



The Synchronization Experts.



MANUAL

GPS183SV

PP-4/TC-AM/DHS

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint & Legal Information

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3 Change Log

Version	Date	Revision Notes
1.0	2025-04-02	- Initial version

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 warnings affixed to the device itself must also be observed.

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

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

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

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

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

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 Grounding the Device



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

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



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



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

5.5 Electrical Safety

This Meinberg product is operated at a hazardous voltage.

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

Custom cables may only be assembled by a qualified electrician.

Never work on cables carrying a live current!

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

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

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

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

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

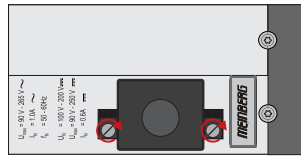
Device cables must be connected or disconnected in the order specified in the user documentation for the device. Connect all cables only while the device is de-energized before you connect the power supply.

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

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



5-Pin MSTB Connector



3-Pin MSTB Connector

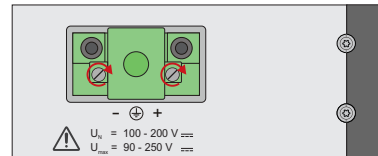


Illustration: Lock screws on an MSTB plug connector; in this case on a LANTIME M320

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

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

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

Protect the device from the ingress of objects or liquids!

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

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



5.5.1 Special Information for Devices with DC Power Supply



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

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

Power supply cables must have adequate fuse protection and have an adequate wire gauge size (1 mm² – 2.5 mm² / 17 AWG – 13 AWG)

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

5.6 Safety when Maintaining and Cleaning the Device

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

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

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

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

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

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



5.7 Battery Safety

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

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

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

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

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



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 17](#).

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 18](#).

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 system, we recommend making a backup of any stored configuration data (e.g., to a USB flash drive from the Web Interface).

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.

6.4.2 Replacing the Fuse



Danger!

This equipment is operated at a hazardous voltage.

Danger of death from electric shock!

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

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

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

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

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

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

Replacement Process

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

6.5 Disposal

Disposal of Packaging Materials



The packaging materials that we use are fully recyclable:

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

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

Disposal of the Device



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



Important!

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

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

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

Disposal of Batteries

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

7 Introduction

This manual is a systematically structured guide that provides with a detailed description of all of your Meinberg product's functions and is designed to assist you with the set-up of your Meinberg product.

Each of the chapters addresses a specific topic such as how the GPS183/PP-4/TC-AM/DHS operates in general, how to correctly install it, and the key technical specifications of the device. This Setup guide also describes the main configuration operations needed to quickly get your product up and running.

How It Works

The GPS183/PP-4/TC-AM/DHS is used to synchronize devices that are directly connected to it. After successful initialization and synchronization, a reference clock (PPS, pulse-per-second) and a reference frequency of 10 MHz are distributed in the system. These signals significantly determine the accuracy of the output signals.

The GPS183/PP-4/TC-AM/DHS can be customized with a variety of signal outputs for a wide range of applications. Possible output options include time code, frequency, pulse and relay outputs, which provide information about the synchronization and power supply status of the GPS183/PP-4/TC-AM/DHS. The GPS183/PP-4/TC-AM/DHS can be individually configured or its status monitored in the management program **Meinberg Device Manager** via a serial RS-232 connection.

The Meinberg Device Manager software and associated manual can be downloaded free to charge from the Meinberg website:

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

8 How the GPS183/PP-4/TC-AM/DHS Works

Your system is fitted with a GPS satellite receiver clock based on technology that has been specially developed from the ground up for time and frequency synchronization. The GPS183/PP-4/TC-AM/DHS serves as a high-accuracy time reference and high-precision frequency reference for your application systems.

Once the GPS183/PP-4/TC-AM/DHS is successfully initialized and synchronized, it distributes a 1PPS (pulse per second) reference clock signal and a 10 MHz reference frequency, both of which are critical in determining the precision and accuracy of the output signals.

The GPS183/PP-4/TC-AM/DHS can be customized with a variety of signal outputs for a wide range of applications. Possible output options include time code, frequency, pulse and an error relay output. The Error Relay provide information about the synchronization status of the GPS/XHS.

Configuration and Status Monitoring

For communication, a serial connection must be established between the D-Sub 9 connector (RS-232) of the GPS/XHS and a PC/laptop. The **"Meinberg Device Manager"** management program developed by Meinberg can be used to configure and monitor the status of the GPS183/PP-4/TC-AM/DHS via this connection.

The "Meinberg Device Manager" software and a manual can be downloaded free of charge from our homepage:

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

8.1 Asynchronous Serial Ports

The satellite clock GPS183/PP-4/TC-AM/DHS has two RS-232 interfaces for serial communication.

The baud rate, framing, and time string format can be configured for each of these interfaces individually. For example, it is possible to have time strings output only once a second, once a minute, or only on demand when prompted with an ASCII "?". The time string formats supported are described in more detail in → [Chapter 15.6, Time String Formats](#).

→ [Chapter 13.2.3, "Serial Ports" Section](#) provides the essential details of configuring the communication of each of the interfaces.

By default, the output of these interfaces is left disabled when the device is switched on until the receiver has successfully synchronized. However, it is possible to configure the serial interfaces to have the outputs enabled immediately when the system is booted. This process is described in detail in → [Chapter 13.2.4, "Outputs" Section](#).

8.2 Pulse Outputs

The signal generator of the satellite clock GPS183/PP-4/TC-AM/DHS has three discrete channels and is capable of generating a wide variety of signals, including pulses and status messages. These signals can be configured individually for each channel using the Meinberg Device Manager software and, for example, the pulse duration in a 10 ms grid can be set between 10 ms and 10,000 ms (10 s) depending on the signal, and the signal can be inverted.

By default, the system's pulse outputs are left disabled when the device is switched on until the receiver has successfully synchronized. However, it is possible to configure the system to have the outputs enabled immediately when the system is booted. The signals are passed through BNC connectors on the front panel of the device.

A list and explanation of all the available programmable pulse signals is provided in → [Chapter 15.8, Overview of Programmable Signals](#).

9 Before You Start

9.1 Contents of Delivery

Unpack the GPS183/PP-4/TC-AM/DHS carefully and check the contents of the delivery against the enclosed packing list to ensure that no parts are missing. If any of the listed items are missing, please contact our Sales Department: ✉ sales@meinberg.de

Check that the product has not been damaged in transit. If the product is damaged or fails to operate upon installation, please contact Meinberg immediately. Only the recipient (the person or company receiving the system) may file claims or complaints against the forwarder for damage caused in transit.

Meinberg recommends that you keep the original packaging materials in case the product needs to be shipped or transported again at a later date.

9.2 Required Software

Meinberg Device Manager

We provide the Meinberg Device Manager free of charge for setting up, configuring, and monitoring the GPS183/PP-4/TC-AM/DHS. This software is a desktop application with a graphical interface that allows you to configure Meinberg devices that are connected to the PC directly via a serial connection or indirectly via an encrypted network connection. One of the key advantages to Meinberg Device Manager lies in its ability to configure and monitor multiple different devices in a network concurrently.

Meinberg Device Manager for Windows supports Windows 7 and all later versions. Supported Linux distributions include Ubuntu, Mint Linux, Debian, SUSE Linux, CentOS, among others.

The software can be downloaded free of charge from our website:

🔗 <https://www.meinbergglobal.com/english/sw/mbg-devman.htm>

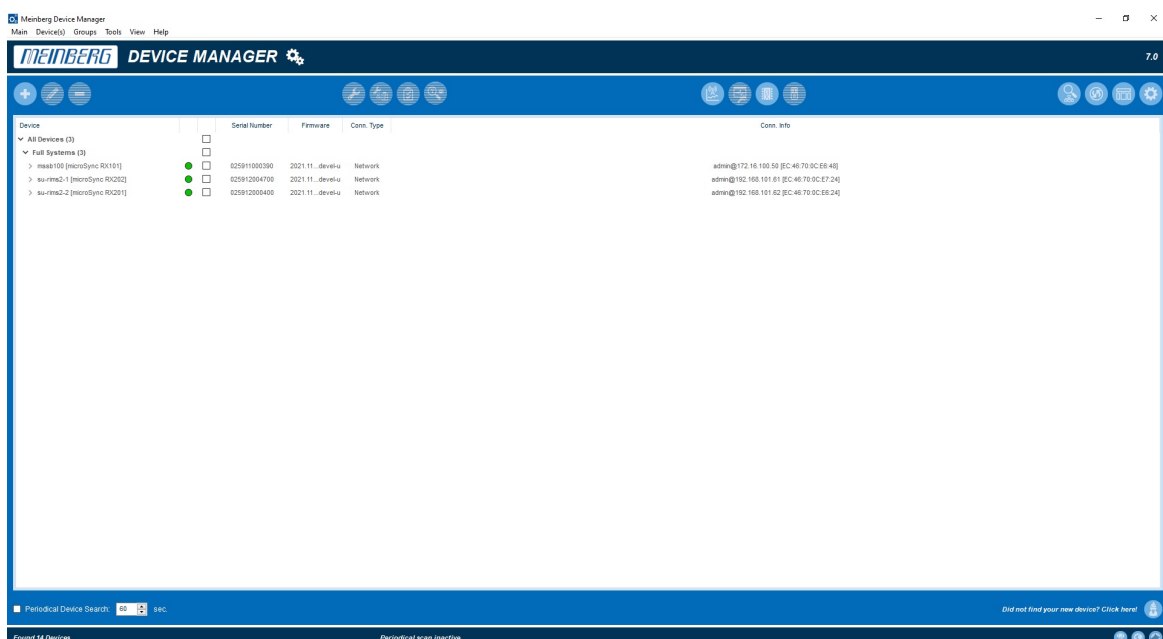


Illustration: Meinberg Device Manager launch window

Meinberg Device Manager: Portable Version

Meinberg systems can also be configured and monitored using the Portable Version of Meinberg Device Manager, which is intended for use in environments where the installation of executable software is either not possible or is discouraged for security reasons.

This Portable Version is also available from the link above and can be executed directly from the directory to which the archive is extracted.

9.3 Preparation for Installation

Meinberg's rail-mounted systems are constructed for installation on a standard DIN EN 60715 rail.

The product package includes all of the parts needed for rail-mounted installation (screws, power supply adapters, etc.) If differing standards apply due to the product being installed in a country other than Germany (e.g., in respect of power supply connectors), please declare in your order which adapters or cables you require to set up the device for operation.

Please ensure that there is enough space in the installation cabinet to enable the system to be consistently ventilated. Avoid soiling with dirt or dust during the installation process.



Caution!

The safety information provided in this manual must be observed to avoid product damage and injury.

9.4 5-Pin MSTB Pin Layout and Cable Assembly

Before the GPS183/PP-4/TC-AM/DHS can be supplied with power, the 5-pin MSTB connector included in the package must first be used to assemble a suitable power cable.

The following chapters go into detail about the correct pin assignment and the assembly of the cable and connector for the corresponding power supply (AC, AC/DC, DC) of your device.

9.4.1 Cable Assembly - DC Power Supply

Required Tools:

1. Slotted screwdriver
2. Wire cutters

Cable Dimensions:

When selecting a cable to use for the power supply (not included), please ensure that the recommended core cross section is observed:

1 mm² – 2.5 mm² / 17 AWG – 13 AWG

Pin Layout

DC Power Supply:

- 1: Unused
- 2: V_{IN} -
- 3: PE (Protective Earth)
- 4: V_{IN} +
- 5: Unused

Cable connection

Insert the wires of the ready-assembled cable individually into the terminals of the 5-pin MSTB connector as shown in the illustration below. The wires should then be secured, one at a time, by tightening the marked screws using a slotted screwdriver.

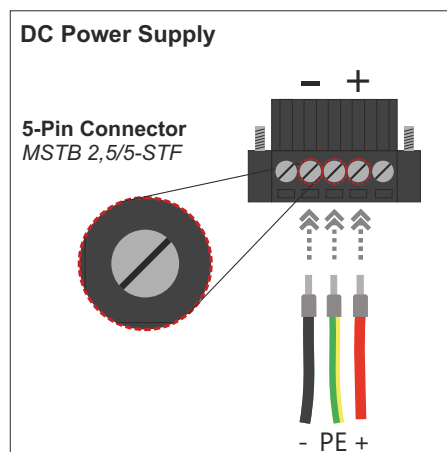


Illustration: DHS Type Power Supply Wiring

Final assembly

Cable ties are provided for strain relief. These should be fed through the designated openings in the lower part of the connector. Bundle all cable wires together in the middle of the lower part of the connector and secure it using the cable tie. Cut the rest of the protruding cable tie off using wire cutters.

Attach the upper part of the connector to the lower part until the latches on the sides click into place.

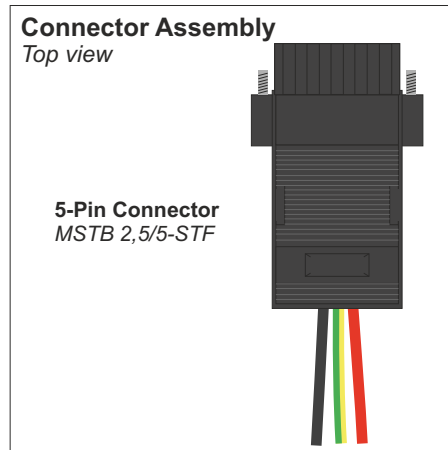


Illustration: Completed DHS Type Connector

10 Installing a GPS Antenna

The following chapters explain how to select a suitable location for your antenna, how to fit the antenna, and how to implement effective anti-surge protection for your antenna installation.

