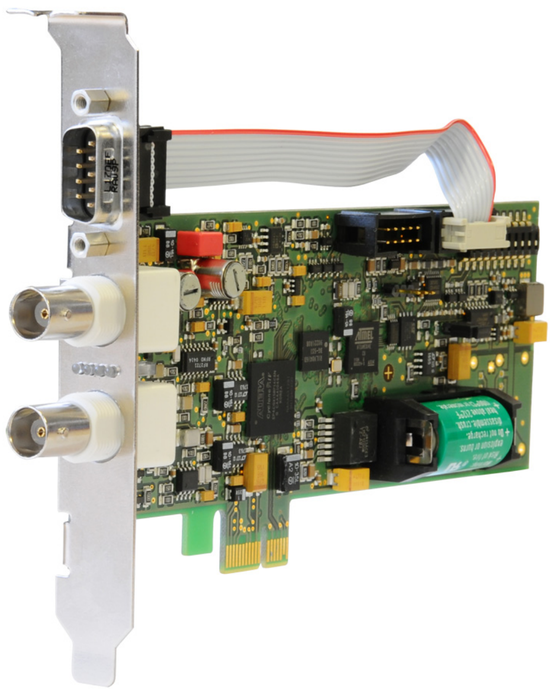

MANUAL

PZF180PEX

PCI Express - DCF77 Radio Clock

11th January 2012

Meinberg Radio Clocks GmbH & Co. KG

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1 Impressum

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Date: 2012-01-06

2 Content of the USB stick

The included USB stick contains a driver program that keeps the computer´s system time synchronous to the received time. If the delivered stick doesn't include a driver program for the operating system used, it can be downloaded from:

http://www.meinberg.de/german/sw/

On the USB stick there is a file called "readme.txt", which helps installing the driver correctly.

3 Powering up the system

Installing the PZF180PEX in your computer
The computer has to be turned off and its case must be opened. The radio clock can be installed in any PCI Express slot not used yet. The rear plane must be removed before the board can be plugged in carefully. The computer´s case should be closed again and the antenna can be connected to the coaxial plug at the clock's rear slot cover. After the computer has been restarted, the monitor software can be run in order to check the clock's configuration.The computer´s case should be closed again and the antenna must be connected to the appropriate connector.

Every PCI Express board is a plug&play board. After power-up, the computer's BIOS assigns resources like I/O ports and interrupt numbers to the board, the user does not need to take care of the assignments. The programs shipped with the board retrieve the settings from the BIOS.

After the board has been mounted and the antenna has been connected, the system is ready to operate. About 10 seconds after power-up the receiver´s TCXO operates with the required accuracy. After 20 minutes of operation the TCXO has achieved its final accuracy and the generated frequencies are within the specified tolerances.

To achieve the technical data given in chapter 'technical specifications', the following points must be observed:

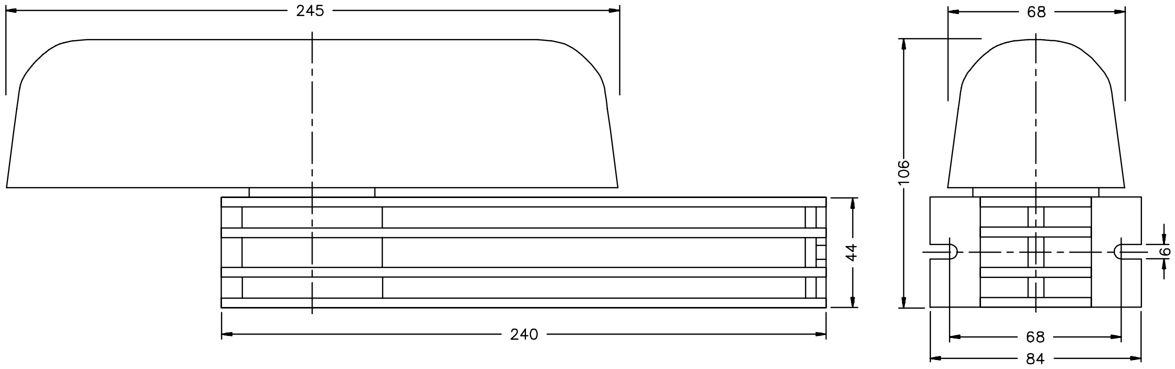
Antenna
The external ferrite antenna AW02 is connected to the receiver by using a 50 ohm coax cable. If reception is sufficient, the length of the cable can be up to several hundred meters without any problems. An antenna amplifier is available for very long antenna cables.

Assembly of antenna
The antenna has to be mounted as exactly as possible. Turning it out of the main receive direction will result in less accurate time frames. The antenna must be placed in longitudinal direction to the DCF-transmitter (Frankfurt). The antenna should be installed with a minimum distance of 30cm to all metal objects and, if possible, to any microcomputers and the PZF180PEX itself as well. A distance of several meters to TV- or computermonitors must be kept.

