The Synchronization Experts.

SETUP GUIDE

IMS-PZF182

Hot-Plug Module

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint and Legal Information

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

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

3 Change Log

Version	Date	Revision Notes
1.0	2023-01-10	Initial Version
2.0	2024-09-25	Full review based on manual for IMS-PZF183

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 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.
- 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 guideline to assist you with the set-up of your Meinberg product.

The IMS-PZF182 is a long-wave radio clock module with receiver technology developed from the ground up specifically for time and frequency synchronization purposes. The IMS-PZF182 provides a high-precision, high-accuracy time and frequency reference for your Meinberg IMS system and is designed to receive signals from the DCF77 timing service situated in Mainflingen, near Frankfurt am Main in Germany. This service provides reception as far afield as Central Finland and Northern Algeria, although for consistent and reliable reception, the best results for commercial applications that rely on continuous synchronization are achieved with reception in Western Europe.

How It Works

The IMS-PZF182's receiver reads the current date and time from the DCF77 long-wave radio signal broadcast on 77.5 kHz. Once the IMS-PZF182 is successfully synchronized with the long-wave reference signal, it generates a PPS (pulse-per-second) phase reference and a 10 MHz frequency reference.

These 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-PZF182 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 7.06** installed.

Antenna Compatibility

Antenna	Meinberg AW02	Meinberg AW02-60	Meinberg AI01
Compatible	✓	✗	✓

The IMS-PZF182 is designed for operation with the **Meinberg AW02 Antenna** or the **Meinberg AI01 Antenna**.

It is **not** compatible with the **Meinberg AW02-60 Antenna**.

Please refer to the following chapters for more information:

- → Chapter 11, “Installing a Long-Wave Antenna”
- → Chapter 15.1, “Technical Specifications: AW02 Antenna”

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 2.14** of your IMS-PZF182 as well as **LANTIME OS Version 7.06**. 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

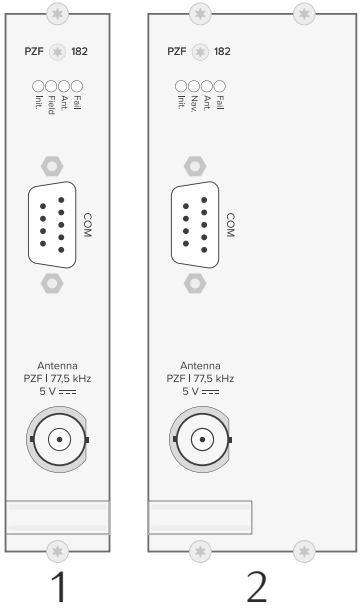
This Setup Guide provides the information required to quickly set up your module in your IMS system with a minimum of problems. We recommend also carefully studying the following manuals alongside this Setup Guide for the use of your IMS-PZF182:

Meinberg IMS System Manuals (all systems)	http://www.mbg.link/doc-en
LANTIME OS Version 7.06 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-PZF182 Models

There are several models of the IMS-PZF182 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.

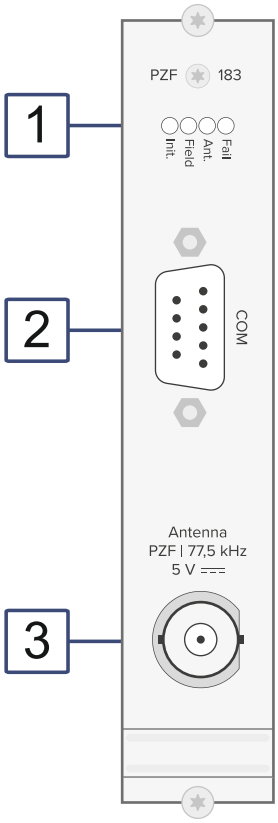


1	Standard	1 Slot	1x BNC (antenna), 1x COM	OCXO-SQ, OCXO-HQ[1]
2	DHQ	2 Slots[2]	1x BNC (antenna), 1x COM	OCXO-DHQ[1]

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

2 Installing an IMS-PZF182 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.

9 IMS-PZF182 Module Connectors and LEDs



Information:

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

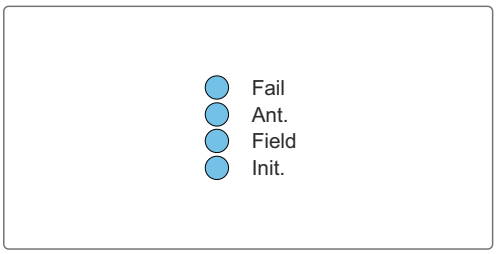
9.1 Status LEDs

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

"*Field*" LED: Reception of DCF77 signal; operating mode

"*Ant*" LED: Antenna connection 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.
Field	Off	The long-wave receiver is not receiving a DCF77 signal or the field strength of the DCF77 signal is inadequate.
	Green, flickering	The receiver is operating in **AM mode** (amplitude-modulated); this means that only the amplitude-modulated portion of the signal is being processed. The flickering represents the incoming data and will appear to occur once a second. The clock will first operate in AM mode when the module is first initialized until the receiver is able to lock on to the phase-shifted portion of the radio signal, at which time it will switch to **PRC mode** (see below). If the signal is of poor quality or an artificially generated signal lacking phase modulation is being used (e.g., a local DCF77 generator), the clock may remain in AM mode.
	Green, steady	The receiver is operating in **PRC mode** (pseudo-random code); this means that the field strength of the received signal is of adequate quality for the reference clock to synchronize to the phase-modulated component of the signal. With good reception, the receiver should switch from **AM mode** to **PRC mode** within 1 to 2 minutes of initialization.