10.1 Selecting the Antenna Location

There are essentially two ways a compatible Meinberg GPS Antenna (such as a GPSANTv2) can be installed using the accessories included:

1. Mounted on a pole
2. Mounted on a wall

To avoid difficulties with synchronization of your connected Meinberg time server, select a location that allows for an unobstructed view of the sky (Fig. 1) so as to ensure that enough satellites can be found.

To ensure that your antenna has the best 360° view possible, Meinberg recommends mounting the antenna on a roof on a suitable metal pole (see Fig. 1, antenna on right). If this is not possible, the antenna may be mounted on the wall of a building, but must be high enough above the edge of the roof (see Fig. 1, antenna on left).

This prevents the line of sight between the antenna and the satellites from being partially or fully obstructed and limits the impact of GNSS signal reflections from other surfaces such as house walls.

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

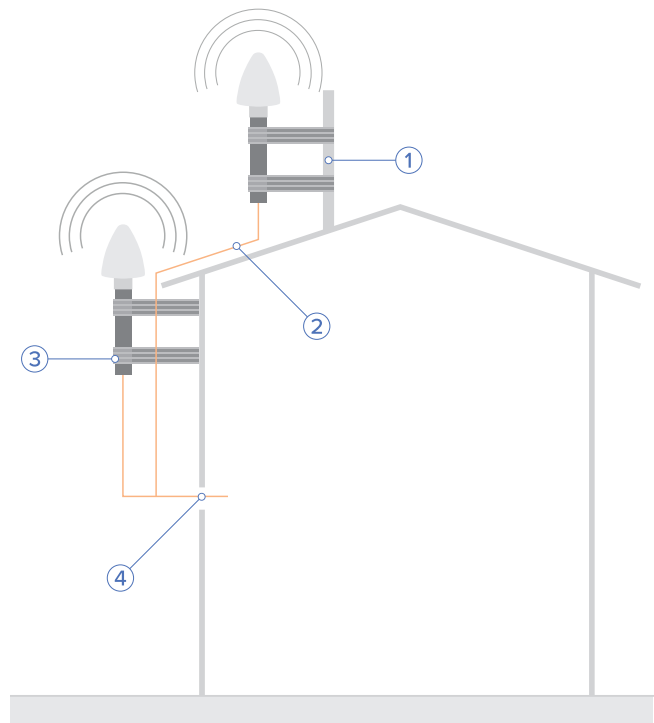


Fig. 1: Ideal Positioning

If there is a solid obstacle (a building or part of a building) in the line of sight between the antenna and each of the satellites (see Fig. 2), it is likely that the satellite signals will be partially or fully obstructed or that reflected signals will cause interference, causing problems with signal reception.

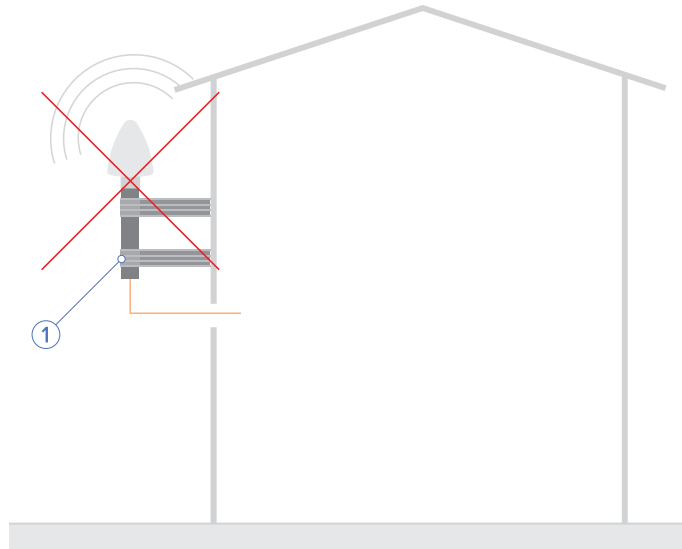


Fig. 2: Not recommended positioning of a wall-mounted antenna (1)

There must also be no conductive objects, overhead power lines, or other electrical lighting or power circuits within the signal cone of the antenna (approx. 98 degrees), as these can cause interference in the already weak signals transmitted in the frequency band of the satellites.

Other Installation Criteria for Optimum Operation:

- Vertical installation of antenna (see Fig. 1)
- At least 50 cm (1.5 ft) distance to other antennas
- A clear view towards the equator
- A clear view between the 55th north and 55th south parallels (satellite orbits).



Information:

Problems may arise with the synchronization of your Meinberg time server if these conditions are not met, as four satellites must be located to calculate the exact position.

10.2 Installation of the Antenna

Please read the following safety information carefully before installing the antenna and ensure that it is observed during the installation.



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 installation during thunderstorms!

Danger of death from electric shock!

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

Mount the Meinberg GPS Antenna (as shown in Fig. 3) at a distance of at least 50 cm (1.6 ft) to other antennas using the mounting kit provided, either onto a vertical pole of no more than 60 mm (2.36 in) diameter or directly onto a wall.

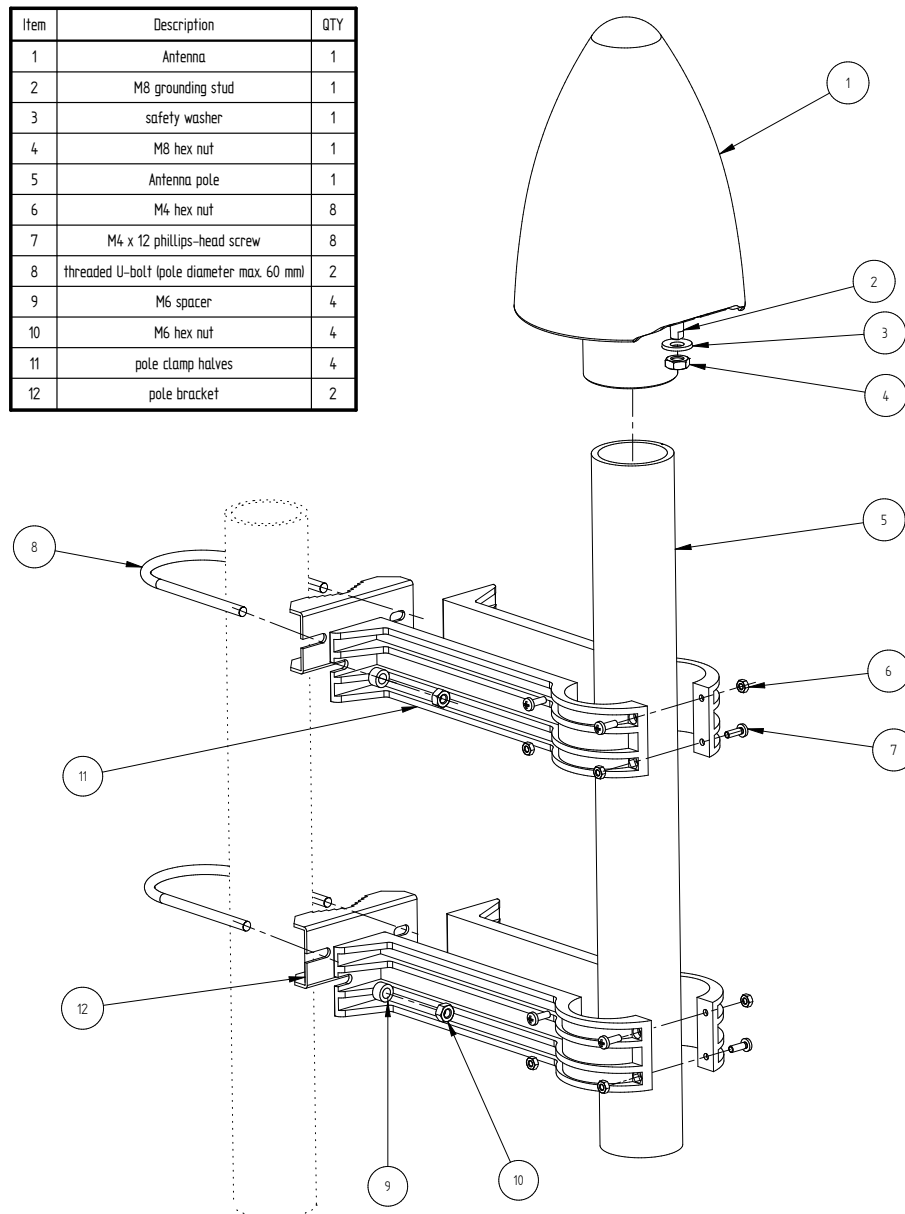


Fig. 3: Mounting a Meinberg GPS Antenna onto a Pole

Fig. 3 illustrates the mounting of a Meinberg GPS Antenna on a pole by way of example. When mounting the antenna on a wall, the four wall plugs and M6x45 screws should be used to mount the two halves of the pole clamp (Fig. 3, Pos. 12) using the provided screw slits.

→ Chapter 10.3, "Antenna Cable" explains how the antenna cable should be laid.

10.3 Antenna Cable

Selecting the Appropriate 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 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:

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.

Laying the Antenna Cable

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.

Lay the coaxial cable from the antenna to the point of entry into the building as shown in Figures 5 and 6 in → [Chapter 10.4, “Surge Protection and Grounding”](#). Like any other metallic object in the antenna installation (antenna and pole), the antenna cable must be integrated into the grounding infrastructure of the building and also connected to the other metallic objects.



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.

Further Points to Consider when Laying Antenna Cable

- The minimum bend radius of the cable must be observed.¹
- Any kinking, crushing, or other damage to the external insulation must be avoided.
- Any damage or contamination of the coaxial connectors must be avoided.

¹The bend radius is the radius at which a cable can be bent without sustaining damage (including kinks).

Compensating for Signal Propagation Time

The propagation of the signal from the antenna to the receiver (reference clock) can incur a certain delay. This delay can be compensated for using the Meinberg Device Manager tool.

To do this, open the panel "Settings" → "Clock". The length of the antenna cable used can be entered here.

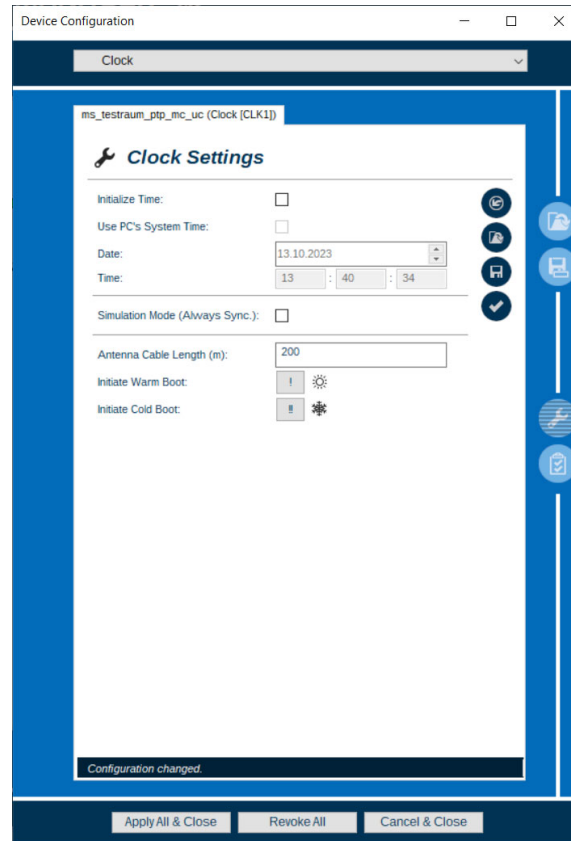


Illustration: "Clock" menu in Meinberg Device Manager

→ Chapter 10.4, "Surge Protection and Grounding" explains how to implement effective surge protection for an antenna installation.

10.4 Surge Protection and Grounding

The greatest risk to an antenna installation and the electronic devices connected to it is exposure to lightning strikes. An indirect lightning strike in the vicinity of the antenna or coaxial cable can induce significant surge voltages in the coaxial cable.

Without inline protection, such induced surge voltages can be passed to the antenna and to other indoor devices patched into the coaxial line (specifically, your Meinberg System), potentially causing significant damage to or even destroying not only your antenna but also any connected receivers and signal distributors. Such surge voltage scenarios also present a risk of fire and injury.

This is why antennas and antenna cables must always be integrated into a building's equipotential bonding infrastructure (Point 4, Figure 5) 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.



Warning!

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

Meinberg GPSANTv2

Meinberg's new-generation "GPSANTv2" antenna features 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.

However, in order to preserve the safety of the building and to protect your Meinberg system, Meinberg recommends the use of the MBG-S-PRO surge protector, which is addressed in more detail later in this chapter.

