The Synchronization Experts.

MANUAL

IMS-PZF180 Setup Guide

Hot-Plug Module

31st January 2020

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint

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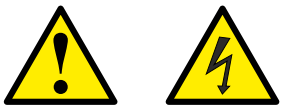
Date: 2020-01-31

2 Safety Instructions for hot pluggable Modules



Check before every maintenance work on the system:

- If a data backup is required?
- Is a backup required, verify the data recovery which is done by this backup.
- Make sure to avoid any static discharge while working - use a grounding cable and/or antistatic gloves during installation and removal of hot pluggable components.
- If you are replacing a hot pluggable power supply, unplug the power cable prior to removing the module from the case.
- Never open a power supply. In power supplies dangerous voltages can still remain even after disconnection from the power supply. Always send power supplies back to the manufacturer for maintenance.

Exchange of hot-swap components

- Ensure that components which will be replaced during operation, always be treated with the utmost care. Avoid contact with live components.
- Electrostatic discharge can damage electronic components. For this reason, ensure protection against electrostatic discharges by wearing anti-static shoes while working with the system.
- Take care when removing and installing the hot-plug modules. Always work with the utmost caution. Touch the modules only at the edges.
- Place the module out of the box or after removal from the system with the component side to the top on a grounded and static-free surface.
- Storage of an IMS module must be done in a dry place.
- Installation or removal from hot-swap components only by authorized personnel!

2.1 Additional Safety Hints

This manual contains important information for the installation and operation of this device as well as for your safety. Make sure to read carefully before installing and commissioning the device.

Certain operating conditions may require the observance of additional safety regulations not covered by this manual. Nonobservance of this manual will lead to a significant abatement of the security provided by this device. Security of the facility where this product is integrated lies in the responsibility of the installer.

The device must be used only for purpose named in this manual, any other use especially opteration above the limits specified in this document is considered as improper use.

Keep all documents provided with the device for later reference.

This manual is exclusively for qualified electricians or by a qualified electrician trained personnel who are familiar with the applicable national standards and specifications, in particular for the construction of high voltage devices.

2.2 Supply Voltage

WARNING!
This device is powered by a dangerous voltage. Nonobservance of the safety instructions of this manual may lead to serious damage to persons and property and to danger to life! Installtion, commissioning, maintenance and operation of this device are to be carried out by qualified personnel only.

The general safety instructions and standards (e.g. IEC, DIN, VDE, EN) for installation and work with high voltage equipment as well as the respective national standards and laws must be observed.

NONOBSERVANCE MAY LEAD TO SERIOUS DAMAGE TO PERSONS AND PROPERTY AND TO DANGER TO LIFE!

The device may not be opened. Repair services may only be carried out by the manufaturer.

Supply lines for this decice must be equipped via an appropriate switch that must be mounted close to the device and must be marked as a mains switch for the device.

To ensure safe operation supply mains connected to this decice must be equipped with a fuse and a fault-current circuit breaker according to the applicable national standards for safe operation.

The device must be connected to a protective earth with low grounding resistance according to the applicable national rules.

2.3 Cabling

WARNING!
DANGER TO LIFE BY ELECTRICAL SHOCK! NO LIVE WORKING!
Wiring or any other work done the connectors particularly when connectors are opened may never be carried out when the installation is energized. All connectors must be covered to prevent from accidental contact to life parts.

ALWAYS ENSURE A PROPER INSTALLATION!

