronized with the rising edge of the PPS signal).

Synthesizer Frequency

This mode is used to output a custom frequency, which is defined using the “**Clock**” → “**Synthesizer**” section of the Web Interface.

Time Slots per Minute

This mode divides each minute up into a number of equal time slots, which can be individually enabled during those seconds of each minute. For example, if *six* time slots are selected, the user can set whether a signal should be output during the 0–10-second, 10–20 second, 20–30 second, 30–40 second, 40–50 second, and 50–60 second slots. If only the *10–20 second* slot is selected, a signal will only be output between 10 and 20 seconds of each minute and disabled outside of that.

PTTI 1PPS

This mode is used to pass a PPS signal of 20 μs pulse width through the output.

10.10 General Information about Timecode

The need to transmit encoded time information became a topic of some importance as early as the 1950s. The U.S. space program in particular was a key driver of advancement in this field, using timecode information to correlate different sets of measurements. However, the formats and usage of these signals were defined arbitrarily at the whims of the specific users, which resulted in the development of hundreds of different timecode formats, some of which were standardized by the "Inter Range Instrumentation Group" (IRIG) in the early 1960s. These standardized timecode formats are referred to as "IRIG Timecodes" today.

In addition to these general-purpose time signals, there are other codes in use designed for specific applications, among them NASA36, XR3, or 2137. The GPS183/D(A)HS, however, limits itself to the output of IRIG-A, IRIG-B, AFNOR NF S87-500, and IEEE 1344 formats, as well as IEEE C37.118, the successor to IEEE 1344.

The AFNOR timecode is a variant of the IRIG-B format that uses the available "control functions" segment of the IRIG timecode to supply full date information.

Visit our website for more detailed information about IRIG and other timecodes:
https://www.meinbergglobal.com/english/info/irig.htm

10.10.1 Description of IRIG Timecodes

Each IRIG timecode format is denoted by an alphabetical character followed by a three-digit number sequence as specified in IRIG Standard 200-04. Each character in a timecode format designation has the following meaning:

Character	Bit Rate	A	1000 pps
		B	100 pps
		E	10 pps
		G	10000 pps
1^{st} Character	Pulse Wave	0	DC Level Shift (DCLS), pulse-width modulated
		1	Sine-wave carrier, amplitude-modulated
2^{nd} Character	Carrier Frequency	0	No carrier (DC Level Shift)
		1	100 Hz, time resolution 10 ms
		2	1 kHz, time resolution 1 ms
		3	10 kHz, time resolution 100 μs
3^{rd} Character	String Content	0	BCD$^{(\text{TOY})}$, CF, SBS
		1	BCD$_{(\text{TOY})}$, CF
		2	BCD$_{(\text{TOY})}$
		3	BCD$_{(\text{TOY})}$, SBS
		4	BCD$_{(\text{TOY})}$, BCD$_{(\text{YEAR})}$, CF, SBS
		5	BCD$_{(\text{TOY})}$, BCD$_{(\text{YEAR})}$, SBS
		6	BCD$_{(\text{TOY})}$, BCD$_{(\text{YEAR})}$
		7	BCD$_{(\text{TOY})}$, BCD$_{(\text{YEAR})}$, SBS

BCD:	Time and day-of-year in BCD format
CF:	Control Functions (for unspecified use)
SBS:	Number of seconds in the day since midnight (binary)

In addition to the original IRIG standards, there are other specifications issued by other bodies that define specific extensions.