Surge Protection

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

If the antenna represents the highest point of a building or pole, the lightning protection strategy should incorporate a safety zone (angle α , Fig. 5 and 6), 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

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

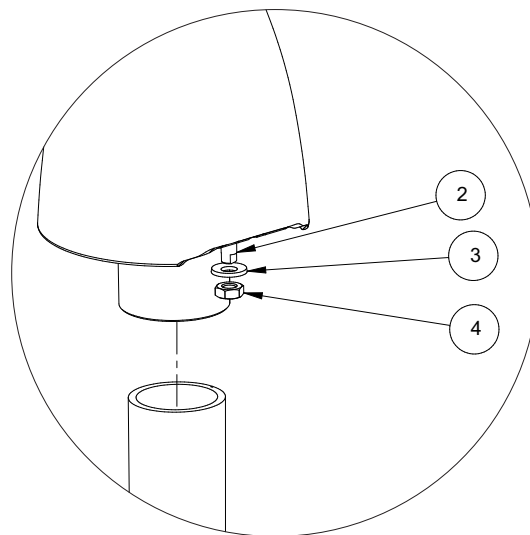
To this end, the following elements should be connected and integrated into a bonding system:

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

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

Connecting the Grounding Terminal of the Antenna

As mentioned previously, the antenna must be connected to a grounding busbar using a grounding cable (not included). A grounding cable must be assembled for this purpose; the recommended conductor thickness is 4 mm² – 6 mm² and a ring terminal fitting the M8 (0.315 inch) grounding bolt must be used.



Grounding Cable Installation Procedure:

1. Remove the nut (Pos. 4) and the safety washer (Pos. 3).
2. Place the ring terminal onto the grounding bolt (Pos. 2).
3. First place the safety washer (Pos. 3) onto the grounding bolt (Pos. 2), then screw the M8 nut (Pos. 4) onto the thread of the grounding bolt.
4. Tighten the nut (Pos. 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. 5 and 6).

The following drawings illustrate how a Meinberg GPS Antenna can be installed in accordance with the above conditions on a pole (e.g., antenna pole) or building roof.

Antenna Installation without Insulated Lightning Rod System

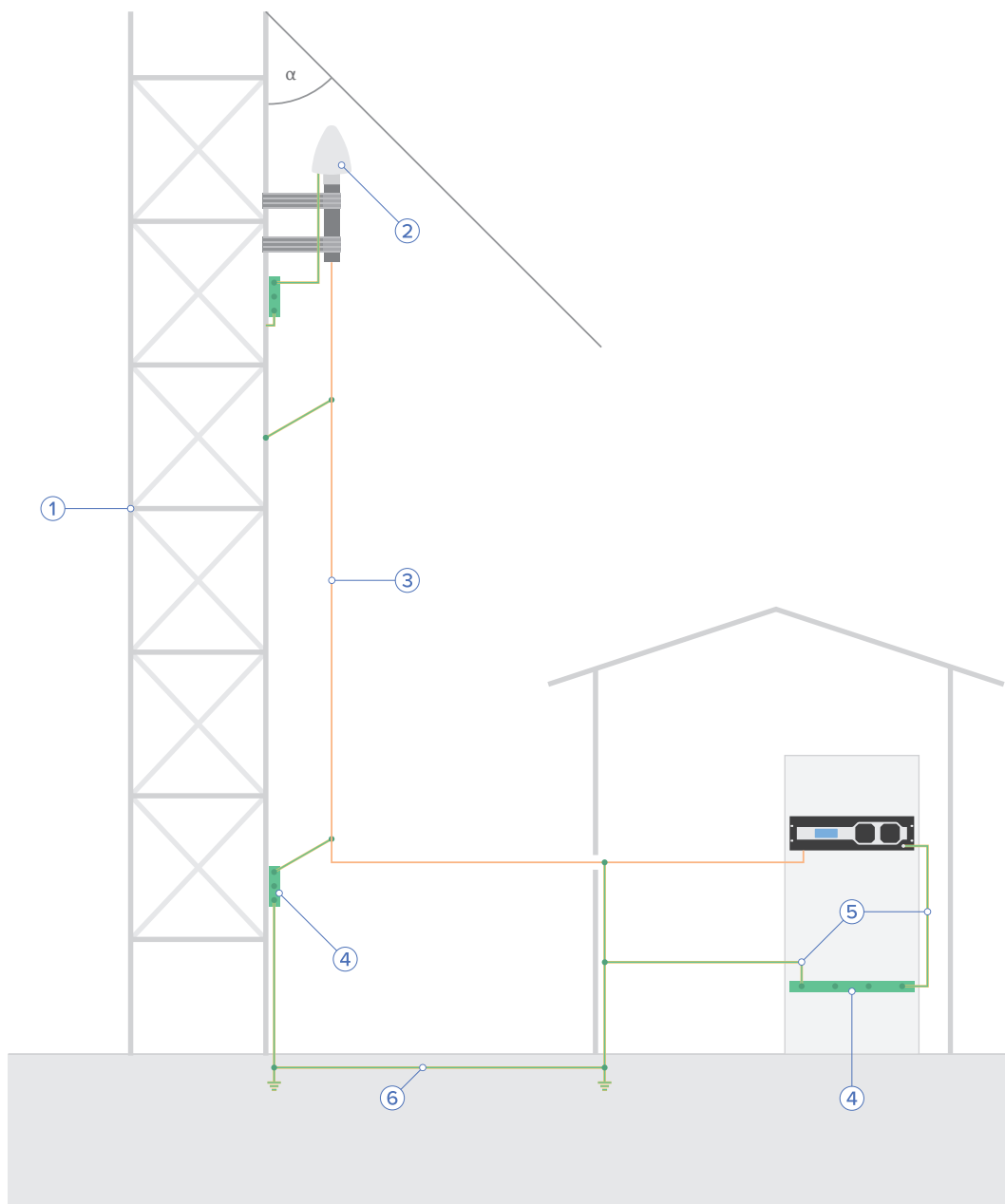


Fig. 5: Installation on a Pole

- 1 Antenna Pole
- 2 Meinberg GPS Antenna
- 3 Antenna Cable
- 4 Bonding Bar
- 5 Bonding Conductor
- 6 Foundation Electrode
- α Safety Zone

Antenna Installation with Insulated Lightning Rod System

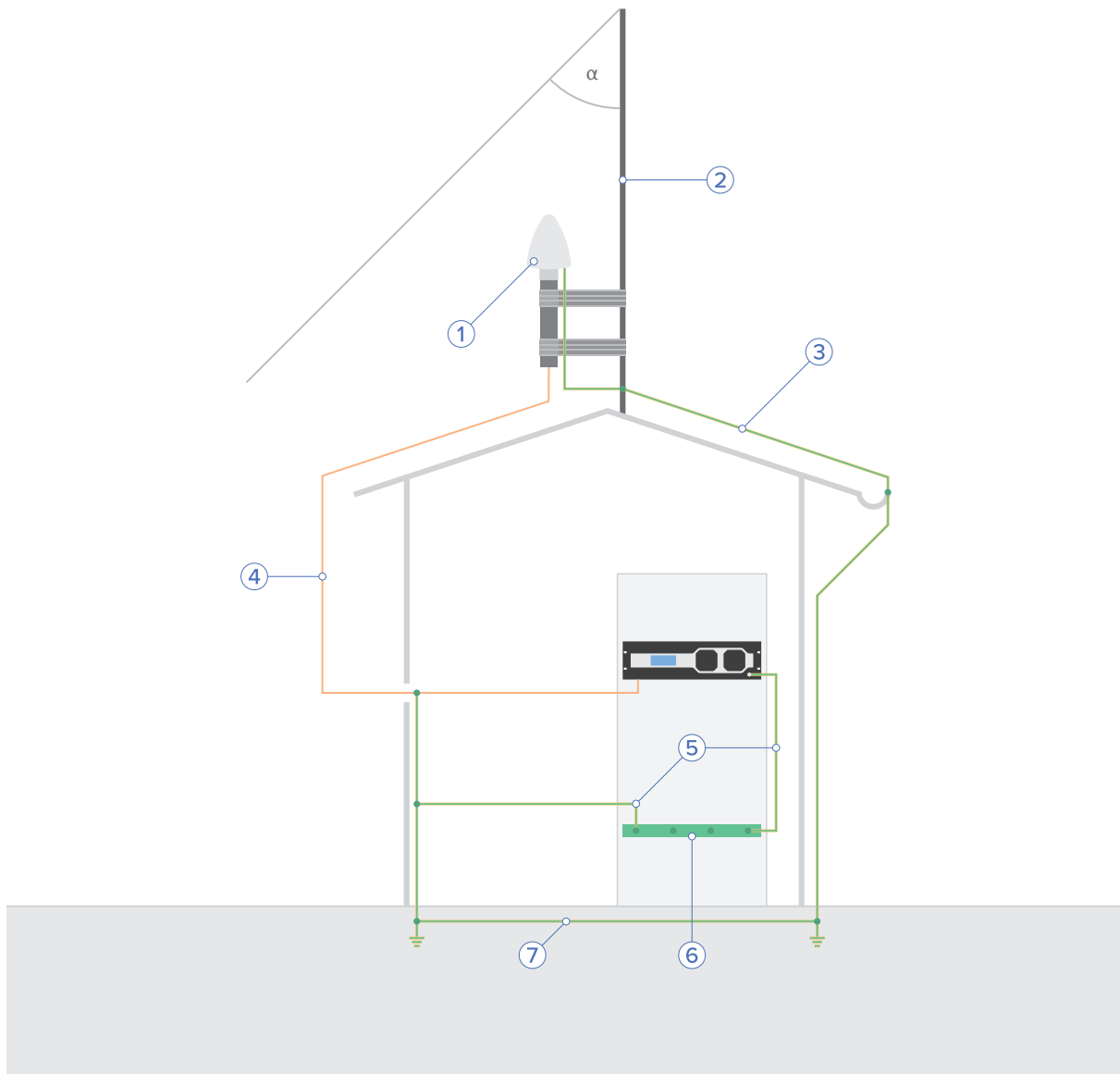


Fig. 6: Roof Installation

- 1 Meinberg GPS Antenna
- 2 Lightning Rod
- 3 Lightning Rod Conductor
- 4 Antenna Cable
- 5 Bonding Conductor
- 6 Bonding Bar
- 7 Foundation Electrode
- α Safety Zone

Optional MBG S-PRO Surge Protector



Information:

The surge protector and suitable coaxial cable are not included as standard with a Meinberg GPS Antenna, but can be ordered as an optional accessory.

Construction

The MBG-S-PRO is a surge protector (Phoenix CN-UB-280DC-BB) for 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.

Installation Conditions

To protect the building from possible surge voltages, the MBG-S-PRO 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.

Ideal Installation Conditions:

- Installation at the point where the antenna cable passes through the building wall
- Ground conductor cable from surge protector to grounding busbar as short as possible

Installation and Connection

This surge protector has no dedicated input or output polarity and therefore has no preferred installation orientation. It features Type-N female connectors at both ends.

Installation

1.

Fit the surge protector to the supplied mounting bracket as shown in the illustration.

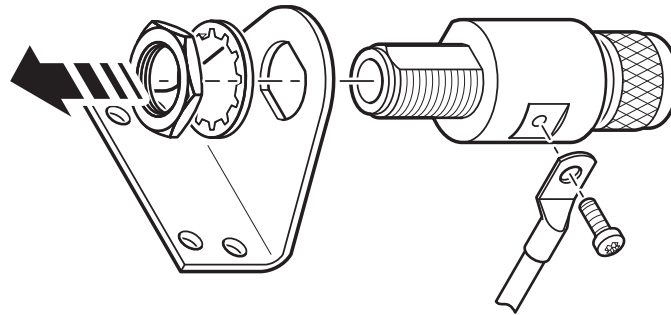


Fig. 7: Installation of the Surge Protector

2.

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.

3.

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



Caution!

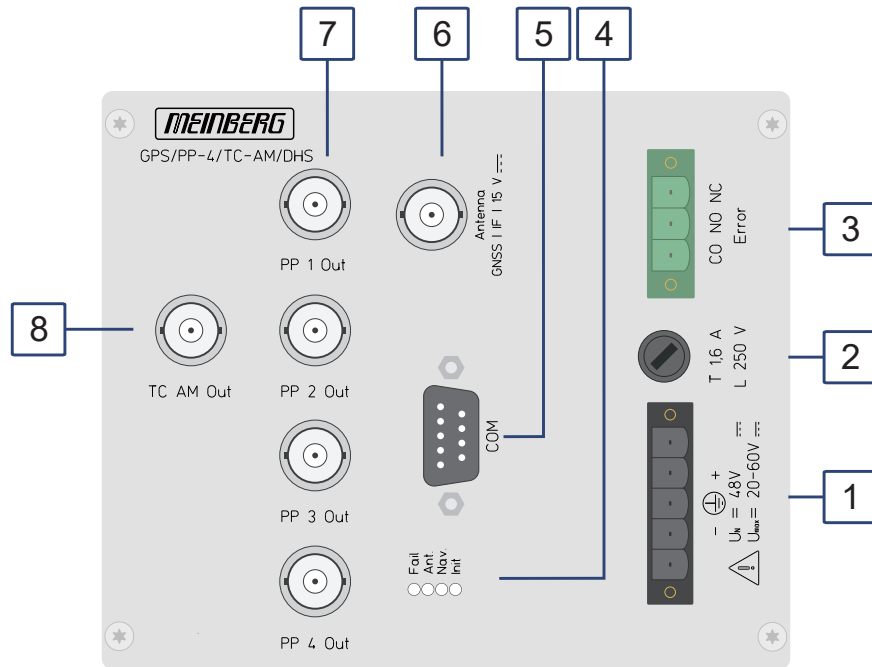
For safety reasons, the antenna cable must not exceed a certain length if there are no other devices such as a power distributor between the surge protector and the downstream electronic device with integrated surge protection at the mains connector level.

Please refer to the document [“Technical Specifications: MBG-S-PRO Surge Protector”](#) in the appendix as well as the manufacturer’s data sheet for detailed installation instructions and technical specifications for the surge protector.

