The Synchronization Experts.

MANUAL

PZF180

DCF77 Correlation Receiver

December 8, 2021

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint

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2 Safety instructions for building-in equipment

2.1 Important Safety Instructions and Protective Measures

The following safety instructions must be observed whenever the device is being installed or operated. Failure to observe safety instructions and other special warnings and operating instructions in the product manuals constitutes improper usage and may violate safety standards and the manufacturer's requirements.

Depending on the configuration of your device or installed options, some information may not specifically apply to your device.

CE

The device satisfies the requirements of the following EU regulations: EMC Directive, Low Voltage Directive, RoHS Directive and—where applicable—the Radio Equipment Directive.

If a procedure is marked with the following signal words, you may only proceed with it if you have understood and fulfilled all requirements. Hazard notices and other relevant information are classified and indicated as such in this manual according to the following system:

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.

WARNING!
This signal 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.

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.

ATTENTION!
This signal word refers to a procedure or other action that may result in product damage or the loss of important data if not observed or if improperly performed.

2.2 Used Symbols

The following symbols and pictograms are used in this manual. Pictograms are used in particular to indicate potential hazards in all hazard categories.

Symbol	Beschreibung / Description
	IEC 60417-5031 Gleichstrom / *Direct current*
	IEC 60417-5032 Wechselstrom / *Alternating current*
	IEC 60417-5017 Erdungsanschluss / *Earth (ground) terminal*
	IEC 60417-5019 Schutzleiteranschluss / *Protective earth (ground) terminal*
	ISO 7000-0434A Vorsicht / *Caution*
	IEC 60417-6042 Vorsicht, Risiko eines elektrischen Schlages / *Caution, risk of electric shock*
	IEC 60417-5041 Vorsicht, heiße Oberfläche / *Caution, hot surface*
	IEC 60417-6056 Vorsicht, Gefährlich sich bewegende Teile / *Caution, moving parts*
	IEC 60417-6172 Trennen Sie alle Netzstecker / *Disconnect all power connectors*
	IEC 60417-5134 Elektrostatisch gefährdete Bauteile / *Electrostatic Discharge Sensitive Devices*
	IEC 60417-6222 Information generell / *General information*
	2012/19/EU Dieses Produkt fällt unter die B2B Kategorie. Zur Entsorgung muss es an den Hersteller übergeben werden. *This product is handled as a B2B-category product. To ensure that the product is disposed of in a WEEE-compliant fashion, it must be returned to the manufacturer.*

The product manuals are provided on a USB flash drive delivered with the system. The manuals can also be downloaded from the Meinberg website at https://www.meinbergglobal.com, where you can enter your system name into the search box at the top of the page to find the relevant manual. Alternatively, contact Meinberg Support for further assistance.

This manual contains important safety instructions for the installation and operation of the device. Please read this manual thoroughly before using the device.

This device may only be used for the purpose described in this manual. In particular, the specified operating limits of the device must be heeded. The person setting up the device is responsible for safety matters in relation to any larger system in which the device is installed!

Failure to observe these instructions may have an adverse impact on device safety!

Please keep this manual in a safe place.

This manual is only intended to be used by qualified electricians, or by persons who have been appropriately instructed by a qualified electrician and who are familiar with applicable national standards and with safety rules & regulations. This device may only be installed, set up, and operated by qualified personnel.

2.3 Safety Hints PZF180

This building-in equipment has been designed and tested in accordance with the requirements of Standard DIN EN 62368-1 "Audio/video, information and communication technology equipment - Part 1: Safety requirements).

During installation of the building-in equipment in an end application (i.e. PC) additional requirements in accordance with Standard DIN EN 62368-1 have to be taken into account.

General Safety instructions

- The building-in equipment has been evaluated for use in office environment (pollution degree 2) and may be only used in this environment. For use in rooms with a higher pollution degree more stringent requirements are applicable.
- The equipment/building-in equipment was evaluated for use in a maximum ambient temperature of 50°C.
- Protection against fire must be assured in the end application.

2.4 Prevention of ESD Damage

ATTENTION!

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

Symbol Indicating Devices with ESDS Components

The following measures will help to protect ESDS components from damage and malfunction.

When preparing to dismantle or install devices:
Ground your body (for example, by touching a grounded object) before touching sensitive devices.

Ensure that you wear a grounding strap on your wrist when handling such devices. These straps must in turn be attached to an uncoated, non-conductive metal part of the system.

Use only tools and devices that are free of static electricity.

When transporting devices:
Devices must only be touched or held by the edges. Never touch any pins or conductors on the device.

When dismantling or installing devices:
Avoid coming into contact with persons who are not grounded. Such contact may compromise your connection with the earth conductor and thus also compromise the device's protection from any static charges you may be carrying.

When storing devices:
Always store devices 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 device has a lithium battery fitted on it.

2.5 Cabling

WARNING!
Danger of death from electric shock! Never work on the system while the power is live! Always disconnect the cables from the devices at **both** ends before working on the plugs and terminals of connected cables!

2.6 Replacing the Lithium Battery

Skilled/Service-Personnel only: Replacing the Lithium Battery
The life time of the lithium battery on the receiver boards is at least 10 years. If the need arises to replace the battery, the following should be noted:

There is a Danger of explosion if the lithium battery is replaced incorrectly. Only identical batteries or batteries recommended by the manufacturer must be used for replacement.

The waste battery has to be disposed as proposed by the manufacturer of the battery.

3 General information PZF

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 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 build 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 wide-bandwidth. 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.

3.1 Features of PZF

The PZF is a high precision receiveer module for the DCF77-signal build in euro card size (100 mm x 160 mm).

The micro controller of the system correlates its receiver-PZF with the incoming pseudorandom sequence and decodes the time information of the DCF-telegram simultaneously. The controller handles input and output functions of the PZF180 and synchronizes the internal real-time clock.

By evaluating the pseudorandom phase noise, the PZF is able to generate time frames with thousand times the accuracy of standard AM-time code receivers. The precise regulation of the main oscillator (TCXO, OCXO optional for higher accuracy) of the radio clock is possible therefore. So, the PZF can be used as a standard frequency generator besides the application as a time code receiver. Three fixed and one settable TTL-level standard frequencies are available at the rear VG-connector. The synthesizer frequency exists as an open drain output and a sine wave signal also.

The PZF delivers TTL-low and TTL-high active pulses per minute and per second further. To distribute information concerning date, time and status, four independent serial interfaces (RS232) are used which are configurable in a setup menu.

Like mentioned before, the PZF includes a battery-backed real-time clock which runs crystal-precise if the main power supply fails.

4 PZF180 Features

The carrier frequency of 77.5kHz 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.

By evaluating the pseudorandom phase noise, the PZF180 is able to generate time frames with thousand times the accuracy of standard AM-time code receiver. The precise regulation of the main oscillator of the radio clock is possible therefore. So, the PZF180 can be used as a standard frequency generator besides the application as a time code receiver. One fixed 10MHz frequency and one settable TTL-level standard frequencies are available at the rear VG-connector. These frequencies are provided as sinewave outputs as well.

The PZF180 provides the capability to evaluate the high-precision pseudorandom phase noise as well as the common amplitude modulated AM signal. If the PZF signal is disturbed an cannot be received, the PZF180 automatically switches over to decode the AM signal, if available, and ensures synchronisation.

4.1 Pulse and Frequency Outputs

The pulse generator of PZF180 generates pulses once per second (P_SEC) and once per minute (P_MIN). Additionally, master frequencies of 10 MHz, 1 MHz and 100 kHz are derived from the OCXO. All the pulses are available with TTL level at the rear connector.

Frequency Outputs (optional)
The included synthesizer generates a frequency from 1/8 Hz up to 10 MHz synchronous to the internal timing frame. The phase of this output can be shifted from -360° to +360° for frequencies less than 10 kHz. Both frequency and phase can be setup by using the serial port COM0. Synthesizer output is available at the rear connector as sine-wave output (F_SYNTH_SIN), with TTL level (F_SYNTH) and via an open drain output (F_SYNTH_OD). The open drain output can be used to drive an optocoupler when a low frequency is generated.

In the default mode of operation, pulse outputs and the synthesizer output are disabled until the receiver has synchronized after power-up. However, the system can be configured to enable those outputs immediately after power-up. An additional TTL output (TIME_SYN) reflects the state of synchronization. This output switches to TTL HIGH level when synchronization has been achieved and returns to TTL LOW level if not a time signal can be received or the receiver is forced to another mode of operation by the user.

4.2 Time Capture Inputs

Two time capture inputs called User Capture 0 and 1 are provided at the rear connector (CAP0 and CAP1) to measure asynchronous time events. A falling TTL slope at one of these inputs lets the microprocessor save the current real time in its capture buffer. From the buffer, capture events are transmitted via COM0 or COM1 and displayed on LCD. The capture buffer can hold more than 500 events, so either a burst of events with intervals down to less than 1.5 msec can be recorded or a continuous stream of events at a lower rate depending on the transmission speed of COM0 or COM1 can be measured.

