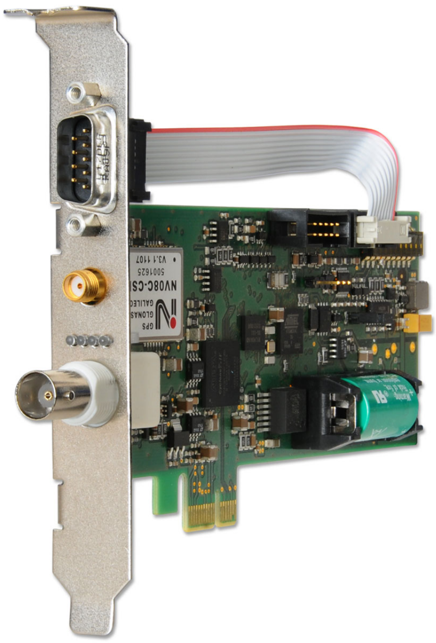

MANUAL

GLN180PEX

Combined GPS/GLONASS
Satellite controlled Radio Clock

23rd November 2015

Meinberg Radio Clocks GmbH & Co. KG

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1 Imprint

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Date: 2015-11-23

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.meinbergglobal.com/english/sw/

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

3 GPS/GLONASS satellite controlled clock

The satellite receiver clock GLN180 has been designed to provide extremely precise time to its user. The clock has been developed for applications where conventional radio controlled clocks can´t meet the growing requirements in precision. High precision available 24 hours a day around the whole world is the main feature of the new system which receives its information from the satellites of the russian GLONASS (GLObal NAvigation Satellite System) and the american GPS (Global Positioning System).

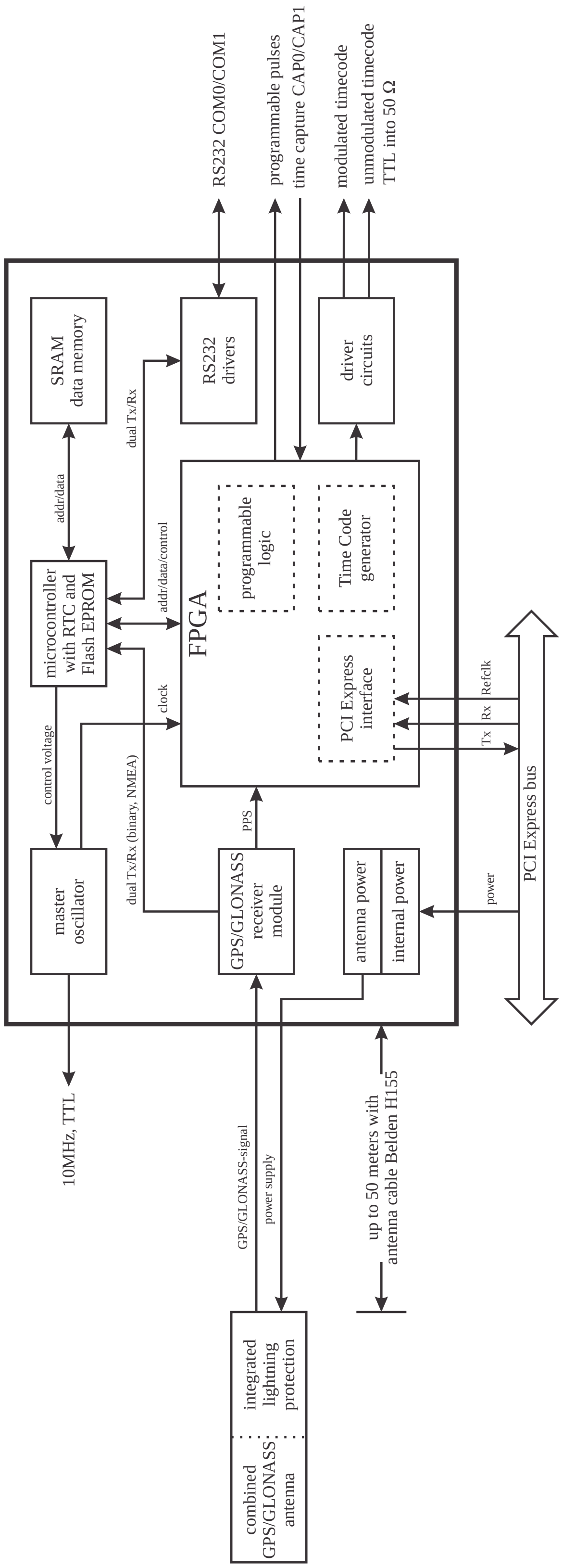
GPS and GLONASS are satellite-based radio-positioning, navigation, and time-transfer systems. They are based on accurately measuring the propagation time of signals transmitted from satellites to the user's receiver. A fully operational constellation of more than 24 GPS satellites and 21 GLONASS satellites together with several active spares in six (GPS) respectively three (GLONASS) orbital planes in 20183 km (GPS) respectively 19100 km (GLONASS) over ground provides a minimum of four satellites to be in view 24 hours a day at every point of the globe. Four satellites need to be received simultaneously if both receiver position (x, y, z) and receiver clock offset from GPS/GLONASS system time must be computed. All the satellites are monitored by control stations which determine the exact orbit parameters as well as the clock offset of the satellites´ on-board atomic clocks. These parameters are uploaded to the satellites and become part of a navigation message which is retransmitted by the satellites in order to pass that information to the user´s receiver.