Data Sheet (Download):

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

11 GPS183/PP-4/TC-AM/DHS Connectors



Information:

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

11.1 DC Power Supply

DC Power Supply

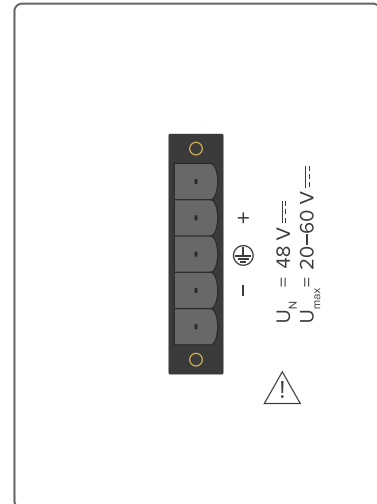
Connector Type:	5-Pin MSTB
Pin Assignment:	1: Not Connected
	2: V_{IN-}
	3: PE (Protective Earth)
	4: V_{IN+}
	5: Not Connected

Power Supply Specifications

Nominal Voltage:	U_N	=	48 V $\overline{=}$
Rated Voltage Range:	U_{max}	=	20 V – 60 V $\overline{=}$
Rated Current:	I_N	=	0.63 A $\overline{=}$

Output Specifications

Max. Power:	P_{max}	=	30 W
Typical Heat Output*:	E_{therm}	=	108.00 kJ/h (102.37 BTU/h)

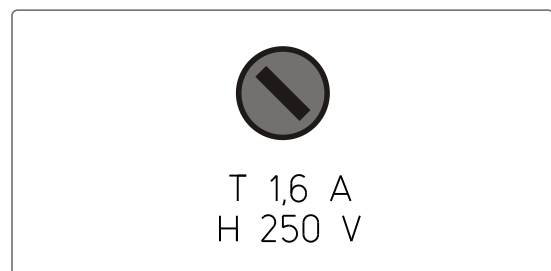


11.2 Fuse

The fuse protects against overload or short circuits and thus prevents damage to the installed power supply. The fuse is accessible from the front panel and can be replaced.

Technical Specification

Rated Voltage:	250 V
Shutter delay:	Timelag
Rated Current:	1.6 A



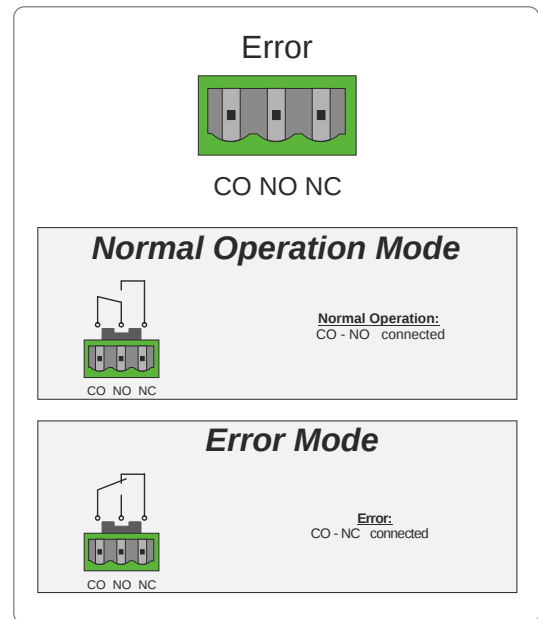
11.3 Error Relay

The device is equipped with a 3-pin relay output labeled with "Error". This 0 V ("dry") relay output is connected to the TTL TIME_SYNC output of the reference clock (GPS, GNS, GNS-UC, etc.) Normally, when the internal reference clock has been synchronized to its source (GPS, DCF77, or IRIG), this relay will switch to "NO" (Normally Open) mode. However, if there is a poor antenna signal or the device has been switched off, the relay will fall back to "NC" (Normally Closed) mode.

This relay can also be switched to a "NO" state using messages, providing a variety of switch states at this output.

Technical Specifications

Max. Switching Voltage:	125 V DC	
	140 V AC	
Max. Switching Current:	1 A	
Max. Switching Load:	DC	30 W
	AC	60 VA
UL/CSA Switching Current:	0.46 A	140 V AC
	0.46 A	65 V DC
	1 A	30 V DC
Response Time:	Approx. 2 ms	



Danger!

Danger of death due to electrical shock!

This equipment is operated at a hazardous voltage.



- Never work with open terminals and plugs while the power is on!
- When handling the connectors of the error relay cable, always disconnect both ends of the cable from their respective devices!
- Hazardous voltages may be passing through the terminal of the error relay! Never handle the error relay terminal while the signal voltage is present!

11.4 RS-232 COMx Time String Output

Data Transfer Mode: Serial I/O

RS-232 Baud Rates: 19200 (*Default*), 9600, 4800, 2400, 1200, 600, 300

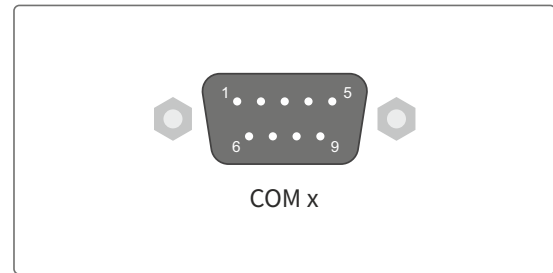
Framing: 7N2, 7E1, 7E2, 8N1 (*Default*), 8N2, 8E1, 8O1

Time String Formats: Meinberg Standard (*Default*)
Meinberg GPS
SAT
NMEA RMC
NMEA GGA
NMEA ZDA
NMEA RMC GGA (*RMC followed by GGA*)
Uni Erlangen
Computime
Sysplex 1
SPA
RACAL
ION
ION Blanked
IRIG-J-1
6021
(see → [Chapter 15.6, "Time String Formats"](#))

Pin Assignment: Pin 2: RxD (*Receive*)
Pin 3: TxD (*Transmit*)
Pin 5: GND (*Ground*)

Connector Type: D-Sub, Male, 9-Pin

Cable Type: Standard RS-232 Cable (Shielded)



Information:

Please note that the pin layout of the device receiving the time string output will dictate whether you require a "straight-through" or a null modem cable to connect your system to a time string receiver. A null-modem cable has Pins 2 and 3 'crossed over', so that Pin 2 at one end leads to Pin 3 at the other, and vice versa.

If Pins 2 and 3 have identical assignments on both devices, you will require a null-modem cable. If they are opposite to one another, you will require a "straight-through" cable. Either way, it is important that the transmitter pin (TxD) of each device is connected to the receiver pin (RxD) of the other device.

11.5 Antenna Input: GPS Reference Clock

Antenna Input

Receiver Type: GPS
12-Channel GPS C/A Code Receiver

Mixing Frequency
(Reference Clock to Antenna)
(GPS Converter): 10 MHz ¹

Intermediate Frequency
Antenna (GPS Converter)
to Reference Clock: 35.4 MHz ¹

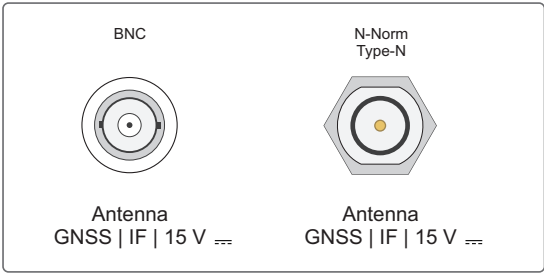
1) These frequencies are transferred via the antenna cable

Power Supply: 15 V, 100 mA (provided via antenna cable)

Connector Type: BNC, Female/Type-N, Female

Cable Type: Coaxial Cable, Shielded

Cable Length: Max. 300 m (RG58)
Max. 700 m (RG213)



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.

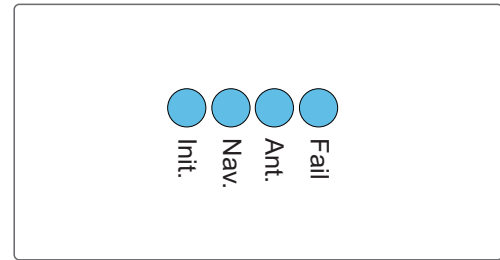
11.6 Status LEDs

"Fail" LED: Synchronization status

"Ant" LED: Antenna status

"Nav" LED: Geolocation status

"Init" LED: Initialization status of clock

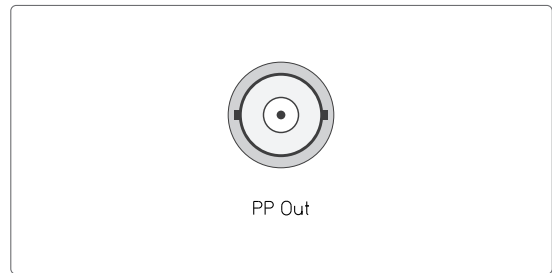


LED	Colors	Description
<i>Fail</i>	Red	The clock can identify no way to successfully synchronize.
<i>Ant</i>	Green	The antenna is correctly connected, there is no fault detected in the connection, and the clock is synchronized with the GPS reference.
	Red	The antenna is faulty or not correctly connected.
	Red/yellow (flashing)	The clock is in " Holdover Mode "; it is controlled solely via the internal oscillator and has not yet been synchronized to the GPS reference since the device was last started.
	Green/yellow (flashing)	The clock is in " Holdover Mode "; it is controlled solely via the internal oscillator, but has been synchronized at least once to the GPS reference since the device was last started.
<i>Nav</i>	Off	The GPS receiver has not yet determined its position (or has been unable to).
	Green	The GPS receiver has successfully determined its position.
<i>Init</i>	Blue	The internal firmware is initializing.
	Off	The initialization of the internal firmware is complete but the oscillator is not yet locked to its phase reference.
	Green	The initialization of the clock's firmware is completed and the oscillator is locked to its phase reference.

11.7 Programmable Pulse Output (TTL)

Output Signal:	Programmable Pulses
Signal Level:	TTL = 5 V (without load), 2.5 V (with 50 Ω load)
Rise Time:	Typically 4 ns
Fall Time:	Typically 4 ns
Connector Type:	BNC, Female
Cable Type:	Coaxial Cable, Shielded
Pulse Outputs:	Idle Timer Single Shot Cyclic Pulse Pulse Per Second Pulse Per Min Pulse Per Hour DCF77 Marks Position OK Time Sync All Sync DCLS Time Code 10 MHz Frequency DCF77-like M59 Synthesizer Frequency PTTI 1 PPS 1 MHz Frequency 5 MHz Frequency

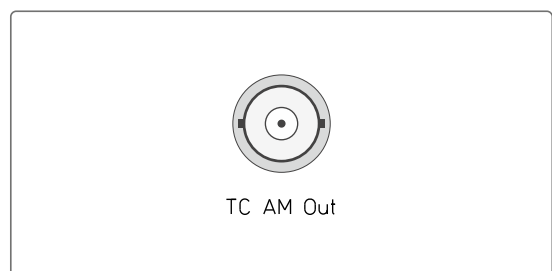
(more information about Progr. pulse outputs in
[→ Chapter 15.8, "Overview of Programmable Signals"](#))



11.8 AM Timecode Output

Connector Type:	BNC, Female (on device)
Output Signal:	AM Timecode (Amplitude-Modulated Sine-Wave Signal)
Signal Level:	3 V _{pp} / 1 V _{pp} (MARK/SPACE) (50 Ω load)
Carrier Frequency:	1 kHz (IRIG-B)
Cable Type:	Coaxial Cable, Shielded

(For detailed information about timecode, please refer to
[→ Chapter 15.7, "General Information about Timecode"](#))



12 System Installation

12.1 Connecting the System

The diagram below illustrates how a GPS183/PP-4/TC-AM/DHS is connected.