The format of the output string is ASCII, see the technical specifications at the end of this document for details. If the capture buffer is full a message "** capture buffer full" is transmitted, if the interval between two captures is too short the warning "** capture overrun" is being sent.

4.3 Asynchronous Serial Ports

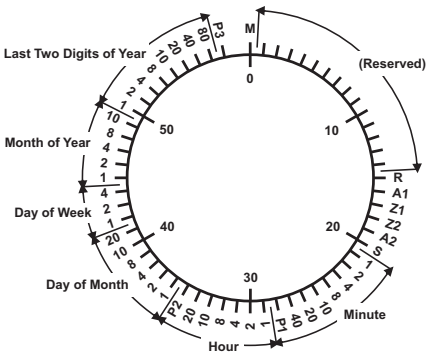
Up to four asynchronous serial RS-232 interfaces (COM0 ... COM3) are available to the user. By default, automatic transmission of a time string via the serial ports is disabled until the receiver has synchronized.

However, it is possible to change the device configuration so that serial time strings are always transmitted immediately after power-up.

Transmission speeds, framings and mode of operation can be configured separately using the setup menu. COM0 is compatible with other radio remote clocks made by Meinberg. It sends the time string either once per second, once per minute or on request with ASCII '?' only. Also the interfaces can be configured to transmit capture data either automatically when available or on request. The format of the output strings is ASCII, see the technical specifications at the end of this document for details.

4.4 DCF77 Emulation

The clock generates TTL level time marks (active HIGH) which are compatible with the time marks spread by the German long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany: time of day, date of month and day of week in BCD coded second pulses. Once every minute the complete time information is transmitted. However, the generates time marks representing its local time as configured by the user, including announcement of changes in daylight saving and announcement of leap seconds. The coding sheme is given below:



M	Start of Minute (0.1 s)	
R	RF Transmission via Secondary Antenna	
A1	Announcement of a Change in Daylight Saving Time	
Z1, Z2	Time Zone Identification	
	Z1, Z2 = 0, 1:	Daylight Saving Time Disabled
	Z1, Z2 = 1, 0:	Daylight Saving Time Enabled
A2	Announcement of a Leap Second	
S	Start of Time Code Information	
P1, P2, P3	Even Parity Bits	

Time marks start at the beginning of new second. If a binary "0" is to be transmitted, the length of the corresponding time mark is 100 msec, if a binary "1" is transmitted, the time mark has a length of 200 msec. The information on the current date and time as well as some parity and status bits can be decoded from the time marks of the 15th up to the 58th second every minute. The absence of any time mark at the 59th second of a minute signals that a new minute will begin with the next time mark. The DCF emulation output is enabled immediately after power-up.

4.5 Programmable pulse

At the male connector Typ VG96 there are four programmable TTL outputs (Prog Pulse 0-3), which are arbitrarily programmable.

4.6 Time Code (Option)

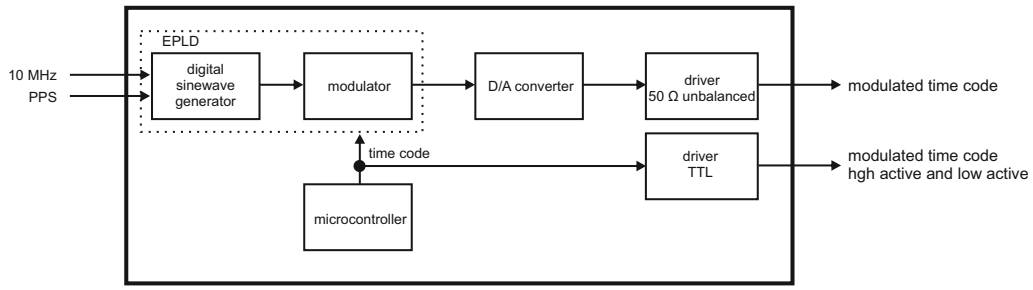
4.6.1 Abstract of Time Code

The transmission of coded timing signals began to take on widespread importance in the early 1950's. Especially the US missile and space programs were the forces behind the development of these time codes, which were used for the correlation of data. The definition of time code formats was completely arbitrary and left to the individual ideas of each design engineer. Hundreds of different time codes were formed, some of which were standardized by the "Inter Range Instrumentation Group" (IRIG) in the early 60's.

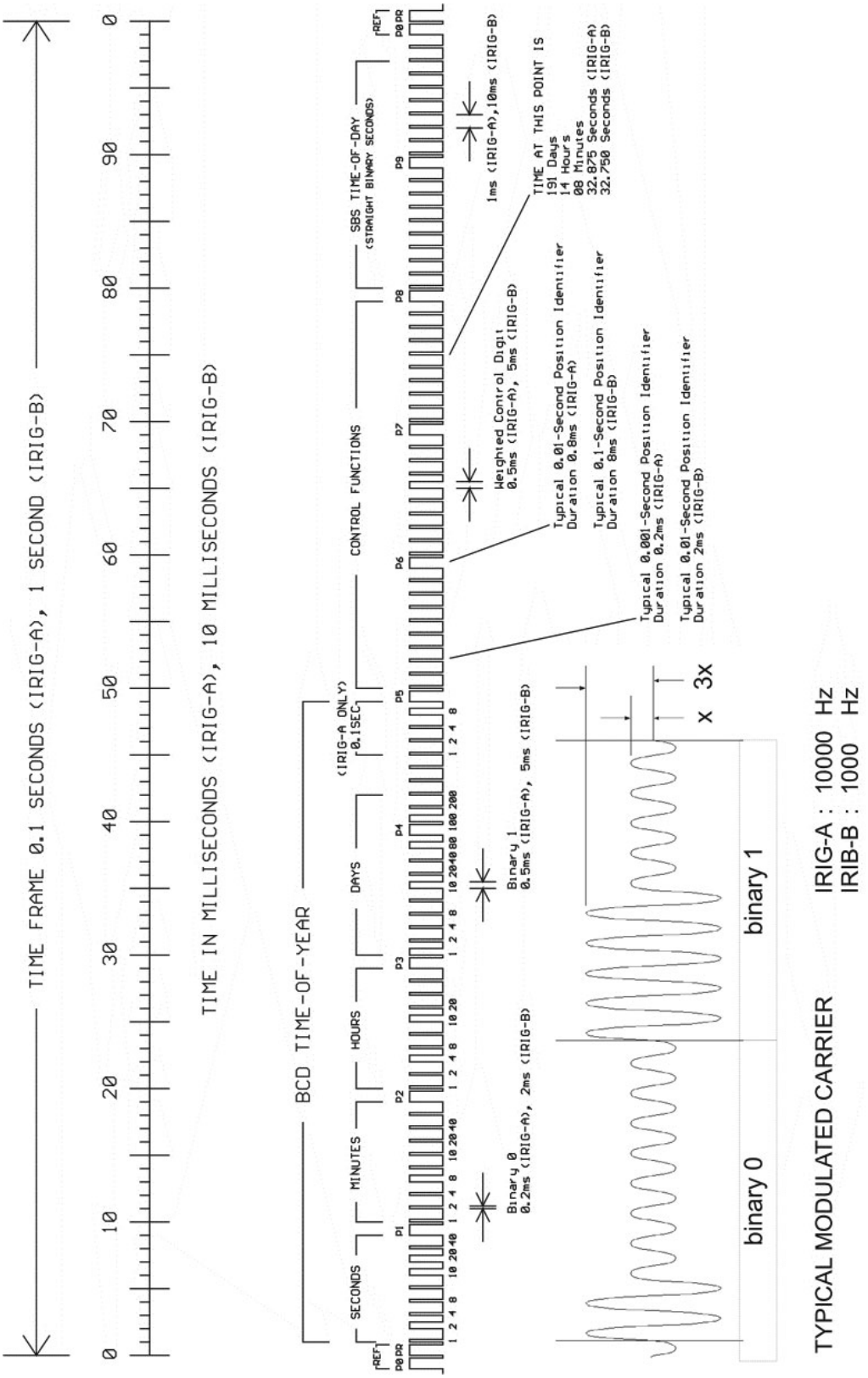
Except these "IRIG Time Codes", other formats like NASA36, XR3 or 2137 are still in use. The board PZF180 however generates the IRIG-B, AFNOR NFS 87-500 code as well as IEEE1344 code which is an IRIG-B123 coded extended by information for time zone, leap second and date. Other formats may be available on request.

A modulated IRIG-B (3 V_{pp} into 50W) and an unmodulated DC level shift IRIG-B (TTL) signal are available at the VG64 male connector of the module.