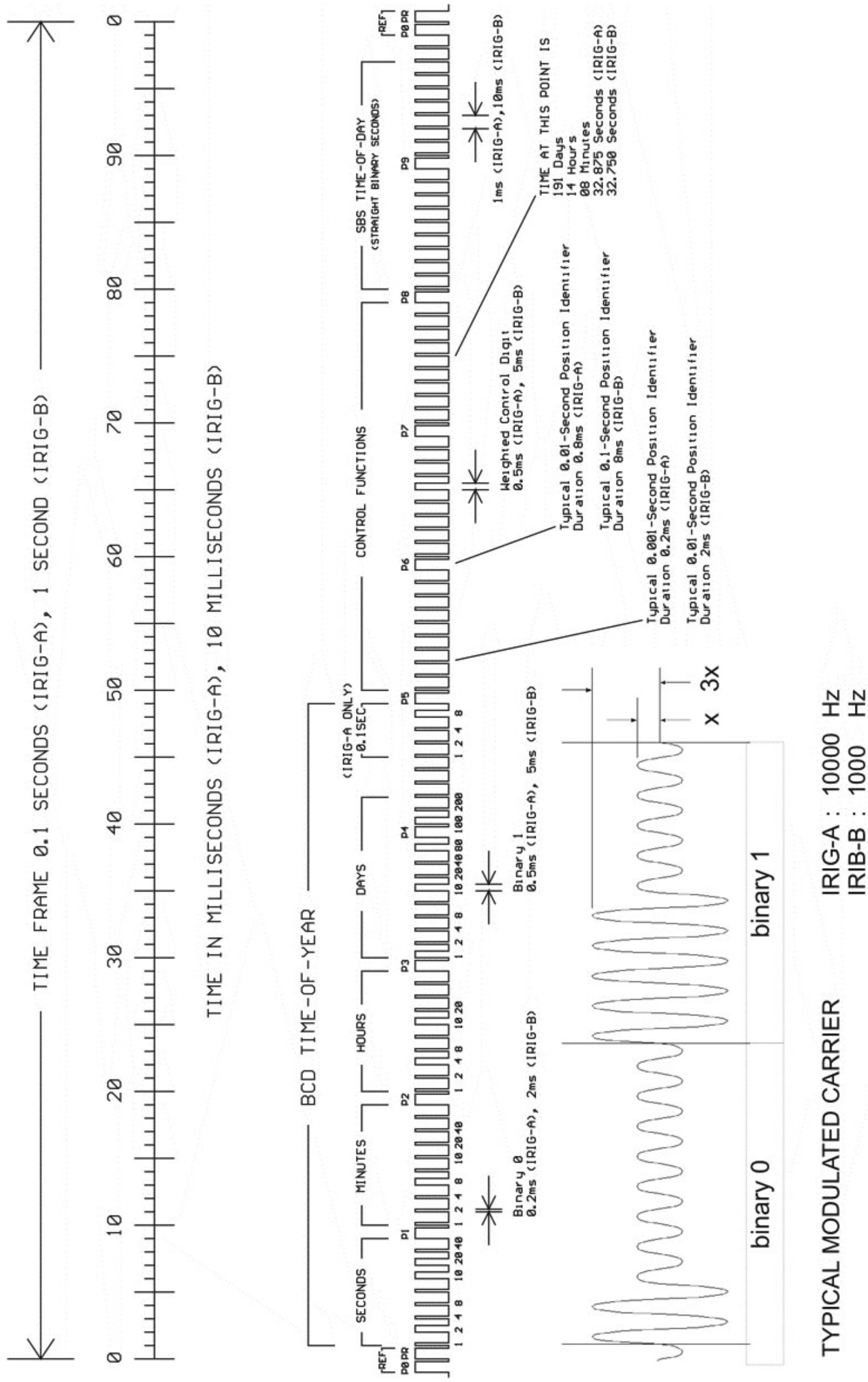
AFNOR:	Code according to NF S87-500, 100 pps, AM sine-wave signal, 1 kHz carrier frequency, BCD time-of-year, complete date, SBS time-of-day, signal level specified by standard.
IEEE 1344:	Code according to IEEE 1344-1995, 100 pps, AM sine-wave signal, 1 kHz carrier frequency, BCD time-of-year, SBS time-of-day, IEEE 1344 extensions for date, time zone, Daylight Saving Time, and leap seconds in Control Functions (CF) segment. (See also table "**Structure of CF Segment in IEEE 1344 Code**")
IEEE C37.118:	Identical to IEEE 1344, but with UTC offset +/- sign bit reversed
NASA 36:	100 pps, AM sine-wave signal, 1 kHz carrier frequency, Time Resolution: 10 ms (DCLS), 1 ms (AM carrier) BCD time-of-year: 30 bits – seconds, minutes, hours, and days