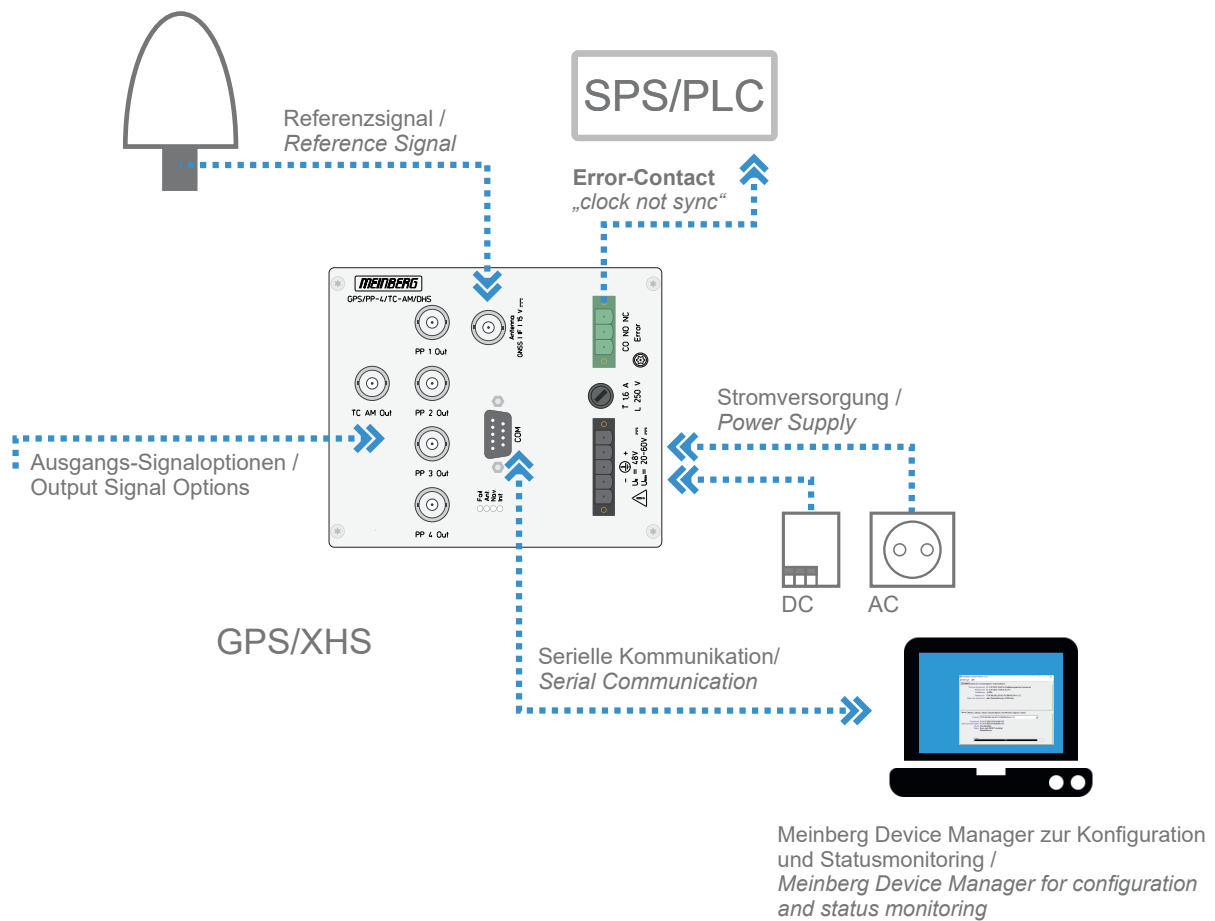


Illustration: Connecting the Main Interfaces and Signals of a GPS183/PP-4/TC-AM/DHS

12.2 Connecting the Power Supply

The device is supplied with power and grounded using the 5-pin "**Power**" connector on the front. It must be possible to establish and disconnect the power connection using a suitable physical power switch. The power switch must be in an easily accessible location near the device and suitable for use as a power switch for the device. The device must be connected to a properly installed grounding conductor.



Important!

Danger!

Danger of death from electric shock!

This equipment is operated at a hazardous voltage.



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

12.3 Data and Signal Cables

Ensure that all of the signal and interface cables required for the GSR190SEA are connected.

Coaxial Cable

The GSR190SEA has a BNC connector via which the signal from the antenna is supplied.

When laying the antenna cable between the antenna and receiver, take note of the maximum cable length, which is dependent on the cable type used (RG213, RG58) and its attenuation factor (refer to → [Chapter 10.3, "Antenna Cable"](#)).

A mismatched cable impedance will result in signal distortion, while poor shielding can cause signal interference.

D-Sub 9-Pin cable

The 9-pin D-Sub serial COM0 and COM1 communication interfaces are located on the front of the device. These RS-232 interfaces can be connected to a PC using the included "straight-through" RS-232 cable. TxD designates the transmission pin, while the receiving pin on the GSR190SEA is marked with RxD.

Please refer to → [Chapter 11.4, "RS-232 COMx Time String Output"](#) for more detailed information on these interfaces.

If your PC or laptop has no D-Sub 9 RS-232 serial port, you will require a serial-to-USB adapter to establish a serial connection between COM0 (on the GPS183/PP-4/TC-AM/DHS) and the corresponding serial interface on your laptop or PC.

12.4 Powering Up the System

Once both the antenna and power supply have been connected, the system is ready for operation. Within between 10 seconds and 3 minutes of power-up, the receiver will have warmed up and be operating with the required accuracy. If the receiver finds valid almanac and ephemeridal data in its battery-backed memory and the receiver's position has not changed substantially since it was last on, the system's CPU will be able to calculate which satellites should currently be in view. In this case, only a single satellite needs to be received to synchronize the receiver and generate output pulses, meaning that the pulse outputs will be enabled within no more than 1 to 10 minutes. After around 20 minutes of operation the OCXO will be fully adjusted and the output frequency will fall within the specified tolerance range.

If the location of the receiver has changed by several hundred miles since the last time the system was on, the elevation and Doppler shift of the satellites will not match the calculated values. This will cause the system to switch to "Warm Boot" mode, in which it will systematically search for satellites in view. The receiver can use the valid almanac data to detect the identification numbers of existing satellites. If four satellites are in view, the receiver's new position can be determined and the device will switch to "*Normal Operation*" mode. If there is no almanac data available (e.g., because the battery-backed memory has been wiped), the GPS reference clock will launch in "*Cold Boot*" mode, in which the receiver searches for a satellite and reads the entire almanac from it. This process is completed in around 12 minutes, after which the system will switch to "*Warm Boot*" mode.

By default, neither the pulse and synthesizer outputs nor the serial ports will be enabled after power-up until synchronization has been achieved. However, it is possible to configure one or several of those outputs to be enabled immediately after power-up. If the system starts up in a new environment (e.g., receiver position has changed or new power supply), it may take several minutes for the OCXO's output frequency to be adjusted.

Until that time, the accuracy of the OCXO's frequency is limited to 10^{-8} , which reduces the accuracy of the pulses to $\pm 3 \mu\text{s}$.

13 Using Meinberg Device Manager to Configure and Monitor the GPS183DHS

13.1 Introduction to Meinberg Device Manager

The software **Meinberg Device Manager** is used to configure the GPS183DHS and to monitor its status.

The current version of Meinberg Device Manager can be downloaded free of charge for Windows, either as an executable installer or as a portable ZIP archive, and is also available for a variety of Linux distributions.

To enable the GPS183/PP-4/TC-AM/DHS to be correctly detected, configured, and monitored, **Version 7.3** or better of Meinberg Device Manager is required.

The software can be downloaded at:

🔗 <https://www.meinbergglobal.com/english/sw/mbg-devman.htm>

Documentation

A comprehensive user guide for Meinberg Device Manager is also available to download and contains detailed information on all of the configuration and system monitoring options provided by the software for the GPS183/PP-4/TC-AM/DHS. The manual can be downloaded in PDF format under the following link:

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

13.2 Configuring the GPS183DHS

This chapter describes the initial set-up process of a GPS183DHS using Meinberg Device Manager.

13.2.1 "System" Section

The "System" section can be used to perform basic operations such as the generation of a diagnostic file.

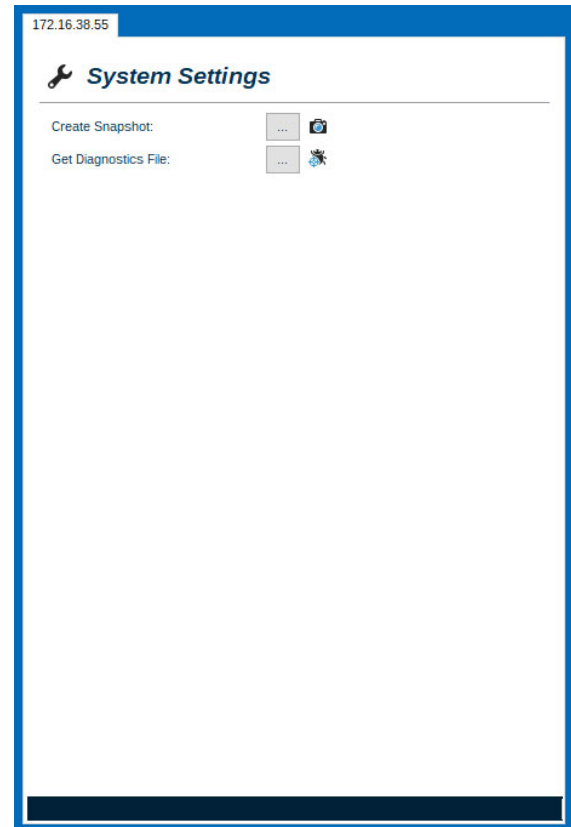
1. To do this, select the device listed on the start page of Meinberg Device Manager.
2. Select it by clicking on it once, then click on "Configure Device(s)".

Create Snapshot

Meinberg Device Manager exports all configuration and status information into text files. This allows you to save this text file containing the current configuration of your device (ZIP archive). If necessary, this file can be sent to Meinberg's Technical Support team.

Get Diagnostics File

Saves the configuration as a diagnostic file (*tar.gz* format). If necessary, this file can be sent to Meinberg's Technical Support team.



13.2.2 "Clock" Section

The following settings can be configured in the "Clock" section:

- Initialize Time:** Allows the date and time to be modified manually.
- Use PC's System Time:** When enabled, the local PC's clock will be used once as a reference to set the local clock of your Meinberg system.
- Date:** Allows the date to be specified in the format dd.mm.YYYY.
- Time:** Allows the time to be specified in the format HH:ii:ss.
- Simulation Mode:** Allows the system to be used without a connected antenna. The synchronization status in this case is 'forged' so that all system processes assume that the clock is synchronized.
- GNS System:** Allows the satellite system or a combination of systems to be selected with GNS receivers.
- Antenna Cable Length:** Allows signal propagation times to be compensated for. The propagation delay inherent in the cable is affected by the length of the cable (approx. 5 ns/m).
- Initiate Warm Boot:** Forces the receiver to "warm boot", whereby the lock on all detected satellites is cleared and the receiver tries anew to lock onto satellites using the saved almanac data.
- Initiate Cold Boot:** Forces the receiver to "cold boot", whereby the lock on all detected satellites is cleared and all almanac data is erased. The receiver then locks onto one satellite and downloads the almanac again.

The screenshot displays the 'Clock Settings' window. At the top, the title bar shows '172.16.38.55 (Clock)'. The window has a blue header with a wrench icon and the title 'Clock Settings'. On the right side, there are four circular icons: a globe, a document, a folder, and a refresh symbol. The settings are organized into sections: 'Initialize Time' with a checkbox; 'Use PC's System Time' with a checkbox; 'Date' with a text field showing '23.08.2019'; 'Time' with three spinners showing '13', '46', and '44'; 'Simulation Mode (Always Sync.)' with a checkbox; 'GNS System(s)' with a list box containing 'GPS' (checked), 'GLONASS' (checked), 'BeiDou' (unchecked), and 'Galileo' (unchecked); 'Antenna Cable Length (m)' with a text field showing '20'; 'Initiate Warm Boot' with a button showing a sun icon; and 'Initiate Cold Boot' with a button showing a snowflake icon.



Information:

The system may under certain circumstances automatically perform a warm or cold boot. For example, this might happen if the receiver no longer has enough satellites 'in view' or the almanac is older than three weeks.

13.2.3 "Serial Ports" Section

The available serial interfaces on the selected module or device can be displayed and configured in the "Serial Ports" section.

The following settings can be configured in the "Serial Ports" section:

- Baud Rate:** The baud rate is the data transmission rate for serial time strings.
- Framing:** The framing represents the format in which the data is transmitted.
- String Type:** You can select from a large number of different time string types. These are output as ASCII code sequences and can be displayed on the serial terminal of the start page.
- Mode:** This is used to select how frequently the time string as configured above should be output or whether it should only be output on request ("?" sent to the RxD pin of the serial interface).

The screenshot displays the "Serial Ports Settings" window. At the top, a status bar shows the time "172.16.38.55 (Clock)". The main title is "Serial Ports Settings" with a wrench icon. Below the title, there are four configuration rows for "COM0":

- COM0 Baud Rate:** A dropdown menu set to "19200". A list of available baud rates is shown below: 300, 600, 1200, 2400, 4800, 9600, and 19200.
- COM0 Framing:** A dropdown menu set to "8N1". A list of available framing options is shown below: 7N2, 7E1, 7E2, 8N1, 8N2, 8E1, and 8O1.
- COM0 String Type:** A dropdown menu set to "Meinberg Standard". A large list of available string types is shown below, including: Meinberg Standard, SAT, NMEA RMC, Uni Erlangen, Computime, Sysplex 1, SPA, RACAL, Meinberg GPS, NMEA GGA, NMEA RMC GGA, NMEA ZDA, ION, ION BLANKED, 6021, and IRIG-J.
- COM0 Mode:** A dropdown menu set to "Per second". A list of available modes is shown below: Per second, On request only ("?"), Per second, and Per minute.

On the right side of the window, there are four circular icons representing different serial port configurations.

13.2.4 “Outputs” Section

The IRIG time codes that can be output by the system can be configured here. This section can also be used to set the frequency and phase of the synthesizer and define the conditions under which the output signals are enabled.

The various time code formats are described in Chapter 15.6, “Time String Formats”.

The following options are configurable in the “Outputs” section:

IRIG TFOM: Only applies to IEEE 1344, C37.118. A 4-bit Time Figure of Merit value (TFOM) that represents the accuracy of the generated IRIG signal. Here, 0 represents the highest accuracy, while TFOM 15 (Hex) represents the lowest accuracy.

IRIG Timescale: IRIG time code can be output as UTC or local time. Local time is calculated based on the time zone configuration.

Synth. Frequency: The output frequency of the integrated synthesizer is configured here.

Please Note: If a frequency of 0 Hz is set, the synthesizer is disabled.

Synth. Phase (deg): The phase of the integrated synthesizer can be specified here in order to control the timing of the zero-crossings.

Please Note: Higher phase offsets will cause the delay in the output signal to be increased. If a frequency of more than 10 kHz is set, the phase cannot be modified.