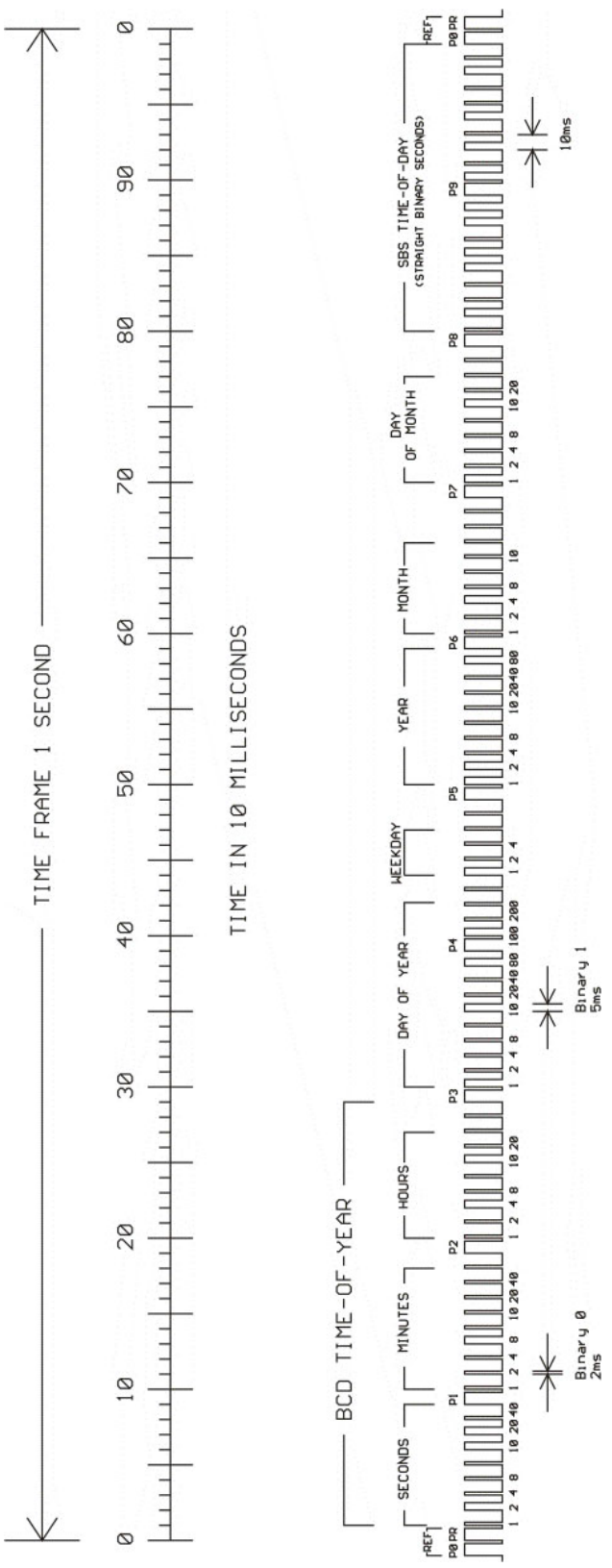
4.6.2 Block Diagram Time Code



4.6.3 IRIG Standard Format



4.6.4 AFNOR Standard Format



4.6.5 Assignment of CF Segment in IEEE1344 Code

Bit No.	Designation	Description
49	Position Identifier P5	
50	Year BCD encoded 1	
51	Year BCD encoded 2	low nibble of BCD encoded year
52	Year BCD encoded 4	
53	Year BCD encoded 8	
54	empty, always zero	
55	Year BCD encoded 10	
56	Year BCD encoded 20	high nibble of BCD encoded year
57	Year BCD encoded 40	
58	Year BCD encoded 80	
59	Position Identifier P6	
60	LSP - Leap Second Pending	set up to 59s before LS insertion
61	LS - Leap Second	0 = add leap second, 1 = delete leap second 1.)
62	DSP - Daylight Saving Pending	set up to 59s before daylight saving changeover
63	DST - Daylight Saving Time	set during daylight saving time
64	Timezone Offset Sign	sign of TZ offset 0 = '+', 1 = '-'
65	TZ Offset binary encoded 1	
66	TZ Offset binary encoded 2	Offset from IRIG time to UTC time.
67	TZ Offset binary encoded 4	Encoded IRIG time plus TZ Offset equals UTC at all times!
68	TZ Offset binary encoded 8	
69	Position Identifier P7	
70	TZ Offset 0.5 hour	set if additional half hour offset
71	TFOM Time figure of merit	
72	TFOM Time figure of merit	time figure of merit represents approximated clock error. 2.)
73	TFOM Time figure of merit	0x00 = clock locked, 0x0F = clock failed
74	TFOM Time figure of merit	
75	PARITY	parity on all preceding bits incl. IRIG-B time

1.) current firmware does not support leap deletion of leap seconds
2.) TFOM is cleared, when clock is synchronized first after power up. see chapter Selection of generated timecode

4.6.6 Generated Time Codes

Besides the amplitude modulated sine wave signal, the board also provides unmodulated DC-Level Shift TTL output in parallel. Thus six time codes are available.

a) B002: 100 pps, DCLS signal, no carrier
BCD time-of-year

b) B122: 100 pps, AM sine wave signal, 1 kHz carrier frequency
BCD time-of-year

c) B003: 100 pps, DCLS signal, no carrier
BCD time-of-year, SBS time-of-day

d) B123: 100 pps, AM sine wave signal, 1 kHz carrier frequency
BCD time-of-year, SBS time-of-day

e) B006: 100 pps, DCLS Signal, no carrier
BCD time-of-year, Year

f) B126: 100 pps, AM sine wave signal, 1 kHz carrier frequency
BCD time-of-year, Year

g) B007: 100 pps, DCLS Signal, no carrier
BCD time-of-year, Year, SBS time-of-day

h) B127: 100 pps, AM sine wave signal, 1 kHz carrier frequency
BCD time-of-year, Year, SBS time-of-day

i) AFNOR: Code according to NFS-87500, 100 pps, wave signal,
1kHz carrier frequency, BCD time-of-year, complete date,
SBS time-of-day, Signal level according to NFS-87500

j) IEEE1344: Code according to IEEE1344-1995, 100 pps, AM sine wave signal,
1kHz carrier frequency, BCD time-of-year, SBS time-of-day,
IEEE1344 extensions for date, timezone, daylight saving and
leap second in control functions (CF) segment.
(also see table 'Assignment of CF segment in IEEE1344 mode')

k) C37.118 Like IEEE1344 - with turned sign bit for UTC-Offset

4.6.7 Selection of Generated Time Code

The time code to be generated can be selected by Menu Setup IRIG-settings or by the used Monitorprogram (except Lantime models). DC-Level Shift Codes (PWM-signal) B00x and modulated sine wave carrier B12x are always generated simultaneously. Both signals are provided at the VG64-Connector, i.e. if code B132 is selected also code B002 is available. This applies for the codes AFNOR NFS 87-500 and IEEE1344 as well.

The TFOM field in IEEE1344 code is set dependent on the 'already sync'ed' character ('#') which is sent in the serial time telegram. This character is set, whenever the preconnected clock was not able to synchronize after power up reset. The 'time figure of merit' (TFOM) field is set as follows.

Clock synchronized once after power up:	TFOM = 0000
Clock not synchronized after power up:	TFOM = 1111

For testing purposes the output of TFOM in IEEE1344 mode can be disabled. The segment is set to all zeros then.

4.6.8 Outputs

The module PZF180 provides modulated (AM) and unmodulated (DCLS) outputs. The format of the timecodes is illustrated in the diagramms "IRIG-" and "AFNOR standard-format".

4.6.8.1 AM - Sine Wave Output

The carrier frequency depends on the code and has a value of 1 kHz (IRIG-B). The signal amplitude is 3 Vpp (MARK) and 1 Vpp (SPACE) into 50 Ohm. The encoding is made by the number of MARK-amplitudes during ten carrier waves. The following agreements are valid:

a)	binary "0":	2 MARK-amplitudes, 8 SPACE-amplitudes
b)	binary "1":	5 MARK-amplitudes, 5 SPACE-amplitudes
c)	position-identifier:	8 MARK-amplitudes, 2 SPACE-amplitudes

4.6.8.2 PWM DC Output

The pulse width DCLS signals shown in the diagramms "IRIG" and "AFNOR standard format" are coexistent to the modulated output and is available at the VG connector pin 13a with TTL level.