Ant	Green	The antenna is correctly connected, there is no fault detected in the connection, and the clock is synchronized with the currently selected MRS reference source (e.g., DCF77).
	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., DCF77, 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., DCF77, 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 cannot be used as a standalone phase reference. The reference clock can only ever be synchronized via this interface in combination with an externally generated time string input to the system via the RxD (receive) pin of this interface.

Refer to → Chapter 13.2, "Synchronization with Time String and PPS" for more information on using PPS & time string inputs to synchronize your IMS-PZF182.

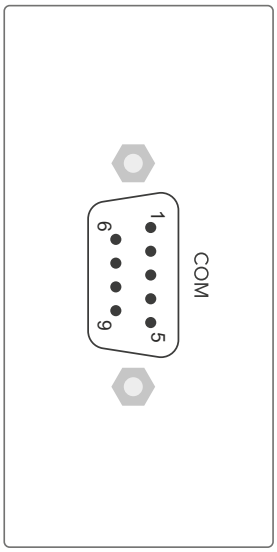
Data Transfer Mode: Serial I/O

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: PZF Receiver

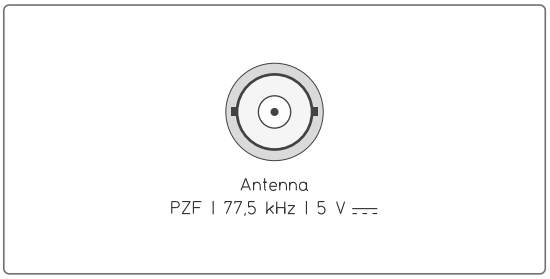
Danger!

Do not work on the antenna installation during thunderstorms!

Danger of death from electric shock!

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

Receiver Type: Quadrature receiver for optimum processing of a DCF77 signal (amplitude-modulated and phase-modulated components)



Reception Frequency: 77.5 kHz

Input Impedance: 50 Ω

Signal Level: 50 μV – 5 mV

Operating Voltage: 5 V, max. 1 mA

Connector Type: BNC, Female

Cable Type: Coaxial Cable, Shielded

Cable Length: Typically 300 m (984 ft) with RG58 Coaxial Cable

10 Before You Start

10.1 Contents of Delivery

Unpack the IMS-PZF182 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 Long-Wave Antenna

11.1 Geographical Considerations

The antenna location plays a critical role in determining the quality of reception and thus the signal strength of the signal, and should therefore be selected carefully so as to avoid difficulties with synchronization. If the antenna is not precisely aligned, signal reception and timing accuracy will be affected.

The antenna must be directed towards Mainflingen, Germany, near Frankfurt am Main, in accordance with the installation conditions specified below.

The DCF77 signal has a theoretical range of 2000 km (measured fromm the transmission tower) and enables DCF77 receiver-clocks in not only Germany but also countries such as France, Denmark, Sweden, Austria, and Italy to be synchronized. Depending on the time of day, sensitive receivers can receive a sufficiently strong signal even in the furthermost regions of the reception area.

