The Synchronization Experts.

SETUP GUIDE

IMS-GPS183

Hot-Plug Module

Meinberg Funkuhren GmbH & Co. KG

Table of Contents

1 Imprint and Legal Information

Publisher

Meinberg Funkuhren GmbH & Co. KG

Registered Place of Business:
Lange Wand 9
31812 Bad Pyrmont
Germany

Telephone:
+49 (0) 52 81 – 93 09 - 0

Fax:
+49 (0) 52 81 – 93 09 - 230

The company is registered in the "A" Register of Companies & Traders (Handelsregister A) maintained by the Local Court of Hanover (Amtsgericht Hannover) under the number:

17HRA 100322

Executive Management:	Heiko Gerstung Andre Hartmann Natalie Meinberg Werner Meinberg
Website:	https://www.meinbergglobal.com
Email:	info@meinberg.de

Document Publication Information

Manual Version:	1.21
Revision Date:	September 9, 2024
PDF Export Date:	September 9, 2024

2 Copyright and Liability Exclusion

At the time of writing of this document, reasonable effort was made to carefully review links to third-party websites to ensure that they were compliant with the laws of the Federal Republic of Germany and relevant to the subject matter of the document. Meinberg accepts no liability for the content of websites not created or maintained by Meinberg, and does not warrant that the content of such external websites is suitable or correct for any given purpose.

While Meinberg makes every effort to ensure that this document is complete, suitable for purpose, and free of material errors or omissions, and periodically reviews its library of manuals to reflect developments and changing standards, Meinberg does not warrant that this specific document is up-to-date, comprehensive, or free of errors. Updated manuals are provided at https://www.meinbergglobal.com and https://www.meinberg.support.

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

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

3 Change Log

Version	Date	Revision Notes
1.0	2023-08-06	Initial Version
1.1	2024-02-23	Updated → Chapter 11, "Installing a GPS Antenna" (GPS Antenna with ground terminal)
1.2	2024-08-16	New link system for internal references and external links New → Chapter 4, "Presentation Conventions in this Manual" Expanded → Chapter 7, "Introduction" Restructured → Chapter 8, "IMS-GPS183 Models" Restructured → Chapter 9.1, "Status LEDs" Restructured → Chapter 9.2, "COMx Time String I/O and Pulse-Per-Second Input" Restructured → Chapter 9.3, "Antenna Input: GPS Receiver" Overhauled initial setup with information on synchronizing with PPS & time string or other external input IMS modules → Chapter 13, "Initial Setup" Reworked troubleshooting → Chapter 14, "Troubleshooting" Added information on oscillator options, the IMS module interface, and Multi-Reference Source functionality → Chapter 15, "Technical Appendix"
1.21	2024-09-09	Added overview table illustrating antenna compatibility Corrected quotation marks in German version Changed German name of chapter → Chapter 9.3, "Antenna Input: GPS Receiver"

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 and operation procedure of the device, as well as its removal from service.

Any safety information affixed to the product itself must also be observed.

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

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

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

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

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

5.1 Appropriate Usage

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

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

5.2 Product Documentation

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.4 Battery Safety

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

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

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

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

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

6 Important Product Information

6.1 CE Marking

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

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

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.

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.

6.5 Prevention of ESD Damage

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

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

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

6.6 Disposal

Disposal of Packaging Materials

The packaging materials that we use are fully recyclable:

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

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

Disposal of the Device

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

Important!

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

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

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

Disposal of Batteries

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

7 Introduction

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

The IMS-GPS183 is a 12-channel satellite clock module with GPS technology that has been developed from the ground up specifically for time and frequency synchronization purposes. The IMS-GPS183 provides a high-precision, high-accuracy time and frequency reference for your Meinberg IMS system and is designed to receive signals from the U.S. Global Positioning System (GPS), allowing your Meinberg system to be used anywhere in the world.

How It Works

The IMS-GPS183's receiver determines its position using at least four visible GNSS satellites. This position is used to calculate an offset for the timing data received from the GNSS satellites. Once the IMS-GPS183 is successfully synchronized with a suitable reference, it generates a PPS (pulse-per-second) phase reference and a 10 MHz frequency reference.

These time of day, PPS, and 10 MHz references are then forwarded to the installed IMS modules to be either directly output or to serve as the basis for the generation of other output signals as required for a variety of applications.

IMS Compatibility

The IMS-GPS183 is an IMS module that is compatible with all current systems in the IMS family:

IMS System	M500	M1000	M1000S	M2000S	M3000	M3000S	M4000
Compatible	✓	✓	✓	✓	✓	✓	✓

The module can only be used in a CLK slot of your IMS system:

IMS Slot	PWR	CLK	CPU	MRI	ESI	I/O
Compatible	✗	✓	✗	✗	✗	✗

To eliminate any risk of compatibility problems, your IMS system should have at least LANTIME OS **Version 7.08** installed.

Antenna Compatibility

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

The IMS-GPS183 is designed for operation with the **Meinberg GPSANTv2 Antenna**, which allows the use of longer antenna routes.

Please refer to the following chapters for more information:

- → Chapter 11, "Installing a GPS Antenna"
- → Chapter 15.2, "Technical Specifications: GPSANTv2 Antenna"

Please note that the IMS-GPS183 is *not* compatible with standard L-band antennas.

Use of Redundant Clock Modules

LANTIME M1000(S) (redundant clock models only), M2000S, M3000(S) and M4000 systems feature an "SCU" slot (Signal Changeover Unit) that handles the transmission of pulse, frequency, and serial string outputs from the reference clock (or redundant reference clocks) to the respective output modules.

When operating LANTIME M3000(S) or LANTIME M4000 systems with redundant reference clocks, an RSC[1] module must be installed that controls the reference clock switchover mechanism based on an automated logic. If only one reference clock is installed, it is necessary to have at least an SPT[2] module installed; this module provides a simple passthrough route for the signals. An IMS system can still be operated with just one reference clock even if an RSC module is installed.

The LANTIME M500 and the standard models of the M1000(S) do not support reference clock redundancy and therefore do not require an SCU module.

LANTIME M1000(S) systems with reference clock redundancy and LANTIME M2000S systems feature an integrated RSC module.

[1] Redundant Signal Controller

[2] Signal Passthrough

Manual Revisions

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

This version of the manual has been prepared based on the feature set provided by **Firmware Version 1.15** of your IMS-GPS183 as well as **LANTIME OS Version 7.08**. When using a LANTIME system or IMS module with different versions, there may be noticeable differences, for example in the presentation and availability of options in the Web Interface as shown in → Chapter 13, "Initial Setup".

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

Further Reading

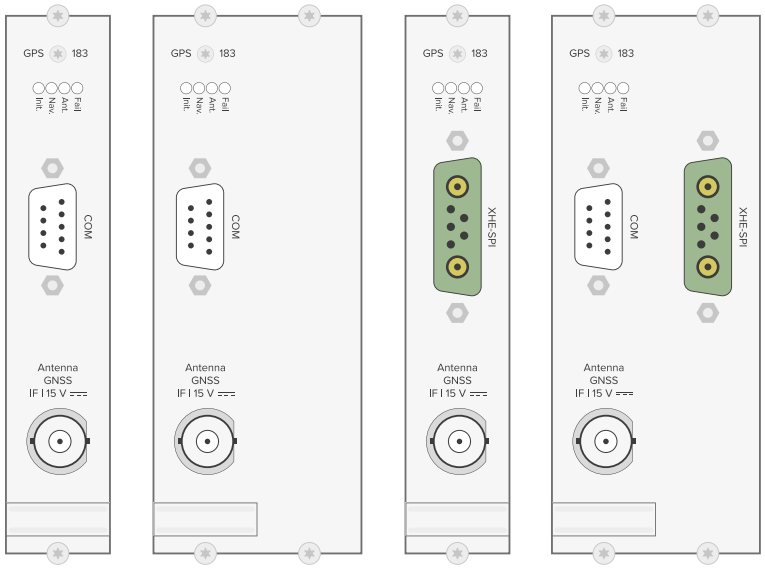
This Setup Guide provides the information required to quickly set up your module in your IMS system with a minimum of problems. We recommend also carefully studying the following manuals alongside this Setup Guide for the use of your IMS-GPS183:

Meinberg IMS System Manuals (all systems)	http://www.mbg.link/doc-en
LANTIME OS Version 7.08 Firmware Manual	http://www.mbg.link/doce-fw-ltos

The IMS system manuals provide additional information on the hardware aspects of your IMS system, while the LANTIME OS manual provides a detailed description of all configuration and monitoring options available for your module in conjunction with other modules. These manuals are also available to download from the Meinberg Customer Portal at https://www.meinberg.support.