4.6.9 Technical Data

Outputs: Unbalanced AM-sine wave-signal:
3 V_{pp} (MARK) / 1 V_{pp} (SPACE) into 50 Ohm

DCLS signal: TTL

5 Installation

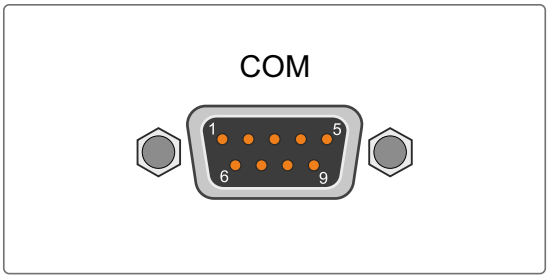
5.1 The Front Panel Layout

Figure: PZF180 with 8TE front and antenna connector and with 4TE front panel

LED Indicators

Init:	blue:	while the receiver passes through the initialization phase
	green:	the oscillator has warmed up
Field:	green:	sufficient field strength
	green: (blinking)	Receiver is in AM-Mode
Ant.:	red:	No signal (antenna faulty, not connected or insufficient reception)
Fail:	red:	time is not synchronized

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



5.2 DCF77 Antenna

The PZF Radio Clock operates with a ferrite antenna which is damped to match the bandwidth needed for the correlation reception. The IP-Code is: IP56

5.2.1 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:

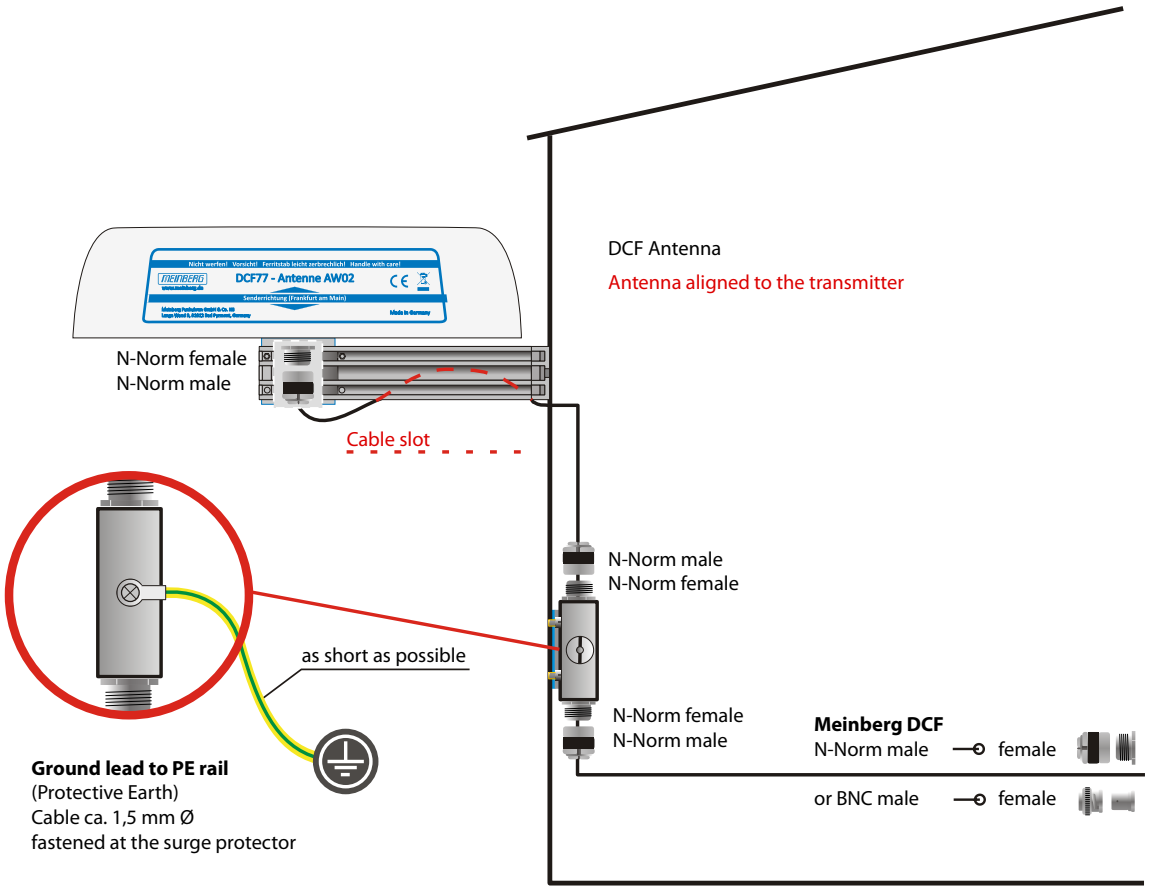


Figure: Longwave antenna mounted on a wall. The optional surge protector keeps high voltage strikes through the antenna cable away from the receiver.

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!

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 without an effective fall arrester!

WARNING!

Do not work on the antenna system during thunderstorms!

Danger of death from electric shock!

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

5.3 Power Supply

The power supply used with a PZF180 has to provide only one output of +5V. The output voltage should be well regulated because drifting supply voltages reduce the short time accuracy of the generated frequencies and timing pulses. The power supply lines should have low resistance and must be connected using both pins a, b and c of the rear connector.

5.4 Powering Up the System

The **Field**-LED is switched on if a DCF-signal with at least minimum field strength needed for the correlation receiption is detected at the input of the receiver. Whenever the reception of the pseudorandom PZF signal is not possible but the AM signal is available, the 'Field'-LED starts to blink once per second with a pulse duration of 100 or 200ms, corresponding to the demodulated DCF pulses.

If the Fail-LED is on, it was not possible to synchronize the internal realtime clock to DCF-time. This condition occures for several minutes after switching on the PZF180, because two DCF-telegrams are checked for plausibility before the data is taken over. Short disturbance of receiption can cause this state too.

This LED is switched off when the receiver is synchronous, this applies for PZF reception as well as for AM reception.

5.5 Meinberg Device Manager

The Meinberg driver software package mbgdevman (Meinberg Device Manager for Windows) can be used under Windows 7 and all newer versions. The software doesn't work under the operating systems Windows 95, Windows 98, Windows ME, Windows 2000, Windows XP and Windows Vista. For older operating systems the GPSMON monitoring software is still available.

Supported Linux distributions are Ubuntu, Mint Linux, Debian, SUSE Linux and CentOS.

The latest software packages can be found on the included USB memory stick or on our software download pages:
https://www.meinberg.de/german/sw/
https://www.meinberg.de/german/sw/mbg-devman.htm

Installing the Configuration Software
On Windows operating systems, an installer setup, with graphical user interface, will perform the installation routine of the mbgdevman. To update an already installed version of the Meinberg Device Manager, you can simply download and run a new version of the installation program. The existing version will then be overwritten by the new version.

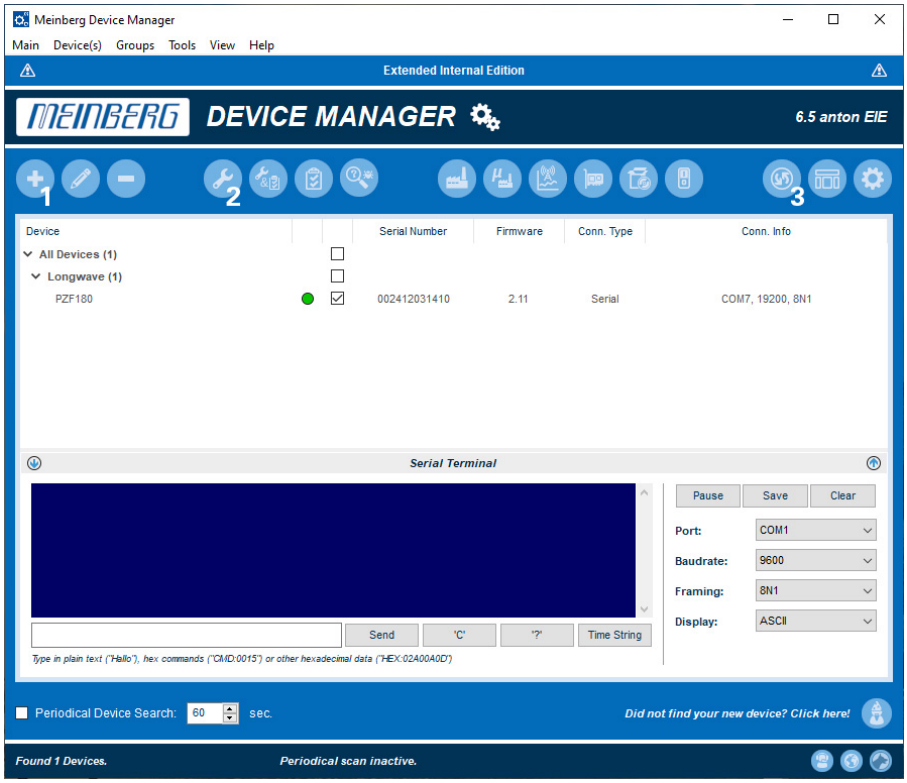
On Linux operating systems, unzip the TAR.GZ archive to the desired directory and run the program - e.g. with a terminal console command.

The Meinberg Device Manager is able to communicate with all standalone devices manufactured by Meinberg, which are equipped with a serial or USB interface or a network adapter.