10.10.2 Generated Time Codes

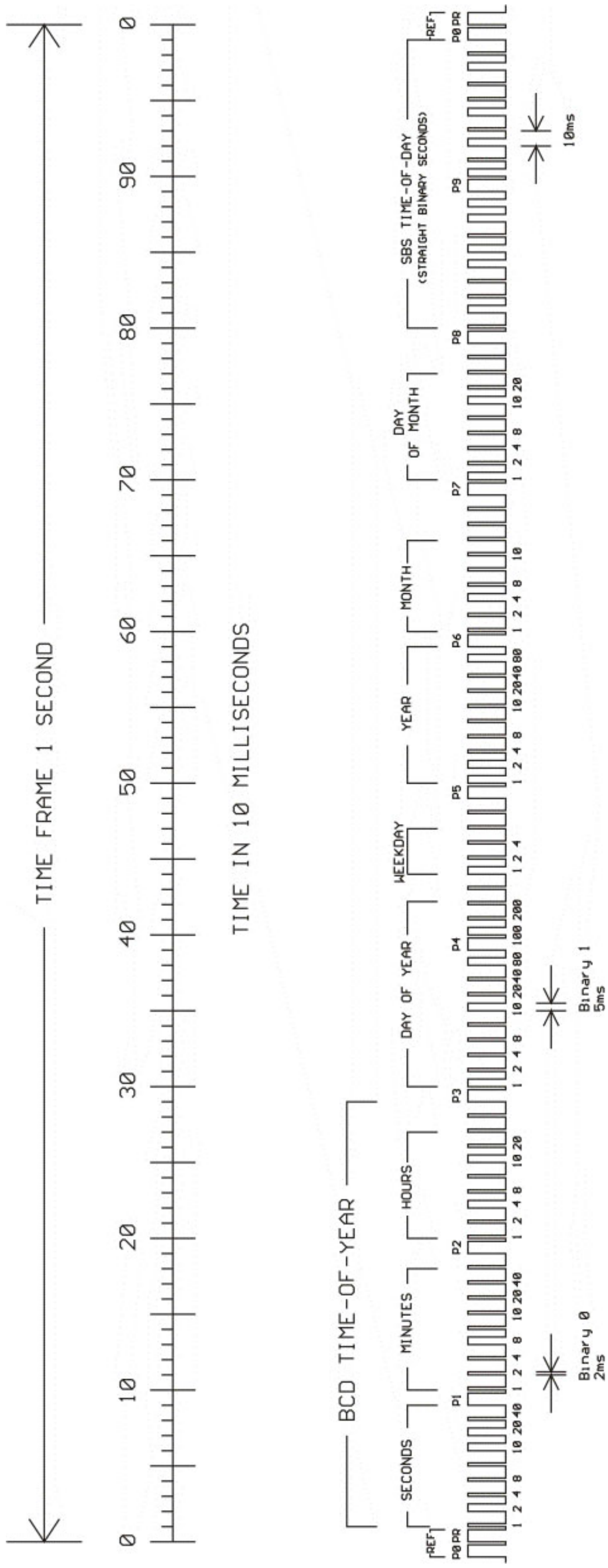
Besides the amplitude modulated sine wave signal, the board also provides unmodulated DC-Level Shift TTL output in parallel. Thus six time codes are available.

a)	B002:	100 pps, DCLS signal, no carrier BCD time-of-year
b)	B122:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year
c)	B003:	100 pps, DCLS signal, no carrier BCD time-of-year, SBS time-of-day
d)	B123:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year, SBS time-of-day
e)	B006:	100 pps, DCLS Signal, no carrier BCD time-of-year, Year
f)	B126:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year, Year
g)	B007:	100 pps, DCLS Signal, no carrier BCD time-of-year, Year, SBS time-of-day
h)	B127:	100 pps, AM sine wave signal, 1 kHz carrier frequency BCD time-of-year, Year, SBS time-of-day
i)	AFNOR:	Code according to NFS-87500, 100 pps, wave signal, 1kHz carrier frequency, BCD time-of-year, complete date, SBS time-of-day, Signal level according to NFS-87500
j)	IEEE1344:	Code according to IEEE1344-1995, 100 pps, AM sine wave signal, 1kHz carrier frequency, BCD time-of-year, SBS time-of-day, IEEE1344 extensions for date, timezone, daylight saving and leap second in control functions (CF) segment. (also see table 'Assignment of CF segment in IEEE1344 mode')
k)	C37.118	Like IEEE1344 - with turned sign bit for UTC-Offset