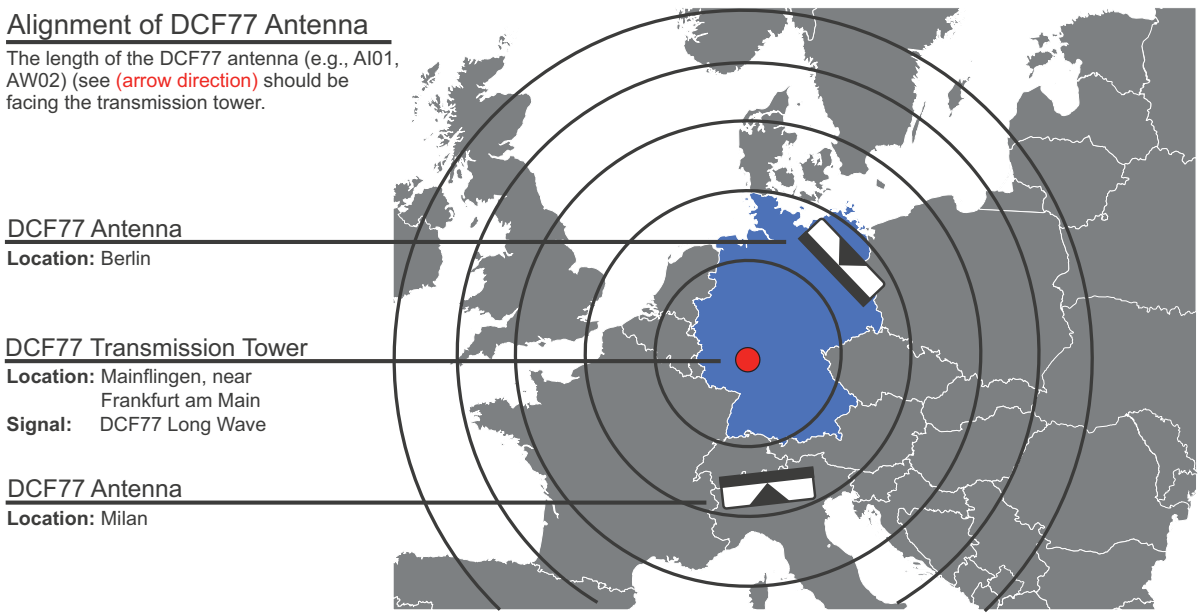


Illustration: Installation of a Meinberg long-wave antenna directed towards the DCF77 transmitter tower in Mainflingen, near Frankfurt-am-Main in Germany.

11.2 Meinberg AW02 Antenna

11.2.1 Selecting the Antenna Location

There are two ways of mounting the antenna using the mounting kit included in the packaging.

1. Mounting on a pole

2. Mounting on a wall

To ensure that the long wave signal can be reliably received and in order to avoid difficulties with the synchronization of your Meinberg product, select a location that allows for an unobstructed view towards Mainflingen, Germany (near Frankfurt am Main).
The following conditions should also be met when choosing a location to mount the antenna:

- The line of sight between the antenna and signal source must not be obstructed by visible obstructions.
- The antenna should be mounted horizontally (see illustration).
- The antenna must not be installed under power lines or other electrical lighting or power circuits.
- A distance of at least 30 cm (1 ft) should be maintained between the antenna for your IMS-PZF182 and other antennas.
- The length of the antenna must be facing the transmission tower (see illustration).

Important!

If these conditions are not met, your IMS-PZF182 may be unable to properly receive the long-wave radio signal, or the signal may be disrupted by atmospheric or electrical interference.

This can result in your Meinberg IMS-PZF182 being unable to synchronize, being only able to synchronize in **AM mode** (with reduced accuracy), or intermittently losing synchronization with the reference source.

11.2.2 Installation of the Meinberg AW02 Antenna

Please read the following safety instructions carefully before installation and be sure to observe them.

Danger!

Do not mount the antenna without an effective fall arrester!

Danger of death from falling!

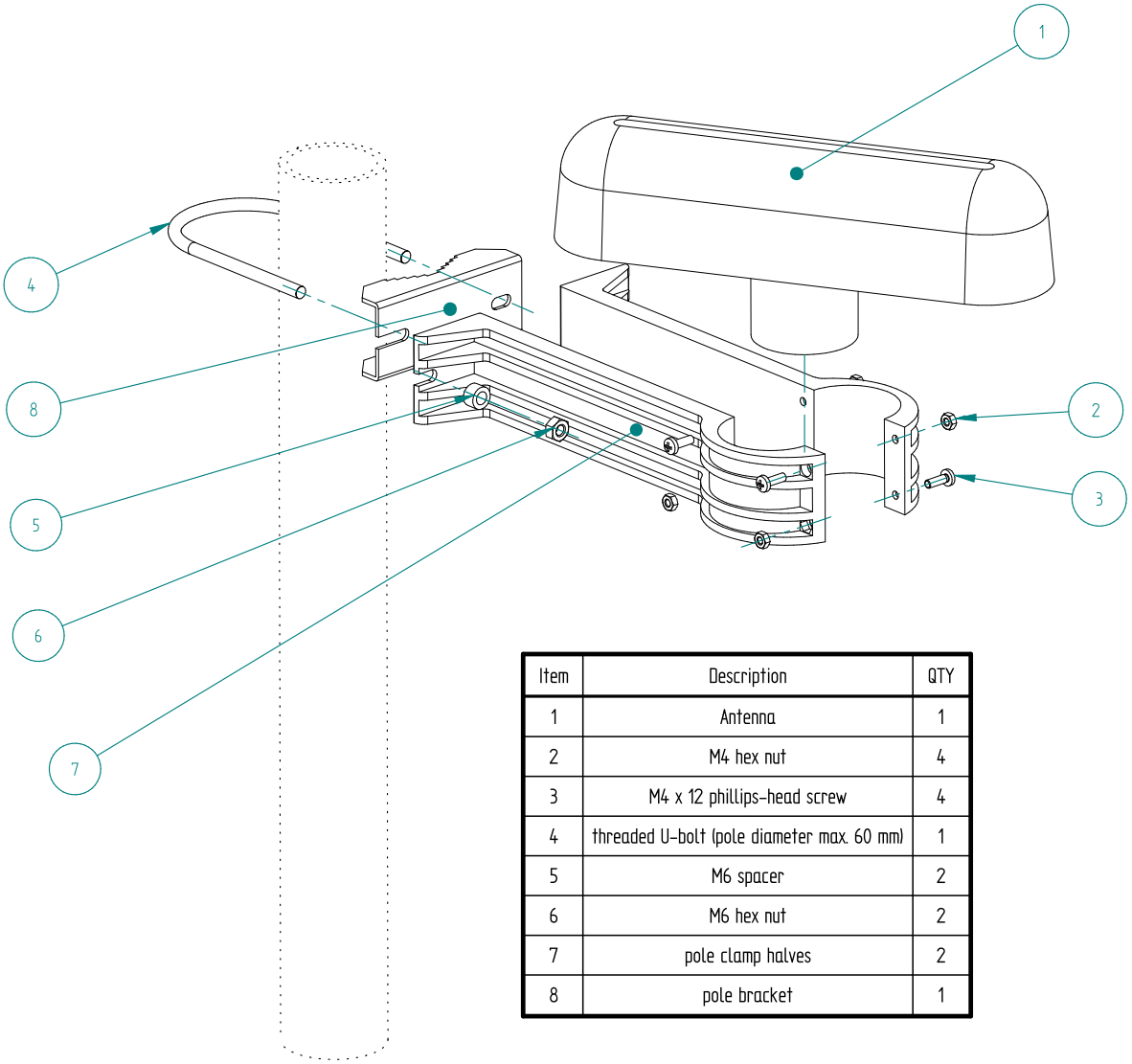
- Ensure that you work safely when installing antennas!
- Never work at height without a suitable and effective fall arrester!

