The Synchronization Experts.

MANUAL

GPS183PEX

GNSS-Synchronized Radio Clock for PCI Express

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint and Legal Information

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3.1	2025-08-20	Overhauled antenna installation chapter (→ Chapter 8.1) with new information on optimizing GNSS antenna positioning (→ Chapter 13.4) Corrected improper chapter order under → Chapter 11

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4 Presentation Conventions in this Manual

4.1 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.

4.2 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.

4.3 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.

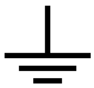
4.4 Generally Applicable Symbols

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

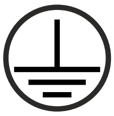
The presence of the “ESD” symbol is indicative of a risk of product damage caused by electrostatic discharge.

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

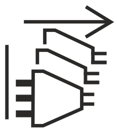
Alternating Current (AC) *(symbol definition IEC 60417-5032)*



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



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



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

5 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 information affixed to the product 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 product 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.

5.1 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!

5.2 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.

5.3 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, condensation may develop; 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.

5.4 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!

6 Important Product Information

6.1 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 15.

6.2 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 16.

6.3 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.

6.4 Maintenance and Modifications

Important!

Before performing any maintenance work on or authorized modification to your Meinberg product, we recommend making a backup of any stored configuration data to an external storage medium (e.g., to a USB flash drive).

6.4.1 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.

6.5 Prevention of ESD Damage

An **ESDS device** (electrostatic discharge-sensitive device) is any device at risk of damage or malfunction due to electrostatic discharge (**ESD**) and thus requires special measures to prevent such damage or malfunction. Systems and modules with ESDS components usually bear this symbol.

Important!

Due to its complexity, the GPS183PEX is especially sensitive to electrostatic discharges and requires special care when handling. Please consider wearing special industrial-grade ESD-proof clothing and shoes when handling the product.

Precautionary measures should be taken to protect ESDS components from damage and malfunction.

- Before removing or installing a module, ground your body first (for example, by touching a grounded object) before touching ESDS components.
- Ensure that you wear a grounding strap on your wrist when handling such ESDS components. This strap must in turn be attached to an uncoated, non-conductive metal part of the system.
- Use only tools and equipment that are free of static electricity.
- Ensure that your clothing is suitable for the handling of ESDS components. In particular, do not wear garments that are susceptible to electrostatic discharges (wool, polyester). Ensure that your shoes enable a low-resistance path for electrostatic charges to dissipate to the ground.
- Only touch or hold ESDS components by the edges. Never touch any pins or conductors on the ESDS components.
- When removing or installing ESDS components, avoid coming into contact with persons who are not grounded. Such contact may compromise your connection with the grounding conductor and thus also compromise the ESDS component's protection from any static charges you may be carrying.
- Always store ESDS components in ESD-proof 'antistatic' bags. These bags must not be damaged in any way. Antistatic bags that are crumpled or have holes cannot provide effective protection against electrostatic discharges. Antistatic bags must have a sufficient electrical resistance and must not be made of conductive metals if the ESDS component has a lithium battery fitted on it.

6.6 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.

7 Introduction

This Setup Guide is a systematically structured guide designed to assist you with the set-up of your Meinberg product.

The GPS183PEX is a 12-channel satellite clock PCI Express card with GPS technology that has been developed from the ground up specifically for time and frequency synchronization purposes. The GPS183PEX is designed to receive signals from the U.S. Global Positioning System (GPS), allowing precise synchronization of your PC's clock and generation of high-precision, high-accuracy time and frequency signals anywhere in the world.

How It Works

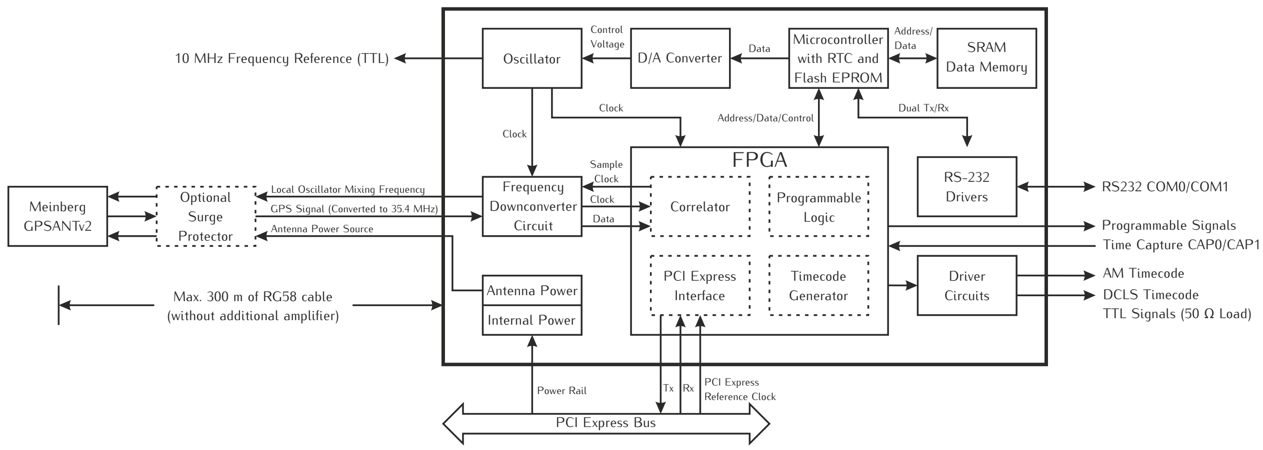


Illustration: Block diagram showing the general functionality of the GPS183PEX

The GPS183PEX PCI Express card is a relatively self-contained clock system, comprising a receiver, an oscillator, an output driver, and a custom FPGA-based processor that handles reference signal decoding, management I/O, and signal generation.

As shown in the diagram above, the PCI Express interface serves three primary purposes: communication of management data between the GPS183PEX card and the host PC, communication of time data from the card to the host PC to allow the host PC's operating system to synchronize the time of the mainboard's real-time clock, and delivery of the required power from the host PC's power source to the card. As such, as long as the PCI Express interface continues to supply the requisite power, the GPS183PEX's internal firmware will continue to synchronize the clock to its reference source and generate output signals through the AM timecode output and D-Sub 9 connector regardless of the software running on the PC. As such, the GPS183PEX is capable of operating autonomously, ensuring signal output stability even in the event of software problems, OS failures, or soft reboots of the PC.

For synchronization, the GPS183PEX's receiver determines its position using at least four visible GPS satellites. This position is used to calculate an offset for the timing data received from the GPS satellites. Once the GPS183PEX is successfully synchronized with a suitable reference, it generates a PPS (pulse-per-second) phase reference and a 10 MHz frequency reference.

Role of the Oscillator

The onboard oscillator (master oscillator) provides the GPS183PEX with the requisite accuracy and stability of the reference frequency. This oscillator is *disciplined* (meaning that the frequency is adjusted) using the external reference clock signal as a point of reference.

While the quality of the oscillator does have a minor influence over the quality of the frequency stability while the reference clock is synchronized to its reference signal, the greatest impact of the oscillator quality is discernable in holdover and free-running scenarios, where better oscillators can maintain superior frequency and phase accuracy over longer periods.

By default, the GPS183PEX is equipped with a TCXO (Temperature Compensated Crystal Oscillator) as master oscillator to provide a good time accuracy and frequency stability. As long as an input signal is supplied the frequency of the oscillator is adjusted from the input signal, and if the input signal is disconnected afterwards the card can still provide accurate time for a certain holdover interval. Optionally the card can be ordered with an OCXO (Oven Controlled Xtal Oscillator) which provides even better frequency stability, and thus provides more accuracy over a longer holdover interval than the TCXO.

All internal timing as well as the output signals are derived from the oscillator. The last known good oscillator adjustment value is stored in non-volatile memory, and is used as default after power-up.

These PPS and 10 MHz references then serve as the basis for the generation of other output signals as required for a variety of applications, while the clock of the PC in which the card is installed is synchronized by means of communication over the PCI Express interface.

Antenna Compatibility

Antenna	Meinberg GPSANT	Meinberg GPSANTv2	PCTEL Multi-GNSS Antenna	Meinberg Multi-Band Antenna
Compatible	✓	✓	✗	✗

The GPS183PEX is designed for operation with the **Meinberg GPSANTv2 Antenna**, which allows the use of longer antenna routes.

Please refer to the following chapters for more information:

- → Chapter 8.1, "Installation of the GNSS Antenna"
- → Chapter 13.2, "Technical Specifications: GPSANTv2 Antenna"

Please note that the GPS183PEX is *not* compatible with standard L-band antennas.

Manual Revisions

Meinberg products are subject to ongoing development even after their market release, with new features and enhancements added on a regular basis via firmware and software updates. Meinberg also revises its product manuals to account for these feature updates.

This version of the manual has been prepared based on the feature set provided by **Firmware Version 1.20** of your GPS183PEX as well as **MbgMon Version 3.16**. When using the GPS183PEX with different firmware or software versions, there may be noticeable differences, for example in the presentation and availability of options in the user interface.

New versions of the manual are published on the Meinberg Customer Portal at https://www.meinberg.support.

8 Basic Installation and Setup of the GPS183PEX

This chapter describes how to set up the basic infrastructure required for operation of the GPS183PEX, how to install the card itself, and how to install and configure the software drivers and management software on the host PC.

It comprises the following main steps:

1. Correct installation of the Meinberg GPSANTv2 antenna, including considerations regarding suitable measures to protect your antenna and GPS183PEX from lightning-induced voltage surges:

   → **Chapter 8.1, "Installation of the GNSS Antenna"**

2. Correct installation of the GPS183PEX card in the host system.

   → **Chapter 8.2, "Installing the GPS183PEX in the Host System"**

3. Installation of the drivers & software, both under Windows and various Linux distributions, including basic information on compiling the requisite drivers and tools under Linux.

   → **Chapter 8.3, "Installation of Drivers and Software"**

4. Connecting input and output cables to the installed GPS183PEX.

   → **Chapter 8.4, "Cable Connections"**

Once this procedure is completed, the GPS183PEX will be ready for general operation and for more advanced configuration.

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 13.4, “The Importance of Good Antenna Positioning”.

Important!

The specified accuracy levels for your GPS183PEX are specified for clear-sky conditions and can only be guaranteed if the above conditions for the installation of the antenna are met fully.

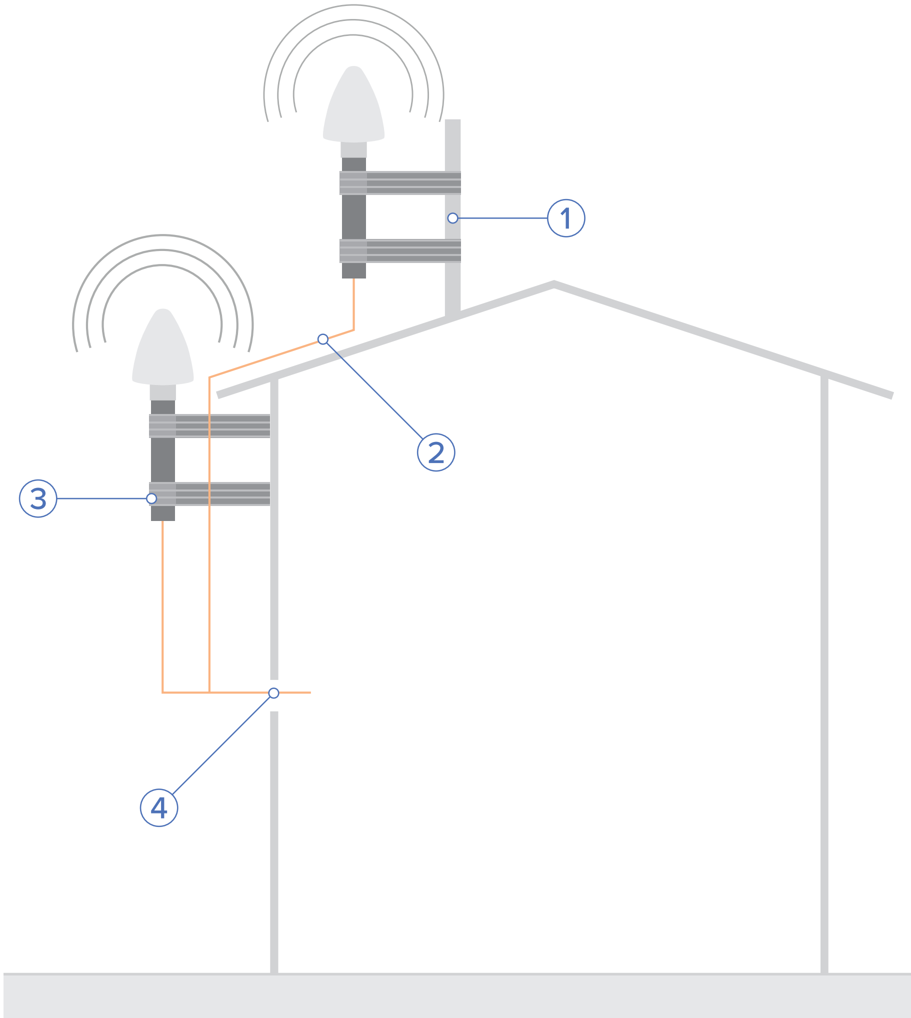


Figure 8.1: Effective Positioning of a GNSS Antenna

1. Mounted on a pole
2. Antenna cable
3. Mounted on a wall
4. Point of entry into building

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.

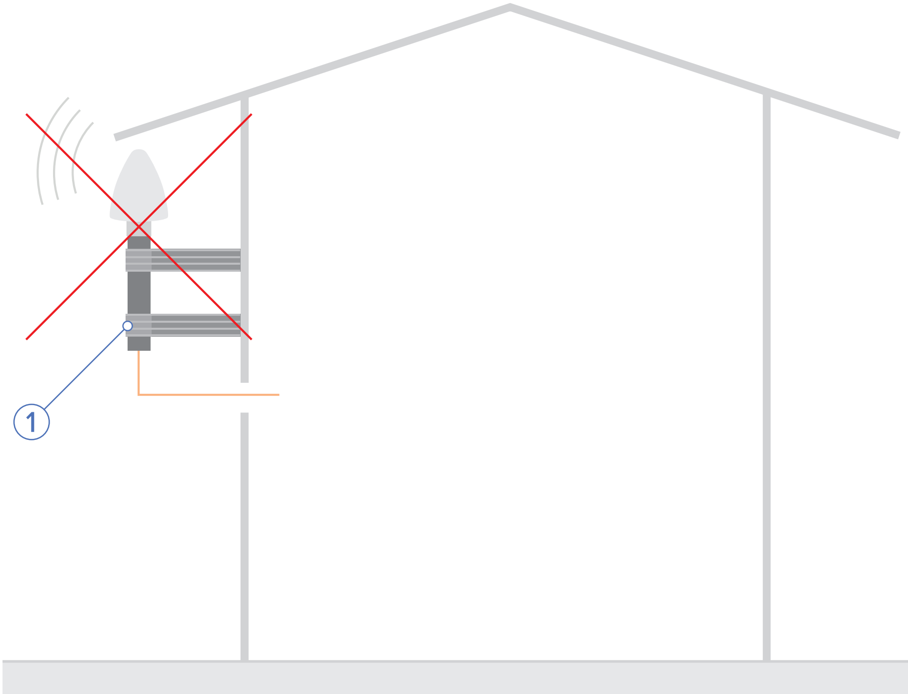


Figure 8.2: Poor Positioning of a GNSS Antenna

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 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, but also maximizes the antenna's exposure to signals reflected from the ground and to other spurious transmissions from ground level.