8 IMS-GPS183 Models

There are several models of the IMS-GPS183 that each vary in terms of the connectors and interfaces provided. The sizes relate to the widths of the faceplates and not the number of actual interface slots of your LANTIME system.



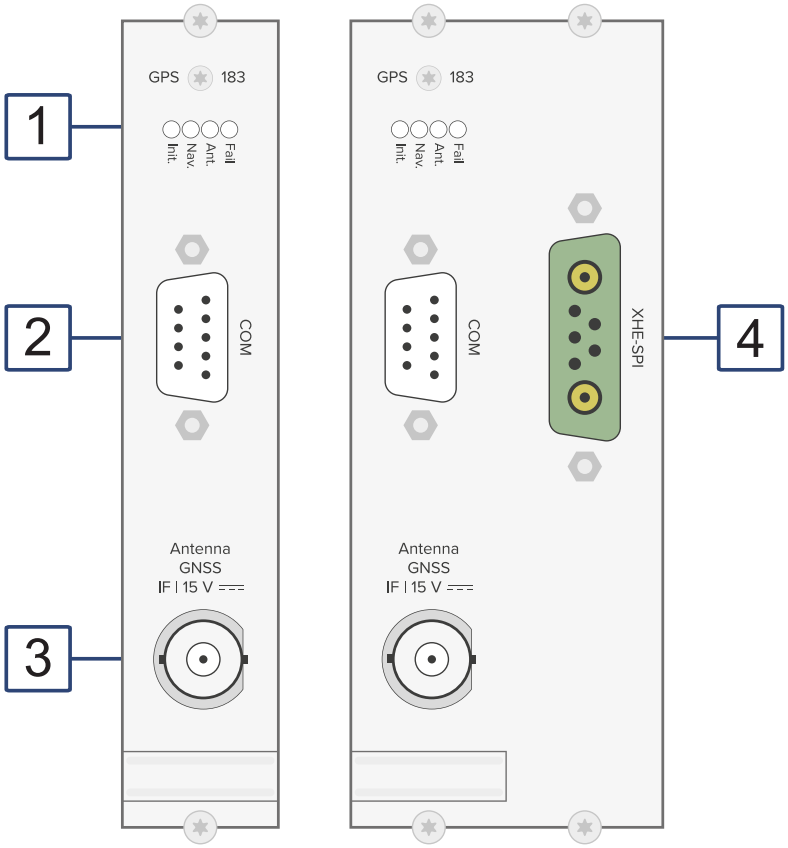
No.	Module	Size	Connectors/Interfaces	Supported Oscillators[1]
1	Standard	1 Slot	1x SMA (antenna), 1x COM	OCXO-SQ, OCXO-HQ
2	COM/DHQ	2 Slots[2]	1x SMA (antenna), 1x COM	OCXO-DHQ
3	XHE-SPI	1 Slot	1x SMA (antenna), 1x XHE-SPI[3]	OCXO-SQ, OCXO-HQ
4	COM/XHE-SPI	2 Slots[2]	1x SMA (antenna), 1x COM, 1x XHE-SPI[3]	OCXO-SQ, OCXO-HQ, OCXO-DHQ

[1] Refer to → Chapter 15.4, "Technical Specifications: Oscillators" for more information on the oscillator specifications.

[2] Installing an IMS-GPS183 module with a two-slot faceplate in an M500, M1000, or M1000S IMS system will result in the adjacent slot (I/O, MRI, or Clock) being obscured and thus unavailable for another IMS module. Please note this when ordering a new IMS system or additional modules for your IMS system.

[3] The XHE-SPI interface is used to connect your LANTIME system to an XHE^{Rb} system for high-accuracy holdover performance.

9 IMS-GPS183 Module Connectors and LEDs



Information:

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

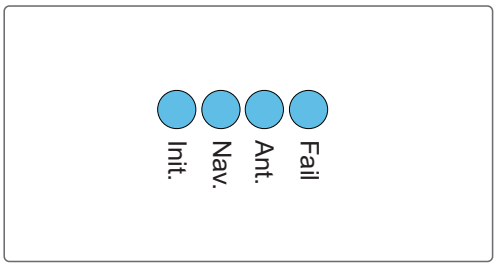
9.1 Status LEDs

Init" LED: Initialization status of reference clock

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

"*Ant*" LED: Antenna status

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



LED	Colors	Description
Init	Blue	The internal firmware is initializing and a connection is being established with the LANTIME system.
	Off	The initialization of the internal firmware is complete and a connection has been established with the LANTIME system, but the oscillator is not yet locked to its phase reference.
	Green	The initialization of the clock's firmware is completed, the connection with the LANTIME system has been established, and the oscillator is locked to the phase reference.
Nav	Off	The GNSS receiver has not yet been able to determine its position.
	Green	The GNSS receiver has successfully determined its position and is receiving time data.
Ant	Green	The antenna is correctly connected, there is no fault detected in the connection, and the clock is synchronized with the GNSS reference.
	Yellow	The clock is in "**MRS Mode**"; it is synchronized to an external signal other than GNSS (e.g., PPS, IRIG).
	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 an external reference (e.g., GNSS, PPS, time string) since it was last initialized.
	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 an external reference (e.g., GNSS, PPS, time string) since it was last initialized.
Fail	Red	The clock can identify no way to successfully synchronize using one of the configured reference sources, i.e., there is no usable signal available at any of the configured inputs.

9.2 COMx Time String I/O and Pulse-Per-Second Input

Information:

Please note that this PPS input is only usable as a phase reference in conjunction with the time string input via this interface and cannot be used as a standalone PPS input.

Refer to → Chapter 13.2, "Synchronization with Time String and PPS" for more information on using PPS & time string inputs to synchronize your IMS-GPS183.

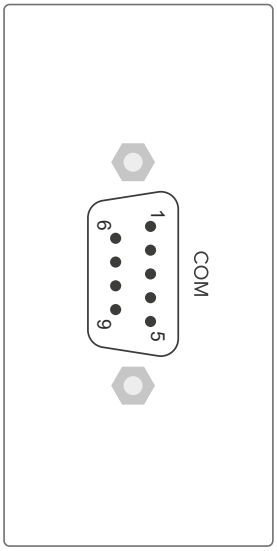
Data Transfer Mode: Serial I/O

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

Framing: 7N2, 7E1, 7E2, 8N1 *(Default)*, 8N2, 8E1, 7O1, 7O2, 8O1, 8E2

Time String Formats: (Input)
Meinberg Standard
NMEA RMC, NMEA ZDA
Uni Erlangen

Time String Formats: (Output)
Meinberg Standard *(Default)*
Meinberg Capture
Meinberg GPS
SAT
NMEA RMC
NMEA GGA
NMEA ZDA
NMEA RMC GGA *(RMC followed by GGA)*
NMEA GGA ZDA *(GGA followed by ZDA)*
Uni Erlangen
Computime
Sysplex 1
SPA
RACAL
ION
ION Blanked
IRIG-J-1
6021
Freelance



Pin Assignment:
Pin 1: PPS In
Pin 2: RS-232 RxD *(Receive)*
Pin 3: RS-232 TxD *(Transmit)*
Pin 5: GND *(Ground)*

PPS Input Signal Level: TTL or RS-232, Active High

PPS Input Pulse Width: $\geq 5\ \mu s$

Connector Type: D-Sub Male 9-Pin

Cable Type:
Output: Standard RS-232 Cable (Shielded)
Input: Modified RS-232 Cable (Shielded) with PPS on Pin 1

9.3 Antenna Input: GPS Receiver

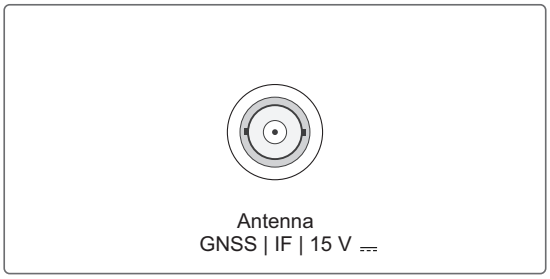
Danger!

Do not work on the antenna installation during thunderstorms!

Danger of death from electric shock!

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

Receiver Type:	12-Channel GPS Receiver
Antenna:	GPSANTv2 (→ Chapter 15.2)
Input Signal:	35.42 MHz [1]
Mixing Frequency:	10 MHz [2]
GNSS Signal Support:	GPS: L1 C/A [3]
DC Voltage:	15 V (Power Supply via Antenna Cable)
DC Current:	Max. 100 mA
Input Impedance:	50 Ω
Connector Type:	BNC, Female
Cable Type:	Coaxial Cable, Shielded
Cable Length:	Max. 300 m (RG58), Max. 700 m (RG213) Max. 1100 m (H2010 Ultraflex)



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

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

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

9.4 XHE-SPI Connector

Important!