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.



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

Fig. 3: Mounting a AW02 antenna onto a pole

Mount the long-wave antenna as shown above in accordance with the conditions specified in ➜ Chapter 11.3.1, "Selecting the Antenna Location" using the mounting kit provided, either onto a vertical pole of no more than 60 mm diameter or directly onto a wall.

The illustration above shows how the antenna is mounted on a pole by way of example. When mounting the antenna directly onto a wall, use the enclosed wall plugs and M6 x 45 screws, which are to be fed directly through the corresponding recesses on the pole clamp halves (Pos. 8).

11.2.3 Procedure for Antenna Alignment

The antenna itself provides no visual indication of the reception quality of the DCF77 signal while aligning it.

Step 1: A field strength meter can be used to determine the ideal direction of the installed DCF77 antenna. First, the length of the antenna (using the arrow printed on the antenna) is pointed in the general direction of Frankfurt am Main, in Germany. Finer adjustments are then made to the direction of the antenna until the field strength is in the optimum range of –60 dB to –70 dB.

If no field strength meter is available, Meinberg recommends that two people perform the process of turning the antenna and verifying the reception quality. Person 1 (at the antenna) should remain in communication with Person 2 (at the receiver) to this end.

Step 2: Person 1 rotates the antenna slowly in an **anticlockwise** direction until Person 2 sees that the "**Field**" LED is flickering once a second.

If the LED does not flash in this way, the antenna should be turned slowly in a **clockwise** direction from the approximate direction until Person 2 sees that the "**Field**" LED is flickering once a second.

Step 3: If the LANTIME has a display, verify that the **Field** value is as high as possible (ideally at least *80*) by accessing the menu "**Reference Time** → **Info** → **Corr. & Field**". These values are dynamically updated, enabling person 2 to communicate with person 1 to make any necessary adjustments to the direction of the antenna.

If the LANTIME has no display, but person 2 has console access to the LANTIME (e.g., via Telnet or SSH), a simulation of the display menu can be accessed using the command `fpc`. In this case, use the arrow keys and Enter to navigate to the field "**Ref. Time** → **Info** → **Corr. & Field**". These values are dynamically updated, enabling person 2 to communicate with person 1 to make any necessary adjustments to the direction of the antenna.

The field strength and correlation values are also displayed under "**Receiver information**" on the "**Main**" tab of the LANTIME OS Web Interface. These values are **not** dynamically updated, and so it will be necessary to refresh the browser page from time to time and communicate with person 1 accordingly.

Please note that a high signal level alone is no guarantee of good reception, as it can also be caused by electrical noise in the associated frequency range.

With good reception, the clock should synchronize within three minutes after initialization.

Successful synchronization is signaled by the "**Field**" LED flickering once a second, and then remaining permanently lit after 1–2 minutes. The display will also show "`PZF: NORMAL OPERATION`".

11.2.4 Optional Antenna Splitter

Up to four Meinberg DCF or PZF receivers can be connected to one antenna using the AV4 antenna splitter. The AV4 is powered via a Type F (CEE 7/4, "Schuko") plug.

The splitter may be installed at any location between the surge protector and the receivers.

11.3 Meinberg AI01 Antenna

11.3.1 Selecting the Antenna Location

The AI01 antenna is intended for indoor use. To ensure that the DCF77 signal can be reliably received and in order to avoid difficulties with synchronization, select a location that allows for a view towards Mainflingen, Germany (near Frankfurt am Main) that has as few obstructions as possible.

- You should ideally select a room within the building with an unobstructed view towards Mainflingen.
- The line of sight between the antenna and signal source should have as few obstructions as possible. Ideally, it should be placed near a window facing Mainflingen without any nearby buildings.
- The antenna should not be installed under power lines, other electrical lighting, or other power circuits.
- Maintain a distance of at least 30 cm (1 ft) from other antennas.