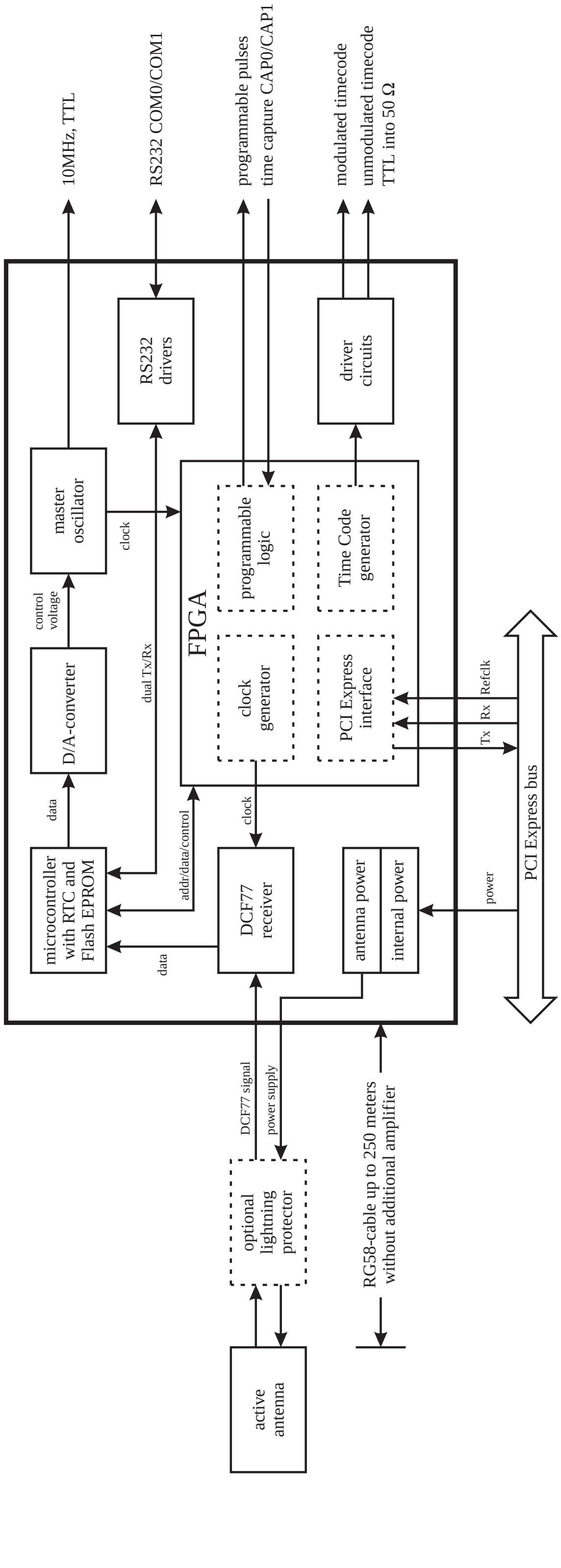
3.1 Technical Specifications DCF77 Antenna AW02

CONSTRUCTION:	Ferrite rod with impregnated winding. Remote powered HF-amplifier
HOUSING:	Unbreakable plastic case, specially for outdoor installation The rubber sealing protects the electronic, the ferrite rod and the winding against external influence.
CONFIGURATION:	Antenna with holder for wall mounting, type-N female connector (RG58 coaxial cable)
ACCESSORY:	Clamp for pole-mounting (max. diameter: 62mm), made of galvanized steel sheet. Cable: Coaxial cabel RG58 for indoor/outdoor mounting (type-N connector) The cable is available in all lenghts and with the required connectors.
INSTALLATION:	For orientation the antenna is rotatable (360°). When the antenna cable is more than 300m lenght an antenna amplifier is needed.
AMBIENT TEMPERATURE:	-25°C ... +65°C

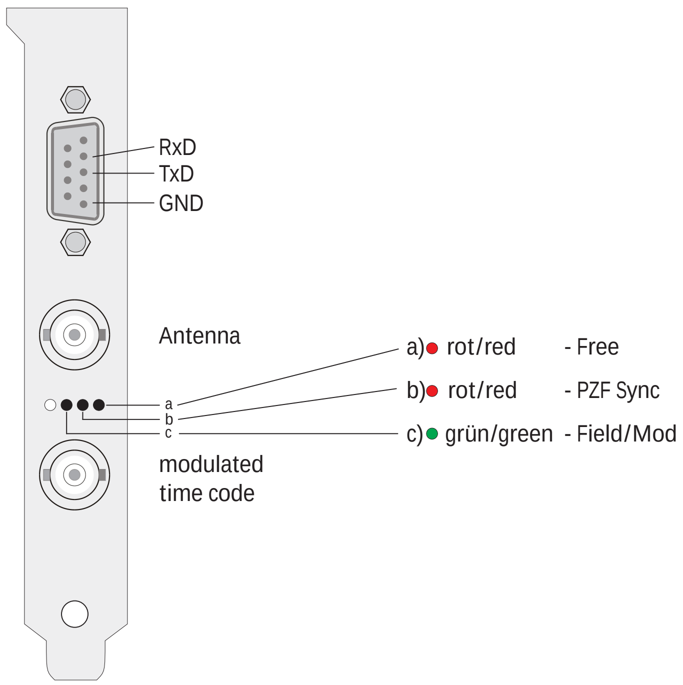
Abmessungen:



3.2 Block Diagram PZF180PEX



3.3 Connectors and LEDs in the rear slot cover



The coaxial antenna connector, two status LEDs and a 9 pin sub D connector can be found in the rear slot cover. (see figure).