Apart from the configuration, the software may also be used to monitor the synchronization status of devices and modules, output signals (e.g. monitoring of an outgoing time string), or to restart a supported device from a remote computer.

A connection between the system and the program can be established by serial port or via network interface.

Connection



If the PC should not have established an automatic connection to the clock, select the tab "Search Device" (No.3). Alternatively, you can select the button "Add Device" (No.1) to enter the identical configuration (Port, Baudrate, Framing) of the device.

Configuration

With tab No. 2 (Configure Device) various configurations can be carried out on the system. Please note that any changes you make in the settings must always be confirmed with the "Apply Configuration" button. Use the "Restore Configuration" button to reset all settings back to their default values. For more information, please refer to the Meinberg Device Manager manual: https://www.meinbergglobal.com/download/docs/sw/english/mbgdevman.pdf

5.6 The program GPSMON32

The program GPSMON32 can be used to monitor and programm all essential functions of Meinberg Receivers. The Software is executable under Windows 7, Windows Vista, Win9X, Win2000, WinXP and WinNT. To install GPSMON32 just run **setup.exe** from the included USB flash drive and follow the instructions of the setup program.

Program and clock can communicate either via serial link or via TCP/IP connection if the clock is prepared for (XPT board). The mode to be used can be selected in menu *"Connection -> Settings"* by the checkboxes serial and network.

5.6.1 Serial Connection

To obtain a connection between you PC and the receiver, connect the receivers COM 0 port to a free serial port of your PC. The PCs comport used by the program GPSMON32 can be selected in submenu "PC-Comport" in menu "Connection".

Also transfer rate and framing used by the program are selected in this menu. Communication between the clock and the PC comes about, only if the receiver serial port is configured in the same way as the PCs comport. You can enforce an access, if the receiver serial port is not configured with appropriate parameters for communication. Select the menu item "Enforce Connection" in menu "Connection" and click "Start" in the apperaring window. Some firmware versions of the receiver do not support this way of setting up a connection. If "Enforce Connection" doesn't succeed apparently, please change the serial port parameter of COM 0 manually to the PCs parameters.

5.6.2 Network Connection

(only clocks with Ethernet access!)

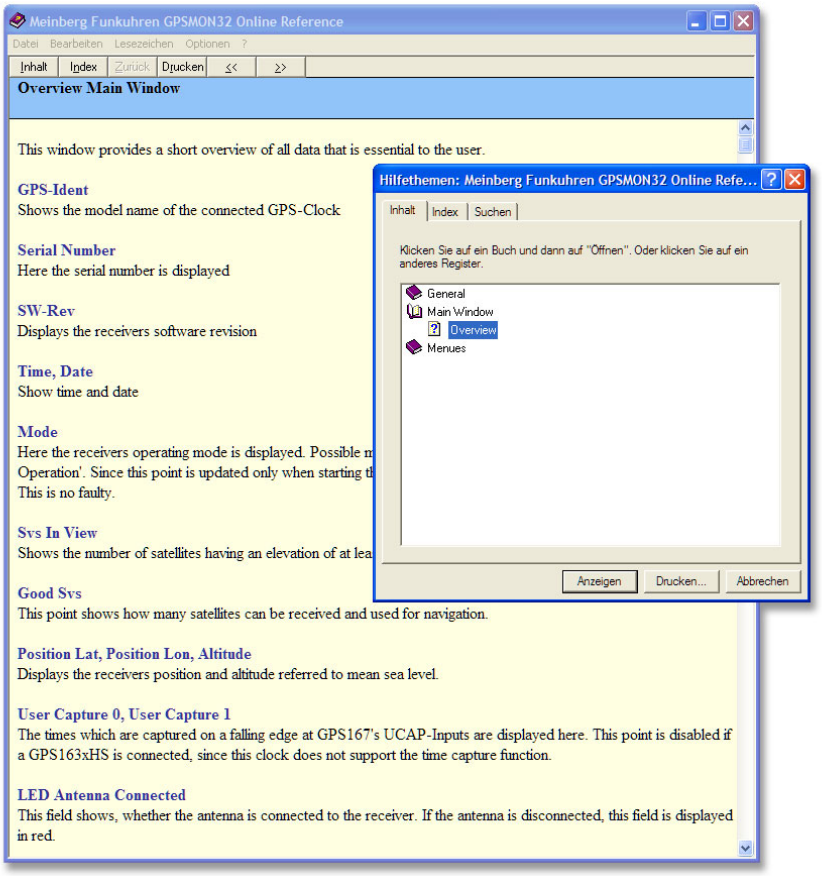
Settings needed for a network connection can be done in menu "Connection->Settings".
To set up a network connection from clock program GPSMON32, the mode "network" must be selected in the field "mode". Further the TCP/IP-Address must be entered in field "IP-Address". If the IP-Address is unknown, the user can let the program search for available clocks in the local network by clicking the "Find" button. A new connection can be set up by clicking to one of the displayed addresses.

Access to radioclocks by network is always protected by a Password.

The online help function of GPSMON32 provides detailed information on setting up a TCP/IP connection.

5.6.3 Online Help

The online help can be started by clicking the menu item "Help" in menu Help. In every program window a direct access to a related help topic can be obtained by pressing F1. The help language can be selected by clicking the menu items German/English in the Help Menu



6 Update of the System Software

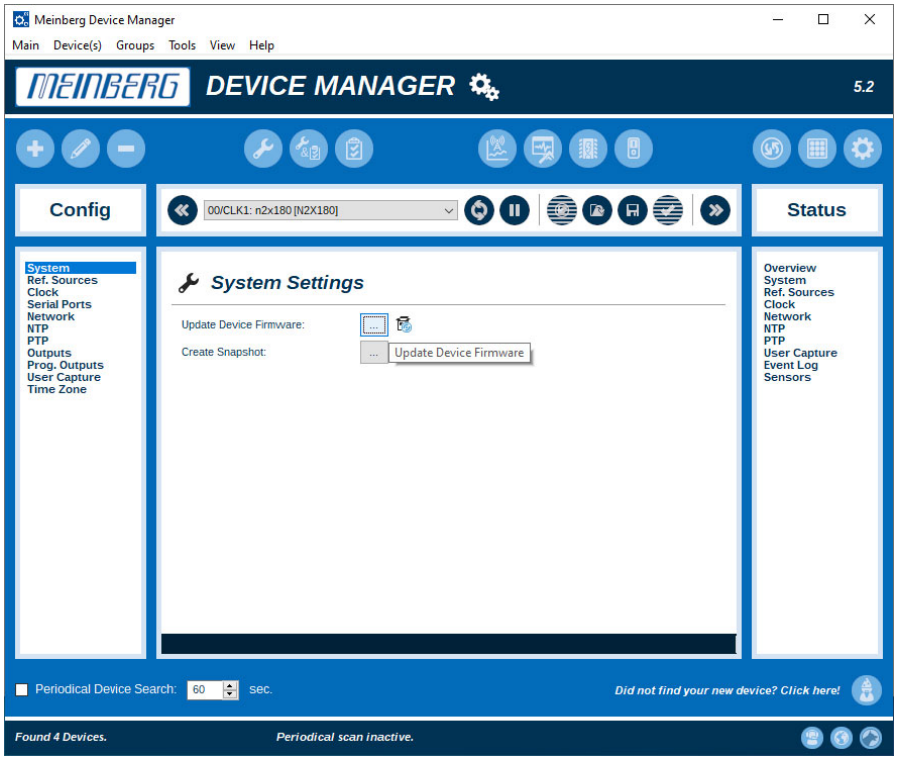


Figure: With the button **Flash Device Firmware** *a current firmware version can be loaded on the PZF180 module.*

If it is ever necessary to copy an updated version of the system firmware to the device, this can be done via the serial interface COM 0 without opening the housing of the device. The new firmware version can easily be loaded onto the system using the Meinberg monitoring software "Meinberg Device Manager".

You can find the software and the "Meinberg Device Manager" documentation on the included USB stick or as download on our website: https://www.meinbergglobal.com/english/sw/mbg-devman.htm

Create Snapshot
It is possible to save the current configuration of the PZF180 module as a text file (zip format). In case of operating problems you can send this file to the MEINBERG support team.

Note:
You may need a "Serial to USB Converter" to connect the system with your PC. This converter is not included in the scope of delivery.

7 Technical specifications PZF180

Receiver: Two seperate receiver channels for signal conversion and best aquisition and tracking of the DCF77 signal.
Reception via external ferrite antenna AW02.

Control of reception: The DCF-signal is checked for minimum field strength by microprocessor.
The result is indicated by LED.