Information:

Problems may arise if these conditions are not met.

11.4 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.

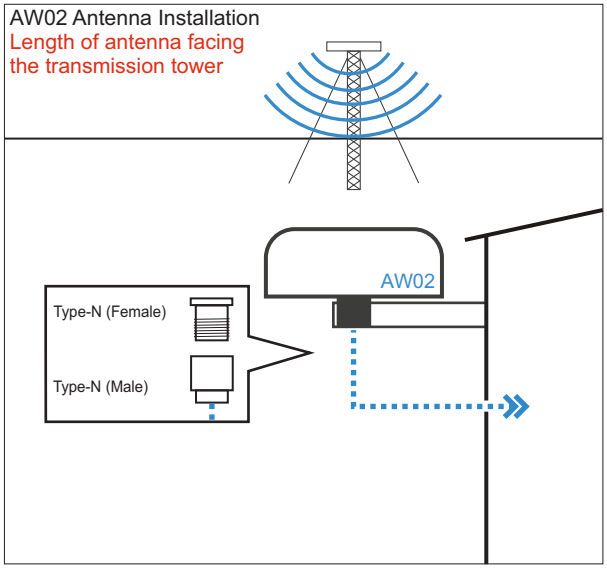
The cable is shipped with both ends fitted with the appropriate connectors as standard, although the cable can also be shipped without any pre-fitted connectors if so requested.

Refer to ➜ Chapter 15.2, "Technical Specifications: Antenna Cable" for information on the specifications of supported antenna cable types.

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.

The antenna cable should then be connected to the Type-N connector of the antenna. Feed the other end of the cable into the building through the wall.



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

11.5 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 IMS-PZF182), 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.

For this reason, effective surge protection measures are an essential part of a safe and reliable time server installation, both in the interest of electrical and fire safety and for protecting your Meinberg antenna and time server.

Warning!

Surge protection systems may only be installed by personnel with suitable electrical installation expertise.

Optional MBG S-PRO Surge Protector

The MBG-S-PRO is a surge protector manufactured by Phoenix Contact (Type Designation CN-UB-280DC-BB) and designed to protect coaxial connections.

It functions by reacting in surge scenarios to automatically isolate those devices at risk of **primary** exposure to surge voltages (i.e., the outdoor antenna) from those devices that would be at risk of **secondary** exposure to surge voltages (i.e., the IMS-PZF182).

Primary exposure in this case refers to direct exposure to surge voltages caused by direct or indirect lightning strikes (i.e., outdoor installations), while secondary exposure refers to devices that are not directly exposed to the surge voltages, but become exposed to them indirectly through electrical connections with devices subject to primary exposure (i.e., typically indoor installations and receivers).

The MBG-S-PRO consists of a replaceable gas discharge tube that isolates downstream devices from the surge voltage by redirecting the energy from the core to the ground potential when ignited.

Information:

The surge protector and suitable coaxial cable are not included as standard with a Meinberg long-wave antenna, but can be ordered as an optional accessory, during or after the purchase of your time server. Reach out to your Meinberg Sales Representative for more information.

Selecting a Location

The MBG-S-PRO is patched into the coaxial line in an outdoor location at—or as close as possible to—the point of entry through the wall. This ensures that the longest possible length of the coaxial line, from the connector of the antenna to the point of entry into the building, is protected by the MBG-S-PRO.

As such, in order to protect the building from voltage surges, the MBG-S-PRO should ideally be installed outside the building directly at the point of entry of the antenna cable into the building. Any 'exposed' part of the coaxial line between the MBG-S-PRO and the point of entry into the building is not protected by the MBG-S-PRO.

The MBG-S-PRO must be installed in a protected location that is shielded against water spray, water jets, and highly conductive atmospheres[1]. If the installation location cannot guarantee protection from water spray or water jets, it must be installed in a suitable IP65-rated protective enclosure.

Finally, the location should be close to the bonding bar of your bonding infrastructure to ensure that the path to ground is as short as possible.

[1] The MBG-S-PRO is rated to Pollution Degree 2 pursuant to IEC/EN 60664-1.

Preparation

In addition to the MBG-S-PRO unit itself and the provided mounting bracket, you will require the following for the installation process:

- A coaxial cable of sufficient length to be connected between the antenna and the MBG-S-PRO; the surge protector connector requires a Type-N male connector.
- A ground conductor cable, which must be as short as possible.
- Suitable wall anchors and screws for affixing the MBG-S-PRO mounting bracket to the wall, and suitable equipment for wall mounting (e.g., drill with suitable drill and screwdriver bits).

The coaxial cable from the receiver must also be laid to the mounting location of the MBG-S-PRO and terminated with a Type-N male connector.