Enable [Signal Type]: Serial Outputs, Pulses, Fixed Freq., Synthesizer

Always: The signal output is enabled immediately upon device startup.

If Sync: The signal output is only enabled once the receiver has synchronized for the first time.

The screenshot displays the 'Outputs Settings' interface. At the top, a status bar shows the clock time '172.16.38.55 (Clock)'. The main settings area includes:

- IRIG Code:** A dropdown menu currently set to 'B002 + B122'. An open dropdown shows a list of options: B002 + B122, B003 + B123, AFNOR NF S87-500, IEEE 1344, B006 + B126, B007 + B127, and IEEE C37.118.
- IRIG Timescale:** A dropdown menu currently set to 'UTC'. An open dropdown shows options: UTC and Local Time.
- Synth. Frequency:** A numeric input field showing '000.0' with a unit dropdown set to 'Hz'.
- Synth. Phase (deg):** A numeric input field showing '0.0'.
- Enable Serial Outputs:** A dropdown menu set to 'Always'.
- Enable Pulses:** A dropdown menu set to 'Always'.
- Enable Fixed Freq.:** A dropdown menu set to 'Always'.
- Enable Synth.:** A dropdown menu with options 'Always', 'If Sync', and 'Always' (highlighted).

On the right side of the window, there are four circular icons: a gear (Settings), a document (Help), a folder (Storage), and a signal (Outputs).

13.2.5 “Time Zone” Section

This section is used to configure the time zone and summertime/wintertime adjustments (*Daylight Saving Time, DST*). The internal time zone of the system and for NTP is always UTC.

These parameters affect the serial outputs and the time code outputs (IRIG, AFNOR, etc.)

Note Regarding Configuration:

Some systems provide multiple timescale options such as GPS or TAI. In this case you will not be able to customize the time zone, as UTC or local will be set as the fixed timescale as appropriate.

Timescale:	<u>GPS</u> GPS system time with the epoch January 1, 1980. A monotonic timescale without leap seconds. Incorporates the leap seconds from between 1970 and 1980.
	<u>UTC</u> Coordinated Universal Time (includes leap seconds, which are continuously amended)
	<u>TAI</u> International Atomic Time with the epoch January 1, 1970. A monotonic timescale without leap seconds. Offset relative to GPS time: 19 seconds.

The parameters for the UTC, CET/CEST, and EET/EEST time zones are fixed and cannot be modified. However, you can define a custom profile for a time zone and customize all of the parameters of this.

Name:	The time zone name can be assigned any desired name.
Offset (sec):	The offset defines the difference relative to UTC time. You can select a positive or negative value for this offset.
Daylight Saving (DST):	This can be used to enable or disable Daylight Saving Time.
Name DST:	The specific summertime nomenclature can be specified here.
Offset DST (sec):	An offset must also be configured for summertime.
DST Mode:	It is also possible to specify a weekday on which the summertime starts and ends.
Dynamic Calculation:	Daylight Saving Time is applied or removed on the configured day of

week, either on or after the configured date. (Example of CEST: First Sunday on or after March 25 and October 25). As such, the configuration only needs to be performed once and the appropriate date is calculated automatically each year.

Fixed Date: Daylight Saving Time is applied or removed on the configured date and needs to be reconfigured each year.

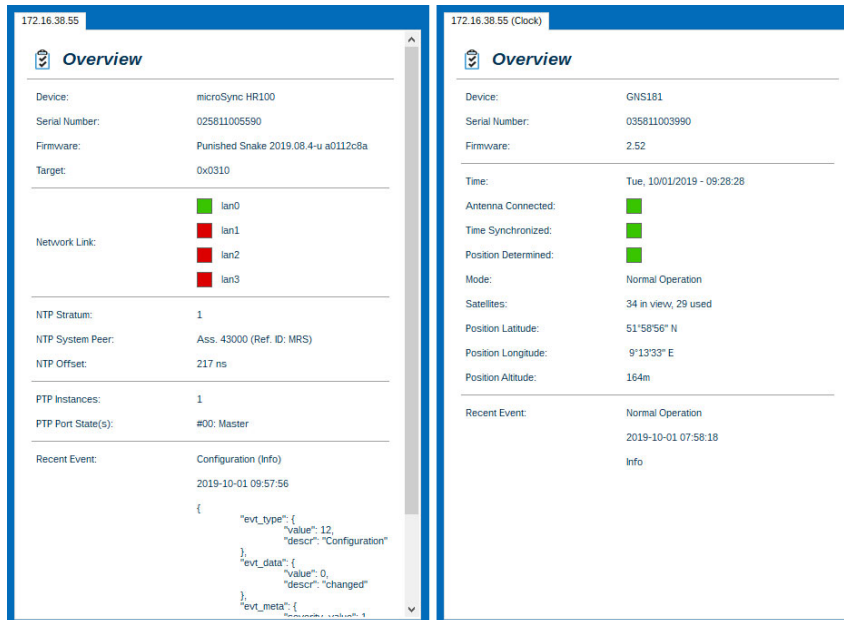
DST Start: The application of Daylight Saving Time can be customized depending on the location of the module or system.

DST End: The end of Daylight Saving Time can be customized depending on the location of the module or system.

13.3 Monitoring the GPS183DHS

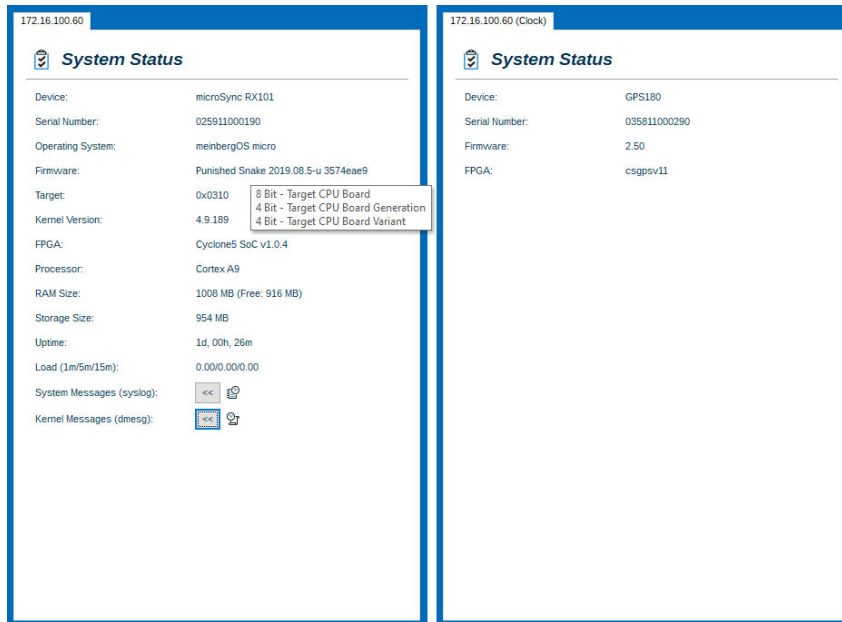
Once you have successfully logged into the GPS183DHS, you can display the status of the device. The Dashboard shows all relevant system information:

13.3.1 “Overview” Section



Device:	The specific system name.
Serial Number:	The serial number of the device (please always specify when contacting Technical Support).
Firmware:	The current firmware version.
Target:	Shows the version of the CPU board.
Network Link:	The network ports with an active link-up are shown in green, while those with no active link-up are shown in red.
NTP Stratum:	The current stratum of the internal NTP server. This will usually be Stratum 1 as Meinberg products typically have an integrated GNSS receiver. However, if at any point the system is no longer synchronized to its reference, the Stratum will usually be 16.
NTP System Peer:	In connection with NTP, this is normally
NTP Offset:	The offset between the NTP time and GNSS time.
PTP Instances:	The PTP instances enabled and configured via the system configuration.
PTP Port State:	The current PTP port mode: Master or Slave.
Recent Event:	The most recent event shown in an XML structure.

13.3.2 "System" Section



In addition to the information displayed under the "Overview" section, this section also shows the FPGA version, firmware version, serial number, and product designation.

13.3.3 “Clock” Section

The Clock Status section provides important status information about your receiver module. For example, you can see the synchronization status of your receiver, the satellite constellations currently in use, and the number of satellites that are visible and/or in use.

Time:	Displays the current system time.
Status:	Displays various states for your receiver, including the synchronization, antenna connection, and oscillator status.
Oscillator Type:	Displays the type of oscillator that is installed.
Mode:	The current mode of the integrated receiver e.g., Normal Operation, Cold Boot, Warm Boot.
Satellites:	The total number of available satellites and the total number of GNSS systems used for synchronization.
Position:	The current location of the receiver.

172.16.38.55 (Clock)	
 Clock Status	
Time:	Mon, 09/30/2019 - 15:05:59
Status:	Clock synchronized Antenna connected Oscillator warmed up
Oscillator Type:	OCXO SQ
Mode:	Normal Operation
Satellites:	22 in view, 17 used
GPS:	12 in view, 9 used
GLONASS:	10 in view, 8 used
Position:	Lat.: 51°58'56" N Long.: 9°13'33" E Alt.: 164m

13.3.4 "Satellites" Section

The "Satellites" section allows the visibility and quality of the detected satellites to be monitored and analyzed.

This can be presented in various ways that can be selected as needed.

Satellite List

A list of all detected satellites sorted by satellite system.

- GNSS:** This column lists the satellites of the previously selected systems.
- SVNO:** ID number of the satellite.
- Last Status:** Shows the last known status of the satellite.
- Last Locked:** Shows the time when the receiver last locked onto this satellite.

Satellite Map

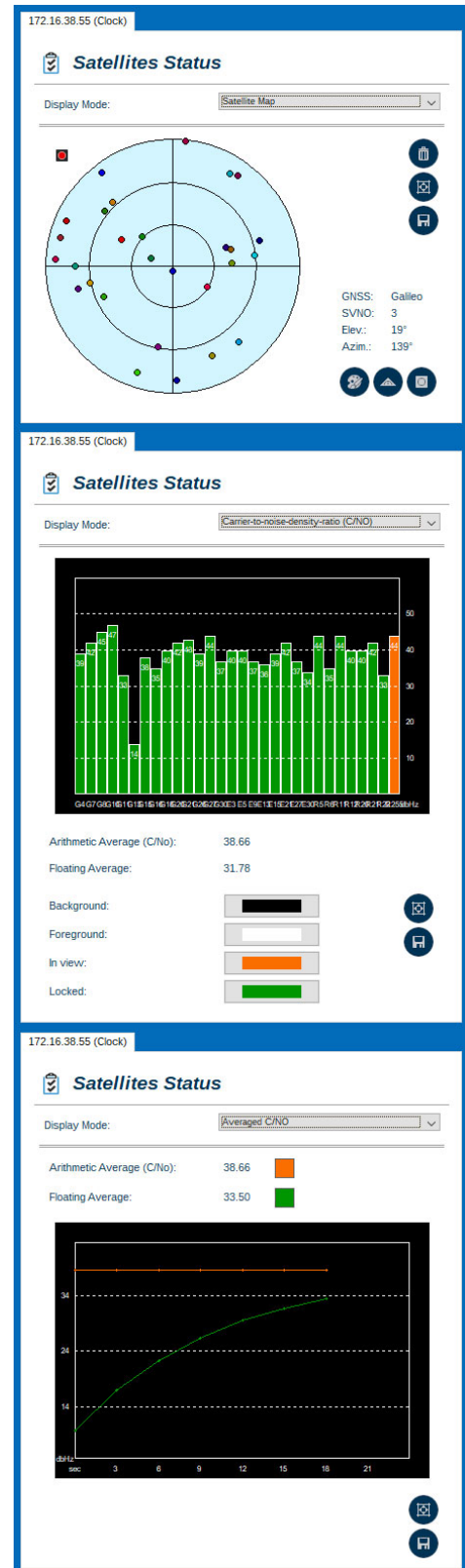
Detailed information about each of the satellites can be displayed here by hovering with the mouse cursor over the points (representing satellites) on the Satellite Orbit Map.

Carrier-to-Noise Density Ratio

This section shows the signal quality (*Carrier-to-Noise Density Ratio, C/N₀*) of all available satellites in the form of a bar chart. The height of each of the bars indicates the reception quality of each of the satellites.

Averaged C/NO

The average quality of the satellites in the coordinate system (x = seconds, y = dBHz as unit for C/NO Carrier-to-Noise Density).



13.3.5 “Event Log” Section

This section is used to log system events and identify any changes.



Clear Event Log – Deletes all displayed event logs.



Save Event Log – Saves event logs as a text file.

Current Entries:

The number of event log entries currently displayed.

Max. Entries:

Displays the maximum number of event log entries.

172.16.38.55 (Clock)

Event Log

Current Entries: 20
Max. Entries: 20

Time	Level	Type
2019-08-23 11:01:48	Info	Normal Operation
2019-08-26 09:38:53	Warn	Power Up Reset
2019-08-26 09:38:53	Info	Normal Operation
2019-08-26 09:39:18	Info	Normal Operation
2019-08-26 15:52:14	Info	Normal Operation
2019-09-19 14:52:21	Warn	Power Up Reset
2019-09-19 14:52:21	Info	Normal Operation
2019-09-19 14:52:48	Info	Normal Operation
2019-09-20 07:34:47	Crit.	Watchdog Reset
2019-09-20 07:34:47	Info	Normal Operation
2019-09-20 07:34:49	Info	Normal Operation
2019-09-20 07:38:08	Warn	Power Up Reset
2019-09-20 07:38:08	Info	Normal Operation
2019-09-20 07:38:56	Info	Normal Operation
2019-09-20 08:38:48	Warn	Power Up Reset
2019-09-20 08:38:48	Info	Normal Operation
2019-09-20 08:39:18	Info	Normal Operation
2019-09-20 09:57:20	Crit.	Antenna Disconn.
2019-09-20 09:58:01	Info	Antenna OK
2019-09-20 09:58:01	Info	Normal Operation

Event Log

Time: Shows the local date & time (of the receiver) at which the events were generated.