This connector must only be used to connect a Meinberg IMS-XHE^{Rb} Rubidium expansion chassis. The use of this port to connect other devices is not supported and may invalidate the warranty of your LANTIME system and your IMS-GPS183 module.

Supported Device: Meinberg IMS-XHE^{Rb}
Rubidium Expansion Chassis

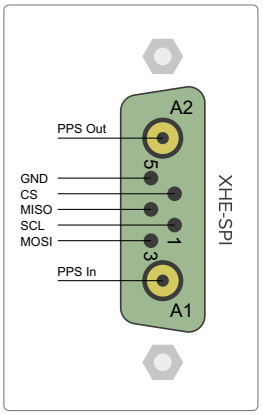
Connector Type: XHE-SPI

Cable Type: XHE-RB Cable

Pin Assignment:

A1: PPS In
A2: PPS Out

Pin 1: SCL_Out (SPI Clock)
Pin 2: CS (Chip Select)
Pin 3: MOSI (Master Out, Slave In)
Pin 4: MISO (Master In, Slave Out)
Pin 5: GND



10 Before You Start

10.1 Contents of Delivery

Unpack the IMS-GPS183 and all accessories 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 at ✉ 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.

11 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.

11.1 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 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.

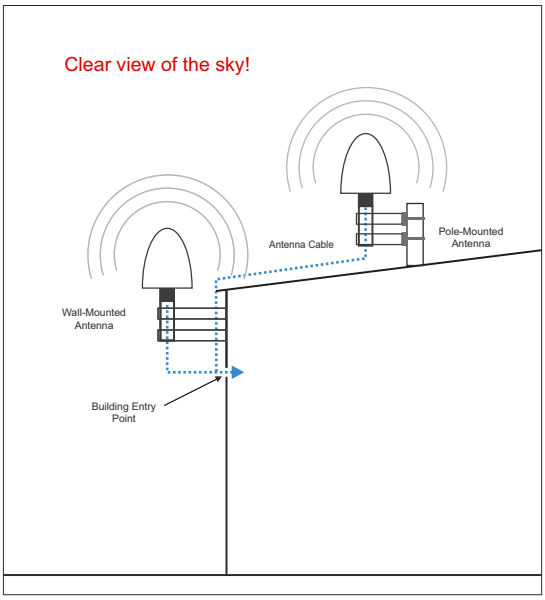


Fig. 1: Ideal Positioning

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 reflected signals will cause interference, causing problems with signal reception.

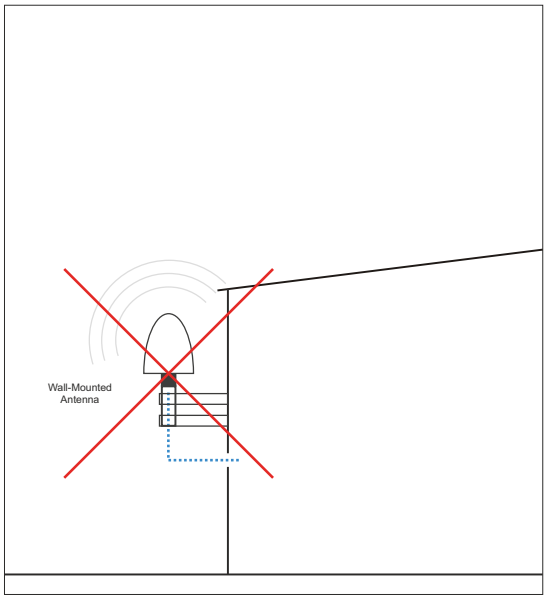


Fig. 2: Poor positioning of a wall-mounted antenna

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.

11.2 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 to other antennas using the mounting kit provided, either onto a vertical pole of no more than 60 mm diameter or directly onto a wall.

Item	Description	QTY
1	Antenna	1
2	M8 grounding stud	1
3	safety washer	1
4	M8 hex nut	1
5	Antenna pole	1
6	M4 hex nut	8
7	M4 x 12 phillips-head screw	8
8	threaded U-bolt (pole diameter max. 60 mm)	2
9	M6 spacer	4
10	M6 hex nut	4
11	pole clamp halves	4
12	pole bracket	2

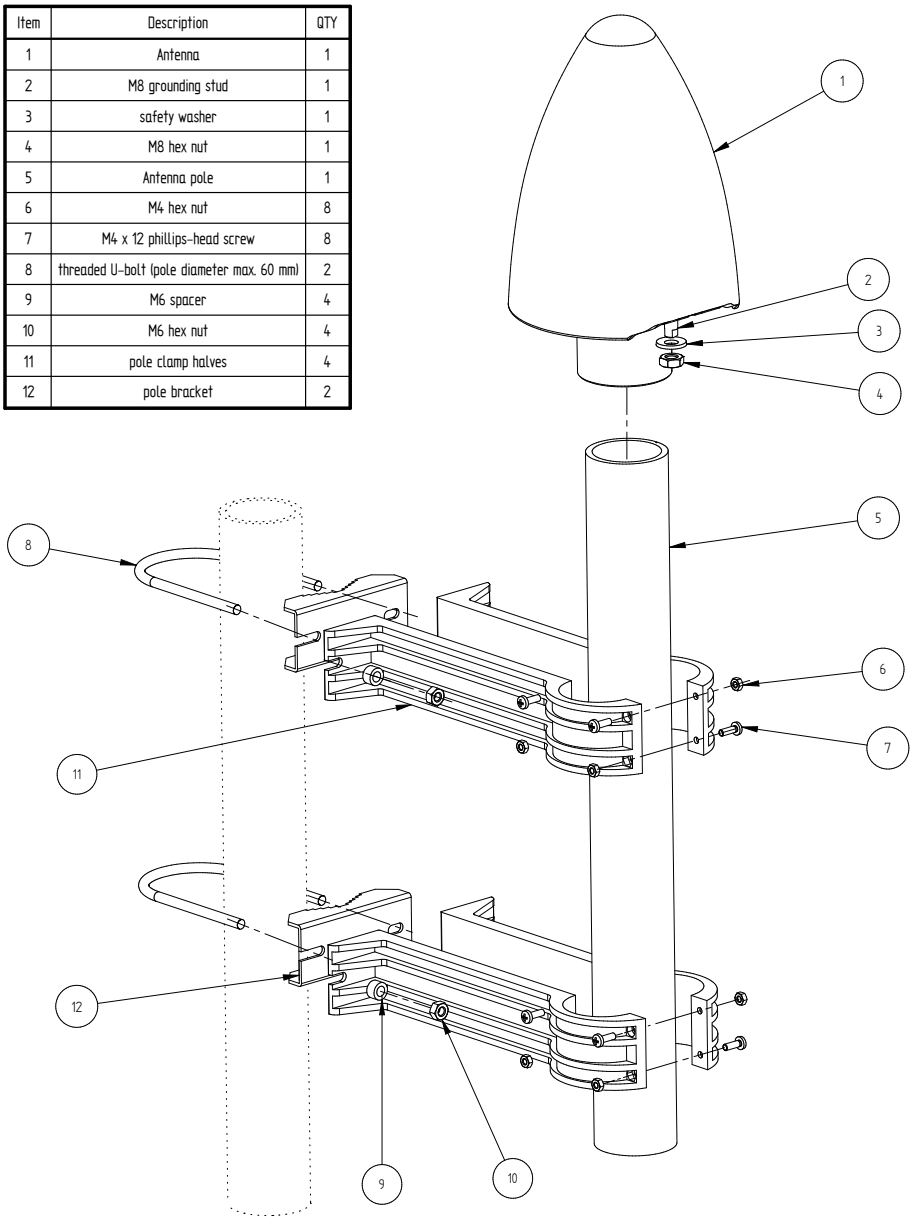


Fig. 3: Mounting a Meinberg GPS Antenna onto a Pole

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 11.3, "Antenna Cable"** explains how the antenna cable should be laid.

11.3 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 11.4, "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.

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

→ Chapter 11.4, "Surge Protection and Grounding" explains how to implement effective surge protection for an antenna installation.

11.4 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. This induced surge voltage can then be passed to the antenna and to the building interior, which can damage or even destroy both your antenna and your Meinberg system.

This is why antennas and antenna cables must always be integrated into a building's equipotential bonding infrastructure (Fig. 4, Item 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.