8.1.2 Laying the Antenna Cable

Your GPS183PEX 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 13.3, "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 mast), the antenna cable must be integrated into the grounding infrastructure of the building and also connected to the other metallic objects. Refer to → Chapter 8.1.5, "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 8.1.3, "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.

8.1.3 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

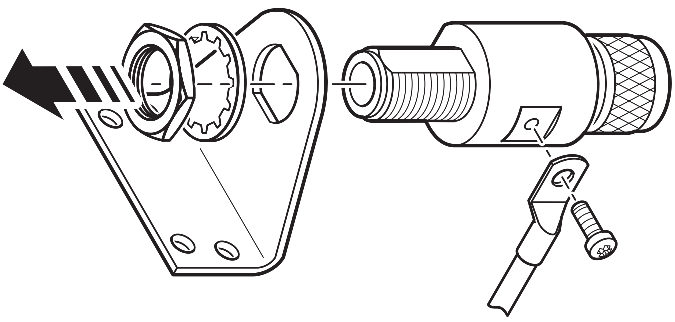


Figure 8.3: Assembly of the MBG S-PRO surge protector

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. 8.3, 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.

Detailed technical specifications and a link to the data sheet are provided in the Appendix under:

→ Chapter 13.5, "Technical Specifications: MBG S-PRO Surge Protector"

8.1.4 Mounting the Antenna

8.1.4.1 Mounting the Antenna onto a Mast

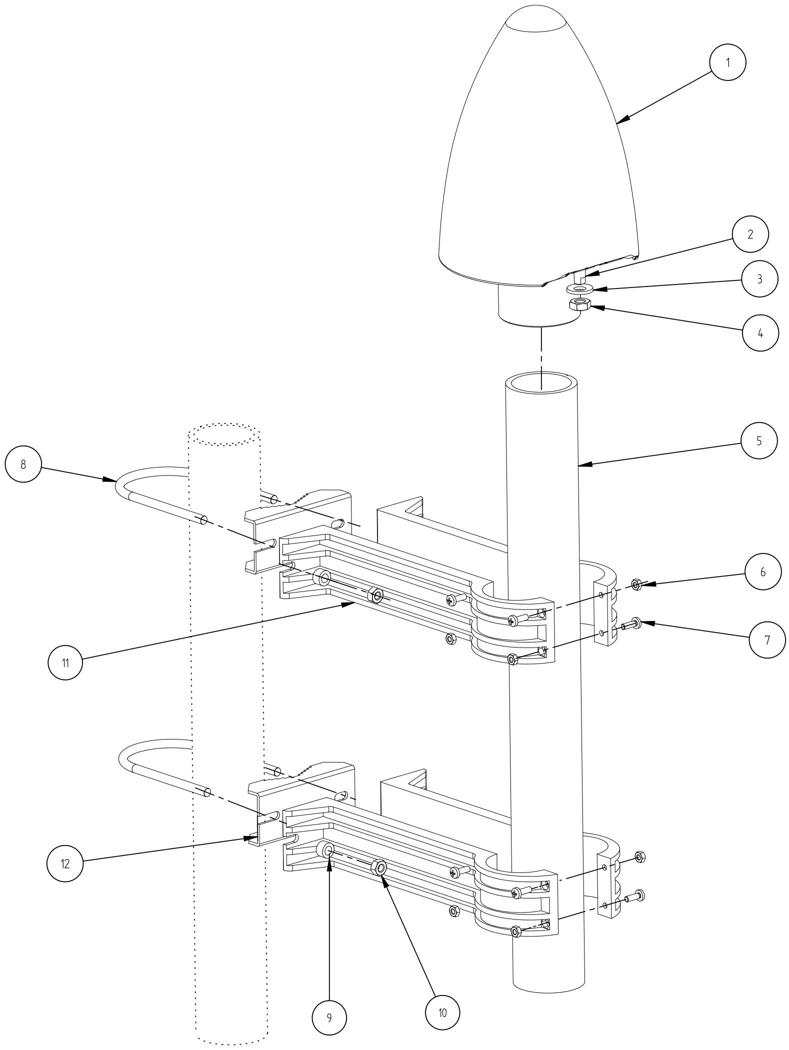


Figure 8.4: Mounting a GPSANTv2 antenna onto a mast

No.	Description	Quantity	No.	Description	Quantity
1	Antenna	1	7	M4x12 Phillips Head Screw	8
2	M8 Grounding Bolt	1	8	Threaded U-Bolt	2
3	Safety Washer	1	9	M6 Spacer	4
4	M8 Hex Nut	1	10	M6 Hex Nut	4
5	Antenna Tube	1	11	Tube Clamp Half	4
6	M4 Hex Nut	8	12	Mast Bracket	2

The antenna may be mounted onto an existing mast (maximum pole diameter 60 cm / 2.3 inches) using the included accessories, provided that the installation conditions specified in → Chapter 8.1.1, "Planning the Installation of the Antenna" and → Chapter 13.4, "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.

Installation of the Antenna on a Mast

Fig. 8.4 illustrates the installation of a Meinberg GPSANTv2 antenna on a mast.

1. Insert the antenna tube (Item 5 in Fig. 8.4) into the designated rounded recesses of the two pairs of antenna tube clamp halves (Item 11). Secure the tube inside each of the two clamps using four M4x12 Phillips screws (Item 7) and corresponding M4 hex nuts (Item 6). To ensure that the tube (Item 5) is as secure as possible, the top and bottom M4x12 screws (Item 7) of each tube clamp should be inserted from opposing directions as shown in Fig. 8.4.

2. Place the threaded bolts (Item 8) around the designated mast pole and feed the two prongs into the holes of the mast bracket (Item 12) and tube clamp (Item 11). Secure each of the tube clamps to each of the mast brackets (Item 12) using two M6 spacers (Item 9) and two M6 hex nuts (Item 10) and tighten until the mast bracket and U-bolt are secure.

3. Verify that the tube clamps (Item 11) are securely mounted to the mast, that they exhibit no movement without significant force, and that the tube is securely held by the tube clamps.

4. Feed one end of the antenna cable (Type-N connector, male) through the antenna tube (Item 5) from below and screw it by hand onto the female Type-N connector (Item 1) of the antenna. You may then place the antenna on the top of the mounting tube and push it until it is seated. Insert the fixture screw into the base of the antenna using a suitable screwdriver (Phillips head) to secure the antenna (Item 1) onto the antenna tube (Item 5).

8.1.4.2 Mounting the Antenna onto a Wall

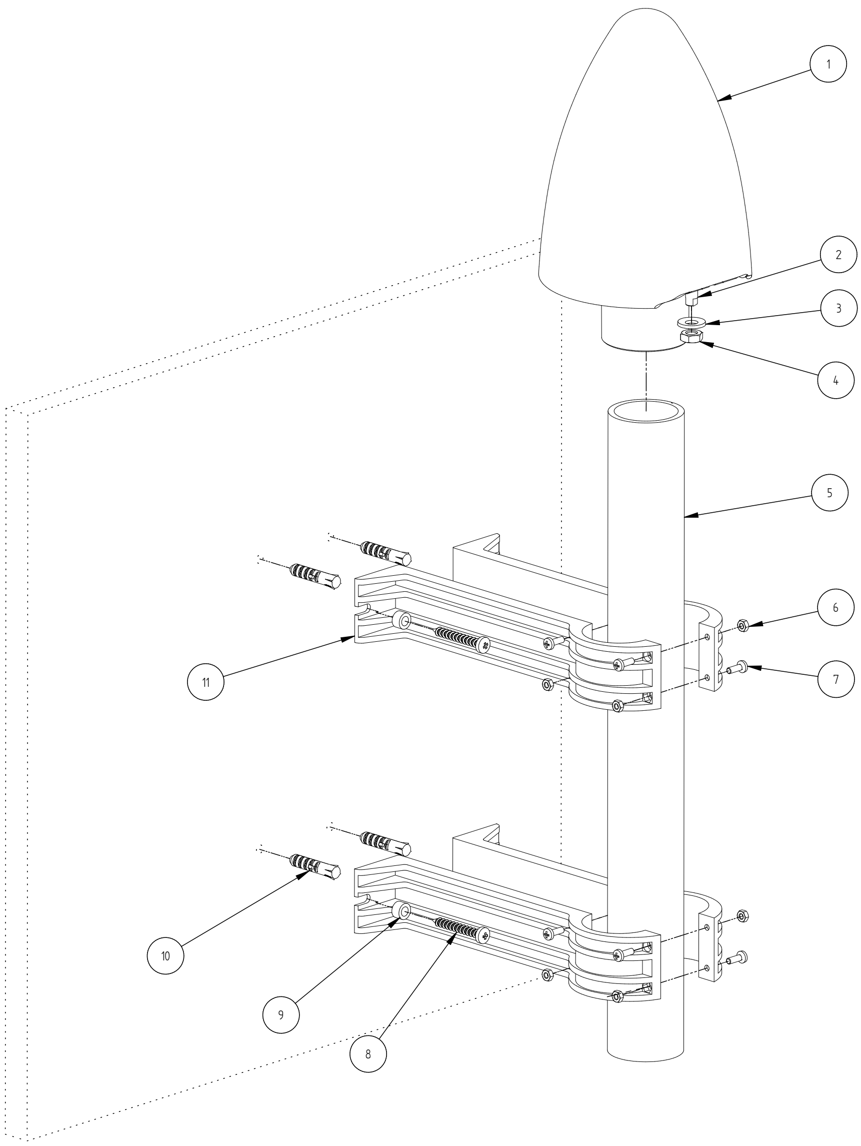


Figure 8.5: Mounting a GPSANTv2 antenna onto a wall

No.	Description	Quantity	No.	Description	Quantity
1	Antenna	1	7	M4x12 Screw (Phillips Head)	8
2	M8 Grounding Bolt	1	8	M6x45 Screw	4
3	Safety Washer	1	9	M6 Spacer	4
4	M8 Hex Nut	1	10	8 mm Wall Plug	4
5	Antenna Tube	1	11	Antenna Tube Clamp Half	4
6	M4 Hex Nut	8			

The antenna may be mounted directly onto a wall using the included accessories, provided that the installation conditions specified in → Chapter 8.1.1, "Planning the Installation of the Antenna" and → Chapter 13.4, "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.

Installation of the Antenna on a Wall

Fig. 8.5 illustrates the installation of a Meinberg GPSANTv2 antenna on a wall.

1. Insert the antenna tube (Item 5 in Fig. 8.5) into the designated rounded recesses of the two pairs of antenna tube clamp halves (Item 11). Secure the tube inside each of the two clamps (Item 11) using four M4x12 Phillips screws (Item 7) and corresponding M4 hex nuts (Item 6). To ensure that the tube (Item 5) is as secure as possible, the top and bottom M4x12 screws (Item 7) of each tube clamp should be inserted from opposing directions as shown in Fig. 8.5.

2. Drill four holes for M6x45 screws (Item 8) in the underlying wall to match the two screw slits on each of the clamps (Item 11). Insert four wallplugs (Item 10) into these holes.

3. Use four M6 spacers (Item 9) and four M6x45 screws (Item 8) to mount the tube clamps (Item 11) onto the wall using the slits on each of the clamps.

4. Verify that the tube clamps (Item 11) are securely mounted to the wall, that they exhibit no movement without significant force, and that the tube (Item 5) is securely held by the tube clamps.

5. Feed one end of the antenna cable (Type-N connector, male) through the antenna tube (Item 5) from below and screw it by hand onto the female Type-N connector (Item 1) of the antenna. You may then place the antenna on the top of the mounting tube and push it until it is seated. Insert the fixture screw (Item xx) into the base of the antenna using a suitable screwdriver (Phillips head) to secure the antenna (Item 1) onto the antenna tube (Item 5).

8.1.5 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 8.1.3, "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 mast, 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 hazardous 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 masts
- 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.