The high precision orbit parameters of a satellite are called ephemeris parameters whereas a reduced precision subset of the ephemeris parameters is called a satellite´s almanac. While ephemeris parameters must be evaluated to compute the receiver´s position and clock offset, almanac parameters are used to check which satellites are in view from a given receiver position at a given time. Each satellite transmits its own set of ephemeris parameters and almanac parameters of all existing satellites.

GPS was installed by the United States Department of Defense and provides two levels of accuracy: The Standard Positioning Service (SPS) and the Precise Positioning Service (PPS). While PPS is encrypted and only available for authorized (military) users, SPS has been made available to the general public.

GLONASS was developed to provide real-time position and velocity determination, initially for use by the Soviet military in navigating and ballistic missile targeting. Also GLONASS satellites transmit two types of signals: a Standard Precision (SP) signal and an obfuscated High Precision (HP) signal.

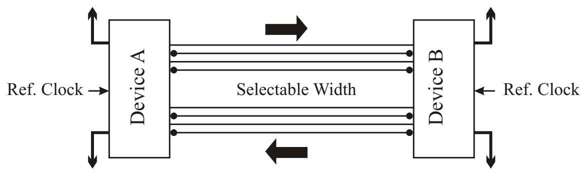
4 Blockdiagramm GLN180PEX



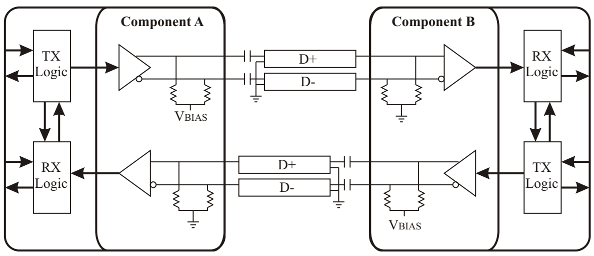
5 PCI Express (PCIe)

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.

6 GLN180PEX Features

The board GLN180PEX 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 antenna is connected to the receiver by a 50Ω coaxial cable with length up to 50m (when using RG58 cable). Power is supplied to the unit DC insulated across the antenna cable.

The navigation message coming in from the satellites is decoded by satellite clock's microprocessor in order to track the GPS system respectively the GLONASS system time with an accuracy of better than 250nsec. Compensation of the RF signal´s propagation delay is done by automatic determination of the receiver´s position on the globe. A correction value computed from the satellites´ navigation messages increases the accuracy of the board´s temperature compensated master oscillator (TCXO) to +/- 5E-9 and automatically compensates the TCXO´s aging. The last recent value is restored from the nonvolatile memory at power-up. Optionally, the clock is also available with a higher precision time base.

6.1 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 GLN180PEX is available with these settings or with UTC as reference. This can be set by the monitor program.