Batterybackup: In case of power failure an internal realtime clock runs crystal-precise.
Important parameters are stored in the system-RAM.
Life time of lithium battery: 10 years minimum

Pulse Outputs: change of second (P_SEC, TTL level)
change of minute (P_MIN, TTL level)

Frequency Outputs: 10 MHz, TTL level into 50 Ohm
1 MHz, TTL level
100 kHz, TTL level

Frequency Synthesizer: 1/8 Hz up to 10 MHz

Accuracy of Synthesizer: base accuracy depends on system accuracy

1/8 Hz to 10 kHz	Phase syncron with pulse output P_SEC
10 kHz to 10 MHz	frequency deviation < 0.0047 Hz

Synthesizer Outputs:

F_SYNTH: TTL level

F_SYNTH_OD: open drain

drain voltage:	< 100 V
sink current to GND:	< 100 mA
dissipation power at 25°C:	< 360 mW

F_SYNTH_SIN: sine-wave

output voltage:	1.5 V eff.
output impedance:	200 Ohm

Time_Syn Output: TTL HIGH level if synchronized

Time Capture Inputs: triggered on falling TTL slope
Interval of events: 1.5msec min., Resolution: 100ns

Serial Ports:	Up to 4 asynchronous serial ports RS-232	
	Baud Rate:	300, 600, 1200, 2400, 4800, 9600, 19200 Baud
	Framing:	7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8N1, 8N2, 8O1
Default setting:	COM0:	19200, 8N1 Meinberg Standard time string, per second
	COM1:	9600, 8N1 Capture string, automatically
Time Code Outputs:	Unbalanced modulated sine wave signal: $3V_{pp}$ (MARK), $1V_{pp}$ (SPACE) into 50 ohm	
	DCLS-signal: TTL into 50 ohm, active-high or -low	
Power Requirements:	+5 V +-5%, max. 1,2 A	
Ambient Temp.:	0 ... 50°C	
Humidity:	85% max.	

Steckerbelegung / Pin Assignment PZF180

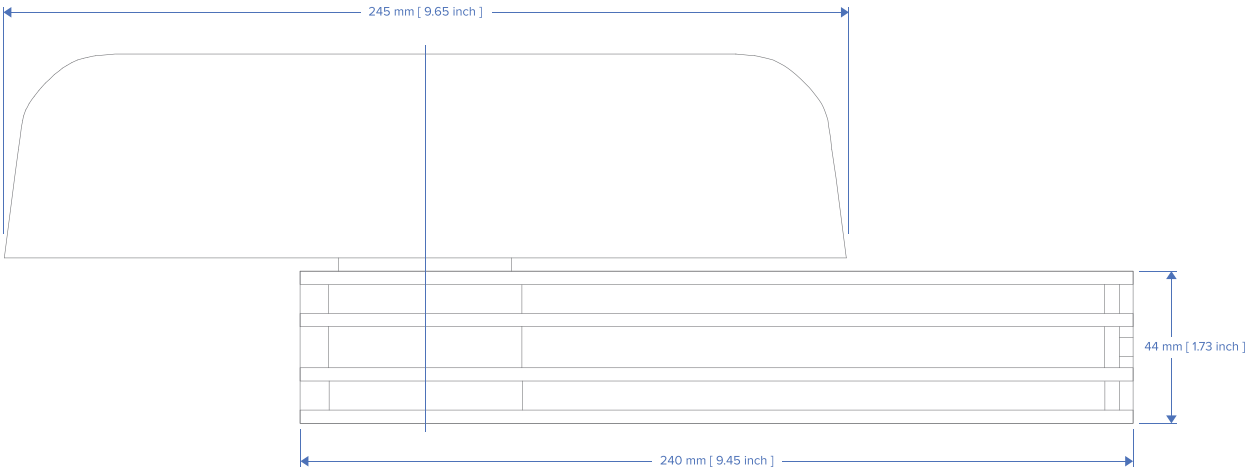
	a	b	c
1	Vcc (+5V)	Vcc (+5V)	Vcc (+5V)
2			
3	V_{DD} (Osc.)		V_{DD} (Osc.)
4	(OSC_ADJ in)	PPS Out	ProgPulse3 out
5	FF out	GND	10MHz in
6	PPS in		PPS out
7	TC DCLS in	GND	PPS2 in
8	(10MHz_OSC in)		PPM out
9	(10MHz sine out)		
10	100kHz out		ProgPulse0 out
11	1MHz out		ProgPulse1 out
12	10MHz Out		ProgPulse2 out
13	TC DCLS out		
14	TC AM out	GND	RxD4 in
15	RxD2 in		
16	TxD2 out		Reserve0 in
17	RxD3 in		DCF_MARK out
18	TxD3 out		(TxD2 TTL out)
19	GND		TIME_SYN out
20	GND	GND	Reserve1 in
21	GND		F_SYNTH out
22	GND	GND	F_SYNTH_OD out
23	GND		F_SYNTH_SIN out
24	GND		TxD1 out
25	GND	Slot ID0	TxD4 out
26	GND	Slot ID1	TxD0 out
27	GND	Slot ID2	CAP1 in
28	GND	Slot ID3	CAP0 in
29	GND	+USB **(**IMS**)**	RxD1 in
30	GND	-USB **(**IMS**)**	RxD0 in
31	GND	GND	GND
32	GND	GND	GND

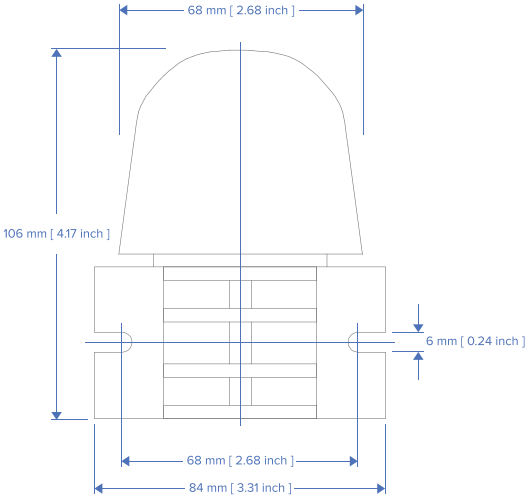
Signale in (Klammern) sind über Lötbrücken zugänglich

Signals in (parentheses) are accessible via solder bridges

7.1 Technical Specifications AW02 Antenna

Physical Dimensions:





Specifications:

Power supply:	3,5 V - 5 V
Receive frequency:	77.5 kHz
Bandwidth:	1 kHz
Signal level:	50 μV - 5 mV
Connector:	N-Norm female connector
Form factor:	ABS plastic case for outdoor installation
Protection class:	IP56
Temperature range:	-25 °C to +65 °C (-13 to 149 °F)
Weight:	0,55 kg (1,2 lbs) incl. mounting kit

7.1.1 Antenna Cable

Cable Type	Cable Diameter (mm/in)	Attenuation at 100 MHz (db)/100 m/328 ft	Max. Cable Length (m/ft)	Used for Receiver Type
RG58/CU	5/0.2	17	300/984	GPS/GNS-UC/PZF
RG213	10.3/0.41	7	700/2297	GPS/GNS-UC
H155	5.4/0.21	9.1	70/230	GNM/GNS
H2010 Ultraflex	7.3/0,29	5.8	150/492	GNM/GNS

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

7.1.2 Antenna Short Circuit

This information only applies to devices with a front display.

If the antenna line is short-circuited, the following message will be shown on the display:

If this message appears, the clock must be switched off and the cause of the problem must be eliminated before the clock can be switched back on. The supply voltage for the antennas/converter unit is around 15 V DC with the antenna connected.

7.1.3 Technical Specifications: MBG S-PRO Surge Protection

Adapter plug with replaceable gas discharge tube for coaxial signal connections.

Connection: Type-N connector female/female. The MBG S-PRO set includes a surge protector (Phoenix CN-UB-280DC-BB), a pre-assembled coaxial cable, and a mounting bracket.

The coaxial cable surge protector must be installed on the antenna line. The shielding is grounded using a conductor that is short as possible. The CN-UB-280DC-BB is equipped with two Type-N female connectors, and has no dedicated input/output polarity and no preferred installation orientation.