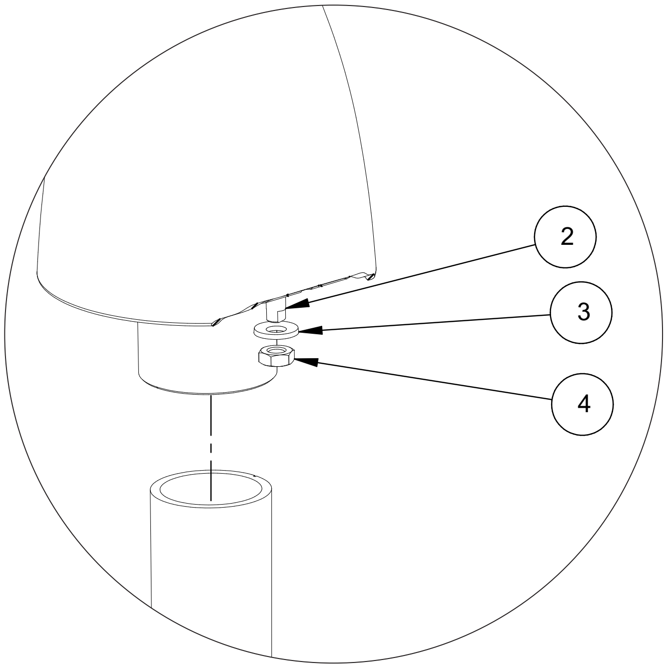


Figure 8.6: Grounding Terminal Assembly

Grounding Cable Installation Procedure

1. Remove the nut (Item 4 in Fig. 8.6) and the safety washer (Item 3).

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

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

4. Tighten the nut (Item 4) 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. 8.7 and Fig. 8.8).

Antenna Installation without Insulated Lightning Rod System

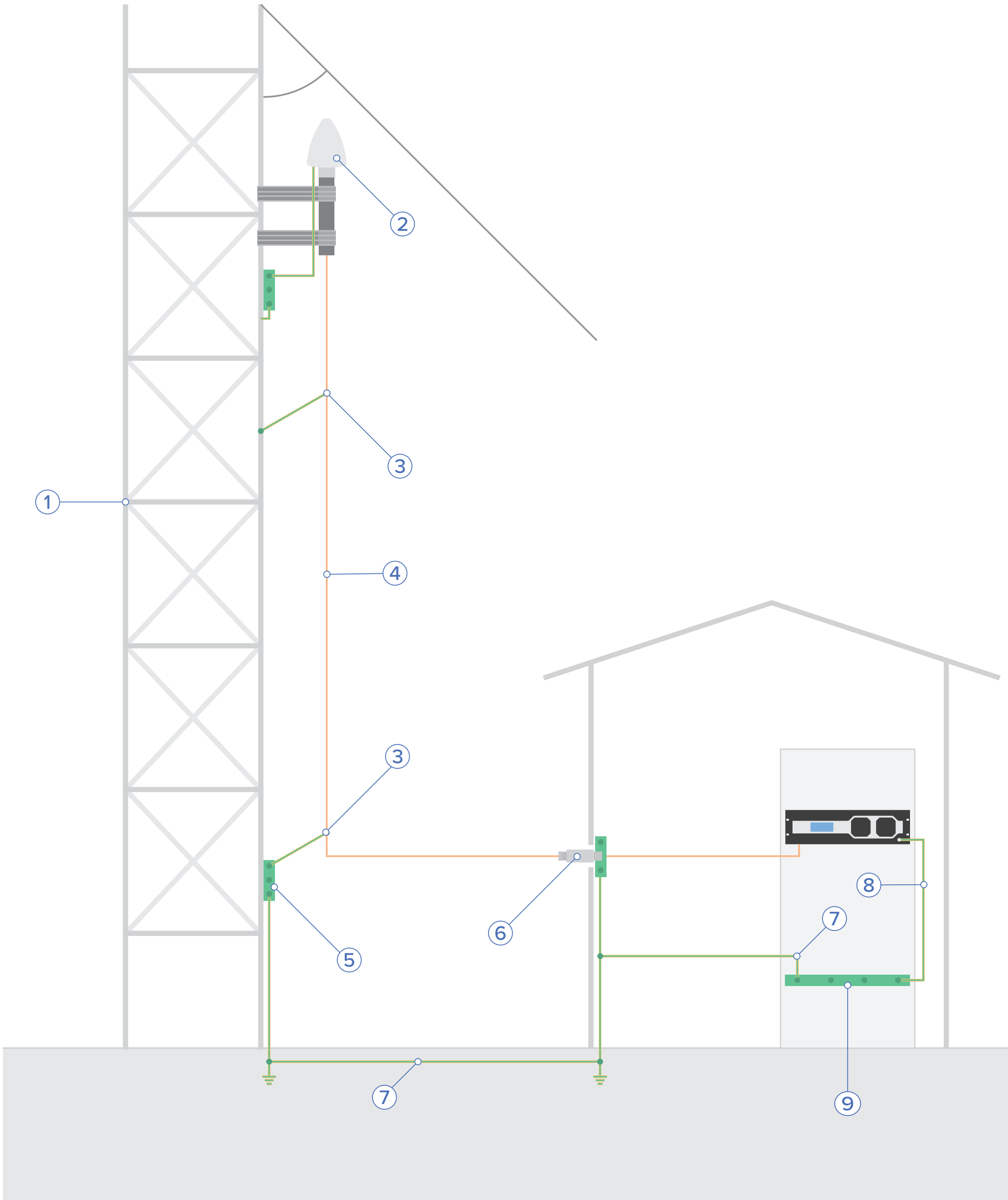


Figure 8.7: Grounding of a Mast-Mounted Antenna

1	Antenna Mast
2	Antenna
3	Shield Clamp
4	Antenna Cable
5	Bonding Bar
6	MBG S-PRO Surge Protector
7	Bonding Cable
8	Device Grounding Terminal
9	Main Ground Rail
α	Safety Zone

Antenna Installation with Insulated Lightning Rod System

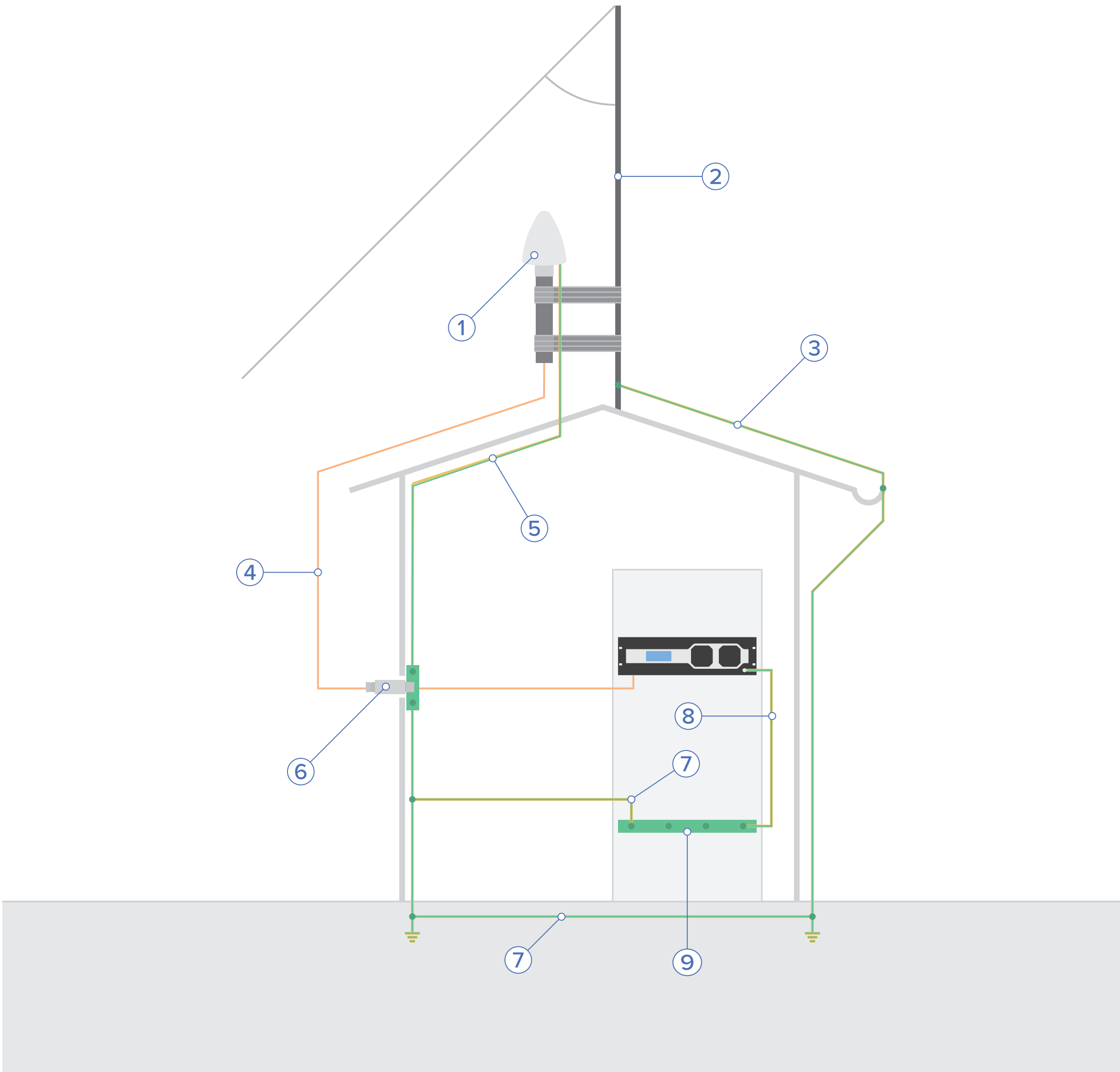


Figure 8.8: Grounding of a Roof or Wall-Mounted Antenna

1	Antenna
2	Lightning Rod
3	Lightning Rod Conductor
4	Antenna Cable
5	Antenna Grounding Terminal
6	MBG S-PRO Surge Protector
7	Bonding Cable
8	Device Grounding Terminal
9	Main Ground Rail
α	Safety Zone

8.2 Installing the GPS183PEX in the Host System

Danger!

Do not work on exposed computer components while connected to a power supply!

Danger of death from electric shock!

- **Always** disconnect the computer or server from its power source by switching off the power source, pulling out the power cable from the device's power supply unit, and taking measures to ensure that it is not reconnected before the installation is complete.
- It is strongly advisable to leave the system dormant for 10–15 minutes in order to allow any residual currents inside the PC to dissipate before beginning with the installation.

This chapter explains how to install the GPS183PEX in your PC or server system.

Please note that this guide assumes that the card is being installed in an upright ATX or EATX enclosure. If you are installing this card in a non-standard chassis such as a custom 1U rack enclosure, the installation procedure can vary and additional tools and accessories such as a PCI Express riser solution may be necessary, which is beyond the scope of this documentation.

Important!

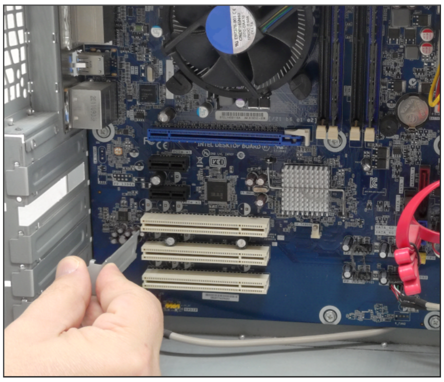
The GPS183PEX is highly sensitive to electrostatic discharges and may be damaged by improper ESD management. Please consult → Chapter 6.5, "Prevention of ESD Damage" and take suitable measures before removing the card from the antistatic bag.

Preparation

Please ensure that you have all tools required to hand for the disassembly and reassembly of your PC enclosure and for securing the PCI Express card on the chassis.

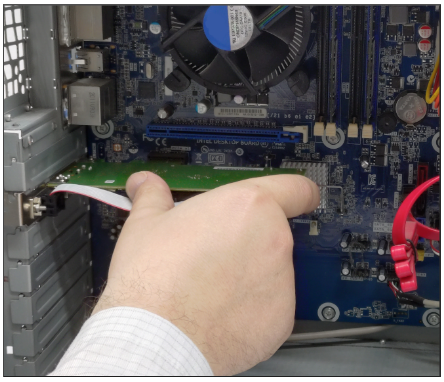
Procedure

1. Disconnect the power supply from your PC, open your PC enclosure and ensure that a free PCI Express slot is available. Ensure that the corresponding rear cover panel is removed if not already done.

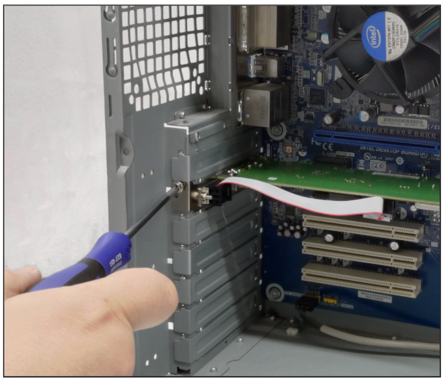


2. Insert the GPS183PEX into the PCI Express slot, taking care to hold the card by the edges while doing so. A certain amount of force may be required to ensure that the PCI Express connector is inserted securely into the slot; however, do not apply excessive force, or the connector may break.

   The GPS183PEX is powered entirely by the PCI Express power rail and does not require an external power supply.



3. Secure the card tightly to the chassis using a suitable fixture screw, then reassemble the chassis.



Important!

The card **must** be securely affixed to the chassis as shown in **Step 3** above! Failure to do so may result in the card becoming unseated from the PCI Express slot when connecting or disconnecting the signal cables, which is very likely to result in serious damage to the card.

8.3 Installation of Drivers and Software

8.3.1 Installation of Drivers and Software under Windows

Meinberg provides an all-in-one driver & software package for Windows users that includes the drivers required to not only manage the GPS183PEX's configuration and monitor its status but also to synchronize the host PC's clock.

This package also includes the **Meinberg Radio Clock Monitor** tool, also known simply as **MbgMon**, which is used to manage the GPS183PEX's internal configuration, analyze its status, and monitor its operating conditions.

Please note that the GPS183PEX requires v3.16 or later of the Meinberg Driver & Software Package for Windows (*DKWIN*), which is available to download from the Meinberg website at the following link:

https://www.meinbergglobal.com/english/sw/

The GPS183PEX drivers support every NT-based version of Microsoft Windows from Windows NT up to the current (at time of writing) Windows 11.

Installation

The Meinberg Driver & Software Package is installed quite simply by executing the *DKWIN* package. Please note that installation of the Meinberg Driver & Software Package requires administrative privileges.

Important!

If you wish to install Meinberg's **NTP for Windows** package concurrently with the Meinberg Driver & Software Package, Meinberg strongly recommends **first** installing the Meinberg Driver & Software Package (remove NTP for Windows from the system beforehand if already installed), **then** installing NTP for Windows.

The reason for this is that NTP for Windows installation process detects the presence of the driver package for GPS183PEX. If you have the Meinberg Driver & Software Package installed, the list of available options for the pool server will include *Follow Meinberg Time Service*. This option ensures that the NTP client service **yields** to the Meinberg Time Service as long as the Meinberg Time Service is synchronized to a reference source.

If this NTP configuration is not used, it is likely that the the Meinberg Time Service and NTP service will operate concurrently against one another to adjust the Windows system time, resulting in reduced synchronization quality.

Running MbgMon

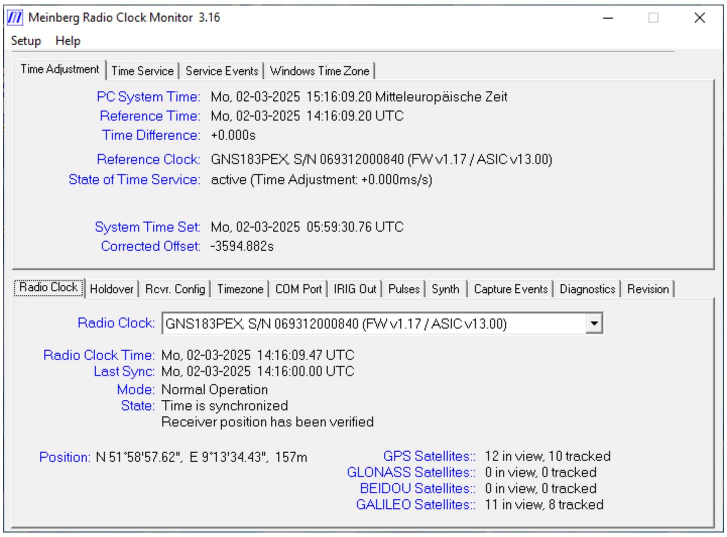


Illustration: The main MbgMon window, as shown when running with administrative privileges

To run MbgMon, double-click on the **MbgMon** desktop shortcut or execute it from the Windows start menu. Please note that many functions, in particular the initial configuration, require administrative privileges.

Initial Configuration with MbgMon

While MbgMon offers a wide range of configuration options (a full guide is provided under → Chapter 9, "MbgMon Guide"), your GPS183PEX can be configured to synchronize your host PC's internal clock in just a few steps:

1. Ensure that MbgMon has been run with administrative privileges; if it is not, you will be advised of this by a warning message when launching the software, and by the message "*Run as admin to change settings!*" in the window's title bar.

2. Check that the settings, time, and date are correct. Once they are, open the menu "**Setup**" and select the option "**Start Time Service**".

3. Ensure that the tab "**Radio Clock**" is selected in the lower half of the window. In the "**Radio Clock**" drop-down menu, ensure that *GPS183PEX* is selected.