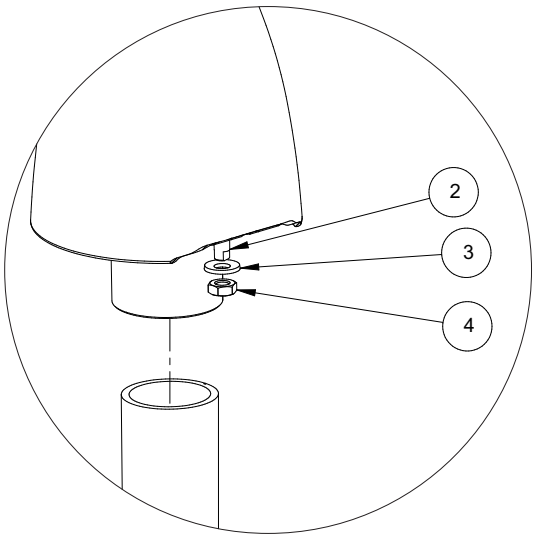
To this end, the following elements should be connected and integrated into a bonding system:

- 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 mm^2 – 6 mm^2 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

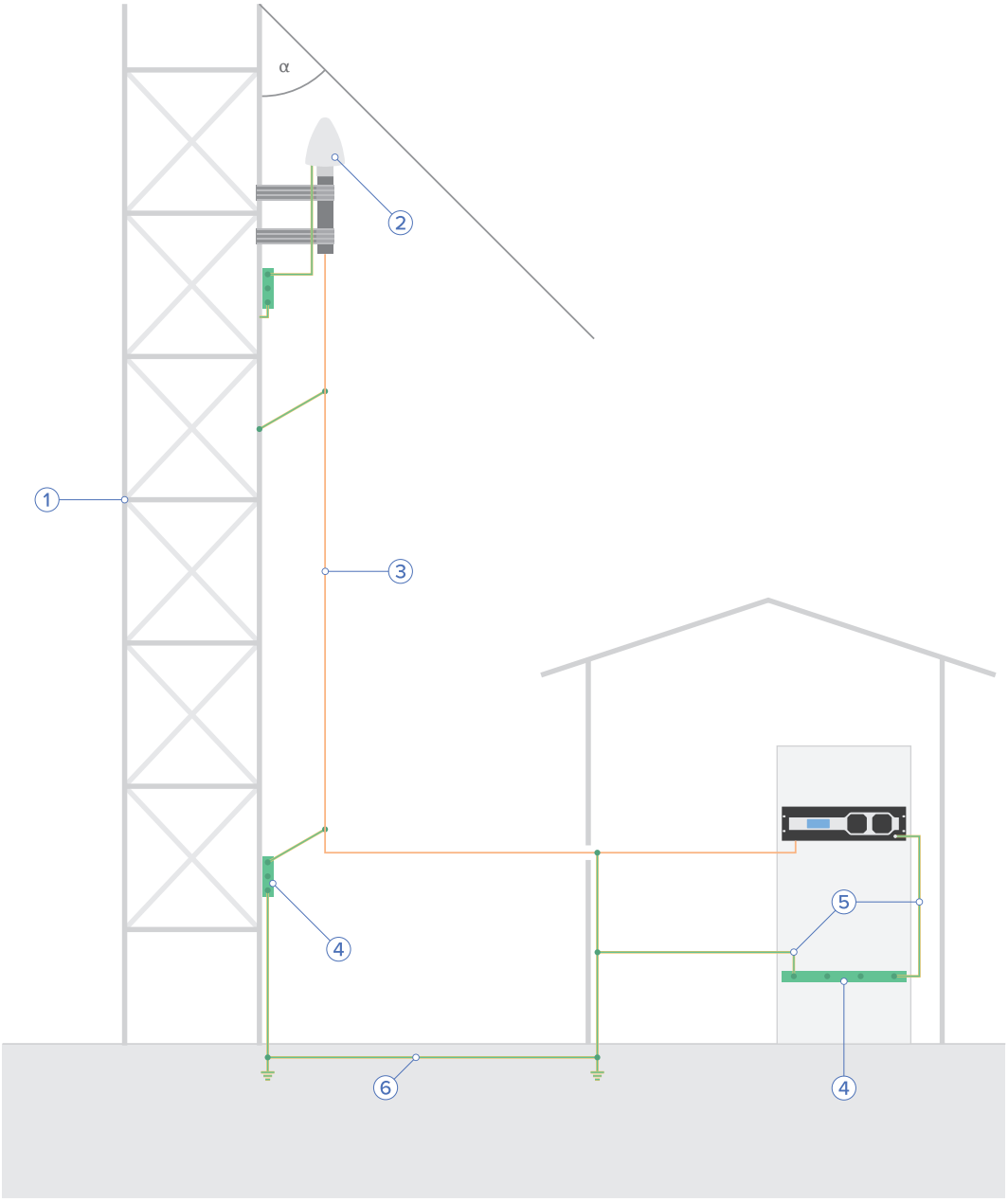


Fig. 5: Installation on a Pole

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

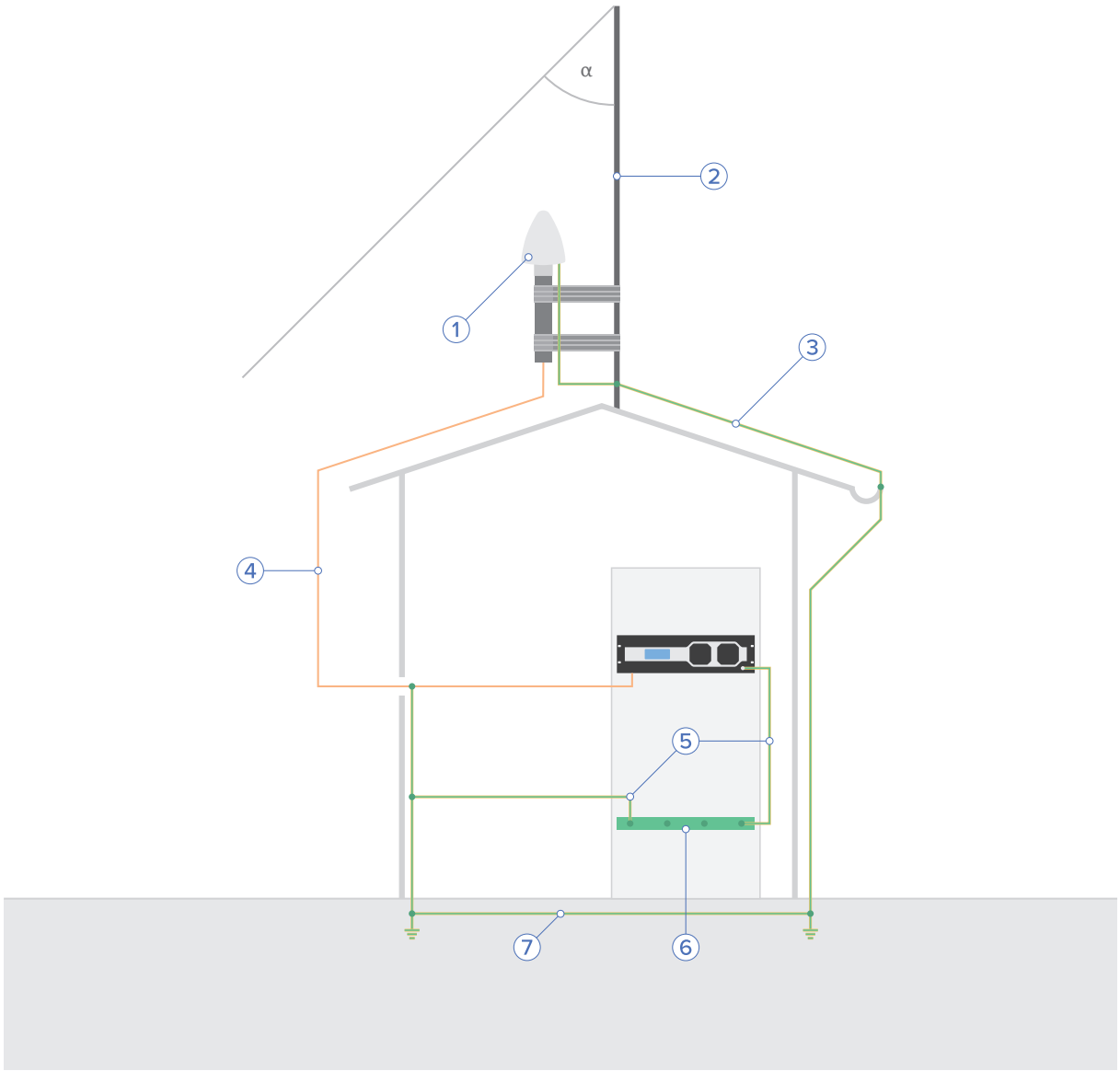


Fig. 6: Roof Installation

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.