6.2 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.

6.3 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.

6.4 Pulse and frequency outputs

The pulse generator of the clock GLN180PEX 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

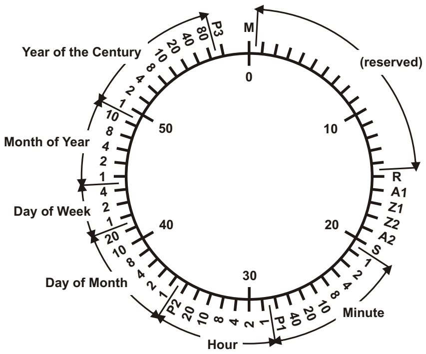
The default configuration for the pulse outputs is:

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.

6.5 DCF77 Emulation (Option)

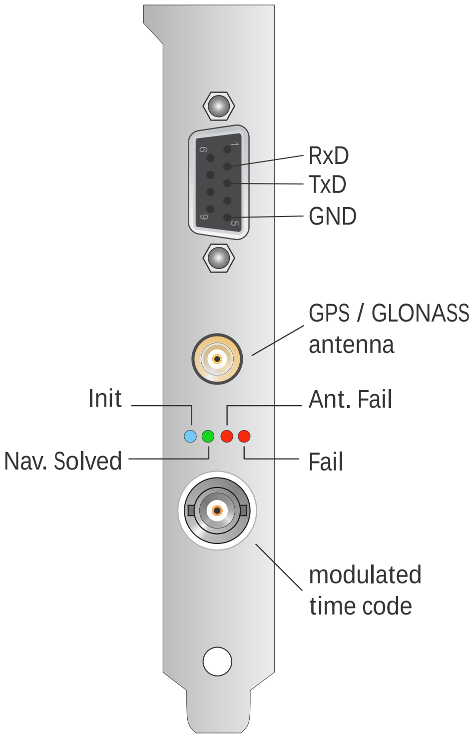
The satellite controlled clock generates TTL level time marks (active HIGH) which are compatible with the time marks spread by the German long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany: 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	
Z1, Z2	Time zone identification	
	Z1, Z2 = 0, 1:	Daylight saving disabled
	Z1, Z2 = 1, 0:	Daylight saving enabled
A2	Announcement of a leap second	
S	Start of time code information	
P1, P2, P3	Even parity bits	

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.

7 Connectors and LEDs in the rear slot cover



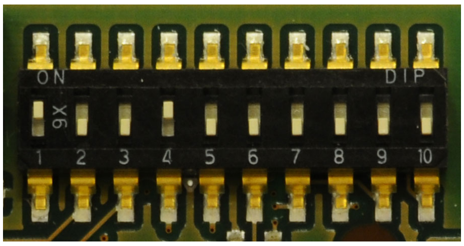
The coaxial antenna connector, four status LEDs, a male BNC connector for modulated time code and a 9 pin sub D connector can be found in the rear slot cover. (see figure). The "Nav. Solved" LED lights green when the receiver has computed its position. In normal operation the receiver position is updated continuously as long as at least four satellites can be received. The LED "Fail" lights red if a time synchronization error occurs during operation. The LED "Init" lights blue until the receiver has finished its initialisation, and the "Ant. Fail" LED lights red if the antenna is not connected correctly or the satellite signal is been disturbed.

The 9 pin sub D connector is wired to the serial port COM0 of GLN180PEX. 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.

7.1 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

8 Powering up the system

Installing the GLN180PEX 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. If the receiver finds valid almanac and ephemeris data in its battery buffered memory and the receiver´s position has not changed significantly since its last operation the receiver can find out which satellites are in view now. Only a single satellite needs to be received to synchronize and generate output pulses, so synchronization can be achieved at least one minute after power-up. After 20 minutes of operation the TCXO has achieved its final accuracy and the generated frequencies are within the specified tolerances.