   If your GPS183PEX does not appear in the menu, the drivers may not be correctly installed. In this case, remove the Meinberg Driver & Software Package (see **Uninstallation** below) and reinstall, ensuring that you do so with administrative privileges. If problems persist, contact Meinberg's Technical Support team at ✉ techsupport@meinberg.de.

mbgtools-win

The *mbgtools-win* suite comprises a number of command-line programs for Windows that are used to manage, monitor, and analyze your GPS183PEX's operation and represents an alternative method for managing and monitoring your GPS183PEX under Windows as well as incorporating functions of your GPS183PEX in scripting.

A pre-built version of the latest mbgtools-win package is available from the Meinberg Knowledge Base at the following link:

https://kb.meinbergglobal.com/kb/driver_software/driver_software_for_windows/mbgtools_for_windows

Uninstallation

The Meinberg Driver & Software Package can be uninstalled from the host PC using the "**Uninstall**" tool from the Windows Start Menu or from the Windows program management tool (**Add/Remove Programs** or **Apps and Features**).

Updates

Updates to the Meinberg Driver & Software Package, which may contain bugfixes, additional features, and support for new Meinberg products, are made available on the Meinberg website:

https://www.meinbergglobal.com/english/sw/

Updated packages are installed in the same way as described under **Installation** above; the installation package will automatically detect that you have an older version installed and migrate your existing configuration settings accordingly.

Further Information

For more information on the use of MbgMon, please refer to the full guide in → Chapter 9, "MbgMon Guide". The Meinberg Knowledge Base, available at the following link, is also a useful reference when encountering problems:

https://kb.meinbergglobal.com/kb/driver_software/driver_software_for_windows

8.3.2 Installation of Drivers and Software under Linux

Meinberg provides an all-in-one driver & tool package for Linux users that includes the drivers required to not only manage the GPS183PEX's configuration and monitor its status but also to synchronize the host PC's clock. The drivers and software must be built manually under Linux as they require a kernel module to be built for your specific kernel version.

This package also includes the ***mbgtools*** suite, which is used to configure the GPS183PEX's internal configuration, analyze its status, and monitor its operating conditions.

Please note that the GPS183PEX requires v4.2.28 or later of *mbgtools*.

Meinberg strongly recommends reading the `README` file in the archive carefully and thoroughly before building the drivers and tools, as this document contains up-to-date distribution-specific information regarding building the kernel module. The Meinberg Knowledge Base is also a useful source of up-to-date information about common issues with compilation:

https://kb.meinbergglobal.com/kb/driver_software/driver_software_for_linux/start

General Preparation

The need to install specific prerequisites for your distribution will depend on what packages have been pre-installed in your distribution and which are possibly out of date. However, as a general rule, you will need to verify if the following are installed:

- the Linux kernel header files for the currently running kernel and/or any other kernel versions that you wish to compile the kernel module for,
- the GNU Compiler Collection (*gcc*),
- GNU Make (*make*).

The default installation of many Linux distributions already has the GNU Compiler Collection, GNU Make, and kernel header files pre-installed. However, if the OS has had kernel updates since the initial installation, these header files may be outdated.

The best way to be sure that the prerequisites for the *currently running kernel* are installed and up-to-date is shown for a number of common distributions below. These assume the use of fairly recent versions of the distributions, and the need for `sudo` will of course depend on whether the terminal is in a root context):

Debian & Derivatives (e.g., Ubuntu, Linux Mint, Raspberry Pi OS):

```
sudo apt install linux-headers-$(uname -r) gcc make
```

Fedora/RHEL & Derivatives (e.g., CentOS, Rocky Linux):

```
sudo dnf install kernel-devel-$(uname -r) gcc make
```

Arch Linux & Derivatives (e.g., EndeavourOS):

```
sudo pacman -S linux-headers gcc make
```

Downloading, Building & Installation

Information:

This manual only provides a general description of how to build and install the GPS183PEX drivers under Linux. For more up-to-date, distribution-specific information, consult the README file in the driver archive or visit the Meinberg Knowledge Base under the following link:

https://kb.meinbergglobal.com/kb/driver_software/driver_software_for_linux/start

Begin by verifying that the PCI Express card has been correctly detected by your system with:

```
lspci | grep -e "Meinberg Funkuhren"
```

This should return one or more entries with "`System peripheral: Meinberg Funkuhren`" for each Meinberg PCI Express card in your system.

If you have not already done so, you should download the Meinberg Linux Driver Package, which is available from the Meinberg website at the following link:

https://www.meinbergglobal.com/english/sw

Once downloaded, you may unpack the .tar.gz archive into a suitable subdirectory with:

```
tar xvzf mbgtools-lx-*.tar.gz
```

where the wildcard asterisk can of course be replaced with the specific version that you have downloaded.

Alternatively, you may also use `git` to clone the driver package from the Master branch (corresponding to the current stable version of the driver package) of Meinberg's Git repository:

```
git clone https://git.meinbergglobal.com/drivers/mbgtools-lx.git
```

This will create a subdirectory in the current directory into which the contents of the branch will be directly downloaded.

To build the drivers and tools, navigate to the root directory in which the package has been unpacked and execute:

```
make
```

Once the build process is complete, you can install the drivers and tools with:

```
sudo make install
```

Once this is complete, execute the following to load the kernel module:

```
sudo modprobe mbgclock
```

This should also ensure that the kernel module is loaded automatically upon boot, as long as any compatible Meinberg device is detected by the kernel. The kernel module is responsible for handling general communication between the host PC and the GPS183PEX.

Finally, execute the following to load the Meinberg Time Service (`mbgsvcd`):

```
sudo make install_svc
```

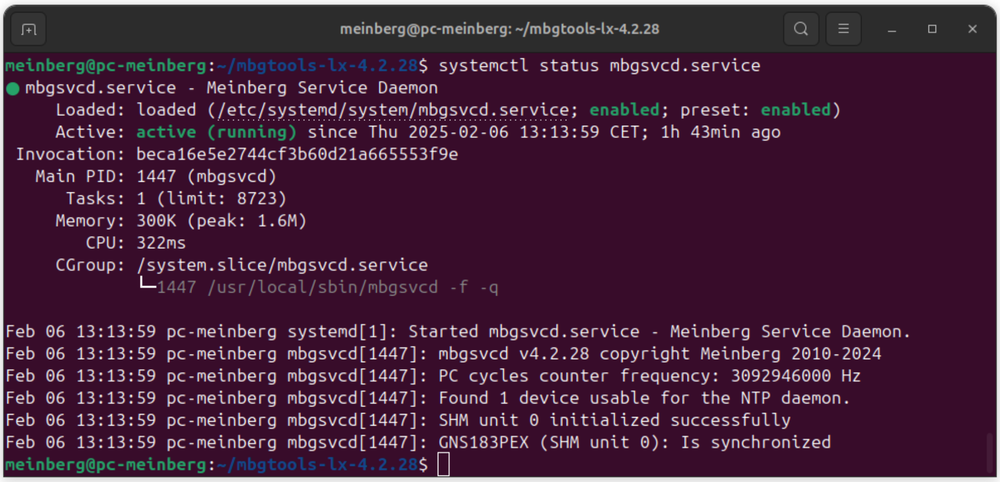
As with the kernel module, this should ensure that the service is loaded automatically upon boot. The Meinberg Time Service is responsible for handling communication specifically between the GPS183PEX and the local NTP service running on the host PC for the purpose of synchronizing the host PC's local clock.

Note that this process may output a number of seemingly critical errors as the script attempts to identify which service manager your Linux distribution is running. The most relevant indication of success that the service has successfully been installed is a message from the service manager towards the end of the terminal output confirming that the service is running.

You can also confirm manually that the service is running. On systems using *systemd* for example, execute:

```
systemctl status mbgsvcd
```

Under Ubuntu installations using *systemd* as the service manager, the message in the `make install` and `systemctl` output will resemble the following:



```
meinberg@pc-meinberg: ~/mbgtools-lx-4.2.28
meinberg@pc-meinberg:~/mbgtools-lx-4.2.28$ systemctl status mbgsvcd.service
● mbgsvcd.service - Meinberg Service Daemon
     Loaded: loaded (/etc/systemd/system/mbgsvcd.service; enabled; preset: enabled)
     Active: active (running) since Thu 2025-02-06 13:13:59 CET; 1h 43min ago
 Invocation: beca16e5e2744cf3b60d21a665553f9e
   Main PID: 1447 (mbgsvcd)
      Tasks: 1 (limit: 8723)
     Memory: 300K (peak: 1.6M)
        CPU: 322ms
     CGroup: /system.slice/mbgsvcd.service
             └─1447 /usr/local/sbin/mbgsvcd -f -q

Feb 06 13:13:59 pc-meinberg systemd[1]: Started mbgsvcd.service - Meinberg Service Daemon.
Feb 06 13:13:59 pc-meinberg mbgsvcd[1447]: mbgsvcd v4.2.28 copyright Meinberg 2010-2024
Feb 06 13:13:59 pc-meinberg mbgsvcd[1447]: PC cycles counter frequency: 3092946000 Hz
Feb 06 13:13:59 pc-meinberg mbgsvcd[1447]: Found 1 device usable for the NTP daemon.
Feb 06 13:13:59 pc-meinberg mbgsvcd[1447]: SHM unit 0 initialized successfully
Feb 06 13:13:59 pc-meinberg mbgsvcd[1447]: GNS183PEX (SHM unit 0): Is synchronized
meinberg@pc-meinberg:~/mbgtools-lx-4.2.28$
```

mbgtools

The *mbgtools* suite comprises a number of command-line programs that are used to manage, monitor, and analyze your GPS183PEX's operation.

Uninstallation

The Meinberg Driver & Tools Package can be uninstalled from the host PC by executing the following from the command line while in the directory in which the Meinberg Driver & Tools archive was unpacked:

```
sudo make uninstall
```

Note that this process may output a number of seemingly critical errors as the script attempts to identify which service manager your Linux distribution is running. The most relevant indication of success that the service has successfully been terminated and removed is a message from the service manager towards the end of the terminal output confirming that the service is running. In the case of *systemd*, this will be similar to:

```
Removed '/etc/systemd/system/multi-user.target.wants/mbgsvcd.service'.
```

Updates

Updates to the Meinberg Driver & Tools Package, which may contain bugfixes, additional features, and support for new Meinberg products, are made available on the Meinberg website:

https://www.meinbergglobal.com/english/sw

When downloading a new driver archive, please ensure that you unpack it to a new folder.

If you have downloaded the driver archive by cloning the Meinberg Git repository, you can update the contents of the build folder by *pulling* the latest updates to the Master branch by executing:

```
git pull
```

while the current directory is the build folder. In this case, before rebuilding the drivers based on the new source code, you should remove any legacy binary and object files from the build folder using:

```
make clean
```

Further Information

https://kb.meinbergglobal.com/kb/driver_software/driver_software_for_linux/start

8.4 Cable Connections

Important!

Please ensure that you have read and understood the safety information at the start of this manual before you connect your GPS183PEX, and that you perform the procedure in the order listed here.

This chapter assumes that you already have the requisite antenna infrastructure installed for your GPS183PEX.

Procedure

1. Connect the BNC connector from your antenna or signal distributor to the antenna input. Twist the male connector in a clockwise direction to lock it into place.
2. If you wish to connect an amplitude-modulated timecode receiver to your GPS183PEX, you can do so using a suitable coaxial cable as specified in → Chapter 11.1, "AM Timecode Output".
3. Switch on your PC. At this point, if the antenna is correctly connected, the "**A**" LED should be green indicating that the antenna is correctly connected. Eventually, the "**N**" LED should also turn green, indicating that the receiver has successfully and accurately determined its position on the basis of four locked satellites. Once this process has been completed, you can proceed with the configuration of your GPS183PEX.

   Please note that even once the GPS183PEX has a GNSS lock, it may take some time for your GPS183PEX to begin synchronizing the clock of the host PC and generate signals via the outputs, as the card's oscillator still needs to adjust to the time reference. However, the management software *MbgMon* and *mbgTools* can be used to monitor and manage this behavior.

   Refer to → Chapter 9, "MbgMon Guide" for more information.

9 MbgMon Guide

9.1 Configuration Options

The MbgMon user interface is divided into three sections: the **menu bar**, the **upper panel** and the **lower panel**.

The **menu bar** contains a number of the most essential functions relating to starting and stopping services and selecting connected Meinberg products.

The **upper panel** shows status readouts as well as a number of settings relating to the time services running under Windows.

The **lower panel** shows the options and status displays for the GPS183PEX.

9.1.1 MbgMon Menu Bar

The menu bar in the MbgMon window provides access to a number of essential functions relating to the starting, stopping, and initialization of the time service.

Setup Menu

Start/Stop Time Service:	This starts (or if already started, stops) the Meinberg time service running on the host PC that governs how the PC's internal clock (system time) is synchronized to the GPS183PEX's reference signal.
Start/Stop NTP Service:	This starts (or if already started, stops) the NTP client service running on the host PC. The NTP service can be used to distribute the host PC's time (ideally synchronized with the GPS183PEX) to other PCs in the network.
Language:	This allows the MbgMon user interface to be set to English (using either the U.S. date format *mm-dd-yyyy* or U.K. date format *dd/mm/yyyy*) or to German (using the German standard date format *dd.mm.yyyy*).
Reference Time:	This submenu is used to select the time reference used by the Meinberg Time Service to synchronize the host PC's clock. Typically, this will include the ability to use the GPS183PEX, a serial time string input in Meinberg Time String format via a serial interface, and any other Meinberg clocks that may be connected to or installed in your PC.
Set Ref. Clock Time:	This is used to manually set the time of the GPS183PEX (not the host PC clock). This can be helpful to speed up the synchronization process as the GPS183PEX typically will not make hard adjustments to the time and may not adjust the time at all if the discrepancy between the reference clock's time and the reference signal time is too great. For convenience, a button is provided that allows you to transfer the current time of the host PC directly to the reference clock.

Show Eventlog: This displays the event log relating to the Meinberg Time Service. You may display application-level events (relating to the Meinberg time services running on the host PC) and system-level events (relating to events logged by the GPS183PEX itself), and also load a previously saved log file for reference. The window also provides filter options to limit output to events generated by Meinberg processes and devices only or to include those generated by Windows and other programs in relation to time service events, to limit output to certain error levels or to events containing certain text strings.

Quit: Closes MbgMon. Please note that the GPS183PEX will continue to synchronize the host PC's clock in the background even when MbgMon is closed, as long as the Meinberg Time Service is enabled, the GPS183PEX is correctly configured, and the reference signal is being received.

9.1.2 Upper Panel

9.1.2.1 Time Adjustment

The **Time Adjustment** tab of the upper panel shows status information relating to the Meinberg Time Service.

PC System Time:	The current system time of the host PC. This time is expressed according to the timezone configuration under Windows.
Reference Time:	The current time of the selected reference clock, i.e., the GPS183PEX. This time is expressed according to the timezone configuration in MbgMon.
Time Difference:	Any time difference between the host PC's UTC time and the UTC time of the selected reference clock, i.e., the GPS183PEX. This value will not be displayed if the Meinberg Time Service is not enabled.
Reference Clock:	The currently selected reference clock, i.e., the GPS183PEX. This will also show, where appropriate, the serial number, current firmware version, and ASIC revision of the device.
State of Time Service:	The current state of the Meinberg Time Service, along with the current rate of the time adjustments being performed by the Time Adjustment Service (if any).