Level: Display the event log level:

Info Events of a purely informational nature (e.g., antenna OK)
Crit Critical events (e.g., antenna disconnected)
Error Error events (e.g., warm boot triggered)
Warn Warning events (e.g. power-up, reset)

Type: Display the type of generated event.

13.3.6 “Sensors” Section

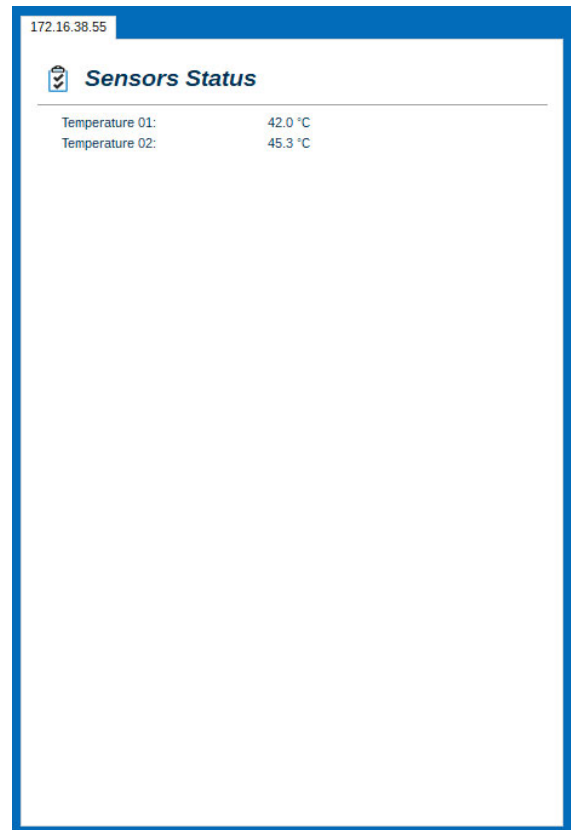
This section allows the sensors integrated into the system to be monitored.

Temperature 01:

Displays the temperature measured at Sensor 01.

Temperature 02:

Displays the temperature measured at Sensor 02.



172.16.38.55	
 Sensors Status	
Temperature 01:	42.0 °C
Temperature 02:	45.3 °C

14 Configuration and Monitoring Using GPSPMON32

The program GPSPMON32 was developed by Meinberg until 2017 and offered for download for programming and monitoring Meinberg products.. The software was supported on Windows 7, Windows Vista, Windows 9x, Windows 2000, Windows XP, and Windows NT.

Meinberg ceased development of GPSPMON32 in 2010 and ended official support in 2017. GPSPMON32 was succeeded from that point by the newer Meinberg Device Manager, which provides many more features and is still in active development.

Meinberg strongly recommends using the newer, more developed, and free Meinberg Device Manager to manage and monitor your GPS183DHS. Even so, GPSPMON32 remains available to download on the Meinberg software download page as a goodwill gesture for end users who are working with older operating systems or who may be familiar with or prefer the operating style of GPSPMON32.

<https://www.meinbergglobal.com/english/sw/#gpsmon>

Important!



Meinberg no longer supports the use of GPSPMON32 for configuring and monitoring your GPS183DHS.

Before submitting a support request, please first install the free Meinberg Device Manager software to find out if that will solve your problem.

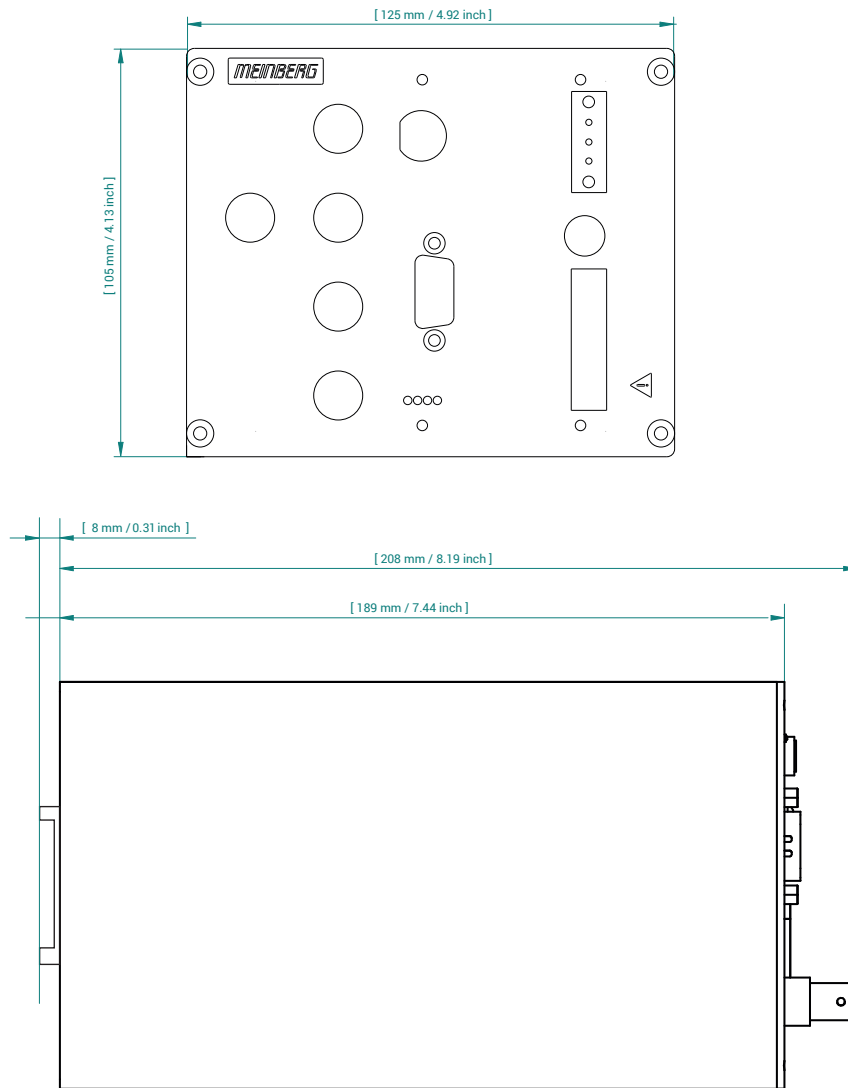
Meinberg provides no guarantee that GPSPMON32 will work correctly on any specific operating system, PC configuration, or with any specific Meinberg product. This applies in particular to PC operating systems (especially Windows 8, Windows 10, and Windows 11), PC configurations, and Meinberg products that were developed after the end of support for GPSPMON32.

15 Technical Appendix

15.1 Technical Specifications: GPS Receiver

Receiver Type:	12-Channel GPS C/A Code Receiver	
Antenna Type:	GPSANTv2 Antenna	
Operating Voltage of Antenna:	15 V DC, Short-Proof Power supply over antenna cable	
Time to Synchronization:	Max. 1 Minute if receiver position is known and almanac is valid, approx. 12 minutes if no valid data stored ("Cold Boot" mode)	
Pulse Outputs:	Pulse-per-Minute (PPM) Pulse-per-Second (PPS)	
Frequency Synthesizer:	1/8 Hz – 10 MHz:	Base accuracy = System accuracy
	1/8 Hz – 10 kHz:	Phase synchronicity with pulse-per-second
	10 kHz – 10 MHz:	Frequency deviation < 0.0047 Hz
Pulse Accuracy:	Following synchronization and within first 20 minutes of operation: Better than $\pm 2 \mu s$ (with OCXO-SQ/HQ/DHQ)	
	Following synchronization and after 20 minutes of operation: Better than ± 50 nsec (with OCXO-SQ/HQ/DHQ)	
Serial Interfaces:	2 asynchronous serial interfaces (RS-232) Baud Rate: 300 – 19200 Framing Options: 7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 8O1	
Default Setting:	COM0:	19200, 8N1 Meinberg Standard string, transmission once per second
	COM1:	19200, 8N1 Meinberg Standard string, transmission once per second
HF Connector:	Coaxial BNC Connector, Female, for GPS Antenna	
Ambient Temperature:	Operation:	0 to 50 °C
	Storage:	–20 to 70 °C
Supported Relative Humidity:	Max. 85 % (non-condensing) at 30 °C	
Housing Type:	DIN Rail Mounted Chassis	
Chassis Material:	Aluminum	
IP Rating:	IP20	

Gehäuseabmessungen

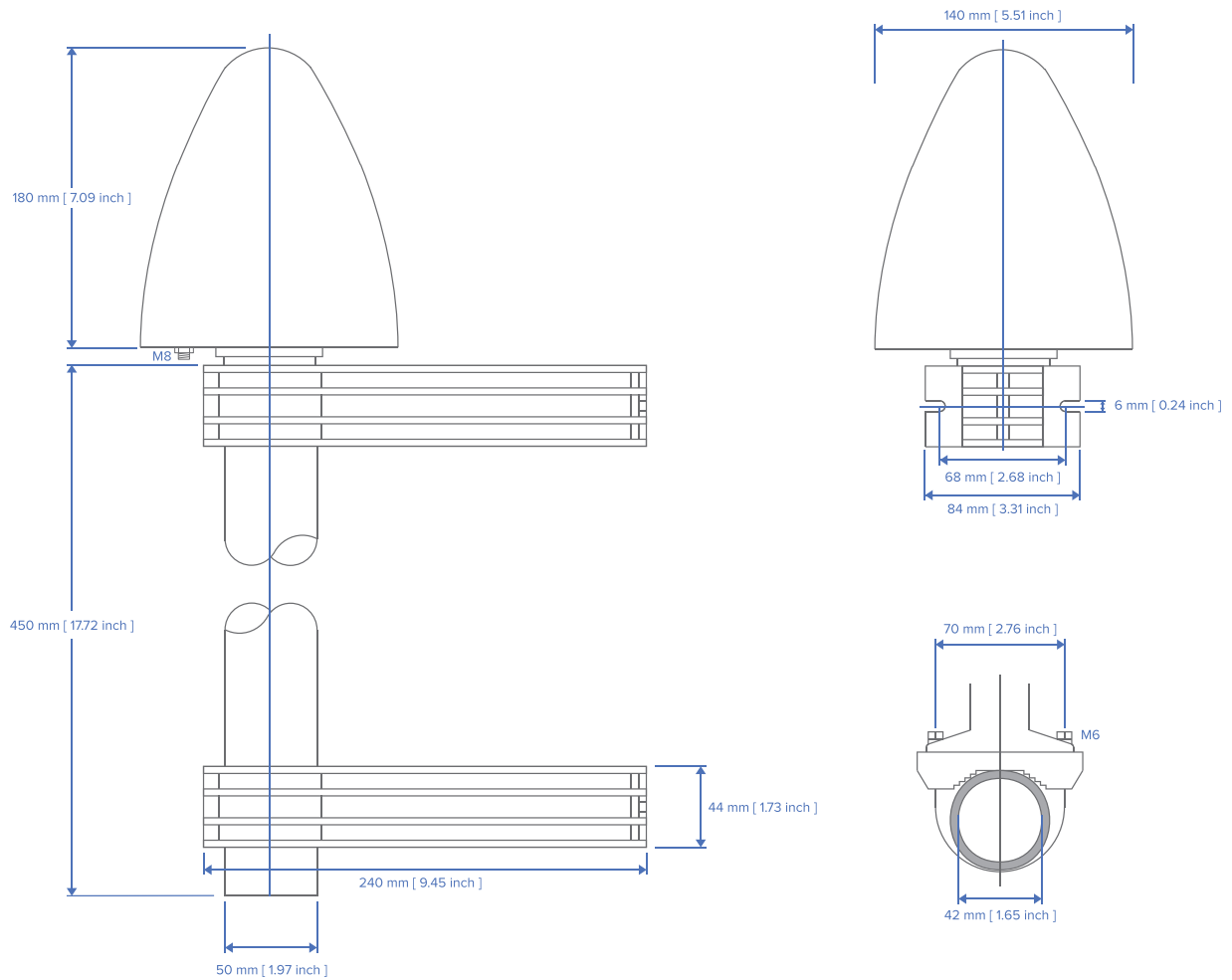


15.2 Technical Specifications: Oscillators

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

15.3 Technical Specifications: GPSANTv2 Antenna

Physical Dimensions



Electrical Specifications

Power Supply: (via Antenna Cable)	15 V $\pm$ 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 $\pm$ 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 $\pm$ 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:	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

15.4 Technical Specifications: MBG-S-PRO Surge Protector

The MBG-S-PRO is a surge protector (Phoenix CN-UB-280DC-BB) for 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.