10.10.3 Timecode Format According to IRIG Standard



10.10.4 Timecode Format According to AFNOR Standard



10.10.5 Structure of CF Segment in IEEE 1344 Code

Bit No.	Designation	Description
49	Position Identifier P5	
50	Year BCD encoded 1	
51	Year BCD encoded 2	Low nibble of BCD-encoded year
52	Year BCD encoded 4	
53	Year BCD encoded 8	
54	empty, always zero	
55	Year BCD encoded 10	
56	Year BCD encoded 20	High nibble of BCD-encoded year
57	Year BCD encoded 40	
58	Year BCD encoded 80	
59	Position Identifier P6	
60	LSP - Leap Second Pending	Set until 59s before LS insertion
61	LS - Leap Second	0 = Add leap second, 1 = Remove leap second 1.)
62	DSP - Daylight Saving Pending	Set until 59s before Daylight Saving Time changeover
63	DST - Daylight Saving Time	Set during Daylight Saving Time
64	Timezone Offset Sign	Sign of TZ offset 0 = "+", 1 = "-"
65	TZ Offset binary encoded 1	
66	TZ Offset binary encoded 2	Offset between IRIG time and UTC time.
67	TZ Offset binary encoded 4	Encoded IRIG time plus TZ offset equals UTC at all times!
68	TZ Offset binary encoded 8	
69	Position Identifier P7	
70	TZ Offset 0.5 hour	Set if additional half-hour offset
71	TFOM Time figure of merit	
72	TFOM Time figure of merit	TFOM represents approximate clock error 2.)
73	TFOM Time figure of merit	0x00 = Clock synchronized, 0x0F = Clock in free-run mode
74	TFOM Time figure of merit	
75	PARITY	Parity of all preceding bits

1.) Current firmware only supports insertion of leap seconds!
2.) TFOM is set to 0 if clock has been able to synchronize since power up. The firmware does not support other codes.

For more information, please refer to the time code specifications.

10.11 General Information about DCF77

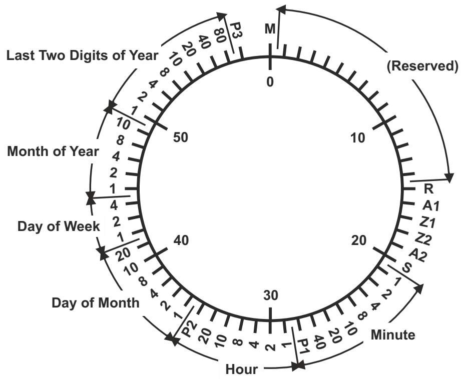
The DCF radio-controlled clocks manufactured by Meinberg receive their signal from the DCF77 long-wave transmitter, which is installed in Mainflingen, near Frankfurt am Main in Germany, and transmits the reference time of the Federal Republic of Germany. This time reference will either be Central European Time (CET) or Central European Summer Time (CEST), depending on the time of year.

The transmitter is controlled by the atomic clocks of the PTB, Germany's national metrology institute located in Braunschweig, and transmits the current time of day, date of the month, and day of the week in coded pulse signals once a second. A complete record of the current time is transmitted once each minute as a 59-bit signal.

This signal is transmitted over the high-accuracy 77.5 kHz carrier frequency. At the start of each second, the amplitude of the carrier wave is lowered to around 15 % for 0.1 or 0.2 seconds. These amplitude reductions constitute one-per-second markers that contain the binary-coded time information; a marker lasting 0.1 seconds represents a binary "0", while a marker lasting 0.2 seconds represents a binary "1". The information on the time of day and the date as well as a number of parity and status bits are provided in the markers from 17 seconds to 58 seconds in each minute. The absence of the 59-second mark is used to signal that the next minute will begin with the following second mark.

The radio-controlled clocks that we produce can receive this high-accuracy time information from anywhere in Germany, and also wholly reliably in Germany's neighboring countries, with reception documented as far afield as Bilbao in Spain or the town of Umeå in northern Sweden. DCF77 clock modules adjust to summertime and wintertime changes (Daylight Saving Time) automatically. The provision of this time signal is a public service that does not require payment of a license fee or registration.