9.1.2.2 Time Service

The **Time Service** tab of the upper panel shows a number of advanced settings relating to the Meinberg Time Service.

Important!

The default settings provided in this tab are optimized for the vast majority of applications. These options generally do not need to be modified.

Any changes here must be saved using the **Save** button before switching to another tab.

Number of Valid Time Strings:	This specifies the number of valid and unique time-of-day strings that the time service must receive before it adjusts the host PC clock.
Sync Radius:	Specifies the threshold in seconds that governs how the reference clock will adjust the host PC clock. If the difference between the reference clock time and host PC time exceeds this threshold, the Meinberg Time Service will apply a 'hard' adjustment of the PC's time. If the difference is below this threshold, the Meinberg Time Service will apply gradual adjustments to the time.

Notification Limit: Specifies the threshold in milliseconds at which a log entry is generated if the time adjustment accuracy crosses this value. This means that a log entry will be generated if the time adjustment rate exceeds this value, and another will be generated when the adjustment rate falls below this value again. If set to `0`, this function is disabled and no log entries will be generated.

Max. Difference: Specifies the threshold at which the Meinberg Time Service is stopped in relation to the difference between the reference clock time and the host PC time.

Allow Initial Timestep: This allows the GPS183PEX to perform one 'hard' adjustment when the reference clock is started for the first time or reset, regardless of the limit set under "**Max. Difference**". For the GPS183PEX, this is permanently set to *on* and cannot be disabled.

Don't Wait for Sync After Reset: If enabled, the GPS183PEX will adjust the host PC's time based on the reference clock time when the GPS183PEX is started or reset, even if the GPS183PEX has never been synchronized to the reference signal since the last reset or start-up. This can be useful for testing if no antenna is connected, but can be dangerous in a productive environment because the time service can accept a wrong time from the unsynchronized device and apply the wrong time to the host PC's system clock.

Generate Statistics File: If enabled, this generates a statistical file logging reference clock events such as antenna failures, reception problems, etc.

Expert Settings

These options are only enabled by selecting the "**Expert**" button and require advanced knowledge of the Windows time service.

Set Local Time: If enabled, this forces the Meinberg Time Service to compare the GPS183PEX's *local* time to the host PC's local time instead of comparing UTC timestamps.

This is generally not recommended, as the host PC's UTC time is likely to be shifted back and forth at every DST change, which can have an adverse impact on applications (such as database applications using timestamped transactions) that draw UTC time from the underlying operating system kernel.

Modify Multimedia Timer: This ensures that the resolution of the Windows Multimedia Timer is permanently set at its maximum resolution while the Meinberg Time Service is running. This option is enabled by default and there is generally no reason on modern PCs to disable it.

Allow Timestep when Ref. Clock Jumps: This option is intended for testing purposes only. Typically, the Meinberg Time Service prevents the host PC's clock from following any time jumps detected by the reference clock in order to avoid disruptive time changes in the PC's clock. Enabling this option disables this behavior, such that the Meinberg Time Service will adjust the host PC's clock regardless of any detected jumps in the reference clock time.

9.1.2.3 Service Events

The **Service Events** tab of the upper panel contains a number of advanced settings relating to how the Meinberg Time Service responds to the GPS183PEX achieving and losing synchronization.

Important!

Any changes here must be saved using the **Save** button before switching to another tab.

Enable Service Events: If enabled, the Meinberg Time Service will execute the commands specified under **Async Event Command** and **Sync Event Command** when the GPS183PEX loses synchronization with its reference signal and when it achieves synchronization respectively.

Async Event Command: This is the shell command that is executed when the GPS183PEX loses synchronization with its reference signal. By default, this is set to `net stop ntp`, which will stop the NTP service.

Sync Event Command: This is the shell command that is executed when the GPS183PEX achieves (re)-synchronization with its reference signal. By default, this is set to `net start ntp`, which will (re)start the NTP service.

Call Async Event Command After: The Meinberg Time Service will wait for this time, specified in minutes, before executing the specified command under **Async Event Command**. This can be useful to avoid unnecessary disruption to services, especially if the performance of the holdover solution (the onboard oscillator) is adequate for a short time.

9.1.2.4 Windows Time Zone

The **Windows Time Zone** tab of the upper panel shows information about the time zone currently configured in Windows and the rules governing offsets relative to UTC at specified times of the year.

9.1.2.5 NTP

Information:

The **NTP** tab will not be visible if *NTP for Windows* has not been installed.

The **NTP** tab of the upper panel provides access to the host PC's NTP service configuration. It automatically detects the current NTP configuration path but allows a different path to be specified if a different configuration file is to be used. Selecting the **Edit** button allows the file to be edited directly within MbgMon, and selecting **Save** will apply any changes to the file.

9.1.3 Lower Panel

9.1.3.1 Radio Clock

The **Radio Clock** tab of the lower panel shows status information relating to the selected reference clock, i.e., the GPS183PEX. This includes the current time of the reference clock, its operating mode, synchronization state, as well as GNSS-related information such as the detected position, the satellites that should be visible according to the current almanac, and those that the GPS183PEX actually has a lock on.

9.1.3.2 Holdover

The **Holdover** tab of the lower panel shows status information relating to the holdover state of the reference clock.

Reception State:	Specifies the current synchronization state of the GPS183PEX. This can be: *Antenna Information Invalid*: There is a fault on the antenna line and the GPS183PEX is not receiving coherent receiver data. *Antenna Connected*: The antenna has been continuously connected to the GPS183PEX and a coherent signal has been received since the GPS183PEX was last (re)initialized. *Antenna Disconnected, Holdover Mode*: A previously detected antenna connection can no longer be found and thus the GPS183PEX is switching to holdover (free-run) mode. *Antenna Reconnected, Waiting for Sync*: After the antenna connection was previously lost, the GPS183PEX has detected an antenna connection again and is trying to re-establish synchronization.
Antenna Disconnected:	The time at which an antenna connection last failed to be detected.
Sync. after Antenna Reconnect:	The time at which synchronization was re-established following re-detection of the antenna connection.
Time Offset after Holdover:	The difference between the time of the reference signal and that of the reference clock upon re-establishment of the reference signal.

9.1.3.3 Rcvr. Config

The **Rcvr. Config** tab of the lower panel allows the length of the cable from the antenna to the GPS183PEX to be adjusted.

Length of Antenna Cable:

To achieve the best possible accuracy in the nanosecond range, you should enter the full length of the antenna line between the antenna and the receiver here, regardless of any signal distribution nodes that may be positioned between them. This will allow the GPS183PEX to adjust the received time to account for the propagation delay of the signal along the coaxial cable connecting the antenna to the GPS183PEX.

The GPS183PEX assumes a delay of 5 ns per meter of RG58 cable. Thus, by way of example, if `30 m` is entered here, the GPS183PEX will apply a 150 ns correction to the received time.

Information:

If you are using antenna signal distributors on the antenna line and the propagation delay from input to output is known and documented for these distributors, you can enhance the synchronization accuracy slightly by increasing the notional cable length accordingly.

For example, if you are using a Meinberg GPSAV4 distributor to distribute a GPS signal from your GPSANTv2 antenna, the processing of the signal within the GPSAV4 is known to incur a delay of *50 ns*. This can be reflected in the cable length by adding *10 m* to the value (*5 ns per meter * 10 meters = 50 ns*).

9.1.3.4 Timezone

The **Timezone** tab of the lower panel shows various options relating to the timescale and timezones used within the GPS183PEX.

Timescale: Specifies the timescale used internally by the GPS183PEX:

UTC/Local:
This setting ensures that outgoing time-of-day transmissions (such as time strings, timecode, etc.) is transmitted in UTC, plus/minus any configured local adjustments relative to UTC. This is intended to be the standard operating mode.

GPS:
This setting ensures that outgoing time-of-day transmissions (such as time strings, timecode, etc.) are in GPS Time, i.e., the time as received from the reference signal directly without leap seconds. This is intended for very specific applications only.

TAI:
This setting ensures that outgoing time-of-day transmissions (such as time strings, timecode, etc.) are in International Atomic Time (TAI). This is intended for very specific applications only.

Timezone Definition

The right side of this tab contains a number of options that allow the local timezone to be defined. It features two buttons that provide presets for Central European (Summer) Time (CET/CEST) and UTC. Other timezones must be configured manually, and this process is described below, using UK civil time as an example:

Daylight Saving Not Active: This is the abbreviated designation of the Winter Time timezone outside of Daylight Saving Time/Summer Time periods. Taking the example of UK civil time, this would be *GMT* for Greenwich Mean Time.

The offset relative to UTC is entered here in hours, minutes, and seconds. In the case of Greenwich Mean Time, this remains *00:00:00*, as GMT runs parallel with UTC.

Daylight Saving Active: This is the abbreviated designation of the Summer Time/Daylight Saving Time period for the timezone. Taking the example of Greenwich Mean Time, this would be *BST* for British Summer Time.

The offset relative to UTC is entered here in hours, minutes, and seconds. In the case of British Summer Time, this is *01:00:00*, as BST is one hour ahead of UTC.

Dynamically Calculated Daylight Saving/Summer Time Adjustments

If the local timezone allows the changeover to be calculated dynamically according to fixed rules relating to the Gregorian Calendar, changeovers can be handled automatically by selecting **Calculated** and modifying the following options:

Beginning: This specifies the rules that allow the GPS183PEX to detect when Daylight Saving Time/Summer Time begins in this timezone. Taking the example of British Summer Time, which is defined to begin on the **last Sunday in March at 01:00 GMT** (i.e., the Sunday after March 25th), we enter:

Beginning **Sunday** after **25** in **March** at **01:00**

End: This specifies the rules that allow the GPS183PEX to detect when Daylight Saving Time/Summer Time ends in this timezone. Taking the example of British Summer Time, which is defined to end on the **last Sunday in October at 02:00 BST** (i.e., the Sunday after October 25th), we enter:

End **Sunday** after **25** in **October** at **02:00**

Daylight Saving/Summer Time Adjustments at Fixed Times

If the local timezone **does not** allow the changeover to be calculated according to fixed rules relating to the Gregorian Calendar (for example, where local timezones are specified by alternative calendars such as a lunar calendar or are announced on a rolling year-by-year basis by local authorities), changeovers can be handled manually by selecting **Fix for One Year** and modifying the following options:

Beginning: This specifies the fixed and singular occasion when the GPS183PEX will apply Daylight Saving Time/Summer Time in this timezone.

End: This specifies the fixed and singular occasion when the GPS183PEX will end Daylight Saving Time or apply Winter Time in this timezone.

9.1.3.5 COM Port

The **COM Port** tab of the lower panel provides configuration options for the time string output of the GPS183PEX.

The two tabs *COM0* and *COM1* relate to the RS-232 pin outputs in the box headers on the GPS183PEX board. By default, the **the outermost box header** is connected to the D-Sub 9 port on the port panel, such that the settings under the tab **COM0** control the time string output via the D-Sub 9 port with the card in its default hardware configuration.

If the ribbon cable from the D-Sub 9 port is connected to the **innermost box header**, the time string configuration under the tab **COM1** dictates the time string output via the D-Sub 9 port.

The GPS183PEX can output separately configured time strings via both COM0 and COM1 simultaneously, for which a suitable cable must be assembled and used to connect the unused box header to the intended receiver or output, for example a separate PCI Express slot bracket with a suitable D-Sub 9 connector.

Please note that time string output usually follows the timezone settings under the → "Timezone" tab. Timezone information will be included in the time string if the selected format supports it. Similarly, the synchronization state may be communicated via the time string if so supported by the format.

Baud Rate: Specifies the baud rate for the output of time strings via the selected serial interface.

Framing: Specifies the framing bit structure for the output of time strings via the selected serial interface.

String:	Specifies the string format to be output via the selected serial interface. Refer to → Chapter 13.7, "Time String Formats" for more information on the supported strings.
Mode:	Specifies the conditions under which time strings are output. *Per Second* has the time string output once a second via the selected serial interface, while *Per Minute* has the time string output once a minute. If set to *On Request '?' Only*, the GPS183PEX will only generate a time string upon receipt of a ? (ASCII code 0x3F) character at the Rx pin of the serial interface.
Enable Serial Output:	If set to *After Sync*, the GPS183PEX will only generate serial time strings once the reference clock has synchronized at least once since the GPS183PEX's last (re)initialization. If set to *Always*, the GPS183PEX will generate serial time strings regardless of the synchronization state of the GPS183PEX (i.e., it will begin immediately upon initialization of the GPS183PEX).

9.1.3.6 IRIG Out

The **IRIG Out** tab of the lower panel provides configuration options for the timecode output of the GPS183PEX.

IRIG TX Code Format:	Specifies the data format of the output signal. Each option represents both an amplitude-modulated timecode format and its pulse-width modulated DCLS equivalent. Therefore, the option *B002+B122* outputs both IRIG-B002 via Pin 7 of the D-Sub 9 connector **and** IRIG-B122 via the BNC connector of the GPS183PEX.
Transmit Local Time Instead of UTC:	As standard, timecode is output as UTC. If this option is enabled, the GPS183PEX will generate timecode pre-adjusted to the local timezone (see → Chapter 9.1.3.4, "Timezone").
Output TFOM always as 'sync':	This option only applies to IEEE timecodes which transmit a Time Figure of Merit (TFOM). If enabled, the GPS183PEX will persistently transmit a TFOM that allows the receiver to assume that the GPS183PEX is synchronized, regardless of the actual synchronization state of the GPS183PEX.
Enable IRIG and Pulses Outputs:	If set to *After Sync*, the GPS183PEX will only generate programmable signals and timecode once the reference clock has synchronized at least once since the GPS183PEX's last (re)initialization. If set to *Always*, the GPS183PEX will generate programmable signals and timecode regardless of the synchronization state of the GPS183PEX (i.e., it will begin immediately upon initialization of the GPS183PEX). The state of this option mirrors the same option in the tab "**Pulses**" (→ Chapter 9.1.3.7, "Pulses").

9.1.3.7 Pulses

The **Pulses** tab of the lower panel provides configuration options for the programmable signal output of the GPS183PEX.

It features four tabs **Out 1** through **Out 4**. These represent four signal channels on the GPS183PEX that are output via the pins *PPO_0* to *PPO_3* (**Out 1** = *PPO_0*, **Out 4** = *PPO_3*).

Programmable Signal Configuration (Out 1 – Out 4)

Function: Specifies the programmable signal to be output via the selected channel.

Invert Output Level: If this option is enabled, the waveform of the output signal is inverted, such that the signal is now active-low. An inverted PPS signal with a pulse width of 200 ms, for example, would be output as 200 ms low, followed by 800 ms high.

Depending on the signal type selected, additional options relating to start and end times, cycle times, and pulse widths are displayed to be configured as appropriate.