3 Replacement or Installation of a Hot-pluggable IMS Module

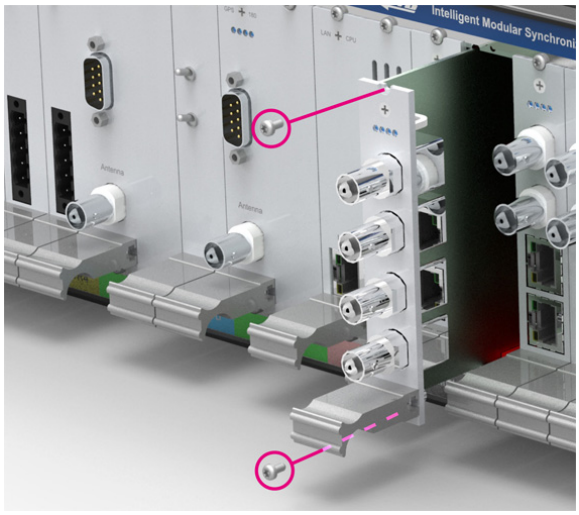
If the system is supplied with an antenna and antenna cable, it is advisable to first mount the antenna in a suitable location (see chapter Antenna Mounting) and lay the antenna cable.

Please use a Torx screwdriver (T8 x 60) for removal and installation of the module.

1. Follow the safety instructions at the beginning of this manual!

1. Remove the two marked Torx screws from the module holder plate or the cover plate of the empty slot.

2. (Only for an already built-in module)
Pull the module carefully out of the holding rail. Note that the module is firmly anchored in the connector block of the housing. You need a certain amount of force to release the module from this link. Once the connection to the connector block of the system's backplane is loosened, the module can be easily pulled out.



3. When installing the new IMS module, please ensure that the board is correctly inserted into the two guide rails of the system housing. Non-observance can cause damage to the module and the chassis. Make sure that the module is securely locked into the connector block before you fasten the two screws.

4. Now you can put the installed module into operation.

Attachment points of an 1U IMS system

3.1 Important Hints for hot-pluggable IMS Modules

The following points should be strictly observed when replacing IMS modules during operation. Not all IMS modules are fully hot-pluggable. Of course, it is not possible to replace a power supply unit of a non-redundant system without first having installed a second power source in operational mode.

The following applies to the individual IMS slots:

PWR:	"hot swappable"	If you operate your system with only one power supply, a second power supply must be installed before removing/replacing it to keep your system functioning.
I/O, ESI and MRI Slots:	"hot swappable".	
CLK1, CLK2:	"hot swappable"	Afer the exchange or the installation of a clock module a rescan of the reference clocks (Rescan Refclocks) must be executed in the web interface menu "System".
CPU	not "hot swappable"	The central management unit must be disconnected from mains before replacement.
RSC/SPT	not "hot swappable"	The RSC switching card must be disconnected from the mains before the replacement.

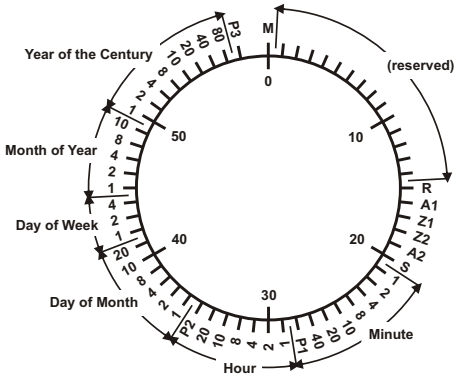
4 PZF - DCF77 Long Wave Receiver

The German long wave transmitter DCF77 started continuous operation in 1970. The introduction of time codes in 1973 build the basic for developing modern radio remote clocks. The DCF77 frequency and signal is derived from the atomic clocks of the Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig, Germany, the national institute for science and technology and the highest technical authority of the Federal Republic of Germany for the field of metrology and physical safety engineering.

The carrier frequency of 77.5 kHz is amplitude modulated with time marks each second. The BCD-coding of the time telegram is done by shifting the amplitude to 25% for a period of 0.1s for a logical '0' and for 0.2s for a logical '1'. The receiver reconstructs the time frame by demodulating this DCF-signal. Because the AM signal is normally superimposed by interfering signals, filtering of the received signal is required. The resulting bandwidth-limiting causes a skew of the demodulated time marks which is in the range of 10 ms. Variations of the trigger level of the demodulator make the accuracy of the time marks worse by additional +/-3 ms. Because this precision is not sufficient for lots of applications, the PTB (Physical and Technical Institute of Germany) began to spread time information by using the correlation technique.