If the receiver position has changed by some hundred kilometers since last operation, the satellites´ real elevation and Doppler might not match those values expected by the receiver thus forcing the receiver to start scanning for satellites. This mode is called Warm Boot because the receiver can obtain ID numbers of existing satellites from the valid almanac. When the receiver has found four satellites in view it can update its new position and switch to normal operation. If the almanac has been lost because the battery had been disconnected the receiver has to scan for a satellite and read in the current almanacs. This mode is called Cold Boot. It takes 12 minutes until the new almanac is complete and the system switches to Warm Boot mode scanning for other satellites. In the default mode of operation, neither pulse outputs nor the serial ports will be enabled after power-up until synchronization has been achieved.

However, it is possible to configure some or all of those outputs to be enabled immediately after power-up. If the system starts up in a new environment (e. g. receiver position has changed or new power supply) it can take some minutes until the TCXO´s output frequency has been adjusted. Up to that time accuracy of frequency drops to 10-8 reducing the accuracy of pulses to +-2μs.

8.1 40dB GPS-L1/GLONASS-L1/GALILEO-E1 Timing Antenna with Integrated Lightning Protection

The GPS and GLONASS satellites are not stationary but circle round the globe in a period of about 12 hours. They can only be received if no building is in the line-of-sight from the antenna to the satellite, so the antenna unit must be installed in a location with a free view to the sky. The best reception is given when the antenna has a free view of 8° angular elevation above horizon. If this is not possible the antenna should be installed with a mostly free view to the equator because of the satellite courses which are located between latitudes of 55° North and 55° South. If even this is not possible problems occur especially when at least four satellites for positioning have to be found.

The active L1 timing reference antenna is specifically designed for long-lasting, trouble-free deployments for a variety of applications. The low noise, high gain amplifier is well suited to address attenuation issues. The proprietary quadrifiliar helix design, coupled with multistage filtering provides superior out-of-band rejection and lower elevation pattern performance than traditional patch antennas.

- Their unique radome shape sheds water and ice, while eliminating problems associated with bird perching.
- This antenna is made of materials that fully comply with provisions stipulated by EU directives RoHS 2002/95/EC.
- The antenna provides integrated lightning protection capability.
- The antenna also features ESD, reverse polarity protection and transit voltage suppression.

A standard coaxial cable with 50 ohm impedance should be used to connect the antenna to the receiver. The max. length of cable between antenna and receiver is 50 meters (H155 - Low-Loss).

See data sheet **"40 dB GPS L1/GLONASSL1/GALILEO E1 Timing Antenna with Integrated Lightning Protection"** (pctel_gpsl1gl.pdf) or download this document:

Active GPS/GLONASS Antenna

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http://www.meinbergglobal.com/download/docs/other/pctel_gpsl1gl.pdf
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9 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.

10 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.

10.1 The time code generator

The board GLN180PEX 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 GLN180PEX), 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 GLN180PEX, which is disciplined by the satellite system.