For more information regarding the supported programmable signal types, please refer to → Chapter 13.6, "Overview of Programmable Signals" .

Enable Output Signals

Fixed Frequency: This option specifies the conditions under which fixed frequencies are output. This option has no effect with the GPS183PEX, which has no fixed frequency outputs.

Enable IRIG and Pulses Outputs: If set to *After Sync*, the GPS183PEX will only generate programmable signals and timecode once the reference clock has synchronized at least once since the GPS183PEX's last (re)initialization. If set to *Always*, the GPS183PEX will generate programmable signals and timecode regardless of the synchronization state of the GPS183PEX (i.e., it will begin immediately upon initialization of the GPS183PEX). The state of this option mirrors the same option in the tab "**IRIG Out**" (→ Chapter 9.1.3.6, "IRIG Out").

> **Information:**
>
> The **Enable Output Signals** options do not relate to the option "*Frequency Synthesizer*". The synthesizer output condition is configured under the tab "**Synth**" (→ Chapter 9.1.3.8, "Synth").

9.1.3.8 Synth

The **Synth** tab of the lower panel provides configuration options for the frequency synthesizer of the GPS183PEX. The frequency synthesizer output is enabled by selecting the option *Frequency Synthesizer* as the output signal for one of the programmable signal channels (→ Chapter 9.1.3.7, "Pulses").

The frequency of the signal is set using the numerical selectors. The scale selector can be used to select between the following scales in hundreds of Hertz:

- 0 Hz – 999.9 Hz (fractional frequency, see below)
- 1.000 kHz – 9.999 kHz (3 decimal places)
- 0.00 kHz – 99.99 kHz (2 decimal places)
- 0.0 kHz – 999.9 kHz (1 decimal places)
- 0.0 MHz – 9.999 MHz (3 decimal places)

The numerical selectors for phase allow the phase of the signal to be adjusted to ±359.9° of the reference signal.

Special Case: Fractional Frequencies

When selecting the lowest *Hz* range of frequencies, the single decimal place represents a high-precision fraction of an oscillation:

.1 Hz = 1/8 Hz or 0.125 Hz
.2 Hz = 1/4 Hz or 0.25 Hz
.3 Hz = 1/3 Hz or 0.3333... Hz
.6 Hz = 2/3 Hz or 0.6666... Hz

Enable Output: If set to *After Sync*, the GPS183PEX will only generate synthesized frequencies via the programmable signal channels once the reference clock has synchronized at least once since the GPS183PEX's last (re)initialization. If set to *Always*, the GPS183PEX will generate the configured synthesized frequency regardless of the synchronization state of the GPS183PEX (i.e., it will begin immediately upon initialization of the GPS183PEX).

9.1.3.9 Capture Events

The **Capture Events** tab of the lower panel provides configuration options for the capture inputs of the GPS183PEX. Detected capture events (the falling edge of a TTL pulse). These events are logged hier in the text window on the left.

The onboard event buffer is capable of holding over 500 events and can be cleared manually using the corresponding "**Clear**" button. Similarly, the monitoring buffer stored on the host PC can be saved to a file or cleared using the corresponding buttons here.

9.1.3.10 Diagnostics

The **Diagnostics** tab of the lower panel provides some diagnostic information relating to the GNSS receiver and oscillator, as well as a number of troubleshooting functions.

Oscillator DAC: This button resets the voltage adjustment of the oscillator.

Important!

Do not use the option **Oscillator DAC** except on the explicit instructions of Meinberg Technical Support or a Meinberg engineer!

User Variables: This button performs a 'warm boot' of the GNSS receiver; any almanac data is preserved but any locks that the receiver has on satellites are cleared and the GPS183PEX attempts to re-lock onto satellites based on existing data.

System Variables: This button performs a 'cold boot' of the GNSS receiver; all almanac data and any locks that the receiver has on satellites are cleared. The GPS183PEX will attempt to reacquire relevant almanac data and re-lock onto satellites.

9.1.3.11 Revision

The **Revision** tab of the lower panel provides some internal information relating to the GPS183PEX, including the kernel driver version, the device type, the serial number, the version of the currently running Meinberg Time Service, and the firmware ID.

Meinberg recommends making a note of this information when contacting Meinberg Technical Support, as it can be useful for diagnosing problems and finding solutions.

10 mbgtools Guide

The mbgtools packages *mbgtools-win* and *mbgtools-lx* contain a number of useful command-line tools for the operation, management, and monitoring of the GPS183PEX.

mbgsvcd (Supported *nix Systems Only)

mbgsvcd is the service daemon that runs in the background (or optionally the foreground) of *nix-based systems. It acquires the current reference time from Meinberg clocks and communicates it to the locally running NTP service. This daemon is typically set up during the installation process in the operating system's service management but can be executed independently as a daemon or optionally in the foreground (`mbgsvcd -f`) to output all operating messages and acquired timestamps to `stdout`.

`mbgsvcd -h` or `mbgsvcd -?` provides a full list of options.

mbgstatus

mbgstatus provides a reading of the GPS183PEX's current status as well as some general information. These include information on the firmware and ASIC revisions, the current receiver state, and the current synchronization status.

`mbgstatus -v` provides a more verbose status reading that includes additional information such as oscillator adjustment parameters, receiver position, and leap second data.

`mbgstatus -h` or `mbgstatus -?` provide a full list of options.

mbgctrl

mbgctrl is the primary configuration and management tool for your Meinberg product.

In general:

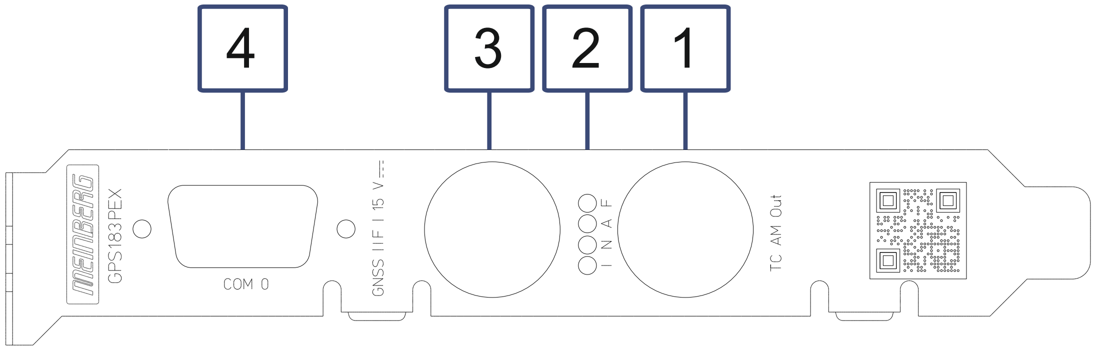
- commands are executed using the syntax `mbgctrl COMMAND` (e.g., `mbgctrl BOOT` to force the receiver to cold boot)
- output is generated for certain parameters using the syntax `mbgctrl PARAMETER` (e.g., `mbgctrl TZOFFS` to show the current time zone offset),
- parameters are set using the syntax `mbgctrl PARAMETER=VALUE` (e.g., `mbgctrl TZOFFS=1` to set the current basic time zone offset),
- parameters with multiple sub-parameters are set using the syntax `mbgctrl PARAMETER=PARMA:1,PARMB:2,PARMC:3`.

Entering `mbgctrl` without any parameters displays all actions and parameters supported by the GPS183PEX.

mbgirigcfg

mbgirigcfg is used to configure the formatting of AM and DCLS timecode output, including timescale/time zone information, and integration of TFOM in supported timecode formats.

11 GPS183PEX Indicators and Connectors



Information:

The numbering in the drawing above relates to the relevant subsection in this chapter.

11.1 AM Timecode Output

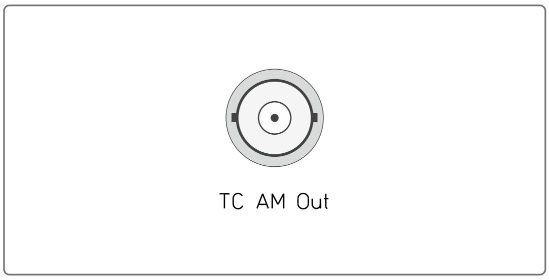
Connector Type: BNC, Female
(on device)

Output Signal: AM Timecode (IRIG-B12x, AFNOR NF S87-500, IEEE 1344, IEEE C37.118)

Signal Level: 3 V_{pp} / 1 V_{pp} (MARK/SPACE) with 50 Ω load

Carrier Frequency: 1 kHz (IRIG-B12x)

Cable: Coaxial Cable, Shielded



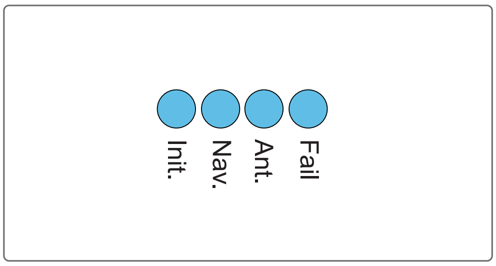
11.2 Status LEDs

"*T*" LED: Initialization status of reference clock

"*N*" LED: Navigation data (position/time) is available

"*A*" LED: Antenna status

"*F*" LED: Lack of available reference sources



LED	Colors	Description
T	Blue	The internal firmware is initializing and a connection is being established with the host PC.
	Off	The initialization of the internal firmware is complete and a connection has been established with the host PC, but the oscillator is not yet locked to its phase reference.
	Green	The initialization of the clock's firmware is completed, the connection with the host PC has been established, and the oscillator is locked to the phase reference.
N	Off	The GNSS receiver has not yet been able to determine its position.
	Green	The GNSS receiver has successfully determined its position and is receiving time data.
A	Green	The antenna is correctly connected, there is no fault detected in the connection, and the clock is synchronized with the GNSS reference.
	Red	The antenna is faulty or not correctly connected.
F	Red	The clock can identify no way to successfully synchronize using one of the configured reference sources, i.e., there is no usable signal available at any of the configured inputs.

11.3 Antenna Input: GPS Receiver

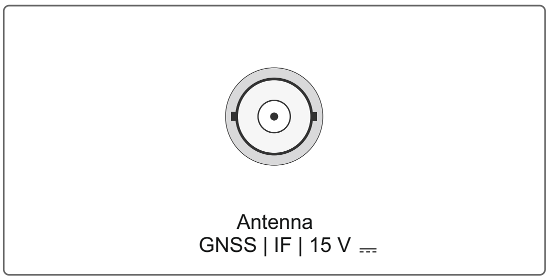
Danger!

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** carry out any work on the antenna installation if it is not possible to maintain the prescribed safe distance to exposed lines and electrical substations.

Receiver Type:	12-Channel GPS Receiver
Antenna:	GPSANTv2 (→ Chapter 13.2)
Input Signal:	35.42 MHz [1]
Mixing Frequency:	10 MHz [2]
GNSS Signal Support:	GPS: L1 C/A [3]
DC Voltage:	15 V (Power Supply via Antenna Cable)
DC Current:	Max. 100 mA
Input Impedance:	50 Ω
Connector Type:	BNC, Female
Cable Type:	Coaxial Cable, Shielded
Cable Length:	Max. 300 m (RG58), Max. 700 m (RG213) Max. 1100 m (H2010 Ultraflex)



[1] This intermediate frequency is the result of the downconversion from the original L-band GNSS frequency by the GPSANTv2 antenna.

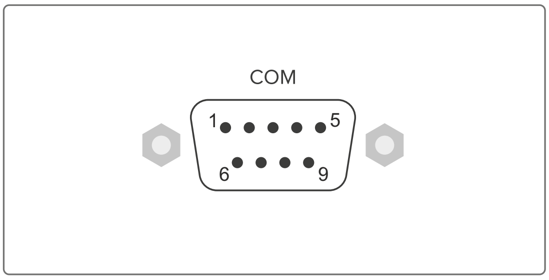
[2] This frequency is transferred from the receiver via the antenna cable towards the antenna in order to generate the 35.42 MHz intermediate frequency signal.

[3] This signal is received and processed by the receiver as a downconverted 35.42 MHz signal and not the original 1575.42 MHz.

11.4 D-Sub 9 Output Port

The D-Sub 9 output of the GPS183PEX provides outputs for a number of clock signals generated on the GPS183PEX board.

The output of certain pins is dependent on the state of the DIP switches on the board of the GPS183PEX.



Connector Type: D-Sub, Male, 9-Pin
(On device)

Cable Type: Standard RS-232 cable (for time string output only)

Modified RS-232 cable/custom D-Sub 9 cable (for other outputs)

Pin Assignment and DIP Switch Settings

Signal	Signal Level	Pin No.	DIP Switch Settings
V_{CC}	+5 V ⎓	1	DIP 1 *ON*, DIP 8 *OFF*
Programmable Signal Channel 0 (Out 1)[2]	RS-232	1	DIP 1 *OFF*, DIP 8 *ON*
RS-232 RxD COM0	RS-232	2	None necessary
RS-232 TxD COM0	RS-232	3	None necessary
Programmable Signal Channel 1 (Out 2)[3]	TTL[1]	4	DIP 5 *ON*, DIP 10 *OFF*
Ground	-	5	-
Capture Input 0	TTL[1]	6	DIP 2 *ON*
Capture Input 1	TTL[1]	7	DIP 3 *ON*, DIP 7 *OFF*
DCLS Timecode	TTL[1]	7	DIP 3 *OFF*, DIP 7 *ON*
Programmable Signal Channel 0 (Out 1)[2]	TTL[1]	8	DIP 4 *ON*
Programmable Signal Channel 2 (Out 3)[4]	TTL[1]	9	DIP 6 *OFF*, DIP 9 *ON*
Programmable Signal Channel 3 (Out 4)[4]	TTL[1]	9	DIP 6 *ON*, DIP 9 *OFF*

[1] TTL level assumes connection of 50 Ω load.

[2] Outputs pulse-per-second signal by default until otherwise configured.

[3] Outputs pulse-per-minute signal by default until otherwise configured.

[4] Outputs DCF Marks signal by default until otherwise configured.

12 Updating the Firmware

While Meinberg continuously updates the firmware of the GPS183PEX, it is generally not necessary to update your firmware unless a specific need to do so arises. If the firmware fails to install due to improper handling, your GPS183PEX may become inoperable and require servicing by Meinberg.

For this reason, you must consult Meinberg Technical Support directly for information on the performance of firmware updates. They will discuss whether a firmware update can resolve any issues you may be having, provide the requisite files, and walk you through the proper and safe installation process if necessary.

Important!

Do not update your GPS183PEX's firmware with any file except one provided directly and explicitly for this purpose by Meinberg Technical Support.

Do not attempt to update your GPS183PEX's firmware without consulting Meinberg Technical Support beforehand!