Pilot LEDs
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.

Syn.-LED
The Syn.-LED indicates that the autocorrelation coefficient decreases beyond a value that is needed and a correct receiption is not possible therefore. This happens if a strong interferer within the bandwidth of the receiver is present or the transmitter is switched of. Furthermore, this LED is switched on whenever the receiver is using the AM signal instead of the PZF signal for synchronisation, no matter if the clock is sync'ed or not.

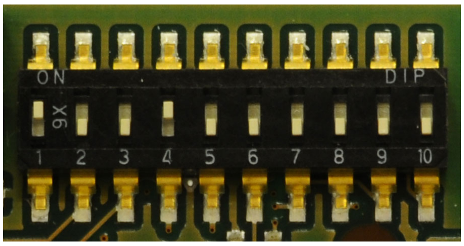
Free-LED
If the Free-LED is on, it was not possible to synchronize the internal realtime clock to DCF-time. This condition occures for at most two minutes after switching on the PZF180PEX, because two DCF-telegrams are checked for plausibility before the data is taken over. Short disturbance of receiption can cause this state too. The Free-LED is switched off when the receiver is synchronous, this applies for PZF reception as well as for AM reception.

The 9 pin sub D connector is wired to the GPS170PEX's serial port COM0. Pin assignment can be seen from the figure beside. This port can not be used as serial port for the computer. Instead, it can be uses to send out Meinberg's standard time string to an external device.

A DIL switch on the board can be used to wire some TTL inputs or outputs (0..5V) to some connector pins. In this case, absolute care must be taken if another device is connected to the port, because voltage levels of -12V through +12V (as commonly used with RS-232 po rts) at TTL inputs or outputs may damage the radio clock.

3.3.1 Configuring the 9 pin connector

By default only the signals needed for the serial port COM0 are mapped to the pins of the connector. Whenever one of the additional signals shall be used, the signal must be mapped to a pin by putting the appropriate lever of the DIL switch in the ON position. The table below shows the pin assignments for the connector and the DIL switch lever assigned to each of the signals. Care must be taken when mapping a signal to Pin 1, Pin 4 or Pin 7 of the connector, because one of two different signals can be mapped to these Pins. Only one switch may be put in the ON position in this case:



Pin 1: DIL 1 or DIL 8 ON
Pin 4: DIL 5 or DIL 10 ON
Pin 7: DIL 3 or DIL 7 ON

The figure left shows DIL1 and DIL4 ON =>
PIN1: VCC out
PIN8: PPO0 - PPS out

Those signals which do not have a lever of the DIL switch assigned are always available at the connector:

D-SUB-Pin	Signal	Signal level	DIL-switch
1	VCC out	+5V	1
1	PPO0 (PPS) out	RS232	8
2	RxD in	RS232	-
3	TxD out	RS232	-
4	PPO1 (PPM) out	TTL	5
4	10MHz out	TTL	10
5	GND	-	-
6	CAP0 in	TTL	2
7	CAP1 in	TTL	3
7	IRIG DC out	TTL into 50 Ω	7
8	PPO0 (PPS) out	TTL	4
9	PPO2 (DCF) out	TTL	9

4 Skilled/Service-Personnel only: Replacing the Lithium Battery

The life time of the lithium battery on the board is at least 10 years. If the need arises to replace the battery, the following should be noted:

ATTENTION!

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.

5 DCF77 Long Wave Transmitter

The German long wave transmitter DCF77 started continious operation in 1970. The introduction of time codes in 1973 build the basic for developing modern radio remote clocks.

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. 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 10ms. Variations of the trigger level of the demodulator make the accuracy of the time marks worse by additional +/-3ms. Because this precision is not sufficient for lots of applications, the PTB (Physical and Technical Institute of Germany) began to spread time informations 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 1,55ms. The carrier of 77.5kHz is modulated with a phase deviation of +/-10° per bit. The bit sequence is transmitted each second, it starts 200ms after the beginning of a 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.

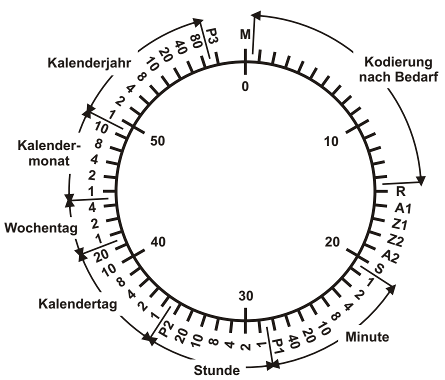
6 General Information about DCF77

The radio remote clocks made by Meinberg receive the signal from the long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany. This time reference is either the Central European Time (Mitteleuropäische Zeit, MEZ) or the Central European Summer Time (Mitteleuropäische Sommerzeit, MESZ). The transmitter is controlled by the atomic clock plant at the Federal Physical Technical Institute (PTB) in Braunschweig/Germany and transmits the current time of day, date of month and day of week in coded second pulses. Once every minute the complete time information is available.