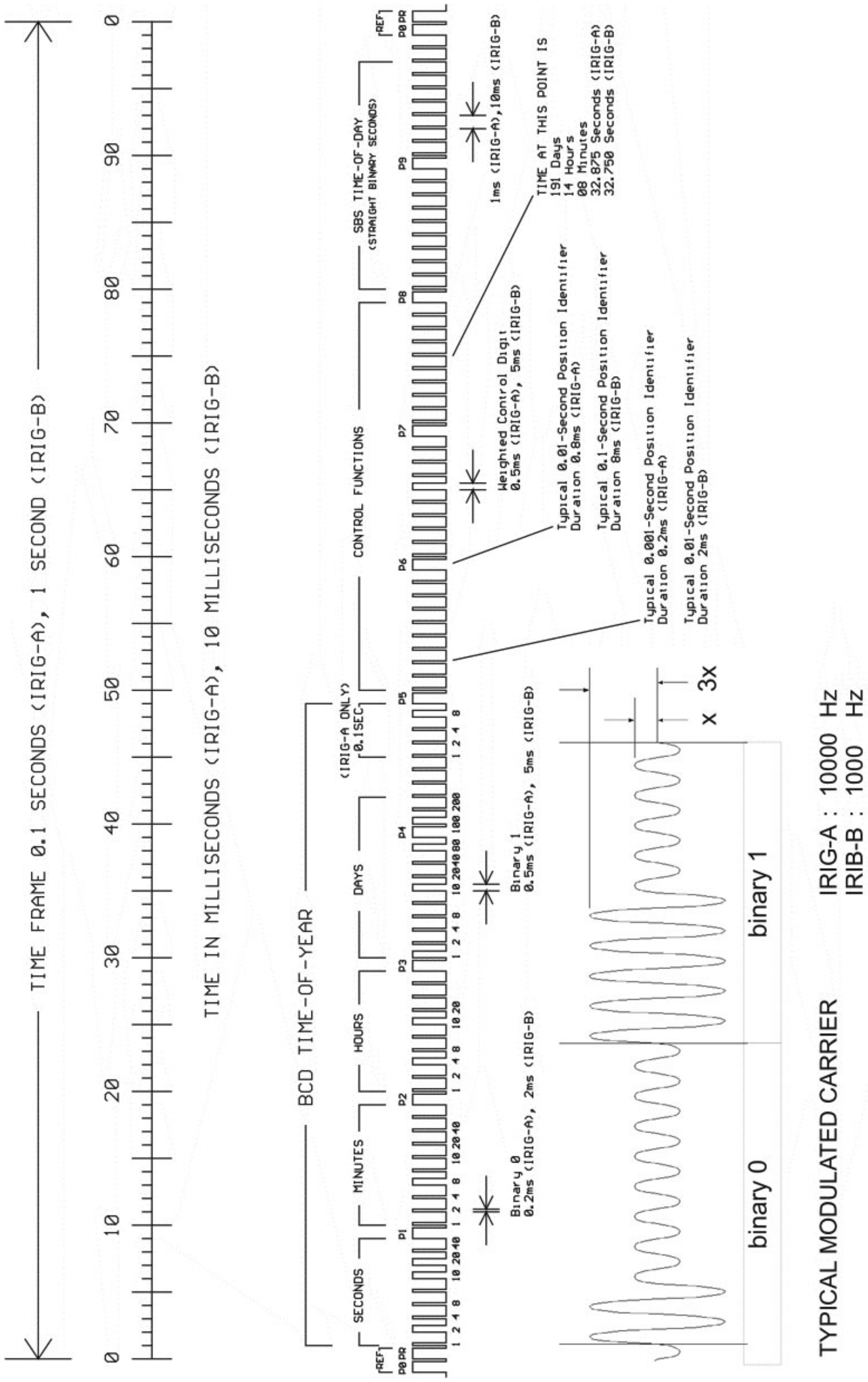
This leads to a sine wave carrier with high accuracy. Transmission of date is synchronized by the PPS (pulse per second) derived from the satellite system. The modulated time code has an amplitude of $3V_{PP}$ (MARK) and $1V_{PP}$ (SPACE) into 50 Ω. The number of MARK-amplitudes within ten periods of 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