You should generally ensure that the receiver antenna is positioned in such a way as to receive the best possible signal. It should be pointed at a 90 degree angle from the direction of the transmitter (Frankfurt) and be placed at least 1 meter away from your computer and 30 cm away from any steel structures, metal plates, etc.



M	Start of Minute (0.1 s)	
R	RF Transmission via Secondary Antenna	
A1	Announcement of a Change in Daylight Saving Time	
Z1, Z2	Time Zone Identification	
	Z1, Z2 = 0, 1:	Daylight Saving Time Disabled
	Z1, Z2 = 1, 0:	Daylight Saving Time Enabled
A2	Announcement of a Leap Second	
S	Start of Time Code Information	
P1, P2, P3	Even Parity Bits	

11 RoHS Conformity

Conformity with EU Directive 2011/65/EU (RoHS)

We hereby declare that this product is compliant with the European Union Directive 2011/65/EU and its delegated directive 2015/863/EU "Restrictions of Hazardous Substances in Electrical and Electronic Equipment" and that no impermissible substances are present in our products pursuant to these Directives.

We warrant that our electrical and electronic products sold in the EU do not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs), bis(2-ethylhexyl)phthalat (DEHP), benzyl butyl phthalate (BBP), dibutyl phthalate (DBP), or diisobutyl phthalate (DIBP) above the legal limits.

12 Declaration of Conformity for Operation in the European Union

EU-Konformitätserklärung
Doc ID: GPS183D(A)HS-August 14, 2025

Hersteller *Manufacturer*	Meinberg Funkuhren GmbH & Co. KG Lange Wand 9, D-31812 Bad Pyrmont

erklärt in alleiniger Verantwortung, dass das Produkt,
declares under its sole responsibility, that the product

Produktbezeichnung *Product Designation*	**GPS183D(A)HS**

auf das sich diese Erklärung bezieht, mit den folgenden Normen und Richtlinien übereinstimmt:
to which this declaration relates is in conformity with the following standards and provisions of the directives:

RED – Richtlinie *RED Directive* 2014/53/EU	ETSI EN 303 413 V1.2.1 (2021-04)
EMV – Richtlinie *EMC Directive* 2014/30/EU	ETSI EN 301 489-1 V2.2.3 (2019-11) ETSI EN 301 489-19 V2.2.1 (2022-09) DIN EN IEC 61000-6-2:2019 DIN EN IEC 61000-6-3:2021 DIN EN 55032:2015/AC:2016/A11:2020/A1:2020 DIN EN 55035:2017/A11:2020
Niederspannungsrichtlinie *Low Voltage Directive* 2014/35/EU	DIN EN IEC 62368-1:2020/A11:2020
RoHS – Richtlinie *RoHS Directive* 2011/65/EU + 2015/863/EU	DIN EN IEC 63000:2018

Bad Pyrmont, den August 14, 2025

MEINBERG
Meinberg Funkuhren GmbH & Co. KG
Lange Wand 9
31812 Bad Pyrmont

Aron Meinberg
Quality Management

13 Declaration of Conformity for Operation in the United Kingdom

UK Declaration of Conformity
Doc ID: GPS183D(A)HS-August 14, 2025

Manufacturer	Meinberg Funkuhren GmbH & Co. KG Lange Wand 9 31812 Bad Pyrmont Germany
declares that the product **Product Designation**	**GPS183D(A)HS**

to which this declaration relates, is in conformity with the following standards and provisions of the following regulations under British law:

Radio Equipment Regulations 2017 (as amended) *SI 2017/1206*	ETSI EN 303 413 V1.2.1 (2021-04)
Electromagnetic Compatibility Regulations 2016 (as amended) *SI 2016/1091*	ETSI EN 301 489-1 V2.2.3 (2019-11) ETSI EN 301 489-19 V2.2.1 (2022-09) EN IEC 61000-6-2:2019 EN IEC 61000-6-3:2021 EN 55032:2015/AC:2016/A11:2020/A1:2020 EN 55035:2017/A11:2020
Electrical Equipment (Safety) Regulations 2016 (as amended) *SI 2016/1101*	EN IEC 62368-1:2020/A11:2020
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (as amended) *SI 2012/3032*	EN IEC 63000:2018

Bad Pyrmont, Germany, dated August 14, 2025

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