Meinberg Technical Support

Phone: +49 (0) 5281 – 9309- 888
Email: techsupport@meinberg.de

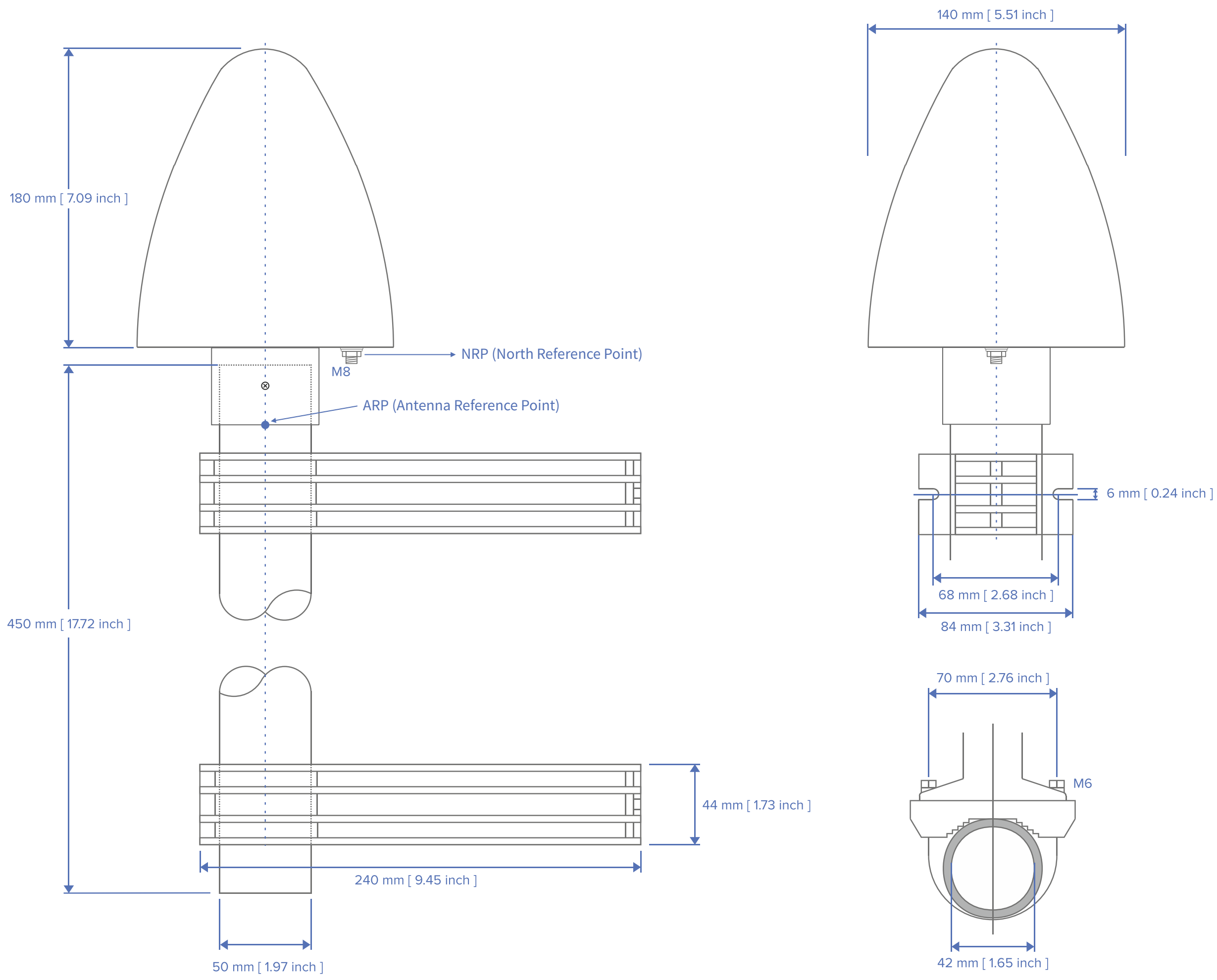
13 Technical Appendix

13.1 Technical Specifications: GPS183PEX

Receiver:	12-channel C/A code receiver based on frequency downconversion technology
Supply Voltage for Antenna:	15 V ⎓
Surge Immunity:	IEC 61000-4-5 Level 4 (test voltage: 4000 V; max. peak current given 2 Ω load: 2000 A)
Operating Temperature:	0 °C – 55 °C (32 °F – 131 °F)
Relative Humidity:	Max. 85 % at 30 °C (86 °F), non-condensing

13.2 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:	$\leq$ 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:	$\geq$ 70 dB @ 1555 MHz $\geq$ 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):	$\leq 1.5 : 1$
Grounding Terminal:	M8 threaded bolt and hexagon nut for use with corresponding ring lug

---

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

13.3 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

PCI und PCI Express GPS Clock Cards

The propagation of the signal from the antenna to the receiver (reference clock) can incur a certain delay. This delay can be compensated for in the Meinberg Monitoring Tool “**MbgMon**”.

If you are using standard RG58 or RG213 cable, the length of the cable can be simply entered in meters by selecting “**By Length**”. This will provide an automatic estimate for the offset based on the known specifications of standard RG58 and RG213 cable.

Launch an up-to-date version of MbgMon and proceed as follows:

1. Open the menu “**Rcvr. Config**”.
2. Enter the length of the antenna cable in meters.
3. Confirm your entry by clicking on the “**Save**” button.

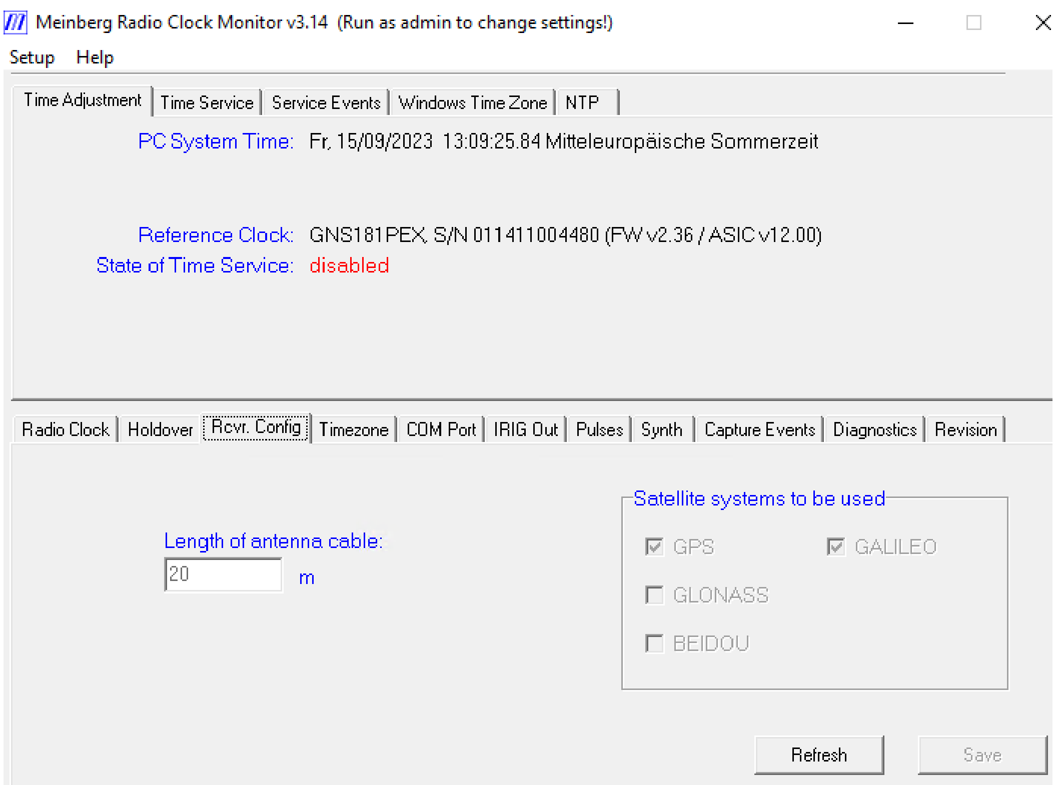


*Fig. 4.1: “**Rcvr. Config**” menu in MbgMon*

13.4 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.

Basics of GNSS Reception for Synchronization Applications

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 reference clock technology 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 GNMANTv2, 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 product 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 stability of the position that is measured from solution to solution.

The specified accuracy of synchronized Meinberg reference clocks 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 (2 ft) from other GNSS antennas, at least 10 m (30 ft) from camera systems (regardless of radio or cable transmission) or HVAC units, and at least 30 m (100 ft) 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.

13.5 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 13.1: 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

13.6 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.

Synthesizer Frequency

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

13.7 Time String Formats

13.7.1 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		

13.7.2 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*;*uv*G*y*;*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		

13.7.3 Meinberg Capture Time String

The Meinberg Capture time string is a sequence of 31 ASCII characters, terminated with the sequence <CR> (Carriage Return, ASCII code 0Dh) and <LF> (Line Feed, ASCII code 0Ah). The format is as follows:

CH*x*<*SP*>*dd.mm.yy_hh:mm:ss.fffffff*<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:

x	0 or 1, number of input		
<SP>	Space (ASCII code 20h)		
dd.mm.yy	Capture date:		
	dd	Day of the month	(01–31)
	mm	Month	(01–12)
	yy	Year without century	(00–99)
hh:mm:ss.fffffff	Capture Time:		
	hh	Hours	(00–23)
	mm	Minutes	(00–59)
	ss	Seconds	(00–59, or 60 during leap second)
	fffffff	Fractions of second, 7 digits	
<CR>	Carriage Return, ASCII code 0Dh		
<LF>	Line Feed, ASCII code 0Ah		

13.7.4 ATIS Time String

The ATIS standard Time String is a sequence of 23 ASCII characters terminated with a <CR» (Carriage Return) character. The standard interface configuration for this string type is 2400 Baud, 7E1. The format is as follows:

<GID><ABS><TSQ><CC><CS><ST>*yymmddhhmmsswcc*<GID><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:

<GID>	Address of the Receiver, ASCII code 7Fh	
<ABS>	Originator of Message, '0', ASCII code 30h	
<TSQ>	Telegram Number, '0', ASCII code 30h	
<CC>	Command Code 'S' (for 'SET'), ASCII code 53h	
<CS>	Command Code 'A' (for 'ALL'), ASCII code 41h	
<ST>	Time Status 'C' (for valid time), ASCII code 43h	
yymmdd	The current date:	
	yy Year of the Century	(00–99)
	mm Month	(01–12)
	dd Day of month	(01–31)
hhmmss	the current time:	
	hh hours	(00–23)
	mm minutes	(00–59)
	ss seconds	(00–59, or 60 during leap second)
w	Day of the Week	(1–7, 1 = 31h = Monday)
cc	Checksum in hexadecimal, generated from all characters including GID, ABS, TSQ, CC, ST, etc.	
<CR>	Carriage Return, ASCII code 0Dh	

13.7.5 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		

13.7.6 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

13.7.7 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		

13.7.8 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

13.7.9 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)		

13.7.10 ABB SPA Time String

The ABB SPA 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[[lt]SP>hh.mm;ss.fff:cc`*`<CR>`

The letters printed in italics are replaced by ASCII numbers whereas the other characters are directly part of the time string. The groups of characters 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)
	`<SP>`	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)		

13.7.11 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		

13.7.12 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)		

13.7.13 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			

13.7.14 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)			

13.7.15 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			

13.7.16 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

13.7.17 6021 Time String

The 6021 time string is a sequence of 18 ASCII characters starting with the `<STX>` (Start of Text, ASCII code 02h) ASCII control character and terminated with the sequence `<LF>` (Line Feed, ASCII code 0Ah), `<CR>` (Carriage Return, ASCII code 0Dh), `<ETX>` (End of Text, ASCII code 03h).

It is broadly identical to the → **"Freelance Time String"**, but with a different order to the termination sequence.

The format is as follows:

<STX>*C9hhmmssddmmyy*<LF><CR><ETX>

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

<STX> Start of Text, ASCII code 02h

C Clock status. This is represented as an ASCII nibble*, whereby each bit in the binary sequence has the following meaning:

Bit 0 (LSB)	Leap second announced (1) / not announced (0)
Bit 1	Leap second active (1) / not active (0)
Bit 2	Real-time clock time valid (1) / invalid (0)
Bit 3 (MSB)	Clock is synchronized (1) / not synchronized (0)

Example: If the clock outputs `C` (ASCII code 0x43h) at this position, this corresponds to a binary value of *1100*, indicating that the RTC time is valid and the clock is synchronized, and that no leap second has been announced, nor is one in effect.

9 UTC status of clock and day of the week. This is represented as an ASCII nibble*, whereby the three least significant bits represent the day of the week and may be any value between 1 and 7 (corresponding to Monday to Sunday). The most significant bit represents the UTC state and will be 1 if set to UTC and 0 if it is a local time zone. Thus, if the clock is outputting local (non-UTC) time, this will be in a range of 1–7, whereas if the clock is outputting UTC time, this value will be in a range of 9–F.

Example: If the clock outputs `9` (ASCII code 0x39h) at this position, this corresponds to a binary value of *1001*. The most significant bit of *1* here indicates that the clock is running on UTC time, while the 3-bit value represented by the least significant bits *001* indicates that the day is Monday.

hhmmss Current time:

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

ddmmyy Current date:

dd	Day	(01–31)
mm	Month	(01–12)
yy	Last two digits of year	(00–99)

<LF> Line Feed (ASCII code 0Ah)

<CR> Carriage Return (ASCII code 0Dh)

<ETX> End of Text (ASCII code 03h)

* With ASCII nibbles, the actual ASCII character itself (0-9, A-F, ASCII codes *0x30h–0x39h* and *0x41h–0x46h*) represents the hexadecimal equivalent of a 4-bit binary sequence. For example, if the clock outputs "A" at these positions, this is equivalent to a binary sequence of *0x1010b*. Please note that it is not the binary equivalent of the ASCII code (*0x41h*) itself.

13.7.18 Freelance Time String

The Freelance time string is a sequence of 18 ASCII characters starting with the <STX> (Start of Text, ASCII code 02h) ASCII control character and terminated with the sequence <CR> (Carriage Return, ASCII code 0Dh), <LF> (Line Feed, ASCII code 0Ah), <ETX> (End of Text, ASCII code 03h).

It is broadly identical to the ➜ "6021 Time String", but with a different order to the termination sequence.

The format is as follows:

<STX>*C9hhmmssddmmyy*<CR><LF><ETX>

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

<STX> Start of Text, ASCII code 02h

C Clock status. This is represented as an ASCII nibble*, whereby each bit in the binary sequence has the following meaning:

Bit 0 (LSB)	Leap second announced (1) / not announced (0)
Bit 1	Leap second active (1) / not active (0)
Bit 2	Real-time clock time valid (1) / invalid (0)
Bit 3 (MSB)	Clock is synchronized (1) / not synchronized (0)

Example: If the clock outputs C (ASCII code 0x43h) at this position, this corresponds to a binary value of *1100*, indicating that the RTC time is valid and the clock is synchronized, and that no leap second has been announced, nor is one in effect.

9 UTC status of clock and day of the week. This is represented as an ASCII nibble*, whereby the three least significant bits represent the day of the week and may be any value between 1 and 7 (corresponding to Monday to Sunday). The most significant bit represents the UTC state and will be 1 if set to UTC and 0 if it is a local time zone. Thus, if the clock is outputting local (non-UTC) time, this will be in a range of 1–7, whereas if the clock is outputting UTC time, this value will be in a range of 9–F.