The DCF-transmitter is modulated with a pseudo-random phase noise in addition to the AM. The pseudo-random sequence (PZF) contains 512 bits which are transmitted by phase modulation between the AM-time marks. The bit sequence is built of the same number of logical '0' and logical '1' to get a symmetrical PZF to keep the average phase of the carrier constant. The length of one bit is 120 DCF-clocks, corresponding to 1.55 ms. The carrier of 77.5 kHz is modulated with a phase deviation of +/-10 per bit. The bit sequence is transmitted each second, it starts 200ms after the beginning of an AM second mark and ends shortly before the next one. Compared to an AM DCF77-receiver, the input filter of a correlation receiver can be dimensioned wideband width. The incoming signal is correlated with a reconstructed receiver-PZF. This correlation analysis allows the generation of time marks which have a skew of only some microseconds. In addition, the interference immunity is increased by this method because interference signals are suppressed by averaging the incoming signal. By sending the original or the complemented bit sequence, the BCD-coded time information is transmitted.

The absolute accuracy of the generated time frame depends on the quality of the receiver and the distance to the transmitter, but also on the conditions of transmission. Therefore, the absolute precision of the time frame is better in summer and at day than in winter and at night. The reason for this phenomenon is a difference in the portion of the sky wave which superimposes the ground wave. To check the accuracy of the time frame, the comparison of two systems with compensated propagation delay is meaningful.



M	Start of Minute (0.1 s)	
R	RF Transmission via secondary antenna	
A1	Announcement of a change in daylight saving	
Z1, Z2	Time zone identification	
	Z1, Z2 = 0, 1:	Daylight saving disabled
	Z1, Z2 = 1, 0:	Daylight saving enabled
A2	Announcement of a leap second	
S	Start of time code information	
P1, P2, P3	Even parity bits	

The PZF radio clock is a precision receiver system for the time signal transmitter DCF77. It is available as a module for use in systems such as Meinberg IMS, LANTIME M300 models and as a computer plug-in card. The microprocessor of the system performs the correlation of a reproduced pseudo-random bit sequence with the PZF of the transmitter side and simultaneously decodes the AM time and date information of the DCF telegram. By evaluating the pseudo-random phase noise, a time raster can be generated which is up to a factor of a thousand

more accurate than the ones of conventional AM radio clocks. In this way, an exact adjustment of the main oscillator of the radio-controlled clock is also possible, this allows it to be also used as a normal frequency generator, in addition to being used as a pure time receiver. If the PZF signal is temporarily unavailable for some reason, i.e. because a source of interference is in the vicinity, the radio clock will automatically switch to the AM signal - provided this is still receivable. The correlation receiver has a battery-buffered hardware clock, which takes over the time and date in the event of failure of the supply voltage.

5 Long Wave Signal Reception

5.1 Introduction

The longwave antenna **AW02** is a weatherproof and temperature resistant active antenna for outdoor use. It includes a ferrite antenna for reception of the longwave signal, and an amplifier, both assembled in a plastic housing. The standard version has been designed to receive the signal from the German longwave transmitter **DCF77** whose carrier frequency is 77.5 kHz. The DCF77 transmitter is operated by the German Physikalisch-Technische Bundesanstalt (PTB), and is located in Mainflingen near Frankfurt / Main. Its signal can be received in Germany and adjacent countries.

The variant **AW02-MSF** is available for the longwave transmitter **MSF** which is located in Anthorn / U.K., and transmits the time and frequency maintained by the U.K. National Physical Laboratory (NPL). The signal can be received throughout the U.K., and in wide parts of Northern and Western Europe.

Another variant is the **AW02-WWVB** which has been adapted for the **WWVB** radio station which is located in the United States near Fort Collins, Colorado, and is maintained by U.S. National Institute of Standards and Technology (NIST).

Even though these antenna variants are slightly different according to the characteristics of the associated transmitter, the basic requirements for installation are identical.

The longwave antennae can be operated with a cable length up to 300 meters (1000 ft) if standard RG58 coaxial cable is used. They are remotely powered by the receiver via the antenna cable, so no external power supply is required near the location of the antenna if a direct coaxial cable is used.