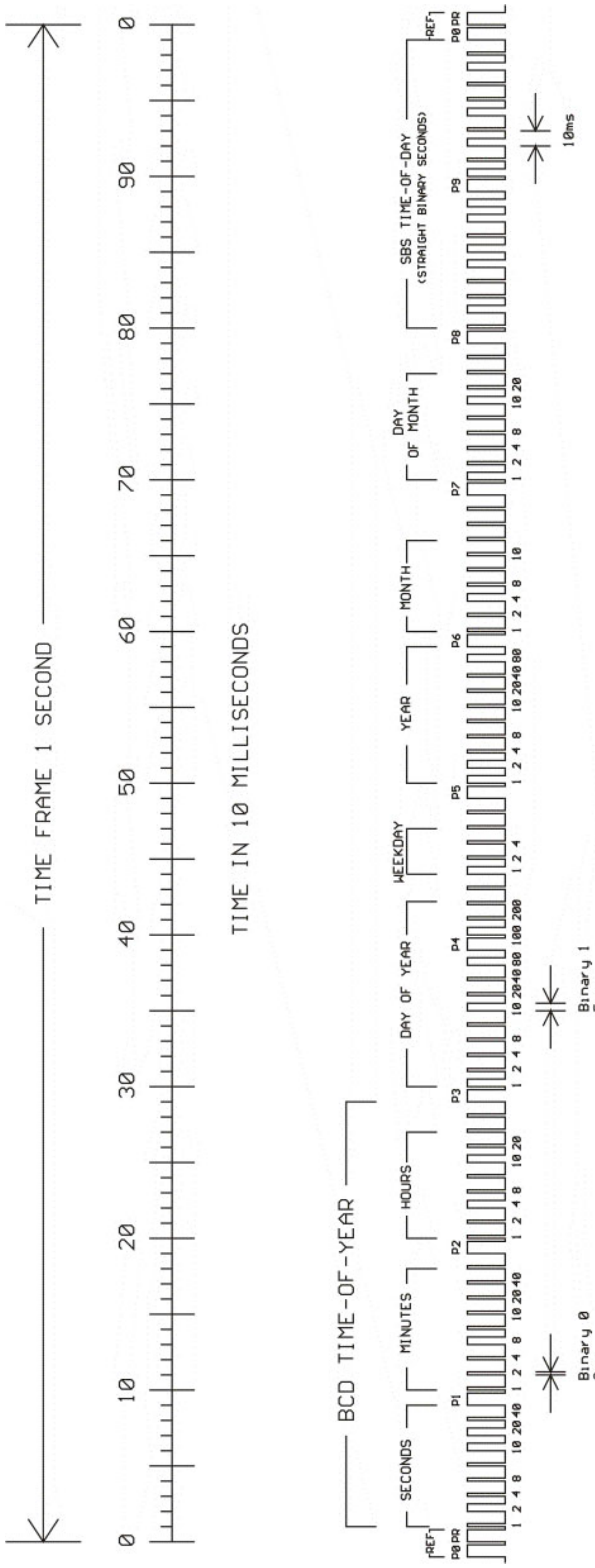
The DC-signal has the following pulse durations accordingly:

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

10.2 IRIG Standard Format



10.3 AFNOR Standard Format



10.4 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

10.5 Generated Time Codes

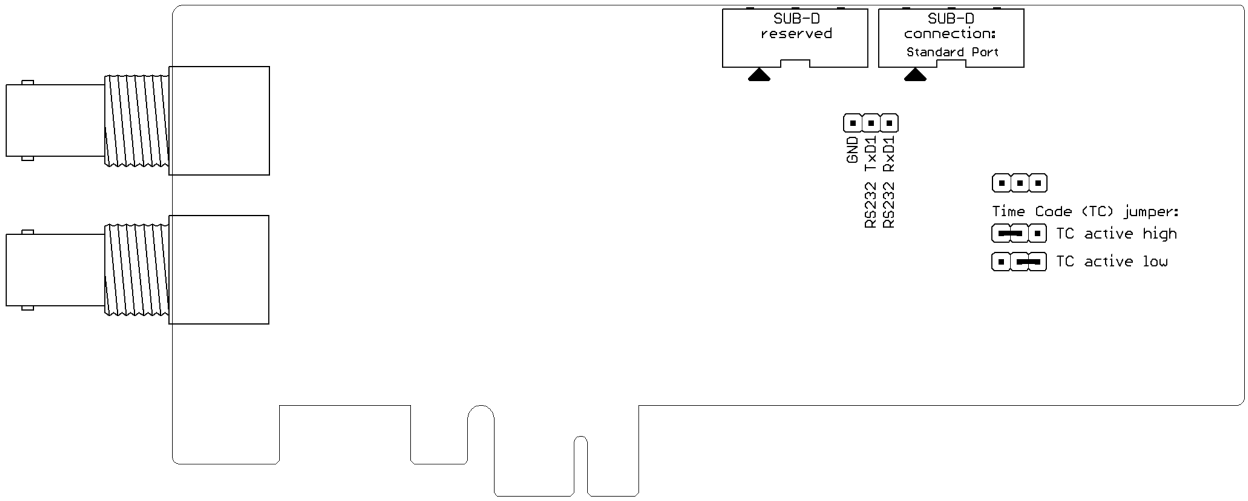
Besides the amplitude modulated sine wave signal, the board also provides unmodulated DC-Level Shift TTL output in parallel. Thus six time codes are available.