At the beginning of every second the amplitude of the high precision 77.5 kHz carrier frequency is lowered by 75% for a period of 0.1 or 0.2 sec. The length of these time marks represent a binary coding scheme using the short time mark for logical zeroes and the long time mark for logical ones. The infomation 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.

Our radio remote clocks decode the highly accurate information on date and time within a wide range around Germany. So some of our clocks are installed in Bibao/Spain as well as in the City of Umeå in northern Sweden - fully statisfying the requirements of the users. The radio remote clocks automatically switch to summertime and back. The reception of the time information is free of charge and does not need to be registered.

Gernerally it is important to position the antenna in an optimal way. It should be mounted at least 30 centimeters away from the clock unit and from solid steel. The antenna should be aligned at a right angle to the direction of the transmitter (Frankfurt).

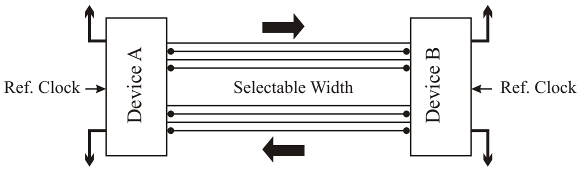


M	Minutenmarke (0.1 s)	
R	Aussendung über Reserveantenne	
A1	Ankündigung Beginn/Ende der Sommerzeit	
Z1, Z2	Zonenzeitbits	
	Z1, Z2 = 0, 1:	Standardzeit (MEZ)
	Z1, Z2 = 1, 0:	Sommerzeit (MESZ)
A2	Ankündigung einer Schaltsekunde	
S	Startbit der codierten Zeitinformation	
P1, P2, P3	gerade Paritätsbits	

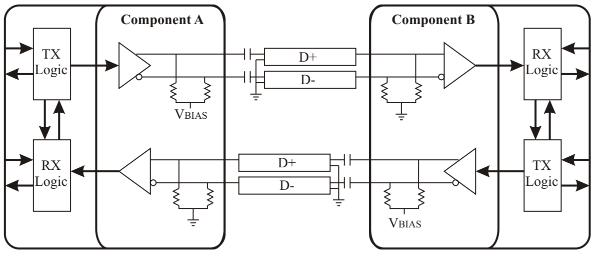
7 PCI Express (PCIe)

The main technical inovation of PCI Express is a serial data transmission compared to the parallel interfaces of other computer bus systems like ISA, PCI and PCI-X.

PCI Express defines a serial point-to-point connection, the so-called Link:

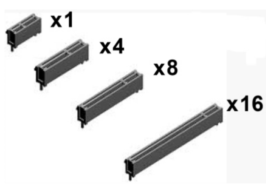


The data transfer within a Link is done via Lanes, representing one wire pair for sending and one wire pair for receiving data:



This design leads to a full duplex connection clocked with 2.5 GHz capable of transfering a data volume of 250 MB/s per lane in each direction. Higher bandwith is implemented by using multiple lanes silmutaneously. A PCI Express x16 slot for example uses sixteen lanes providing a data volume of 4 GB/s. For comparison: when using conventional PCI the maximum data transfer rate is 133 MB/s, PCI-X allows 1 GB/s but only in one direction respectively. A PCIe expansion board (x1 like Meinberg GPS receivers for example) can always be used in slots with a higher lane width (x4, x8, x16):

Interoperability				
Slot	x1	x4	x8	x16
Card				
x1	Yes	Yes	Yes	Yes
x4	No	Yes	Yes	Yes
x8	No	No	Yes	Yes
X16	No	No	No	Yes



One of the strong points of PCI Express is the 100% software compatibility to the well known PCI bus, leading to a fast spreading. The computer and the operating system are „seeing“ the more powerfull PCIe bus just as the convetional PCI bus without any software update.

8 Features of PZF180PEX

The board PZF180PEX is designed as a „low profile" board for computers with PCI Express interface. The rear slot cover integrates the antenna connector, a BNC connector for modulated time codes, two status LEDs and a 9pin SUB-D male connector. The card can be equipped with the delivered low profile cover. The I/O signals, available over a D-Sub plugs (RS-232 - PPS, PPM), are not available in this case.

The microcontroller 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 PZF180PEX and synchronizes the internal realtime clock.

By evaluating the pseudorandom phase noise, the PZF180PEX 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.

Compared to the former PZF computer clock the PZF180PEX 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 PZF180PEX automatically switches over to decode the AM signal, if available, and ensures synchronisation.

The PZF180PEX includes a battery-backed realtime clock which runs crystal-precise if the main power supply fails. Important system parameters are stored in a battery-backed RAM or non-volatile (EEPROM) memory.

The status of the radio clock can be tested and changes to its configuration can be made, by using the monitor program which is provided with the PZF180PEX.