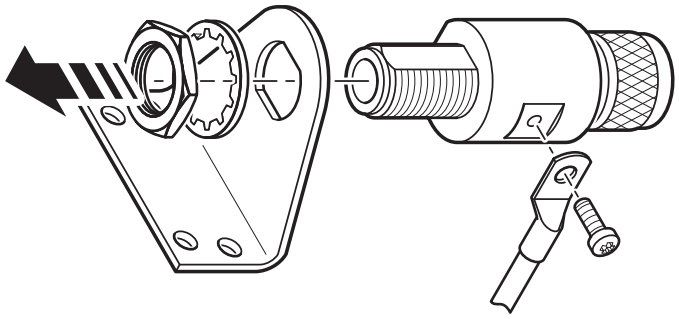


Fig. 7: Installation of the Surge Protector

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 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

12 Installation of the IMS Module

12.1 Important Information Regarding Hot-Pluggable IMS Modules

The following information should be strictly observed when replacing IMS modules during operation. Not all IMS modules are fully hot-pluggable. For example, it is naturally not possible to replace a power supply unit in a system without PSU redundancy without first having installed a second power supply unit while the system is in operation.

The following rules apply for the individual IMS slots:

PWR Slot:	"Hot-Swappable"	If you operate your system with only one power supply unit, a second power supply unit must be installed before removing or replacing it in order to keep your system operational.
I/O, ESI, and MRI Slots:	"Hot-Pluggable"	
CLK1, CLK2 Slots:	"Hot-Pluggable"	When a clock module is replaced or installed, it is important to rescan the reference clocks ("**Rescan Refclocks**") in the "**System**" menu of the Web Interface.
RSC/SPT Slots:	"Hot-Pluggable"	It will not be possible for your IMS system to switch between signal generators while the RSC/SPT is not installed.
CPU Slot:	"Not Hot-Pluggable"	Before the CPU is removed, the IMS system must be powered down. Please note that after powering on and rebooting the LANTIME Operating System, the configuration of some IMS modules may be reset to factory defaults!

Information:

The NTP service and access to the Web Interface will be unavailable while the CPU is not installed. Management and monitoring functions will also be disabled.

12.2 Installation and Removal of Hot-Pluggable IMS Modules

A Torx screwdriver is required (T8 x 60) to remove and install IMS modules.

Important!

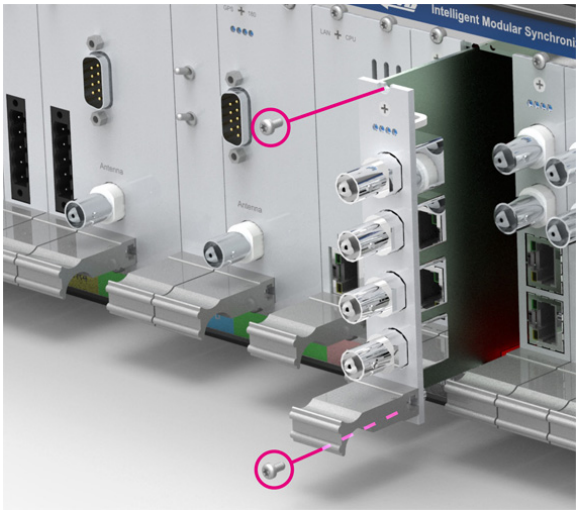
Heed the → "Important Safety Information" in Chapter 5 of this manual!

Removing a Module

1. Remove the two marked Torx screws from the module faceplate.

2. Pull the module **carefully** out of the guide rail. Note that the module will be securely seated in the connector block inside the chassis—a certain amount of force must be applied to release the module. Once the module has been detached from the connector block on the system backplane, the module can be easily pulled out.

3. If the removed module is not to be replaced with another module, a suitable one-slot or two-slot 'placeholder' faceplate should be fitted using the two Torx screws in order to cover this space.



Locations of fixture screws in a 1U IMS system

Installing a Module

1. To replace a module, remove the installed module in accordance with the guide "**Removing a Module**" on the previous page. Otherwise, remove the two Torx screws from the cover plate of the unused slot. We recommend keeping the cover plate in a safe place for later use.
2. Insert the module correctly into the two guide rails of the system chassis. If it cannot be inserted with minimal force, it is possible that the module is not properly seated in the guide rails. In this case, you should pull the module out and try again. **Do not use excessive force when pushing the module in!** Failure to heed this instruction may result in damage to the module and/or chassis.
3. Once the module has reached the connector block of the system backplane, a little more force will be required to insert the module into the connector block. Ensure that the module is locked securely into place and that the faceplate of the module is flush with that of the adjacent modules or cover plates.
4. Insert and tighten the two Torx screws with a **max. torque of 0.6 Nm**.

The installed module is now ready to be set up for use.

12.3 Data and Signal Cables

Ensure that all of the required signal cables are connected to the module's interfaces.

Coaxial Cable

The IMS-GPS183 module has an BNC connector that is used to input the antenna signal.

For further information on the specifications of the supported antenna cables and how to lay them correctly, please refer to the ➜ Chapter 11.3, "Antenna Cable".

9-Pin D-Sub RS-232 & PPS Input Interface

For the purposes of outputting time strings, the pin layout of the serial COM interface follows the RS-232 standard, and thus it is generally possible to use any standard pre-fabricated RS-232 cable of suitable quality (for example, D-Sub 9 to D-Sub 9, D-Sub 9 to D-Sub 25), as long as the receiving device possesses a corresponding RS-232-compliant interface.

For the purposes of using an external time string and pulse-per-second source as a time-of-day and phase reference respectively, the pin layout of the serial COM interface deviates from the RS-232 standard slightly by requiring a PPS signal to be transmitted over Pin 1 of the DSUB9 connector. This will generally require a bespoke cable to be manufactured or an existing RS-232 cable to be modified.

Refer to ➜ Chapter 9.2, "COMx Time String I/O and Pulse-Per-Second Input" for more information on the pin layout. 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 IMS-GPS183 module 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.

For serial communication with receivers using different connector types but supporting RS-232 signaling norms, it may be necessary to assemble a suitable cable with a female 9-pin D-Sub connector on one end (ideally with shielded housing; refer to ➜ Chapter 9.2, "COMx Time String I/O and Pulse-Per-Second Input" for pin layout), and the corresponding connector for the end device on the other end. The cable shielding should ideally be connected to the metallic D-Sub connector housing.

An RS-232-to-USB adapter or RS-232-to-USB cable with an integrated adapter can also be used.

13 Initial Setup

This chapter explains how to set up and monitor the IMS-GPS183 via the Web Interface. The IMS-GPS183 can be set up to be synchronized to a GNSS reference, to an external time string & PPS source, and/or to another external source such as an IMS-MRI, IMS-ESI, or IMS-HPS100 input module. You are not limited to a single reference source in this case; if multiple reference sources are available that your IMS-GPS183 supports, all of them can be set up, configured, and prioritized accordingly.

Of course, this Setup Guide only describes the most basic steps for setting up your IMS-GPS183 for use for the first time. Please refer to the LANTIME OS Manual for a more detailed description of all configuration and monitoring options available for your module.

13.1 Synchronization with GNSS

This chapter describes how to quickly set up the IMS-GPS183 reference clock for synchronization to GPS signals.

Step 1: Connection of the IMS-GPS183 with the GPSANTv2 Antenna

Ensure that the IMS-GPS183 is connected to a correctly installed GPSANTv2 Antenna as described in ➜ Chapter 9.3, "Antenna Input: GPS Receiver" and ➜ Chapter 11, "Installing a GPS Antenna".

Step 2: Configuring the Signal Propagation Time

The propagation of the signal from the antenna to the receiver (reference clock) can incur a certain delay. To enable the connected reference clock to compensate for the cable-induced propagation delay of the signal, the appropriate offset time must be specified. This can be entered in terms of an absolute offset in whole nanoseconds or estimated automatically based on the cable length.

Please note that for the most accurate measurement of the propagation delay for your specific cable, suitable equipment (such as a time-domain reflectometer) and appropriate expertise is recommended.