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

10.6 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 GLN180PEX into the appropriate position:



11 Technical Specifications GLN180

RECEIVER: Combined GPS/GLONASS receiver

Number of channels:	32
Frequency band:	GPS L1, GLONASS L1
Codes:	C/A code (GPS)
	Standard accuracy, CT (GLONASS)

ANTENNA: Combined GPS/GLONASS antenna

3dB Bandwidth:	1590+-30 MHz
Impedance:	50 Ω
Gain:	40+-4 dB
Supply Voltage:	5 V
Length of antenna cable:	20 meters
Operating temperature:	-40°C ... +85°C

TIME TO SYNCHRONIZATION: <30 seconds with known receiver position and valid almanac
12 minutes if invalid battery buffered memory

PULSE OUTPUTS: three programmable outputs, TTL level
Default setting: pulse output 'if sync'

PPO0: pulse on the second change (PPS)
Length 200 msec valid on rising edge

PPO1: Pulse when minute changes (PPM)
Length 200 msec valid on rising edge

PPO2: DCF77 simulation

ACCURACY OF PULSES: after synchronization and 20 minutes of operation

TCXO/OCXO LQ	:	better than +-100 nsec
OCXO MQ/OCXO HQ	:	better than +-50 nsec

better than +-2 μsec during the first 20 minutes of operation

FREQUENCY OUTPUTS: 10 MHz (TTL level)

SERIAL PORTS: asynchronous serial port COM0 (RS-232)

Baudrate:	300 to 19200
Data format:	7N2, 7E1, 7E2, 8N1, 8N2, 8E1

Default settings:
19200 baud, 8N1 - Meinberg Standard Time String (per second)

TIME CODE OUTPUTS: Unbalanced AM sine wave signal:
$3V_{PP}$ (MARK), $1V_{PP}$ (SPACE) into 50 Ω

PWM DC signal:
TTL into 50 Ω, high (default) and low-active, selectable by jumper

Optional optical output (instead of AM sine wave signal):
optical output power: typically 15μW
Optical Connector: ST connector for GI 50/125μm
or GI 62,5/125μm gradient fiber

POWER SUPPLY: +3.3 V: 70 mA
+12 V: 390 mA
All operating voltages are provided by the PCIe interface

CARD FORMAT: Low profile board (150 mm x 68.7 mm)

ENVIRONMENT TEMPERATURE: 0 ... 50 ° C

HUMIDITY: max. 85%

ACCURACY OF FREQUENCY AND PULSE OUTPUTS:

Oscillator Option	TCXO (standard)	OCXO LQ	OCXO MQ	OCXO HQ
short term stability (τ = 1 sec)	2E-9	1E-9	2E-10	5E-12
accuracy of PPS (pulse per second)	< +/- 100 nsec	< +/- 100 nsec	< +/- 50 ns	< +/- 50 ns
phase noise	1 Hz -60 dBc/Hz 10 Hz -90 dBc/Hz 100 Hz -120 dBc/Hz 1 kHz -130 dBc/Hz	1 Hz -60 dBc/Hz 10 Hz -90 dBc/Hz 100 Hz -120 dBc/Hz 1 kHz -130 dBc/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
accuracy free run, one day	+/- 1E-7 +/- 1 Hz (Note 1)	+/- 2E-8 +/- 0,2 Hz (Note 1)	+/- 1,5E-9 +/- 15mHz (Note1)	+/- 5E-10 +/- 5mHz (Note1)
accuracy free run, one year	+/- 1E-6 +/- 10 Hz (Note 1)	+/- 4E-7 +/- 4 Hz (Note 1)	+/- 1E-7 +/- 1Hz (Note1)	+/- 5E-8 +/- 0.5Hz (Note1)
accuracy GPS-synchronous averaged 24 h	+/- 1E-11	+/- 1E-11	+/- 5E-12	+/- 1E-12
accuracy of time free run, one day	+/- 4.3 msec	+/- 865 µs	+/- 65 µs	+/- 22 µs
accuracy of time free run, one year	+/- 16 sec	+/- 6.3 sec	+/- 1.6 s	+/- 788 ms
temperature dependant drift, free run	+/- 1E-6 (-20...70°C)	+/- 2 * 10 -7 (0...60°C)	+/- 5E-8 (-20...70°C)	+/- 1E-8 (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 +/- 1E-7 * 10 MHz = +/- 1 Hz				
The given values for the accuracy of frequency and time (not short term accuracy) are only valid for a constant ambient temperature ! A minimum time of 24h of GPS-synchronicity is required before free run starts.				