8.1 Time zone and daylight saving

GPS system time differs from the universal time scale (UTC) by the number of leap seconds which have been inserted into the UTC time scale after GPS has been initiated in 1980. The current number of leap seconds is part of the navigation message supplied by the satellites, so the satellite clock´s internal real time is based on UTC. Conversion to local time including handling of daylight saving year by year can be done by the receiver´s microprocessor. For Germany, the local time zone is UTC + 3600 sec for standard time and UTC + 7200 sec if daylight saving is in effect.

The clock's microprocessor determines the times for start and end of daylight saving time by a simple algorithm e. g. for Germany:

Start of DST is on the first Sunday after March, 25th, at 2 o'clock standard time.
End of DST is on the first Sunday after October, 25th, at 3 o'clock daylight time.

The monitoring software shipped with the board can be used to configure the time zone and daylight savings parameters easily. Switching to daylight saving time is inhibited if for both start and end of daylight saving the parameters are exactly the same.

The timecode (IRIG, AFNOR, IEEE) generated by PZF180PEX is available with these settings or with UTC as reference. This can be set by the monitor program.

8.2 Asynchronous serial ports

Two asynchronous serial interfaces (RS232) called COM0 and COM1 are available to the user. Only COM0 is available at the rear panel slot cover, COM1 must use another submin-D connector which can optionally be connected to the 5 pin jumper block on the board. The monitoring program can be used to configure the outputs. In the default mode of operation, the serial outputs are disabled until the receiver has synchronized after power-up. However, they can be configured to be enabled immediately after power-up.

Transmission speed, framing and mode of operation can be configured individually for each port. Both of the ports can be configured to transmit either time strings (once per second, once per minute, or on request with ASCII ´?´ only), or to transmit capture strings (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.

8.3 Time capture inputs

The board provides two time capture inputs called User Capture 0 and 1 (CAP0 and CAP1) which can be mapped to pins at the 9 pin connector at the rear panel. These inputs can be used 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, an ASCII string per capture event can be transmitted via COM1 or displayed using the monitoring program. 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 COM1 can be measured. The format of the output string is described in the technical specifications at the end of this document. 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 via COM1.

8.4 DCF77 Emulation

The receiver PZF180 generates TTL level time marks (active HIGH) which are compatible with the time marks spread by the German long wave transmitter DCF77 (see chapter 6)).

8.5 Pulse and frequency outputs

The pulse generator of the clock PZF180PEX contains three independent channels (PPO0, PPO1, PPO2). These TTL outputs can be mapped to pins at the 9-pin connector at the rear slot cover by using a DIL switch. The pulse generator is able to provide a multitude of different pulses, which are configured with the monitor program. The active state of each channel is invertible, the pulse duration settable between 10 msec and 10 sec in steps of 10 msec. In the default mode of operation the pulse outputs are disabled until the receiver has synchronized after power-up. However, the system can be configured to enable those outputs immediately after power-up.

Synthesizer
The programmable pulse outputs are able to 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.

The following modes can be configured for each channel independently:

Timer mode:	Three on- and off-times per day per channel programmable
Cyclic mode:	Generation of periodically repeated pulses. A cycle time of two seconds would generate a pulse at 0:00:00, 0:00:02, 0:00:04 etc.
DCF77-Simulation mode:	The corresponding output simulates the DCF77 time telegram. The time marks are representing the local time as configured by the user.
Single Shot Mode:	A single pulse of programmable length is generated once a day at a programmable point of time
Per Sec., Per Min. Per Hr. modes:	Pulses each second, minute or hour
Synthesizer	Frequency output 1/8 Hz up to 10 MHz
Time Codes	Generation of Time Codes as described in chapter "Time Codes"
Status:	One of three status messages can be emitted: 'position OK': The output is switched on if the receiver was able to compute its position 'time sync': The output is switched on if the internal timing is synchronous to the GPS-system 'all sync': Logical AND of the above status messages. The output is active if position is calculated AND the timing is synchronized
Idle-mode:	The output is inactive

The default configuration for the pulse outputs is:

PPO0:	Pulse each second (PPS), active HIGH, pulse duration 200 msec
PPO1:	Pulse each minute (PPM), active HIGH, pulse duration 200 msec
PPO2:	DCF77 Simulation

A TTL level master frequency of 10 MHz is derived from the TCXO. By default, this frequency is available only at the 5 pin contact strip of the board.

9 Time codes

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 GPS170PEX 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. If desired other formats are available.

9.1 The time code generator

The board GPS170PEX generates modulated and un-modulated timecodes. Modulated signals are transmitting the information by varying the amplitude of a sine wave carrier, un-modulated timecodes are transmitted by pulse duration modulation of a DC-signal (TTL in case of GPS170PEX), see chapter „IRIG standard format“ for details.

The sine wave carrier needed for modulated signals is generated in a digital way by a programmable logic device on the board. The frequency of this signal is derived from the main oscillator of GPS170PEX, which is disciplined by the GPS-system.