Phoenix CN-UB-280DC-BB

Features:

- High RF Performance
- Multiple Strike Capability
- 20 kA Surge Protection
- Bidirectional Protection

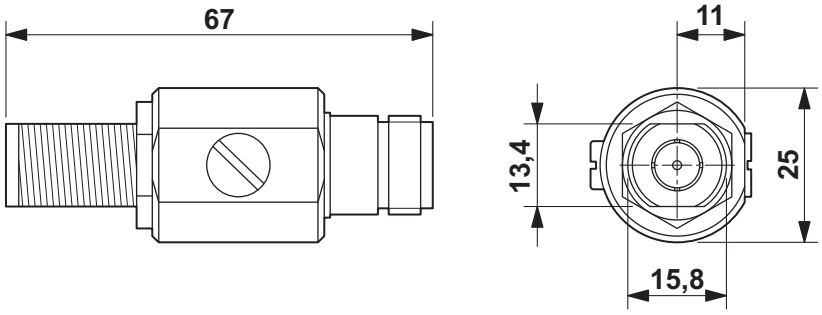
Installation Method:	Connector Type-Specific Adapter Plug	
Direction of Action:	Line Shield/Earth Ground	
Maximum Continuous Operating Voltage:	UC (Wire-Ground) 195 V AC	280 V DC
Rated Current:	I_N	5 A (25 °C)
Effective Operating Current:	IC at UC	$\leq$ 1 μA
Rated Discharge Current:	In (8/20) μs (Core-Earth) In (8/20) μs (Core-Shield)	20 kA 20 kA
Total Surge Current:	(8/20) μs (10/350) μs	20 kA 2.5 kA

Max. Discharge Current:	I_{max} (8/20)μs Maximum (Core-Shield)	20 kA
Rated Pulse Current:	I_{an} (10/1000)μs (Core-Shield)	100 A
Impulse Discharge Current:	(10/350) μs, Peak Value I_{imp}	2.5 kA
Output Voltage Limit:	At 1 kV/μs (Core-Earth) spike At 1 kV/μs (Core-Earth) spike	$\leq$ 900 V $\leq$ 900 V
Response Time:	tA (Core-Earth) tA (Core-GND)	$\leq$ 100 ns $\leq$ 100 ns
Input Attenuation:	aE, asym.	Typically 0.1 dB ($\leq$ 1.2 GHz) Typically 0.2 dB ($\leq$ 2.2 GHz)
Cut-Off Frequency:	fg (3 dB), asym. (Shield) in 50 Ω System > 3 GHz	
Standing Wave Ratio:	VSWR in a 50 Ω System	Typically 1.1 ($\leq$ 2 GHz)
Permissible HF Power:	P_{max} at VSWR = xx (50 Ω System)	700 W (VSWR = 1.1) 200 W (VSWR = ∞)
Capacitance:	(Core-Earth) Asymmetric (Shield)	Typically 1.5 pF Typically 1.5 pF
Surge Current Resistance:	(Core-Earth)	C1 - 1 kV/500 A C2 - 10 kV/5 kA C3 - 100 A D1 - 2.5 kA
Ambient Temperature:	(During Operation)	-40 °C ... 80 °C
Supported Altitude:	$\leq$ 2000 m (above sea level)	
IP Rating:	IP55	
Housing Material:	Nickel-Plated Brass Colored Nickel	
Dimensions:	Height 25 mm, Width 25 mm, Depth 67 mm	
Connection Type:	 IN OUT	Type-N Connector 50 Ω Type-N Connector, Female Type-N Connector, Female
Standards/Regulations:	IEC 61643-21 2000 + A1:2008 EN 61643-21 2001 + A1:2009	

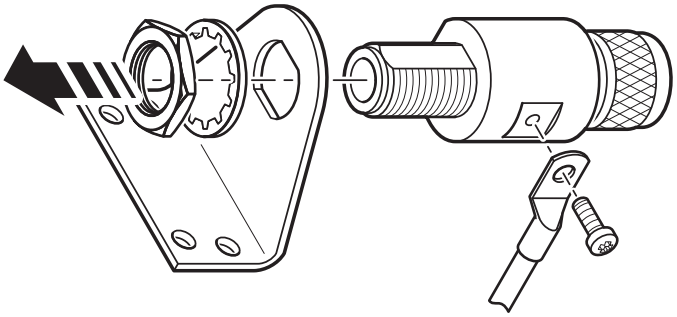
The original product page of the supplier (see link) of the CN-UB-280DC-BB surge protector is the source of the specifications above. Please refer to the manufacturer's product page at the following link for detailed specifications as well as a variety of product-specific documents:

https://www.phoenixcontact.com/online/portal/gb/?uri=pxc-oc-itemdetail:pid=2818850

7.1.3.1 MBG S-PRO: Physical Dimensions



7.1.3.2 Installation and Grounding



7.2 Oscillator specifications

Oscillators available for Meinberg Receivers / Time Servers:
OCXO, TCXO

	TCXO	OCXO LQ	OCXO SQ	OCXO MQ	OCXO HQ	OCXO DHQ
short term stability (τ = 1 sec)	$4 \cdot 10^{-9}$	$2 \cdot 10^{-9}$	$1 \cdot 10^{-9}$	$4 \cdot 10^{-10}$	$2 \cdot 10^{-11}$	$4 \cdot 10^{-12}$
phase noise	1Hz -60dBc/Hz 10Hz -90dBc/Hz 100Hz -120dBc/Hz 1kHz -130dBc/Hz	1Hz -60dBc/Hz 10Hz -90dBc/Hz 100Hz -120dBc/Hz 1kHz -130dBc/Hz	1Hz -70dBc/Hz 10Hz -105dBc/Hz 100Hz -125dBc/Hz 1kHz -140dBc/Hz	1Hz -75dBc/Hz 10Hz -110dBc/Hz 100Hz -130dBc/Hz 1kHz -140dBc/Hz	1Hz < -85dBc/Hz 10Hz < -115dBc/Hz 100Hz < -130dBc/Hz 1kHz < -140dBc/Hz	1Hz < -80dBc/Hz 10Hz < -110dBc/Hz 100Hz < -125dBc/Hz 1kHz < -135dBc/Hz
accuracy free run, one day	$\pm 1 \cdot 10^{-7}$ $\pm$1Hz (1)	$\pm 2 \cdot 10^{-8}$ $\pm$0.2Hz (1)	$\pm 5 \cdot 10^{-9}$ $\pm$50mHz (1)	$\pm 1.5 \cdot 10^{-9}$ $\pm$15mHz (1)	$\pm 5 \cdot 10^{-10}$ $\pm$5mHz (1)	$\pm 1 \cdot 10^{-10}$ $\pm$1mHz (1)
accuracy, free run, 1 year	$\pm 1 \cdot 10^{-6}$ $\pm$10Hz (1)	$\pm 4 \cdot 10^{-7}$ $\pm$4Hz (1)	$\pm 2 \cdot 10^{-7}$ $\pm$2Hz (1)	$\pm 1 \cdot 10^{-7}$ $\pm$1Hz (1)	$\pm 5 \cdot 10^{-8}$ $\pm$0.5Hz (1)	$\pm 1 \cdot 10^{-8}$ $\pm$0.1Hz (1)
temperature depandant drift free run	$\pm 1 \cdot 10^{-6}$ (-20...70°C)	$\pm 2 \cdot 10^{-7}$ (0...60°C)	$\pm 1 \cdot 10^{-7}$ (-10...70°C)	$\pm 5 \cdot 10^{-8}$ (-20...70°C)	$\pm 1 \cdot 10^{-8}$ (5...70°C)	$\pm 2 \cdot 10^{-10}$ (5...70°C)

Note 1: The accuracy in Hertz is based on the standard frequency of 10 MHz.

For example: Accuracy of TCXO (free run one day) is $\pm 1 \cdot 10^{-7} \cdot 10\text{MHz} = \pm 1$ HZ

The given values for the accuracy of frequency and time (not short term accuracy) are only valid for a constant ambient temperature!

7.3 Time Strings

7.3.1 Format of the Interflex Time String

The Interflex Time String is a sequence of 32 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<STX>D:*dd.mm.yy;T:w;U:hh.mm.ss;uvxy*<ETX>

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

<STX>	Start-Of-Text, ASCII Code 02h sending with one bit occuracy at change of second		
dd.mm.yy	the current date:		
	dd	day of month	(01..31)
	mm	month	(01..12)
	yy	year of the century	(00..99)
w	the day of the week		(1..7, 1 = Monday)
hh.mm.ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)

uv clock status characters (depending on clock type):

u:	'#'		Clock has not synchronized after reset
	' '		(space, 20h) Clock has synchronized after reset
v:	'*'		Clock currently runs on XTAL
	' '		(space, 20h) Clock is syncronized with transmitter

x time zone indicator:

'U'	UTC	Universal Time Coordinated, formerly GMT
' '	MEZ	European Standard Time, daylight saving disabled
	'S'	MESZ European Summertime, daylight saving enabled

y anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'!'	announcement of start or end of daylight saving time
'A'	announcement of leap second insertion
' '	(space, 20h) nothing announced

<ETX> End-Of-Text, ASCII Code 03h

7.3.2 Format of the Meinberg Standard Time String

The Meinberg Standard Time String is a sequence of 32 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<STX>D:*dd.mm.yy;T:w;U:hh.mm.ss;uvxy*<ETX>

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

<STX>	Start-Of-Text, ASCII Code 02h		
	sending with one bit occuracy at change of second		
dd.mm.yy	the current date:		
	dd	day of month	(01..31)
	mm	month	(01..12)
	yy	year of the century	(00..99)
w	the day of the week		(1..7, 1 = Monday)
hh.mm.ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)

uv clock status characters (depending on clock type):

u:	'#'	Clock has not synchronized after reset
	' '	(space, 20h)
		Clock has synchronized after reset
v:	'*'	Clock currently runs on XTAL
	' '	(space, 20h)
		Clock is syncronized with transmitter

x time zone indicator:

'U'	UTC	Universal Time Coordinated, formerly GMT
' '	MEZ	European Standard Time, daylight saving disabled
	'S'	MESZ European Summertime, daylight saving enabled

y anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'!'	announcement of start or end of daylight saving time
'A'	announcement of leap second insertion
' '	(space, 20h) nothing announced

<ETX> End-Of-Text, ASCII Code 03h

7.3.3 Format of the Uni Erlangen String (NTP)

The time string Uni Erlangen (NTP) of a GPS clock is a sequence of 66 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<STX>*tt.mm.jj; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.llle hhhhm*<ETX>

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

<STX> Start-Of-Text, ASCII Code 02h
sending with one bit occuracy at change of second

dd.mm.yy the current date:

dd	day of month	(01..31)
mm	month	(01..12)
yy	year of the century	(00..99)
w	the day of the week	(1..7, 1 = Monday)

hh.mm.ss the current time:

hh	hours	(00..23)
mm	minutes	(00..59)
ss	seconds	(00..59, or 60 while leap second)

v sign of the offset of local timezone related to UTC

oo:oo offset of local timezone related to UTC in hours and minutes

ac clock status characters:

a:	'#'	clock has not synchronized after reset
' '	(space, 20h)	clock has synchronized after reset
c:	'*'	GPS receiver has not checked its position
' '	(space, 20h)	GPS receiver has determined its position

d time zone indicator:

'S'	MESZ	European Summertime, daylight saving enabled
' '	MEZ	European Standard Time, daylight saving disabled

f anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'!'	announcement of start or end of daylight saving time
' '	(space, 20h) nothing announced

g anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'A'	announcement of leap second insertion
' '	(space, 20h) nothing announced

i leap second insertion

'L'	leap second is actually inserted (active only in 60th sec.)
' '	(space, 20h) no leap second is inserted

The following information regarding the receiver position is set to zero because receiver does not support this.

bbb.bbbb	latitude of receiver position in degrees leading signs are replaced by a space character (20h)
n	latitude, the following characters are possible: 'N' north of equator 'S' south d. equator
lll.llll	longitude of receiver position in degrees leading signs are replaced by a space character (20h)
e	longitude, the following characters are possible: 'E' east of Greenwich 'W' west of Greenwich
hhhh	altitude above WGS84 ellipsoid in meters leading signs are replaced by a space character (20h)

<ETX> End-Of-Text, ASCII Code 03h

7.3.4 Format of the ATIS standard Time String

The ATIS standard Time String is a sequence of 23 ASCII characters terminated by a CR (Carriage Return) character. The format is:

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

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

<GID>	Address of the receiver		code 7Fh
<ABS>	Originator of message	ASCII '0'	code 30h
<TSQ>	Telegram number	ASCII '0'	code 30h
<CC>	Command code	ASCII 'S' for SET	code 53h
<CS>	Command code	ASCII 'A' for ALL	code 41h
<ST>	Time status	ASCII 'C' for valid time	code 43h
yymmdd	the current date:		
	yy year of the century	(00..99)	
	mm month	(01..12)	
	dd day of month	(01..31)	
hh:mm:ss	the current time:		
	hh hours	(00..23)	
	mm minutes	(00..59)	
	ss seconds	(00..59, or 60 while leap second)	
w	the day of the week	(1..7, 1 = 31h = Monday)	
cc	checksum in hex, built from all characters including GID, ABS, TSQ, CC, ST, ...		
<CR>	Carriage Return, ASCII code 0Dh		

(The standard interface configuration for this string type is 2400 baud, 7E1)

7.3.5 Format of the SYSPLEX-1 Time String

The SYSPLEX1 time string is a sequence of 16 ASCII characters starting with the SOH (Start of Header) ASCII controll character and ending with the LF (line feed, ASCII Code 0Ah) character.

Please note:
To receive the Timestring on a selected terminal correctly you have to send a " **C** " (once, without quotation marks).

The format is:

<SOH>ddd:hh:mm:ssq<CR><LF>

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

<SOH>	Start of Header (ASCII control character) sending with one bit accuracy at change of second		
ddd	day of year		(001..366)
hh:mm:ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	q	Quality indicator	(space) Time Sync (GPS lock) (?) no Time Sync (GPS fail)
<CR>	Carriage-return (ASCII code 0Dh)		
<LF>	Line-Feed (ASCII code 0Ah)		

7.3.6 Format of the SAT Time String

The SAT Time String is a sequence of 29 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<STX>*dd.mm.yy*/*w*/*hh:mm:ss*x*x*x*x*x*uv*<ETX>

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

<STX> Start-Of-Text, ASCII Code 02h
sending with one bit accuracy at change of second

dd.mm.yy the current date:

dd	day of month	(01..31)
mm	month	(01..12)
yy	year of the century	(00..99)
w	the day of the week	(1..7, 1 = Monday)

hh:mm:ss the current time:

hh	hours	(00..23)
mm	minutes	(00..59)
ss	seconds	(00..59, or 60 while leap second)

xxxx time zone indicator:

'UTC'	Universal Time Coordinated, formerly GMT
'CET'	European Standard Time, daylight saving disabled
'CEST'	European Summertime, daylight saving enabled

u clock status characters:

'#'	clock has not synchronized after reset
' '	(space, 20h) clock has synchronized after reset

v anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'!'	announcement of start or end of daylight saving time
' '	(space, 20h) nothing announced

<CR> Carriage Return, ASCII Code 0Dh

<LF> Line Feed, ASCII Code 0Ah

<ETX> End-Of-Text, ASCII Code 03h

7.3.7 Format of the SPA Time String

The ABB SPA Time String is a sequence of 32 ASCII characters starting with the characters ">900WD" and ending with the <CR> (Carriage Return) character. The format is:

>900WD:*jj-mm-tt_hh.mm;ss.fff:cc*<CR>

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

jj-mm-tt	the current date:		
	jj	year of the century	(00..99)
	mm	month	(01..12)
	tt	day of month	(01..31)
	_	Space	(ASCII-code 20h)
hh.mm;ss.fff	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	fff	milliseconds	(000..999)
cc	Checksum. EXCLUSIVE-OR result of the previous characters, displayed as a HEX byte (2 ASCII characters 0..9 or A..F)		
<CR>	Carriage Return		ASCII Code 0Dh

7.3.8 Format of the Computime Time String

The Computime time string is a sequence of 24 ASCII characters starting with the T character and ending with the LF (line feed, ASCII Code 0Ah) character. The format is:

T:*yy:mm:dd:ww:hh:mm:ss*<CR><LF>

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

T	Start character sending with one bit accuracy at change of second		
yy:mm:dd	the current date:		
	yy	year of the century	(00..99)
	mm	month	(01..12)
	dd	day of month	(01..31)
	ww	the day of the week	(01..07, 01 = monday)
hh:mm:ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
<CR>	Carriage Return, ASCII Code 0Dh		
<LF>	Line Feed, ASCII Code 0Ah		

7.3.9 Format of the NMEA 0183 String (RMC)

The NMEA String is a sequence of 65 ASCII characters starting with the '$GPRMC' character and ending with the characters CR (carriage return) and LF (line-feed). The format is:

$GPRMC,*hhmmss.ss,A,bbbb.bb,n,lllll.ll,e,0.0,0.0,ddmmyy,0.0,a*hh*<CR><LF>

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

$	Start character, ASCII Code 24h sending with one bit occuracy at change of second		
hhmmss.ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	ss	fractions of seconds	(1/10 ; 1/100)
A	Status	(A = time data valid) (V = time data not valid)	

The following information regarding the receiver position is set to zero because receiver does not support this.

bbbb.bb	latitude of receiver position in degrees leading signs are replaced by a space character (20h)		
n	latitude, the following characters are possible:		
	'N'	north of equator	
	'S'	south d. equator	
lllll.ll	longitude of receiver position in degrees leading signs are replaced by a space character (20h)		
e	longitude, the following characters are possible:		
	'E'	east of Greenwich	
	'W'	west of Greenwich	

ddmmyy	the current date:		
	dd	day of month	(01..31)
	mm	month	(01..12)
	yy	year of the century	(00..99)
a	magnetic variation		
hh	checksum (EXOR over all characters except '$' and '*')		
<CR>	Carriage Return, ASCII Code 0Dh		
<LF>	Line Feed, ASCII Code 0Ah		

8 RoHS and WEEE

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

WEEE status of the product

This product is handled as a B2B (Business to Business) category product. To ensure that the product is disposed of in a WEEE-compliant fashion, it must be returned to the manufacturer. Any transportation expenses for returning this product (at end-of-life) must be covered by the end user, while Meinberg will bear the costs for the waste disposal itself.