11.1 Time Strings

11.1.1 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 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)

uv clock status characters (depending on clock type):

u:	'#'	GPS: clock is running free (without exact synchr.)
		PZF: time frame not synchronized
		DCF77: clock has not synchronized after reset
	' '	(space, 20h)
		GPS: clock is synchronous (base accuracy is reached)
		PZF: time frame is synchronized
		DCF77: clock has synchronized after reset
v:	'*'	GPS: receiver has not checked its position
		PZF/DCF77: clock currently runs on XTAL
	' '	(space, 20h)
		GPS: receiver has determined its position
		PZF/DCF77: clock is syncronized with transmitter

x time zone indicator:

'U'	UTC	Universal Time Coordinated, formerly GMT
' '	CET	European Standard Time, daylight saving disabled
	'S'	(CEST) 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

11.1.2 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

11.1.3 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 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		

11.1.4 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 accuracy 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)	
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		

11.1.5 Format of the NMEA 0183 String (ZDA)

The NMEA String is a sequence of 38 ASCII characters starting with the **'$GPZDA'** character and ending with the characters **CR** (carriage return) and LF (line-feed). The format is:

$GPZDA,*hhmmss.ss,dd,mm,yyyy,HH,II*cs*<CR><LF>
ZDA - Time and Date: UTC, day, month, year and local timezone.

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 accuracy at change of second		
hhmmss.ss	the current UTC time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59 or 60 while leap second)
HH,II	the local timezone (offset to UTC):		
	HH	hours	(00..+-13)
	II	minutes	(00..59)
dd,mm,yy	the current date:		
	dd	day of month	(01..31)
	mm	month	(01..12)
	yyyy	year	(0000..9999)
cs	checksum (EXOR over all characters except '$' and '*')		
<CR>	Carriage Return, ASCII Code 0Dh		
<LF>	Line Feed, ASCII Code 0Ah		

11.1.6 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.llllе 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'	CEST	European Summertime, daylight saving enabled
	' '	CET	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	
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	

11.1.7 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		

12 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.

CE marking
This device follows the provisions
of the directives 93/68/EEC

13 CE-Label

Low-Voltage guideline

EN 60950-1
Safety of Information Technology Equipment,
including Electrical Business Equipment

Electromagnetic compatibility

EN50081-1
Electromagnetic compatibility (EMC).
Generic emission standard. Part 1: Residential, commercial and light industry

EN50082-2
Electromagnetic compatibility (EMC).
Generic immunity standard. Part 2: Industrial environment

14 Declaration of Conformity

Konformitätserklärung

Doc ID: GLN180PEX-2015-11-23

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 Designation*	**GLN180PEX**

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

EN55022:2010, Class B	Limits and methods of measurement of radio interference characteristics of information technology equipment
EN55024:2010	Limits and methods of measurement of Immunity characteristics of information technology equipment
EN 50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

gemäß den Richtlinien 2014/30/EU (Elektromagnetische Verträglichkeit), 2014/35/EU (Niederspannungsrichtlinie), 2011/65/EU (Beschränkung der Verwendung bestimmter gefährlicher Stoffe) und 93/68/EWG (CE Kennzeichnung) sowie deren Ergänzungen.
following the provisions of the directives 2014/30/EU (electromagnetic compatibility), 2014/35/EU (low voltage directive), 2011/65/EU (restriction of the use of certain hazardous substances) and 93/68/EEC (CE marking) and its amendments.

Bad Pyrmont, 2015-11-23

Günter Meinberg
Managing Director