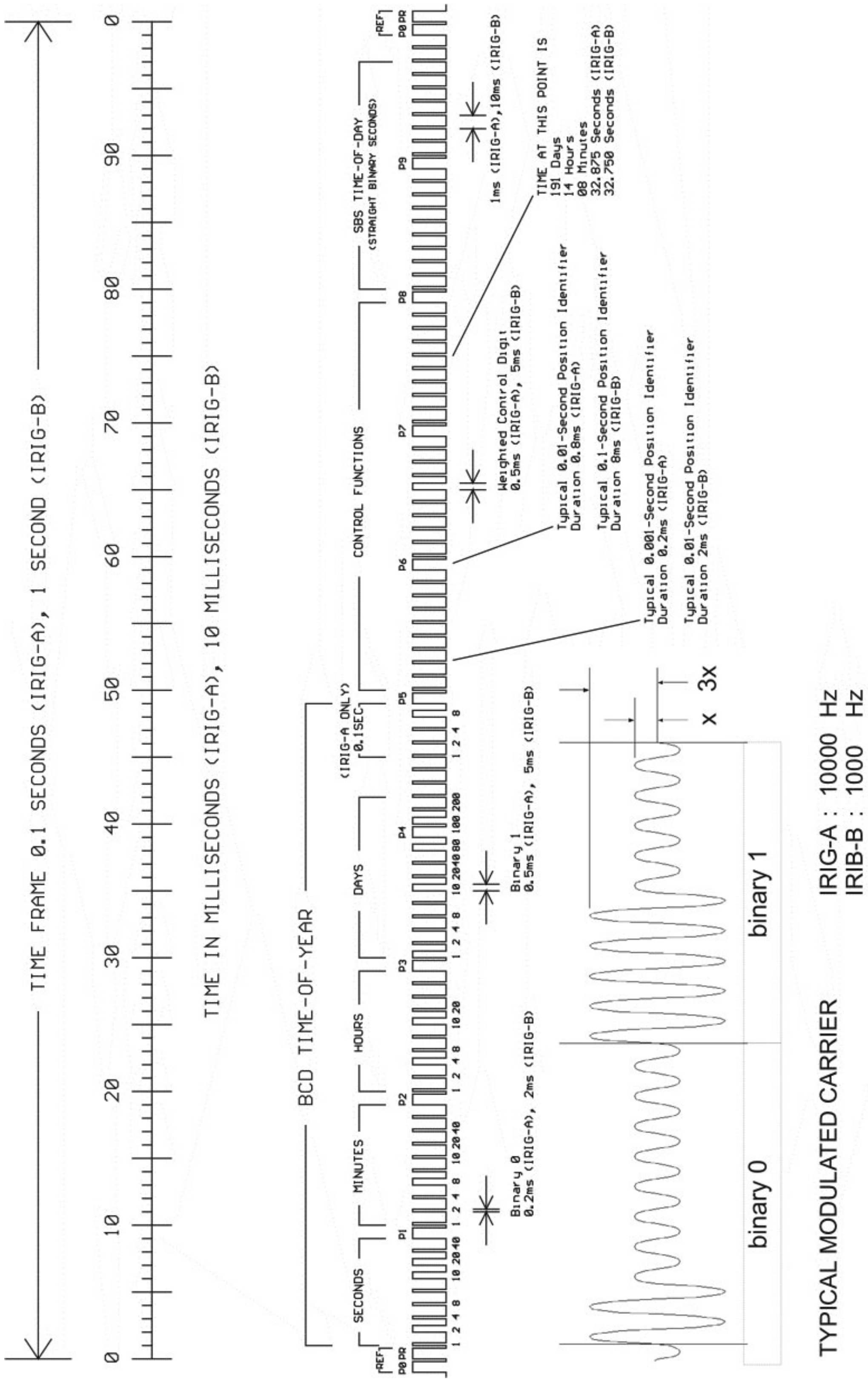
This leads to a sine wave carrier with high accuracy. Transmission of date is synchronized by the PPS (pulse per second) derived from the GPS-system. The modulated time code has an amplitude of 3Vpp (MARK) and 1Vpp (SPACE) into 50 O. The number of MARK-amplitudes within ten periods of the carrier defines the coding:

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

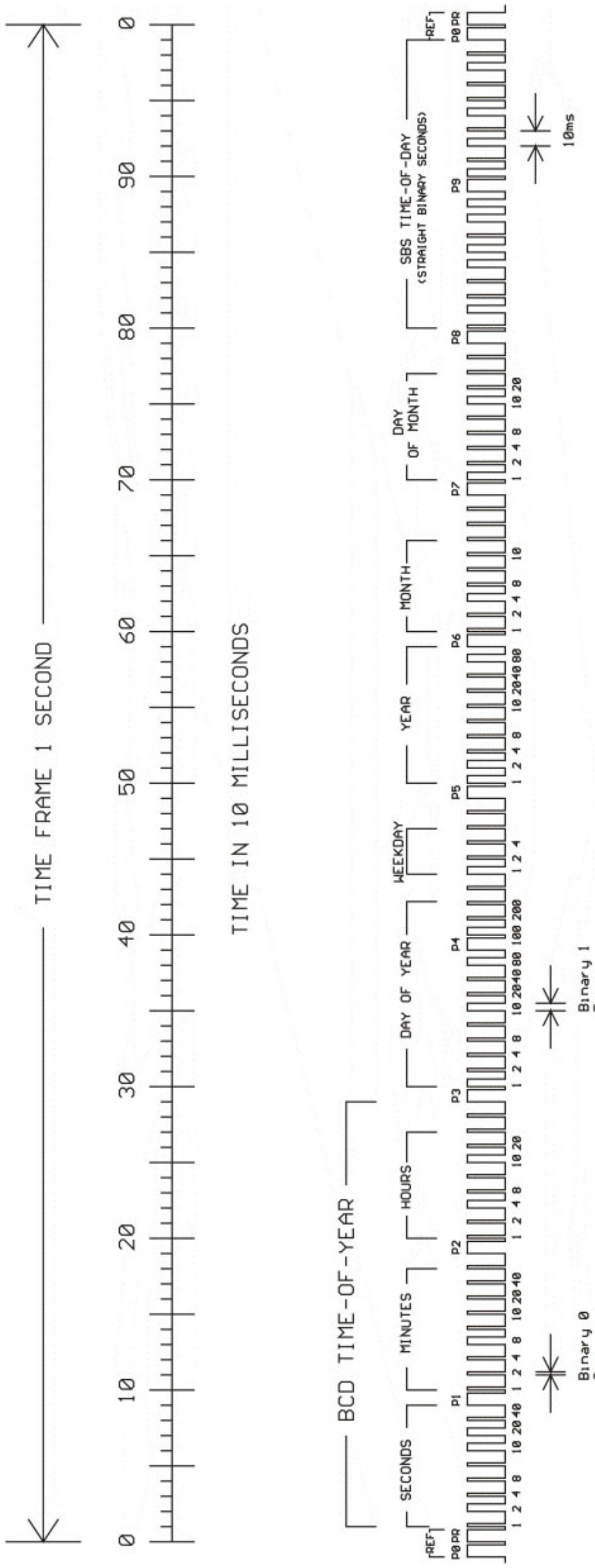
The DC-signal has the following pulse durations accordingly:

a) binary „0“ : 2 msec
b) binary „1“ : 5 msec
c) position-identifier : 8 msec

9.2 IRIG Standard Format



9.3 AFNOR Standard Format



9.4 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

9.5 Generated Time Codes

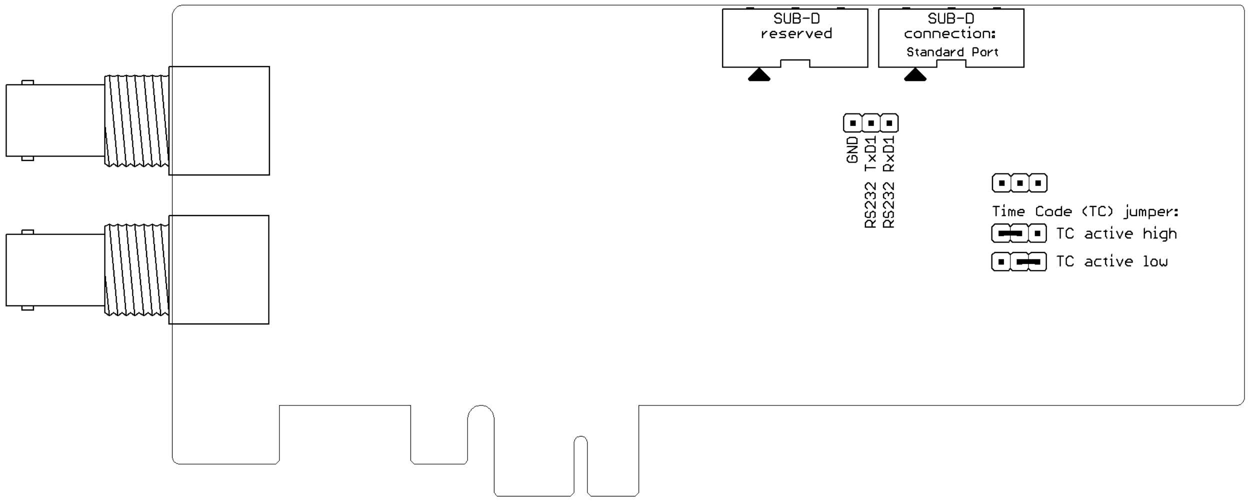
Besides the amplitude modulated sine wave signal, the board also provides unmodulated DC-Level Shift TTL output in parallel. Thus six time codes are available.

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

9.6 Selection of time code

The selection of timecode is done by the monitor software.

The un-modulated time code can be delivered as an active-high (default) or activelow signal by setting a jumper on the board GPS170PEX into the appropriate position:



10 Firmware updates

Whenever the on-board software must be upgraded or modified, the new firmware can be downloaded to the internal flash memory via the radio clock's serial port COM0. There is no need to open the computer case and insert a new EPROM.