Installation and Connection

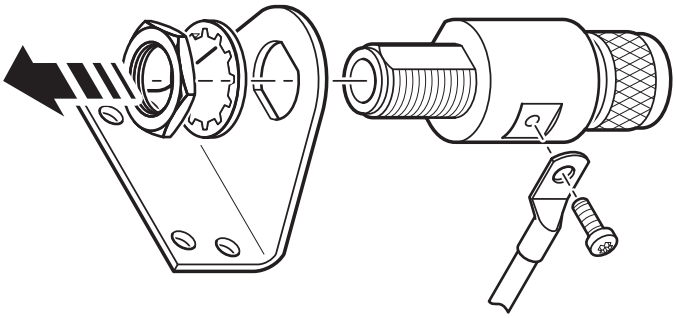


Figure 11.1: Assembly of the MBG-S-PRO Surge Protector

1. Affix the mounting bracket to the wall using suitable wall anchors and screws.

2. Fit the MBG-S-PRO surge protector to the mounting bracket as shown in Fig. 11.1. The MBG-S-PRO has no dedicated input or output polarity and therefore has no preferred installation orientation.

3. Trim the grounding cable from your grounding busbar to the minimum length necessary and connect it to the MBG-S-PRO using a suitable cable lug.

4. Connect the other end of the ground conductor cable to the bonding bar of your equipotential bonding infrastructure.

Important!

The MBG-S-PRO must be connected to the same bonding bar as the connected Meinberg receiver in order to prevent destructive potential differences.

5. Cut the coaxial cable from the antenna to the minimum length necessary and connect it to one of the surge protector connectors, then connect the coaxial cable from the Meinberg receiver or (primary) signal distributor to the other surge protector connector.

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.

Additional Information

This guide only describes the basic installation process of the MBG-S-PRO.
Please refer to ➜ Chapter 15.3, "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 MBG-S-PRO surge protector, including instructions on how to replace the gas cylinder:

Data Sheet

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

User Manual

https://www.meinbergglobal.com/download/docs/manuals/english/eba_tt_cn_ub_280dc_9461776_09.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!

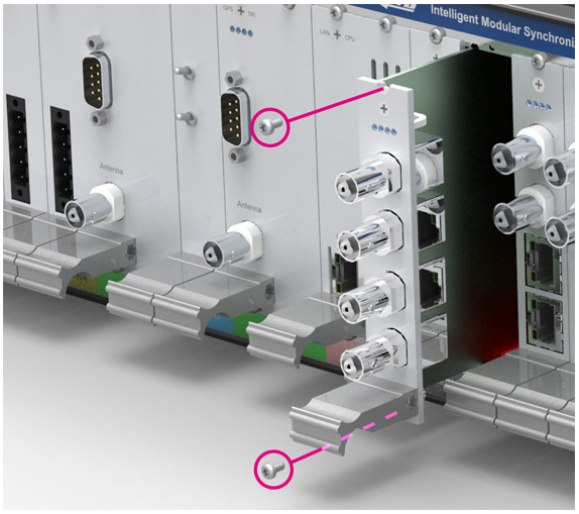
Heed the → "Important Safety Information" in Chapter 5 of this manual!

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-PZF182 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 11.4, "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-PZF182 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-PZF182 via the Web Interface. The IMS-PZF182 can be set up to be synchronized to the DCF77 reference signal, 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-PZF182 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-PZF182 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 DCF77

This chapter describes how to quickly set up the IMS-PZF182 reference clock for synchronization to a DCF77 reference signal.

Step 1: Connection of the IMS-PZF182 with the Reference Source

Ensure that the IMS-PZF182 is connected to either a correctly installed Meinberg AW02 or AI01 Antenna as described in → Chapter 9.3, "Antenna Input: PZF Receiver" or to a functioning DCF77 signal generator.

Step 2: Configuring the Signal Propagation Time

Information:

This step is not necessary if using a local DCF77 signal generator as a reference source.

The propagation of the signal from the transmitter to the receiver (reference clock) can incur a certain delay. To enable the connected reference clock to compensate for the propagation delay of the long-wave signal from the transmitter in Mainflingen, Germany to the local antenna, the straight-line distance between the transmitter in Mainflingen and the antenna location must be specified.

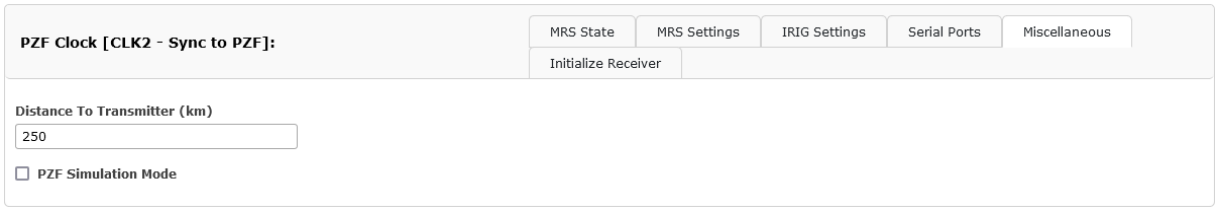


Figure 13.1: Konfiguration der Senderentfernung

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. Enter the distance in kilometers from the DCF77 transmitter in Mainflingen and the local antenna under "**Distance to Transmitter (km)**". If using a local DCF77 signal generator, ensure that this value is left at *0*.