Alternatively, a reliable estimate of the propagation delay can be calculated based on the specifications provided in the data sheet of the specific cable in use and its length. Most cable manufacturers will typically specify the velocity of propagation v_p as a percentage of the speed of light. Given that the speed of light is 3.336 nanoseconds per meter, we can therefore calculate the signal delay over a defined length of cable l_c as:

$$\frac{3.336}{v_p \ / \ 100} \ \text{x} \ l_c$$

If a data sheet provides a velocity of propagation value of 66 %, for example, the above formula will result in a theoretical delay of **5.05** nanoseconds per meter of cable, which would be rounded down to **5** nanoseconds.

If you are unable to measure or calculate the propagation delay using either of the above methods, you can alternatively enter the length of the antenna cable in meters (from antenna to Meinberg system) in order to have the system calculate a plausible estimate of the delay. In the case of the IMS-GPS183, the system will assume that 5 nanoseconds of propagation delay is incurred per meter of antenna cable and assumes that you are using RG 58 C/U coaxial cable.

You can enter the measured or calculated propagation delay or the length of your cable as follows:

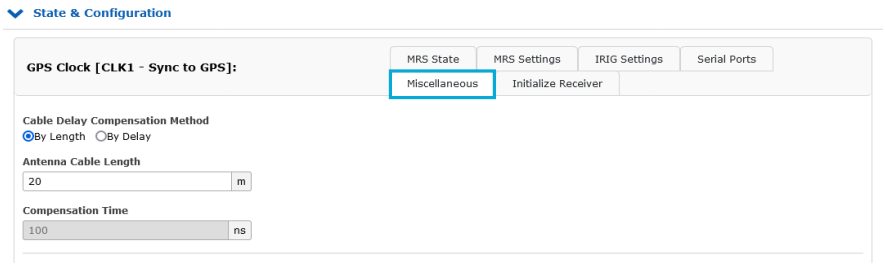


Illustration: Configuring Signal Propagation Time

1. From the same page as Step 1 above (**Clock** → **State and Configuration**), ensure that the "**Miscellaneous**" tab under the corresponding clock module is selected.

2. Select the compensation method under "**Cable Delay Compensation**" and enter the appropriate value.

Important!

While LANTIME OS supports the entry of a theoretical maximum offset of 2000 m or 10000 ns respectively, the maximum lengths specified for supported cable types in → Chapter 11.3, "Antenna Cable" should not be exceeded.

Step 3: MRS Configuration

If you only wish to configure GNSS reception, proceed with the MRS configuration process described in → Chapter 13.4, "MRS Configuration".

Otherwise, proceed with the configuration of other reference sources.

Final Steps

Once the antenna and power supply have been connected, the reference clock is ready for operation.

After around two minutes of the system being switched on, the oscillator will have warmed up and thus achieved the base precision required to receive satellite signals. If valid almanac and ephemeris data are present in the reference clock's battery-backed memory and the receiver's position has not changed since it was last on, the system's CPU will be able to calculate which satellites should currently be receivable.

In this case, only a single satellite needs to be received to enable the clock to synchronize. Otherwise, the system will switch to **Warm Boot** or **Cold Boot** mode as described below.

Warm Boot

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 to receive from.

The receiver can use the valid almanac data to detect the identification numbers of existing satellites. If four satellites can be received, the receiver's new position can be determined and the device will switch to "**Normal Operation**" mode.

Cold Boot

If there is no available almanac data (e.g., because the battery-backed memory has been wiped or corrupted), the GNSS reference clock will launch in "Cold Boot" mode, in which the receiver searches for a satellite and reads the entire almanac.

The almanac is broadcast fully every 12.5 minutes, but the receiver may need to wait for the start of the next transmission. Accordingly, this process can last up to 25 minutes, after which the system will switch to "Warm Boot" mode.

13.2 Synchronization with Time String and PPS

This chapter describes the most important configuration processes for quickly setting up the IMS-GPS183 reference clock to synchronize to an external time string & pulse-per-second reference.

Step 1: Connection of the IMS-GPS183 with the PPS & Time String Sources

Ensure that the IMS-GPS183 is connected to **both** an external PPS phase reference and a valid time string source as described in ➜ Chapter 9.2, "COMx Time String I/O and Pulse-Per-Second Input".

The time string must be received on Pin 2 (RxD) of the DSUB9 RS-232 connector in accordance with the RS-232 standard, and must comply with one of the following time string formats to ensure that it contains full time **and** date information:

- Meinberg Standard
- NMEA RMC
- NMEA ZDA
- Uni Erlangen

The PPS signal must be received on Pin 1; the clock expects a TTL signal with a pulse width of at least 5 μs, active high.

Step 2: Time String Configuration

Illustration: Serial Port Settings of your IMS-GPS183

From the LTOS Web Interface, open the "**Clock**" page and select the "**State & Configuration**" panel. Open the tab "**Serial Ports**" under the corresponding clock.

Please note that the time string format under the "**Serial Ports**" tab relates to string *output* only; the format of the incoming time string signal will be identified automatically by the system and does not need to be manually configured here.

However, the baud rate and framing must be set here to match the incoming signal.

Important!

The external time string must be synchronized with the corresponding PPS signal such that the complete time string arrives within 500 ms of the PPS signal. Any time string that is received later will be disregarded and the clock will be unable to synchronize as a result.

Step 3: MRS Configuration

If you only wish to configure PPS & time string input, proceed with the MRS configuration process described in ➜ Chapter 13.4, "MRS Configuration".

Otherwise, proceed with the configuration of other reference sources.

Final Steps

Once the input cables and power supply have been connected, the reference clock is ready for operation.

After around two minutes of the system being switched on, the oscillator will have warmed up and thus achieved the base precision required to receive time string & PPS inputs.

13.3 Synchronization via Another IMS Input Module

Your IMS-GPS183 reference clock can also be synchronized via an expansion input module such as an IMS-MRI module (allowing AM/DCLS time code input, 10 MHz frequency input, and standalone PPS input), an IMS-ESI module (allowing arbitrary frequency or T1/E1 clock signal inputs), or an IMS-VSI module (allowing clock signals typically used in the broadcasting industry to be used as reference signals).

Please refer to the Setup Guides for those modules for more information on how to configure your IMS-GPS183 for use with those input modules.

13.4 MRS Configuration

Once your reference sources are configured, they must be prioritized in the "**MRS Settings**" (Multi-Reference Source) tab of the clock configuration panel.

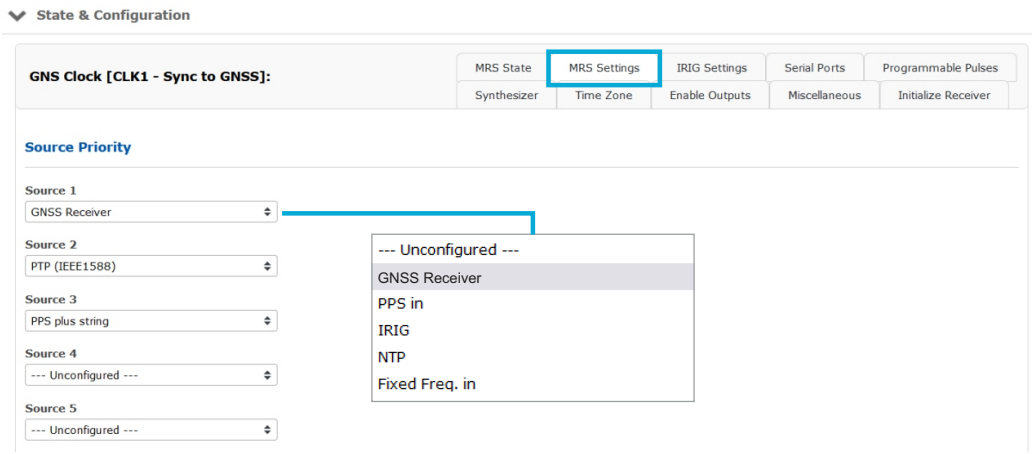


Illustration: MRS Configuration – Selection and Prioritization of the Available Reference Sources

1. Open the "**Clock**" page and select the "**State & Configuration**" panel.
2. Open the tab "**MRS Settings**".
3. Select each of the references that you wish to use as sources in each of the drop-down menus. For example, if you wish to use GNSS as your primary reference and an incoming PPS & time string as a redundant backup, select "*GNSS Receiver*" as **Source 1** and "*PPS plus string*" as **Source 2**.

Information:

The Multi-Reference Source functionality of LTOS is powerful and rather complex and cannot be covered in adequate detail solely in relation to your IMS-GPS183.

For more detailed information on MRS configuration, especially regarding offsets and switching behaviors, a detailed study of → Chapter 15.6, "MRS Functionality" and the LTOS manual is strongly recommended.