A loader program shipped together with the file containing the image of the new firmware sends the new firmware from one of the computer's serial ports to the clock's serial port COM0. The contents of the program memory will not be modified until the loader program has sent the command to erase the flash memory. The system will be ready to operate again after the computer has been turned off and then on again.

11 Technical Specifications GPS180PEX

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.	
PULSE OUTPUTS:	Three programmable outputs, TTL level	
	Default settings:	
	active only ‚if sync'	
	PPO0:	change of second (PPS) pulse duration 200 msec valid on rising edge
	PPO1:	change of minute (PPM) pulse duration 200 msec valid on rising edge
	PPO2:	DCF77 simulation
	Synthesizer	
	1/8 Hz to 10 MHz	base accuracy according to system accuracy
	1/8 Hz to 10 kHz	phase syncron with pulse per second
	10 kHz to 10 MHz	frequency deviation < 0.0047 Hz
ACCURACY OF PULSES:	Better than +/- 50μsec after synchronization and 20 minutes of operation	
TIME CAPTURE INPUTS:	Triggered on falling TTL slope Interval of events: 1.5msec min., Resolution: 100ns	
FREQUENCY OUTPUTS:	10 MHz (TTL level)	
SYSTEM BUS INTERFACE:	Single lane (x1) PCI Express (PCIe) Interface, compatible to PCI Express specifications r1.0a	
DATA FORMAT:	Binary, byte serial	
SERIAL PORTS:	2 asynchronous serial ports (RS-232)	
	Baud Rate:	300 up to 19200
	Framing:	7N2, 7E1, 7E2, 8N1, 8N2, 8E1
	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: 3Vpp (MARK), 1Vpp (SPACE) into 50 ohm	
	DCLS-signal: TTL into 50 ohm, active-high or -low, selected by jumper	

	optionally optical output(instead of modulated sine wave):	
	optical power:	typ. 15μW
	optical connector:	ST-connector for GI 50/125μm or GI 62,5/125μm gradient fiber
POWER REQUIREMENT:	+3.3 V:	330 mA
	+12 V :	30 mA
	power supplies provided by PCI Express interface	
PHYSICAL DIMENSION:	low profile expansion board (69 x 150 mm)	
RF CONNECTOR:	female coaxial BNC-connectors for antenna and modulated time code	
AMBIENT TEMPERATURE:	0 ... 50°C	
HUMIDITY:	85% max.	

12 Time Strings

12.1 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

12.2 Format of the Meinberg Capture String

The Meinberg Capture String is a sequence of 31 ASCII characters terminated by a CR/LF (Carriage Return/Line Feed) combination. The format is:

CH*x*_ *tt.mm.jj*_ *hh:mm:ss.fffffff*<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:

x	0 or 1 corresponding on the number of the capture input
_	ASCII space 20h

dd.mm.yy the capture date:

dd	day of month	(01..31)
mm	month	(01..12)
yy	year of the century	(00..99)

hh:mm:ss.fffffff the capture time:

hh	hours	(00..23)
mm	minutes	(00..59)
ss	seconds	(00..59, or 60 while leap second)
fffffff	fractions of second, 7 digits	

<CR> Carriage Return, ASCII Code 0Dh

<LF> Line Feed, ASCII Code 0Ah

12.3 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:ssxxxxuv*<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)
xxxx	time zone indicator:		
	'UTC'	Universal Time Coordinated, formerly GMT	
	'MEZ'	European Standard Time, daylight saving disabled	
	'MESZ'	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		

12.4 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		

12.5 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.lllle 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

12.6 Format of the ABB 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:*yy-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:

yy-mm-tt	the current date:		
	yy	year of the century	(00..99)
	mm	month	(01..12)
	dd	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	Check sum. 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		

Konformitätserklärung

Declaration of Conformity

Hersteller Manufacturer	**Meinberg Funkuhren GmbH & Co. KG** **Lange Wand 9** **D-31812 Bad Pyrmont**

erklärt in alleiniger Verantwortung, daß das Produkt
declares under its sole responsibility, that the product

Produktbezeichnung Product Name	**DCF77 Funkuhr**
Modell / Typ Model Designation	**PZF180PEX**

auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt
to which this declaration relates is in conformity with the following standards

EN55022:2008-05, Class B	Grenzwerte und Meßverfahren für Funkstörungen von informationstechnischen Einrichtungen Limits and methods of measurement of radio interference characteristics of information technology equipment
EN55024:2003-10	Grenzwerte und Meßverfahren für Störfestigkeit von informationstechnischen Einrichtungen Limits and methods of measurement of Immunity characteristics of information technology equipment

gemäß den Richtlinien 2004/108/EG (Elektromagnetische Verträglichkeit), 2006/95/EG (Niederspannungsrichtlinie) und 93/68/EWG (CE Kennzeichnung) sowie deren Ergänzungen.
following the provisions of the directives 2004/108/EC (electromagnetic compatibility), 2006/95/EC (low voltage directive) and 93/68/EEC (CE marking) and its amendments.

Bad Pyrmont, den 06.01.2012

Günter Meinberg
Managing Director