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 or generator and the power supply have been connected, the reference clock is ready for operation.

The reference clock will first initialize, which will take a few seconds.

After that, the reference clock will begin receiving in *AM mode* almost immediately. In this mode, the reference clock will process the amplitude-modulated portion of the DCF77 signal, indicated by a flickering of the "**Field**" LED on the module once a second.

After around a minute, the IMS-PZF182 will lock on to the phase-modulated portion of the DCF77 signal, allowing the IMS-PZF182 to more accurately calculate the transit time of the signal and synchronize with greater accuracy. This will be signaled by the "**Field**" LED on the module staying lit in green.

Information:

If the IMS-PZF182 is connected to a DCF77 generator, the reference clock will typically remain in AM mode.

13.2 Synchronization with Time String and PPS

This chapter describes the most important configuration processes for quickly setting up the IMS-PZF182 reference clock to synchronize to an external time string & pulse-per-second reference.

Step 1: Connection of the IMS-PZF182 with the PPS & Time String Sources

Ensure that the IMS-PZF182 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

Figure 13.2: Serial Port Settings of your IMS-PZF182

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-PZF182 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-PZF182 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.

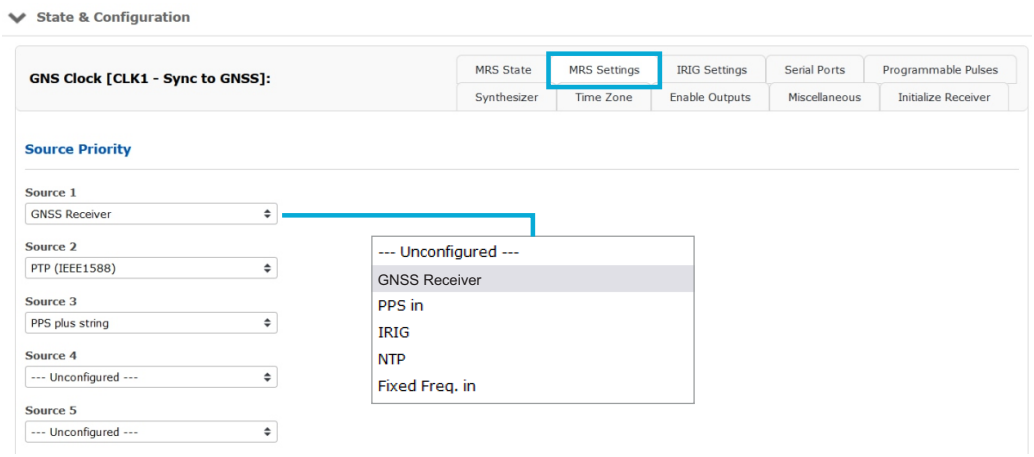


Figure 13.3: MRS Configuration – Selection and Prioritization of the Available Reference Sources

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-PZF182.

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

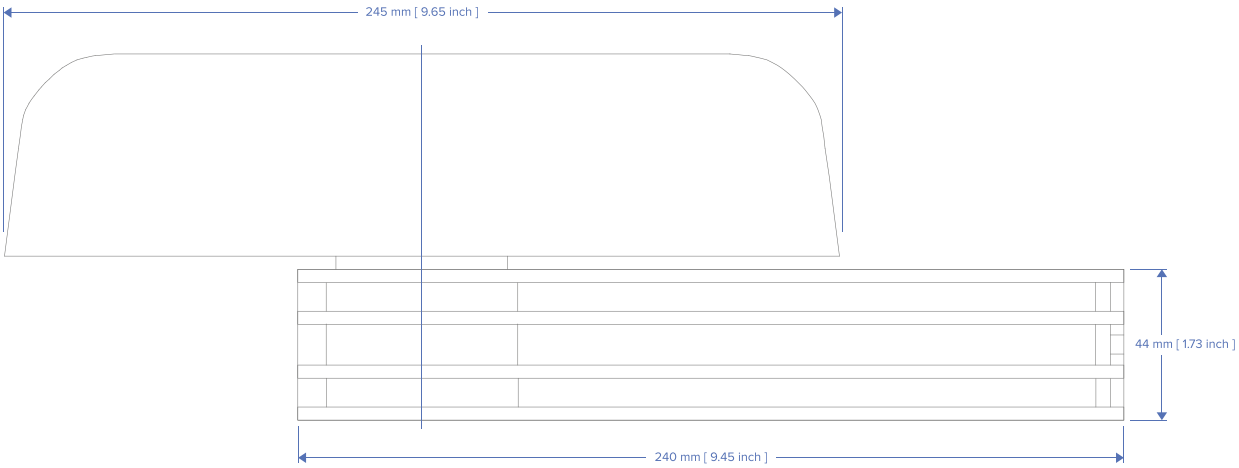
Our Technical Support team will be pleased to help you with any problems that you may be having with your Meinberg IMS-PZF182 module. However, before you contact our Technical Support team, it is advisable to read this chapter through first to see if your problem might be more quickly resolved with one 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 the time being synchronized).	If the position of the antenna is poorly selected, the reference clock may be unable to properly receive the long-wave 77.5 kHz signal 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 Long-Wave Antenna".
The reference clock does not synchronize and the "Fail" LED is red.	Your IMS system is unable to synchronize with any of the reference sources configured under "**MRS Settings**".	Ensure that you have the installed reference sources configured under "**MRS Settings**".
		Verify that your reference sources are delivering a valid signal: - if synchronizing via DCF77, 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 may only sporadically receive the DCF77 long-wave signal. This phenomenon may occur more frequently during the daytime at distances of 1100 km or greater from the DCF77 transmitter, as the ground wave is unavailable at this point, making a receiver at this distance more dependent on the sky wave, less of which is reflected during the daytime.	Ensure that the location of the antenna is selected in accordance with the conditions specified in ➜ Chapter 11, "Installing a Long-Wave Antenna".
The reference clock state is shown as "**AM operation**" instead of "**Normal Operation**".	The PZF reference clock typically only remains in AM mode if it is unable to conclusively process the phase-modulated pseudo-random code sequence in the radio-transmitted 77.5 kHz signal. This can be indicative of signal interference causing phase distortion. Most local DCF77 generators that send a time signal over a wired connection on a 77.5 kHz carrier also do not include the pseudo-random code sequence. This will cause the PZF clock to fall back to AM mode. In this case, however, this behavior is normal and is unlikely to have any adverse impact on signal integrity.	If receiving over a long-wave antenna, reposition or realign the antenna to improve reception.