Surge protectors are optionally available and should be used in the antenna line to protect the receiver from high voltages spikes e.g. due to lightning strikes close to the antenna.

For longer distances from the antenna to the receiver an optional amplifier can be used, which requires an extra power supply. The **BLV** device is an amplifier with integrated surge protector.

Alternatively there is a **DCF Optical Antenna Link (DOAL)** available which uses a fiber optic connection between the antenna and the receiver which allows for a length up to 2000 meters (6500 ft), providing a high level of insulation and surge protection due to the optical transmission. Again, the default device has been designed for DCF77, but there are also variants for MSF and WWVB available. Since the fiber optic connection is unable to provide the antenna with DC current, an extra power supply is required in this case at the location of the antenna.

Longwave receiver equipment from Meinberg has specifically been designed for Meinberg devices and is not necessarily compatible with receivers from 3rd party manufacturers.

5.2 Mounting and Installation of a Longwave Antenna

The careful selection of the antenna location should be at the beginning of each antenna installation. It determines the reception quality and therefore the availability of the DCF77 reception signal decisively. In principle, a DCF77 reception within buildings is possible, however, the DCF77 reception may deteriorate due to metallic objects (e.g. reinforced concrete walls, metal facades, heat protection glazing etc.) that shield or attenuate the reception.

For this reason we always recommend to mount the antenna outside of buildings. This has the advantage that the signal interference distance to electronic devices in buildings is usually enhances and the reliability of the synchronisation is thus significantly increased.

Proper installation of an antenna for DCF77, MSF, or WWVB is illustrated in the figure below:

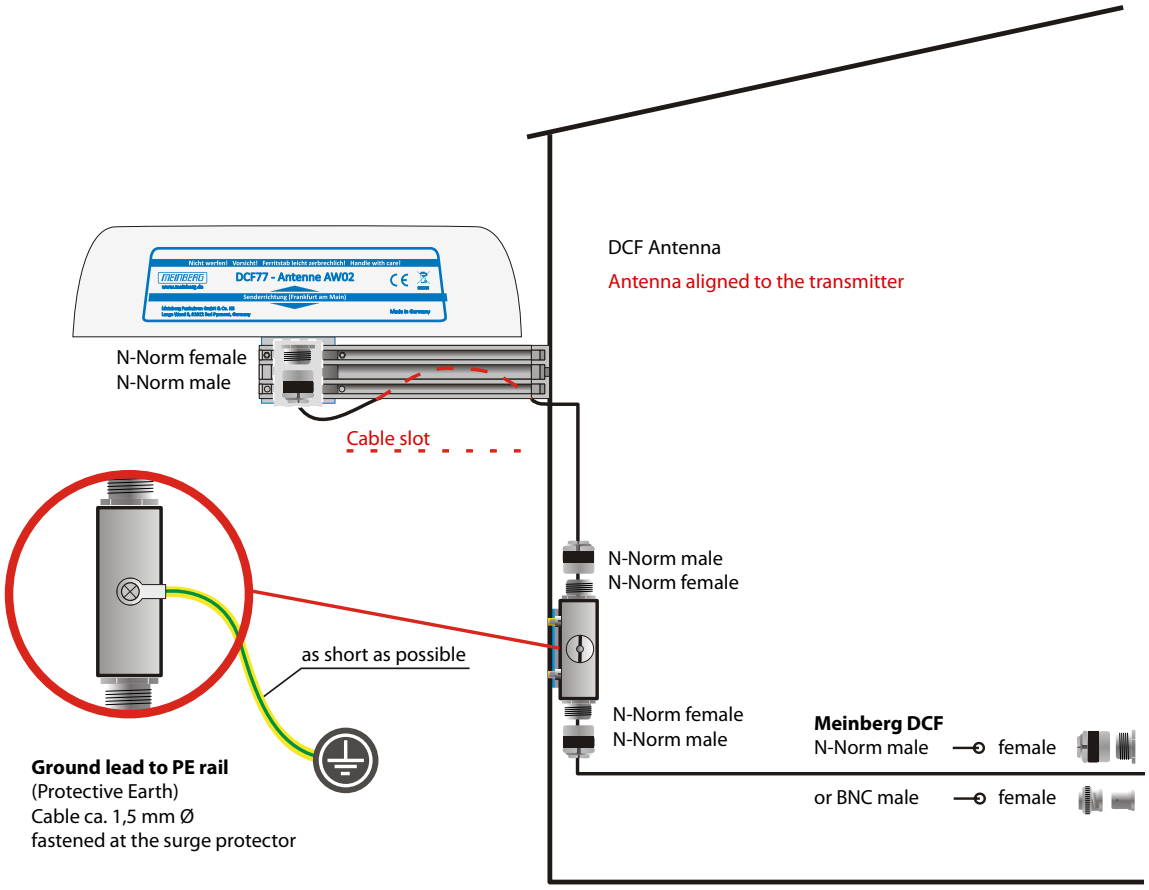


Figure: Longwave antenna mounted on a wall. The optional surge protector keeps high voltage strikes through the antenna cable away from the receiver.

The antenna has to be aligned horizontally in longitudinal direction to the transmitter, i.e. in direction to Mainflingen near Frankfurt / Main in case of DCF77, or in direction to the location of the MSF or WWVB receiver accordingly.

If the antenna is not aligned properly then signal reception is degraded, which can result in a limited time accuracy. The antenna should be installed with a minimum distance of 30 cm away from all metal objects and possibly any microcomputers and electrical devices (engines, electricity, etc.). A distance of several meters from TV and computer monitors should be considered as well.

The best method to align a longwave antenna is to turn the antenna slowly until the monitored signal level is minimized, and then turn the antenna by 90° to achieve maximum reception. However, a high signal level alone is not a guarantee for good reception since it can even be caused by electrical noise in the associated frequency range. For standard longwave receivers it is important that the modulation mark is blinking exactly once per second, without intermediate flickering.

DCF77/PZF receivers use correlation techniques to decode the phase modulation provided by DCF77, and with these types of receiver the maximum interference immunity can be found by looking at the autocorrelation parameter displayed in the display menu "PZF-STATE". The displayed value should be as close as possible to 100 % for best reception.

WARNING!

Antenna mounting without effective anti-fall protection

Danger to life due to fall!

- Pay attention to effective working safety when installing antennas!
- Never work without an effective anti-fall equipment!

WARNING!

Working on the antenna system during thunderstorms

Danger to life due to electrical shock!

- Do not carry out any work on the antenna system or the antenna cable if there is a risk of a lightning strike.
- Do not carry out any work on the antenna system if the safety distance to free lines and sequential circuits is exceeded.

5.3 DCF77 / PZF Receiver

If both the antenna and the power supply have been connected the system is ready to operate. After power up it takes up to three minutes for the receiver to synchronize, if reception is good enough. A high "Correlation & Field" is an indicator for a good signal quality.

To check the field strength and the signal correlation value, select in the Front Panel "Reference Time → Info PZF → Correlation & Field".

The correlation "State" starts in a "raw" mode, when the receiver tries to find the initial correlation. When good correlation has been found the receiver checks it 20 times: this state is labeled "check" and the correlation value is increased from 1 to 20. If the correlation quality stays good the state changes to the "fine" mode. The signal strength should be 100 or higher.

If no correlation with the incoming signal is possible then the clock changes automatically to DCF77 AM reception mode and tries to decode the second marks.

6 PZF Clock

Receiver: High accuracy DCF77 correlation receiver
Two seperate receiver channels for signal conversion and best aquisition and tracking of the DCF77 signal (AM + PZF).

Synchronization Time: 2-3 minutes after correct DCF77 signal reception

Frequency Outputs: Accuracy depends on oscillator
(standard: OCXO-SQ)

Pulse Outputs: Pulse per second (PPS) and pulse per minute (PPM).
TTL level, pulse width: 200msec

Accuracy of pulsees: Better than $\pm 50 \mu$sec after synchronization and 20 minutes of operation.