Example: If the clock outputs 9 (ASCII code 0x39h) at this position, this corresponds to a binary value of *1001*. The most significant bit of *1* here indicates that the clock is running on UTC time, while the 3-bit value represented by the least significant bits *001* indicates that the day is Monday.

hhmmss Current time:

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

ddmmyy Current date:

dd	Day	(01–31)
mm	Month	(01–12)
yy	Last two digits of year	(00–99)

`<CR>` Carriage Return (ASCII code 0Dh)

`<LF>` Line Feed (ASCII code 0Ah)

`<ETX>` End of Text (ASCII code 03h)

* With ASCII nibbles, the actual ASCII character itself (`0-9`, `A-F`, ASCII codes *0x30h–0x39h* and *0x41h–0x46h*) represents the hexadecimal equivalent of a 4-bit binary sequence. For example, if the clock outputs "`A`" at these positions, this is equivalent to a binary sequence of *0x1010b*. Please note that it is not the binary equivalent of the ASCII code (*0x41h*) itself.

13.7.19 ITU-G8271-Y.1366 Time-of-Day Message

The ITU-G8271-Y.1366 standard stipulates the transmission of this time message at 9600 Baud with framing of 8N1. The message data should be sent no sooner than 1 ms after the rising edge of the PPS signal and transmission must be completed within 500 ms. The message should be sent once a second and mark the rising edge of the PPS.

The ITU-G8271-Y.1366 time message itself output by Meinberg clocks is always a sequence of 21 bytes. While the standard briefly references the use of two ASCII characters for the first two characters, it should be noted that this message is not an ASCII string in the typical sense. Multi-octet values are transmitted as big-endian values, while each byte is transmitted with the least-significant bit **first**. Accordingly, while the first two characters are deemed to represent the ASCII characters "`C`" (ASCII code 0x43h, binary `00101011`) and "`M`" (ASCII code 0x4Dh, binary `01001101`) respectively, these are transmitted as `11010100` and `10110010`.

The standard byte sequence (least significant bit first in each byte) is as defined below:

Byte No.	Meaning
0–1	Always 0x43h followed by 0x4Dh. These are Sync Characters 1 & 2 respectively and are used as a delimiter between messages.
2	The message class. This will always carry a value of 0x01h.
3	The message ID. In the time-of-day messages provided by Meinberg clocks this will always be 0x01h.
4–5	The payload length, expressed as an unsigned 16-bit integer, not including the sync characters, message class, message ID, or checksum. In the time-of-day messages provided by Meinberg clocks this will always be 0x0Eh.
6–11	PTP time, or the number of seconds in the TAI timescale. This is expressed as an unsigned 48-bit integer.
12	This byte is reserved for future use and is set to 0x00h.
13	Contains a number of time status flags: **Bit 0:** Positive leap second pending **Bit 1:** Negative leap second pending **Bit 2:** UTC offset valid **Bit 3:** Reserved **Bit 4:** Time is traceable to a primary frequency standard **Bit 5:** Frequency is traceable to a primary frequency standard **Bit 6:** Reserved **Bit 7:** Reserved
14–15	Current offset between TAI and UTC in seconds, expressed as an unsigned 32-bit integer.
16–19	This byte is reserved for future use and is set to 0x00h.
20	An 8-bit cyclic redundancy check value calculated on the basis of bytes 2–19.

13.7.20 CISCO ASCII Time String

The CISCO ASCII time string is a sequence of at least 73 ASCII characters. The format is as follows:

**.A.mjdxx*,*yy/mm/dd*,*hh*:*mm*:*ss*,*+3600.0*,*12N34.567*,*123W45.678*,+1234,
EV<SP>GPS<SP>FLT

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:

`*`	Sync state of clock: `*`: Clock is synchronized to reference `!`: Clock is not synchronized
`A`	The format revision. With Meinberg clocks, this will always be 'A'.
`mjdxx`	The current date in Modified Julian Date format.
`yy/mm/dd`	The current date in Gregorian *yy/mm/dd* format.
`hh:mm:ss`	The current time in 24-hour format.
`+3600`	The current local time offset in seconds. If the clock is outputting UTC time, this will be `00000.0`. If the clock is outputting local time, however, the first character will be the sign (− or +) and the subsequent digits up to the period character are the offset. For example, if CET is set as the time zone, this will show `+3600`.
`0`	Indicator of a pending leap second.
`12N34.567`	The current latitude of the GNSS receiver. If the time reference is not a GNSS receiver, this will show `00 00.000`.
`123W45.678`	The current longitude of the GNSS receiver. If the time reference is not a GNSS receiver, this will show `000 00.000`
`+1234`	The current altitude above sea level of the GNSS receiver. If the time reference is not a GNSS receiver, this will show `+0000`.
`EV`	Indicates the level of any current alarm state of the clock: `EV`: Non-error event `MN`: Minor error `MJ`: Major error `CL`: Critical error
`GPS`	Indicates the source of the current error (e.g., 'GPS' for GPS receiver).
`FLT`	Indicates the cause of the current error (e.g., 'FLT' for hardware fault).

13.7.21 NTP Type 4 Time String

The NTP Type 4 time string is a sequence of 24 ASCII characters. The format is as follows:

`?<SP>yy<SP>ddd<SP>hh:mm:ss.SSSL<SP>S`

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:

`?`	Sync state of clock:		
	Space:	Clock is synchronized to reference	
	'`?`':	Clock is not synchronized	
`yy`	Year of the century		(00–99)
`ddd`	Day of the year		(001–366)
`hh:mm:ss.SSS`	Current time:		
	`hh`	Hours	(00–23)
	`mm`	Minutes	(00–59)
	`ss`	Seconds	(00–59, or 60 while leap second)
	`SSS`	Milliseconds	(000–999)
`L`	Leap second announcement:		
	Space:	No leap second announcement	
	'`L`':	Leap second pending	
`S`	Daylight Savings Time indicator:		
	'`S`':	Standard Time (wintertime)	
	'`D`':	Daylight Savings Time (summertime)	

13.8 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 GPS183PEX, 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

13.8.1 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
1st Character	Pulse Wave	0	DC Level Shift (DCLS), pulse-width modulated
		1	Sine-wave carrier, amplitude-modulated
2nd 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
3rd Character	String Content	0	$\text{BCD}^{(\text{TOY})}$, CF, SBS
		1	$\text{BCD}_{(\text{TOY})}$, CF
		2	$\text{BCD}_{(\text{TOY})}$
		3	$\text{BCD}_{(\text{TOY})}$, SBS
		4	$\text{BCD}_{(\text{TOY})}$, $\text{BCD}_{(\text{YEAR})}$, CF, SBS
		5	$\text{BCD}_{(\text{TOY})}$, $\text{BCD}_{(\text{YEAR})}$, SBS
		6	$\text{BCD}_{(\text{TOY})}$, $\text{BCD}_{(\text{YEAR})}$
		7	$\text{BCD}_{(\text{TOY})}$, $\text{BCD}_{(\text{YEAR})}$, 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.

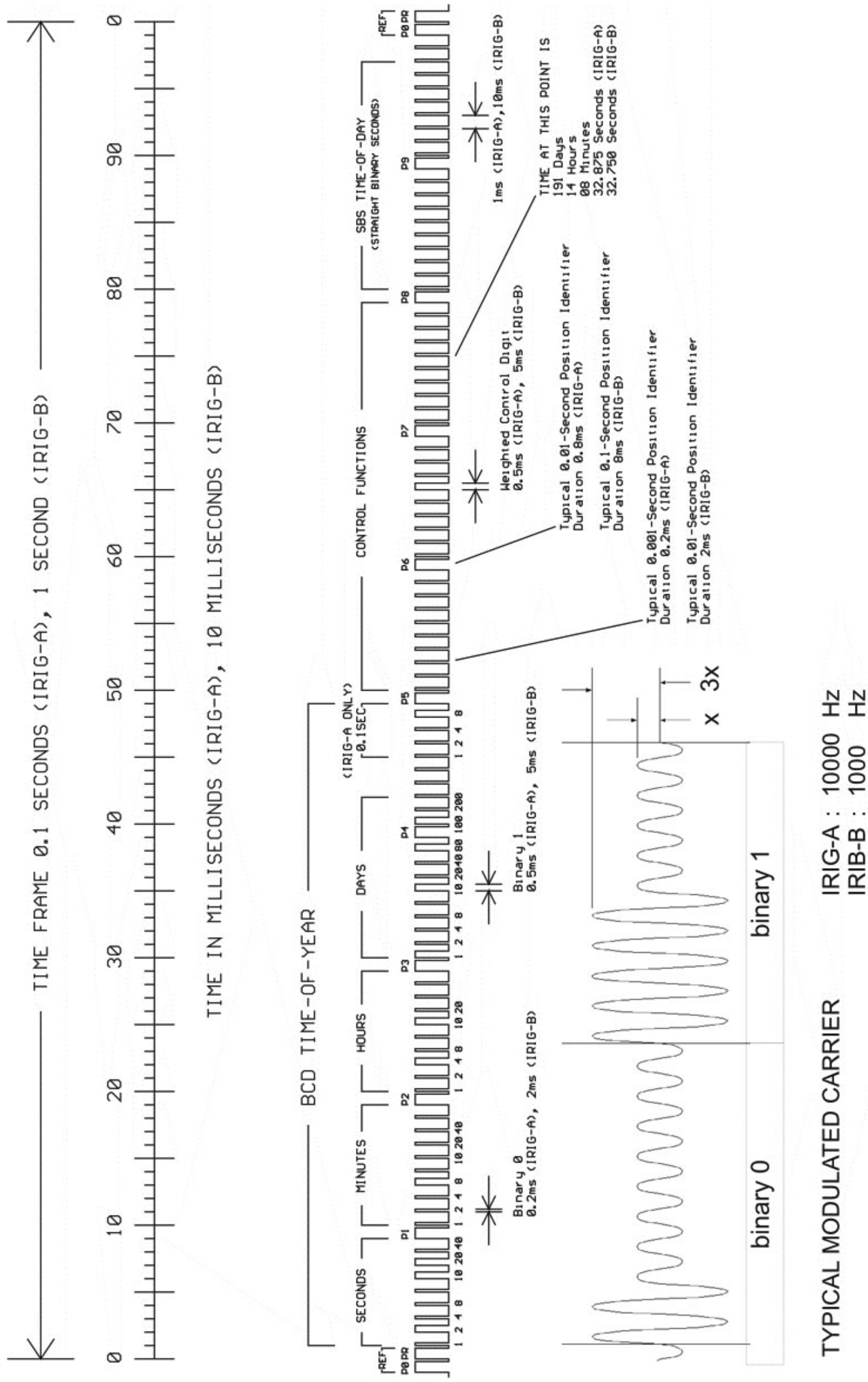
AFNOR: Code according to NF S87-500, 100 pps, AM sine-wave signal,
1 kHz carrier frequency, BCD time-of-year, complete date,
SBS time-of-day, signal level specified by standard.

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**")

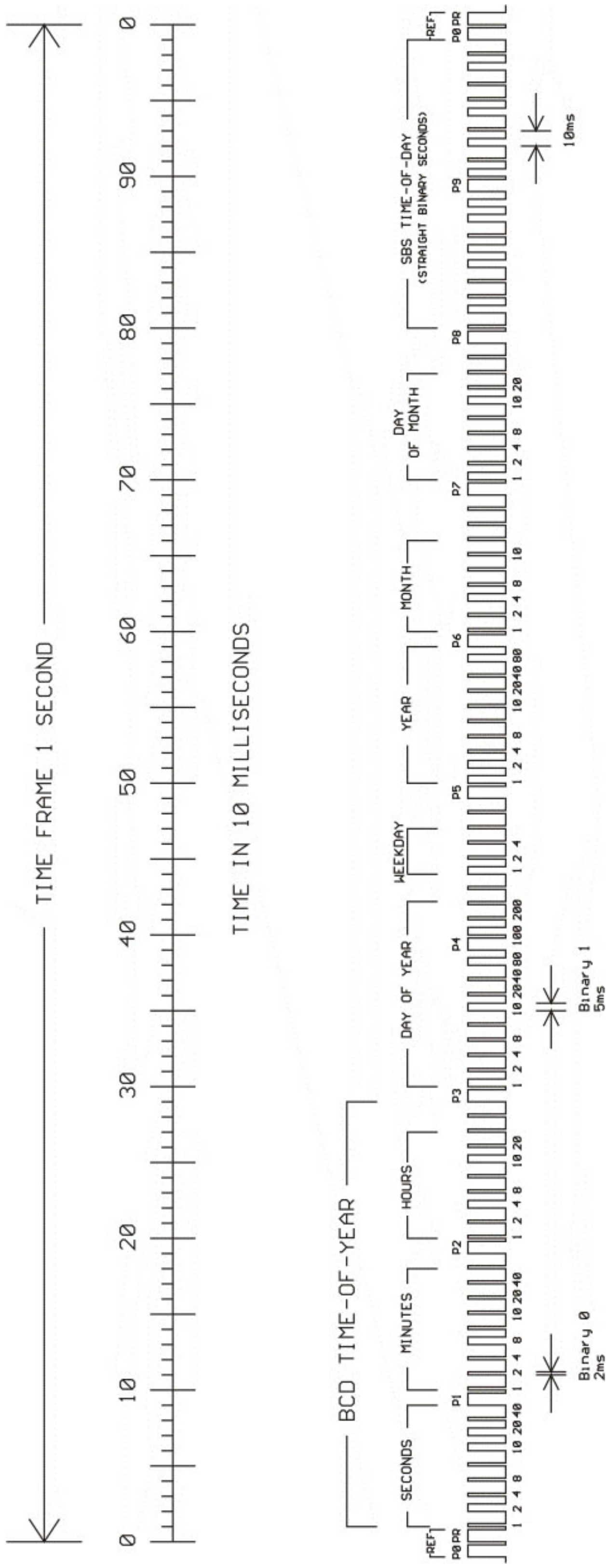
IEEE C37.118: Identical to IEEE 1344, but with UTC offset +/- sign bit reversed

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

13.8.2 Timecode Format According to IRIG Standard



13.8.3 Timecode Format According to AFNOR Standard



14 RoHS and WEEE

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.

WEEE Status of the Product

This product is handled as a B2B (Business to Business) category product. To ensure that the product is disposed of in a WEEE-compliant fashion, it may be returned to the manufacturer. 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.

15 Declaration of Conformity for Operation in the European Union

EU-Konformitätserklärung
Doc ID: GPS183PEX-2025-08-04

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*	**GPS183PEX**

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 2025-08-04

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

Aron Meinberg
Quality Management

16 Declaration of Conformity for Operation in the United Kingdom

UK Declaration of Conformity

Doc ID: GPS183PEX-2025-08-04

Manufacturer	Meinberg Funkuhren GmbH & Co. KG Lange Wand 9 31812 Bad Pyrmont Germany
declares that the product **Product Designation**	 **GPS183PEX**

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 2025-08-04

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