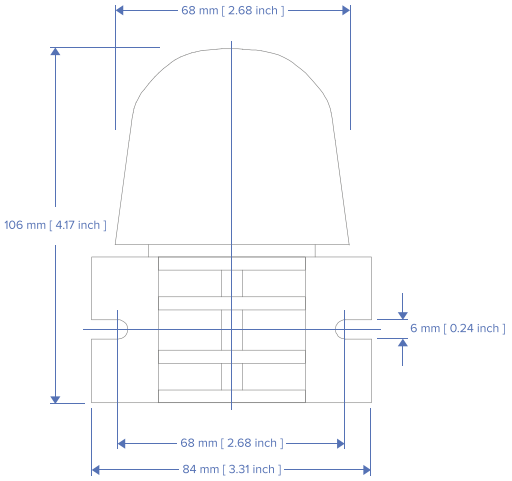
15 Technical Appendix

15.1 Technical Specifications: AW02 Antenna



Specifications

Power Supply Voltage:	3.5 V – 5 V
Reception Frequency:	77.5 kHz
Bandwidth:	1 kHz
Signal Level:	50 μV to 5 mV
Connector Type:	Type-N, Female
Form Factor:	ABS Plastic Case for Outdoor Installation
IP Rating:	IP65
Temperature Range:	-25 °C to +65 °C (-13 °F to 149 °F)
Weight:	0.55 kg (1.2 lbs), including mounting kit for wall installation



15.2 Technical Specifications: Antenna Cable

The table below shows which coaxial cable types and lengths are supported by Meinberg for each of the receiver types. If you need to purchase a replacement cable at any time, please refer to this table to ensure that you select cable with suitable cutoff frequency and attenuation properties.

PZF Reference Clocks

Cable Type	RG58C/U	RG174U
Signal Propagation Time at 77.5 kHz	528 ns/100 m	558 ns/100 m
Attenuation at 77.5 kHz	0.57 dB/100 m	3.35 dB/100 m
DC Resistance	5.3 Ω/100 m	33.8 Ω/100 m
Cable Diameter	5 mm	2.8 mm
Max. Cable Length	300 m	300 m

Please refer to the data sheet of the cable in question for further specifications.

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:

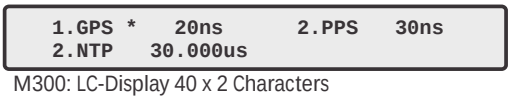
*(precision of next reference) / (precision of current master) * constant [s]*

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

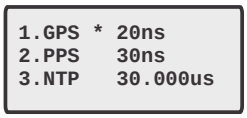
Example: The external pulse-per-second signal (PPS) is the current master. An IRIG time code source is the next reference clock in the order of priority. If the master is lost, the system will switch to the IRIG input (TCR). The PPS has a configured accuracy of 100 ns, while the TCR is set as 10 us accurate. 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.

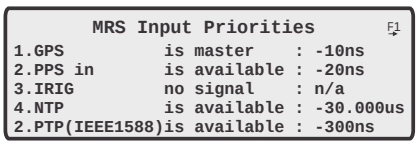
The current status of all active reference clocks can be obtained from the display, which shows the current master (marked with a "*" or in plain text) and its current status (availability). The display also shows the current time deviation relative to the internal clock:



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.

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
HP	Horizontal Pitch
IMS	Intelligent Modular Synchronization
I/O	Input/Output
LTOS	LANTIME Operating System
MRI	Multi-Reference Input
NTP	Network Time Protocol
PWR	Power
RSC	Redundant Switch Control
1PPS/PPS	(One) Pulse per Second
TTL	Transistor–Transistor Logic
USB	Universal Serial Bus