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

15.5 How Satellite Navigation Works

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

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

Satellite Systems

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

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

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

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

15.5.1 Time Zones and Daylight Saving Time

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

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

15.6 Time String Formats

15.6.1 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	(00–99)	Century
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		

15.6.2 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;uvGy;lll<ETX>
```

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

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

15.6.3 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:

CHx<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		

15.6.4 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>*yymddhhmmsswcc*<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
<i>yymdd</i>	The current date: <i>yy</i> Year of the Century (00–99) <i>mm</i> Month (01–12) <i>dd</i> Day of month (01–31)
<i>hhmmss</i>	the current time: <i>hh</i> hours (00–23) <i>mm</i> minutes (00–59) <i>ss</i> seconds (00–59, or 60 during leap second)
<i>w</i>	Day of the Week (1–7, 1 = 31h = Monday)
<i>cc</i>	Checksum in hexadecimal, generated from all characters including GID, ABS, TSQ, CC, ST, etc.
<CR>	Carriage Return, ASCII code 0Dh

15.6.5 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 = 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:		
	"I"	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		

15.6.6 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 ellipsoid Leading zeroes are padded with spaces (ASCII code 20h)
<ETX>	End of Text, ASCII code 03h

15.6.7 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, hhhmmss.ss, A, bbbb.bb, n, llllll.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

15.6.8 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.ss, ffff.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: <i>hh</i> Hours (00–23) <i>mm</i> Minutes (00–59) <i>ss</i> Seconds (00–59, or 60 while leap second) <i>ff</i> 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

15.6.9 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)		

15.6.10 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:

<i>yy-mm-dd</i>	Current Date:
<i>yy</i>	Year without century (00–99)
<i>mm</i>	Month (01–12)
<i>dd</i>	Day of the month (01–31)
<i><SP></i>	Space (ASCII code 20h)
<i>hh.mm;ss.fff</i>	Current Time:
<i>hh</i>	Hours (00–23)
<i>mm</i>	Minutes (00–59)
<i>ss</i>	Seconds (00–59, or 60 during leap second)
<i>fff</i>	Milliseconds (000–999)
<i>cc</i>	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)
<i><CR></i>	Carriage Return (ASCII code 0Dh)

15.6.11 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

15.6.12 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:

XGUyyymmddhhmmss<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)		
yyymmdd	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)		

15.6.13 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:ss*q<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		

15.6.14 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) “?” (ASCII code 3Fh)	Time Sync (GPS Lock) No Time Sync (GPS Fail)
<CR>	Carriage Return (ASCII code 0Dh)		
<LF>	Line Feed (ASCII code 0Ah)		

15.6.15 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>ddd: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		

15.6.16 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:

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

15.6.17 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.

15.6.18 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.

15.6.19 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.

15.6.20 CISCO ASCII Time String

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

```
*.A.mjdxxyy/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'.
<i>mjdxxyy/mm/dd</i>	The current date in Modified Julian Date format. The current date in Gregorian <i>yy/mm/dd</i> format.
<i>hh:mm:ss</i>	The current time in 24-hour format.
<i>+3600</i>	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.
<i>12N34.567</i>	The current latitude of the GNSS receiver. If the time reference is not a GNSS receiver, this will show 00 00.000.
<i>123W45.678</i>	The current longitude of the GNSS receiver. If the time reference is not a GNSS receiver, this will show 000 00.000
<i>+1234</i>	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).

15.6.21 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)	

15.7 General Information about Timecode

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

In addition to these general-purpose time signals, there are other codes in use designed for specific applications, among them NASA36, XR3, or 2137. The GPS183/PP-4/TC-AM/DHS, 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>

15.7.1 Description of IRIG Timecodes

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

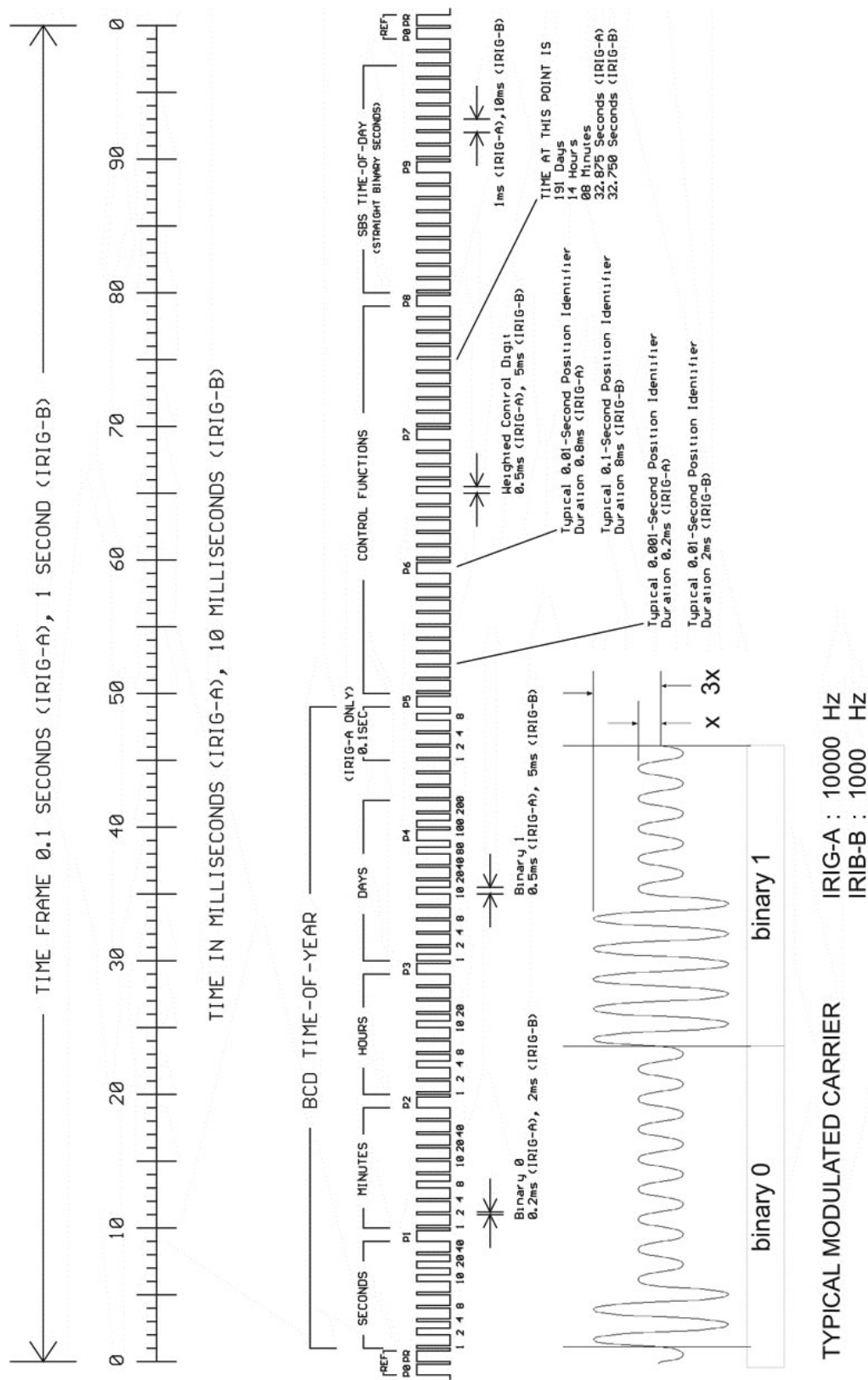
Character	Bit Rate	A	1000 pps
		B	100 pps
		E	10 pps
		G	10000 pps
1 st Character	Pulse Wave	0	DC level shift (DCLS), pulse-width modulated
		1	Sine-wave carrier, amplitude-modulated
2 nd Character	Carrier Frequency	0	No carrier (DC level shift)
		1	100 Hz, time resolution 10 ms
		2	1 kHz, time resolution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

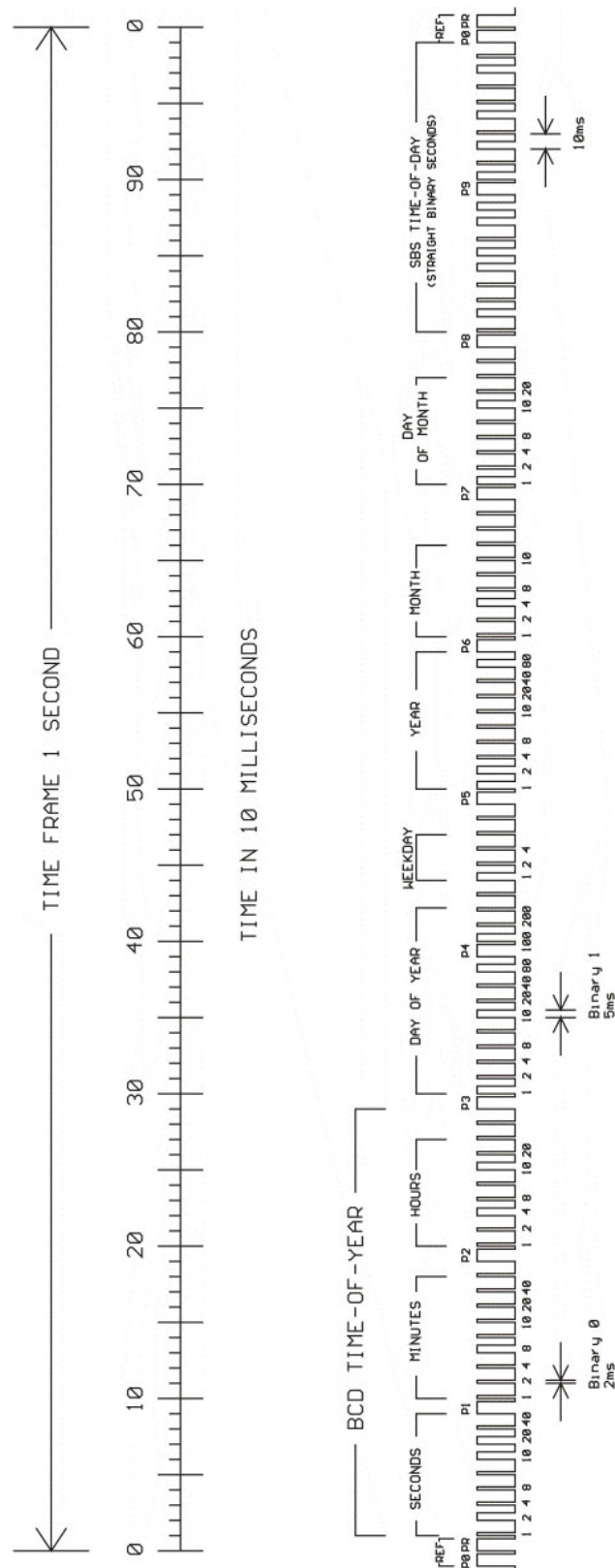
In addition to the original IRIG standards, there are also other specifications issued by other bodies that define specific extensions.

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

15.7.2 Timecode Format According to IRIG Standard



15.7.3 Timecode Format According to AFNOR Standard



15.8 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 output, there must be sufficient satellites for positioning, and the internal timebase must be synchronized to the reference constellation's timebase.

DCLS Timecode

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

1 MHz Frequency, 5 MHz Frequency, 10 MHz Frequency

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

Synthesizer Frequency

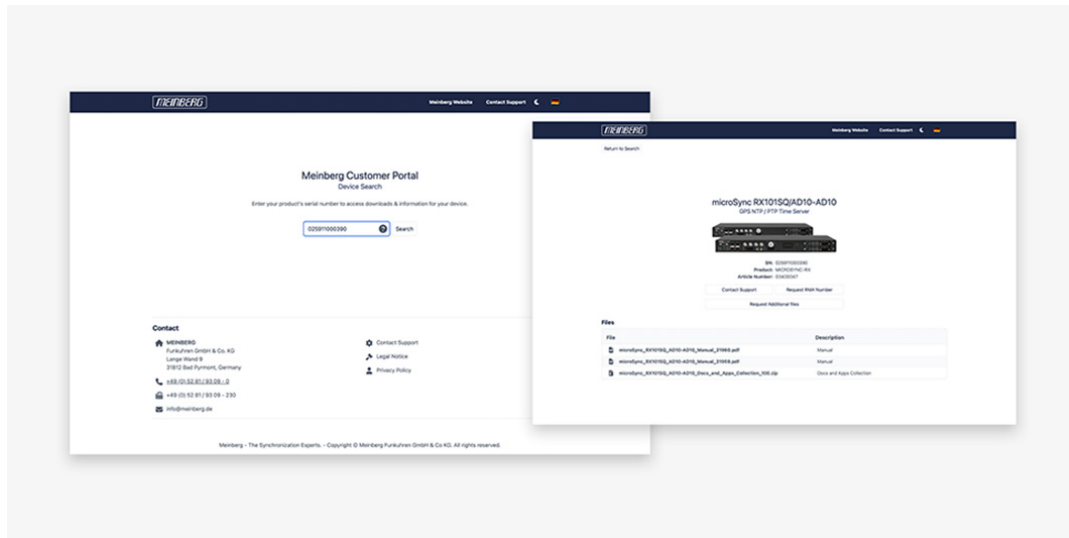
This mode is used to output a custom frequency, which is defined using the **"Clock"** → **"Synthesizer"** section of the Web Interface.

PTTI 1PPS

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

15.9 Meinberg Customer Portal - Software and Documentation

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



No Registration required

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

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

16 RoHS Conformity

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

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

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



18 Declaration of Conformity for Operation in the United Kingdom

UK Declaration of Conformity

Doc ID: GPS183/PP-4/TC-AM/DHS-April 2, 2025

Manufacturer

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

declares that the product

Product Designation

GPS183/PP-4/TC-AM/DHS

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 April 2, 2025

Aron Meinberg
Quality Management


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