14 Troubleshooting

Our Technical Support team will be pleased to help you with any problems that you may be having with your Meinberg IMS-GPS183 module. However, before you contact our Technical Support team, it is advisable to read this chapter through first to see if your problem might be more quickly resolved with one of the solutions below.

Problem	**Possible Causes**	**Possible Solutions**
The module is not detected by the base IMS unit.	The module may not have been properly inserted into the slot.	Ensure that the module is properly aligned with the guide rails inside the IMS unit; the module must lock securely into the socket at the back. The metal plate of the module should be perfectly flush with the metal plates of the other slots and the screws should be straight.
The IMS module is not listed and not configurable in the Web Interface of the IMS system.	The firmware of your IMS system may not be up to date.	Check in the menu **System –> Configuration & Firmware Management** whether the latest version of LANTIME OS is installed, and install the latest version if necessary.
The reference clock does not synchronize even after several hours (despite geolocation having successfully completed and the time being synchronized).	If the position of the antenna is poorly selected, the reference clock may be unable to detect the four satellites needed to synchronize the reference clock.	Ensure that the location of the antenna is selected in accordance with the conditions specified in ➜ Chapter 11, "Installing a GPS Antenna".
The reference clock does not synchronize and the "Fail" LED is red.	Your IMS LANTIME system is unable to synchronize with any of the reference sources configured under "**MRS Settings**".	Ensure that you have the installed reference sources configured in the MRS settings.
		Verify that your reference sources are delivering a valid signal: - if synchronizing via GNSS, that your antenna is correctly connected and aligned; - if synchronizing via PPS & time string, that your source is providing a compliant PPS and time string signal.

The reference clock's precision is poor and/or synchronization is frequently lost.	If the position of the antenna is poorly selected, the reference clock will lose track of the satellites that have been detected.	Ensure that the location of the antenna is selected in accordance with the conditions specified in ➜ Chapter 11, "Installing a GPS Antenna".

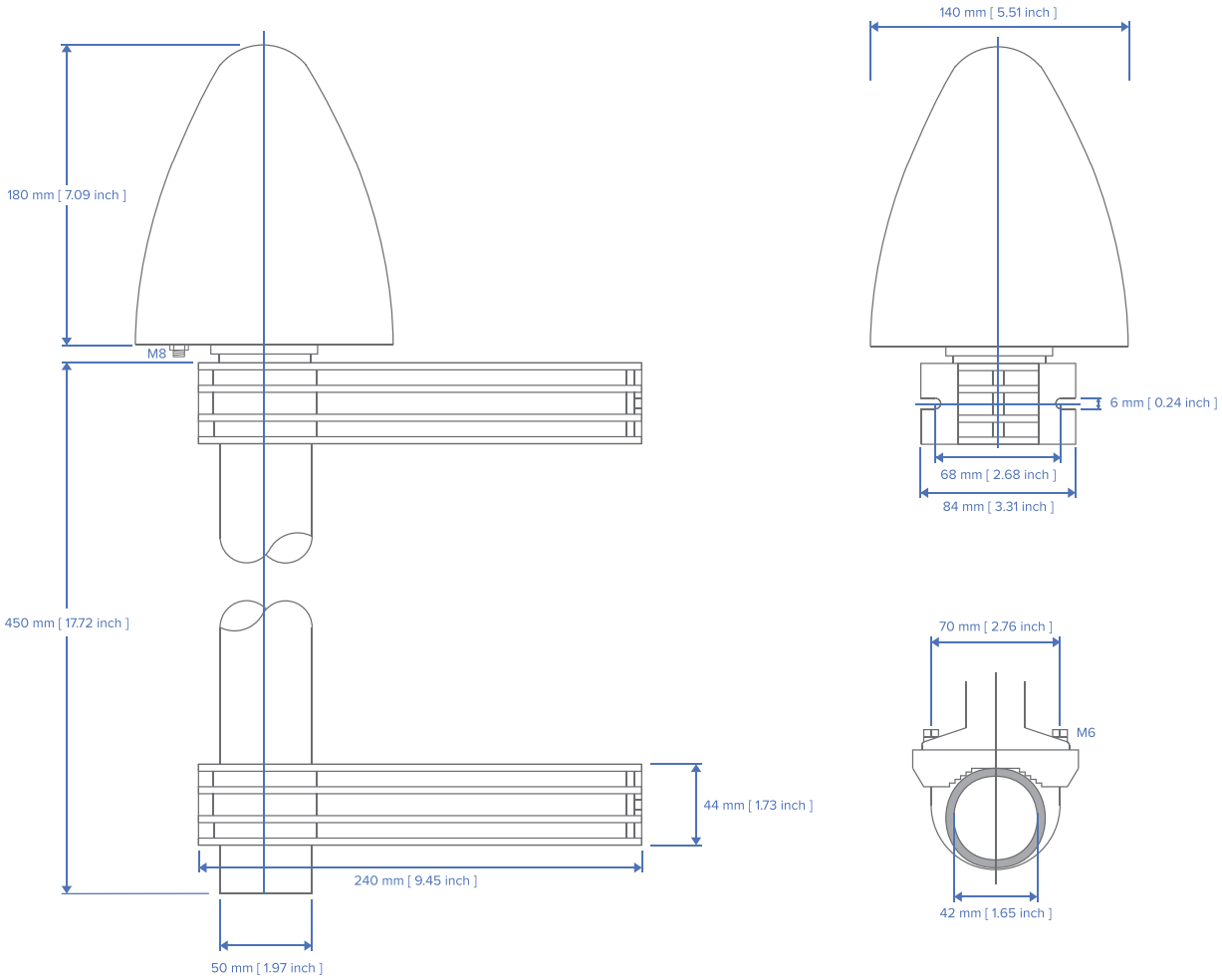
15 Technical Appendix

15.1 Technical Specifications: IMS-GPS183 Module

Electrical Connector:	96-Pin IEC 60603-2 (DIN 41612) Connector
Operating Voltage:	+5 V DC
Current Draw:	Approx. 1.3 A (OCXO-SQ oscillator, other oscillators may draw higher current)
Power Consumption:	Approx. 6.5 W (OCXO-SQ oscillator, other oscillators may draw higher power)
Temperature Range:	0 °C to 55 °C (32 °F to 131 °F)
Relative Humidity:	Max. 85 %
Surge Immunity:	IEC 61000-4-5 Level 4 Test Voltage: 4000 V Max. Peak Current Given 2 Ω Load: 2000 A
Other Surge Protection:	Integrated surge protector for protection of connected antenna

15.2 Technical Specifications: GPSANTv2 Antenna

Physical Dimensions



Specifications

Power Supply:	15 V, approx. 100 mA (provided via antenna cable)
Reception Frequency:	1575.42 MHz (GPS L1/Galileo E1 Band)
Bandwidth:	9 MHz
Mixing Frequency:	10 MHz
Intermediate Frequency:	35.4 MHz
Element Gain:	Typically 5.0 dBic at zenith
Polarization:	Right-Hand Circular Polarization
Axial Ratio:	$\leq$ 3 dB at zenith
Nominal Impedance:	50 Ω
VSWR:	$\leq$ 1.5 : 1
Conversion Gain:	56 dB $\pm$ 3 dB
Out-of-Band Rejection:	$\geq$ 70 dB @ 1555 MHz $\geq$ 55 dB @ 1595 MHz
Noise Figure:	Typically 1.8 dB, maximum 3 dB at +25 °C
Surge Protection:	Level 4 (per IEC 61000-4-5) Test Voltage: 4000 V Max. Peak Voltage @ 2 Ω: 2000 A
ESD Protection:	Level 4 (per IEC 61000-4-2) Contact Discharge: 8 kV Air Discharge: 15 kV
Connector Type:	Type-N, Female
Housing Material:	ABS Plastic Case for Outdoor Installation
IP Rating:	IP65
Temperature Range:	–60 °C to +80 °C (–76 °F to 176 °F)
Weight:	1.4 kg (3.53 lbs), including mounting kit