Backup Battery Type: CR2032 - button cell lithium battery
When main power supply fails, hardware clock runs free on quartz basis, almanac data is stored in RAM
Life time of lithium battery min. 10 years

Oscillator Options: OCXO-SQ, OCXO-MQ, OCXO-HQ, OCXO-DHQ

Antenna Connector: BNC female

Antenna Cable: shielded Coax cable

Cable Length: 300 m with standard coax cable

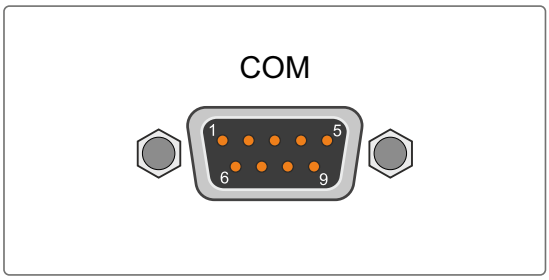
Current Consumption: +5 V 1,1 A to 1,4 A (depends on oscillator)

LED Indicators

Init:	blue:	while the receiver passes through the initialization phase
Field:	green:	minimum field strength needed for the correlation receiption is detected
Ant Fail:	red:	antenna faulty or not connected
Fail:	red:	time is not synchronized

Pin Assignment of the DSUB9 Connectors (male):
Pin 2: RxD
Pin 3: TxD
Pin 5: GND

Synchronization with PPS + String:
Pin 1: PPS
Pin 2: RxD



6.1 Menu Clock in the Web Interface

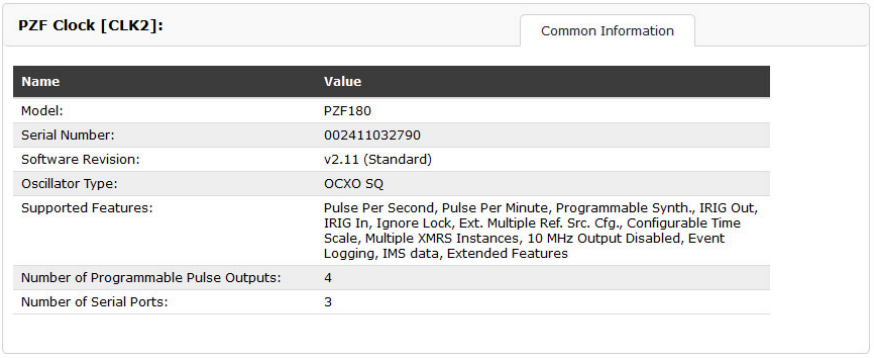
The initial start of operation of the clock and all other settings can be done via the web interface.

Depending on the receiver configuration of the system, i.e. whether it is a single reference clock or a system with two installed radio clocks and a signal cswitchover module (RSC), the web interface is set up accordingly. This also applies to the type of reference signal and its options. If the receiver configuration is redundant, the general settings for "IRIG In/Out", "Serial Ports", "Time Zone", "Enable Outputs", "Programmable Pulses" and "Synthesizers" appear in the "RSC switch card" menu.

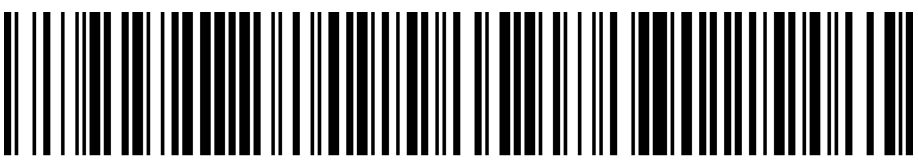
For PZF receivers, the distance to the transmitter (Frankfurt/Mainflingen) should be entered in the "Miscellaneous" submenu so that the PZF clock can compensate the signal transmission time.

PZF Receiver State

The current status of the clock can be monitored in the submenu "Receiver information".



Detailed information about the LANTIME web interface can be found in the current firmware manual, which can be downloaded from our website: https://www.meinbergglobal.com/english/docs/



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