15.3 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

15.4 Technical Specifications: Oscillators

	OCXO-SQ	OCXO-HQ	OCXO-DHQ
Short-Term Stability (where t = 1 second)	5×10^{-10}	5×10^{-12}	2×10^{-12}
Pulse-per-Second Accuracy	< ± 50 ns	< ± 50 ns	< ± 50 ns
Phase Noise	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)	$\pm 5 \times 10^{-9}$ ± 50 mHz	$\pm 5 \times 10^{-10}$ ± 5 mHz	$\pm 1 \times 10^{-10}$ ± 1 mHz
Frequency Accuracy in Free-Run Mode (1 Year)	$\pm 2 \times 10^{-7}$ ± 2 Hz	$\pm 5 \times 10^{-8}$ ± 0.5 Hz	$\pm 1 \times 10^{-8}$ ± 0.1 Hz
Frequency Accuracy with GPS Synchronization (Average over 24 Hours)	$\pm 1 \times 10^{-11}$	$\pm 1 \times 10^{-12}$	$\pm 1 \times 10^{-12}$
Time-of-Day Accuracy in Free-Run Mode (1 Day)	± 65 µs	± 10 µs	± 4.5 µs
Time-of-Day Accuracy in Free-Run Mode (7 Days)	± 9.2 ms	± 1.0 ms	± 204 µs
Time-of-Day Accuracy in Free-Run Mode (30 Days)	± 120 ms	± 16 ms	± 3.3 ms
Time-of-Day Accuracy in Free-Run Mode (1 Year)	± 4.7 s	± 788 ms	± 158 ms
Temperature-Dependent Drift in Free-Run Mode	$\pm 1 \times 10^{-7}$ (–10 to 70 °C)	$\pm 1 \times 10^{-8}$ (5 to 70 °C)	$\pm 2 \times 10^{-10}$ (5 to 70 °C)

15.5 Technical Specifications: IMS Module Interface

Pin	Row A	Row B	Row C
1	V_{cc} in (+5 V)	V_{cc} in (+5 V)	V_{cc} in (+5 V)
2	V_{cc} in (+12 V)	V_{cc} in (+12 V)	V_{cc} in (+12 V)
3	V_{DD} in (TCXO/OCXO)	V_{DD} in (TCXO/OCXO)	V_{DD} in (TCXO/OCXO)
4	Reserved (FreqAdjust Out)	PPS IMS Out	Prog. Pulse 3 Out
5	Fixed Frequency Out	GND	10 MHz IMS In
6	PPS IMS In	Custom	PPS Out
7	DCLS Time Code IMS In	GND	PPS 2 In
8	External Clock In / PPS XHE In	Not Connected	PPM Out
9	10 MHz Sine Out	Not Connected	PPS XHE Out
10	100 kHz TTL Out	Custom	Prog. Pulse 0 Out
11	1 MHz TTL Out	Custom	Prog. Pulse 1 Out
12	10 MHz TTL Out	Not Connected	Prog. Pulse 2 Out
13	DCLS Time Code Out	Not Connected	Not Connected
14	AM Time Code Out	GND	COM4 RxD In
15	COM2 RxD In	Not Connected	Custom
16	COM2 TxD Out	Not Connected	Custom
17	COM3 RxD In	Not Connected	DCF77 Mark Out
18	COM3 TxD Out	Not Connected	Reserved
19	GND	Not Connected	Timesync Out
20	GND	GND	Custom
21	GND	Not Connected	Freq. Synth TTL Out
22	GND	GND	Freq. Synth OD Out
23	GND	Not Connected	Freq. Synth Sine Out
24	GND	Not Connected	COM1 TxD Out
25	GND	Slot ID 0	COM4 TxD Out
26	GND	Slot ID 1	COM0 TxD Out
27	GND	Slot ID 2	CAP1 In
28	GND	Slot ID 3	CAP0 In
29	GND	+USB	COM1 RxD In
30	GND	-USB	COM0 RxD In
31	GND	GND	GND
32	GND	GND	GND

15.6 MRS Functionality

When the system is powered up or rebooted, the oscillator will initially run solely off the internal oscillator ("free-run mode"). As soon as one of the available reference sources has been synchronized and validated, there will be an initial "hard" adjustment of the internal time (main oscillator). The oscillator from that point will then only be adjusted in very small steps.

The following reference time sources can be used, depending on the system (optional):

GNSS	GPS / GLONASS / Galileo / BeiDou satellite receivers
NTP	External NTP servers (up to seven different servers configurable)
PTP (IEEE-1588)	PTP master for clock synchronization (M500 and M900 only)
IRIG	Time code (TC-DCLS or TC-AM)
PPS in	Pulse per second (PPS)
PPS plus String	PPS + serial time strings
Fixed Freq. In	10 MHz frequency input

If more than one reference clock is available and synchronized, the clock with the highest priority (the "master") is used to discipline the internal OCXO.

If the master becomes unavailable, the next reference clock in the order of priority is selected. The reference clock will briefly lose synchronization during this process until it has resynchronized with the new source.

If a reference clock with a higher priority becomes synchronized, it will always be selected as the "master".

Fixed Offset

A fixed offset relative to the reference time can be defined for every reference clock, allowing for known and constant deviations of a reference clock to be accounted and compensated for. When using a GNSS reference source, it is not possible to define a fixed offset—deviations can only be accounted for here indirectly via the specification of the antenna cable length.

Precision

This parameter dictates the fundamental accuracy of this reference source. When switching between different time sources, this value and the accuracy of the oscillator is used to calculate the holdover time, which is the delay until the actual changeover. If the "precision" value is zero, the system will switch to the next reference clock in the order of priority immediately. Otherwise, the delay is calculated as:

*(precision of next reference) / (precision of current master) * constant [s]*

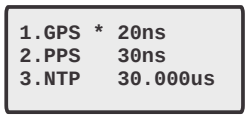
The parameter "constant" depends on the quality of the internal oscillator.

Example: The external pulse-per-second signal (PPS) is the current master. An IRIG time code source is the next reference clock in the order of priority. If the master is lost, the system will switch to the IRIG input (TCR). The PPS has a configured accuracy of 100 ns, while the TCR is set as 10 us accurate. Applying the above formula, a holdover time of 19 minutes is calculated (10000 ns / 100 ns * 11.4). The "MRS Input Priorities" shows the remaining and total holdover time next to the master clock. The holdover time will always be recalculated if the reference clock is lost again.

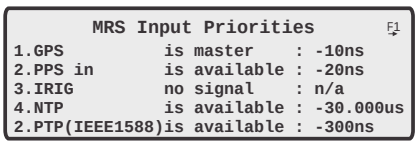
The internal NTP server does not have any direct interface with the external reference clocks and derives its time exclusively from the oscillator of the GNSS/GPS/MRS unit. The OCXO is only disciplined directly by this unit. The external NTP time servers are configured via the internal NTP server as "servers" using the "noselect" option so that time deviations relative to the external NTP time servers can be calculated. These offsets are then cyclically sent to the GPS/GNSS/MRS module.

The current status of all active reference clocks can be obtained from the display, which shows the current master (marked with a "*" or in plain text) and its current status (availability). The display also shows the current time deviation relative to the internal clock:

M300: LC-Display 40 x 2 Characters



M400 / M900: LC-display, 4 x 16 Characters



M600: Vacuum fluorescent graphic display (VFD), 256 x 64 dots

The PTP timestamping unit is queried every 10 seconds (regardless of the broadcast interval of the PTP master). The external NTP servers are queried every 64 seconds. These values are used to calcuate the time deviations. Of the maximum seven external NTP services, the one with the lowest jitter (NTP: filter error) is selected upon each calculation.

IMPORTANT: Whenever the LANTIME/MRS is powered up or restarted, the difference in the time between the internal clock and the external NTP or PTP server must not exceed 1000 seconds. If it does, the internal clock will need to be set manually or synchronized with the GPS/GNSS reference clock.

15.7 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.

15.7.1 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.

16 Your Opinion Matters to Us

This user manual is intended to assist you in the preparation, use, and care of your Meinberg product, and provides important information for configuration and status monitoring.

Be a part of the ongoing improvement of the information contained in this manual. Please contact our Technical Support team if you have any suggestions for improvements or technical questions that are relevant to the manual.

Meinberg – Technical Support

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

17 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 List of Abbreviations

BNC	Bayonet Neill–Concelman Connector
CLK	Clock
CPU	Central Processing Unit
DC	Direct Current
D-Sub	D-Subminiature
ESD	Electrostatic Discharge
ESDS	Electrostatic Discharge Sensitivity/Sensitive
ESI	External Synchronization Input
GND	Ground
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HP	Horizontal Pitch
IMS	Intelligent Modular Synchronization
I/O	Input/Output
LTOS	LANTIME Operating System
MRI	Multi-Reference Input
MRS	Multi-Reference System
NTP	Network Time Protocol
PWR	Power
RSC	Redundant Switch Control
1PPS/PPS	Pulse-per-Second
SPI	Serial Peripheral Interface
TTL	Transistor–Transistor Logic
USB	Universal Serial Bus