MANUAL

GPS180SV

GPS Receiver Eurocard

21st June 2017

Meinberg Radio Clocks GmbH & Co. KG

Table of Contents

1 Imprint

Meinberg Funkuhren GmbH & Co. KG
Lange Wand 9, 31812 Bad Pyrmont / Germany

Phone: + 49 (0) 52 81 / 93 09 - 0
Fax: + 49 (0) 52 81 / 93 09 - 30

Internet: http://www.meinberg.de
Mail: info@meinberg.de

Date: 2014-08-21

2 General Information GPS

The satellite receiver clock GPS180SV has been designed to provide extremly 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 this system which receives its information from the satellites of the Global Positioning System.

The Global Positioning System (GPS) is a satellite-based radio-positioning, navigation, and time-transfer system. It was installed by the United States Departement 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.

GPS is based on accurately measuring the propagation time of signals transmitted from satellites to the user´s receiver. A nominal constellation of 24 satellites together with several active spares in six orbital planes 20000 km 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 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.

3 GPS180SV Features

The GPS180SV is using the "Standard Positioning Service" SPS. Navigation messages coming in from the satellites are decoded by the GPS180SV microprocessor in order to track the GPS system time. Compensation of the RF signal´s propagation delay is done by automatic determination of the receiver´s geographical position. A correction value computed from the satellites´ navigation messages increases the accuracy of the board´s oven controlled master oscillator (OCXO) and automatically compensates the OCXO´s aging. The last state of this value is restored from the battery buffered memory at power-up.

The GPS180SV has several different optional outputs, including four progammable pulses, modulated / unmodulated timecode and max. four RS232 COM ports, depending on the hardware configuation. Additionally, you can get the GPS180SV with different oscillators (e.g. OCXO- LQ/SQ/MQ/HQ/DHQ or Rubidium) to cover all levels of accuracy requirements.

You can review and change the hard- and software configuration options of the clock with the GPSMON32 application(see corresponding section in this manual).

3.1 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 since GPS was initiated in 1980. The current number of leap seconds is part of the navigation message supplied by the satellites, so the internal real time of the GPS180SV is based on UTC time scale. Conversion to local time and annual daylight saving time can be done by the receiver's microprocessor if the corresponding parameters are set up by the user.

3.2 Pulse and Frequency Outputs

The pulse generator of GPS180 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 from the front panel or 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 single satellite can be received or the receiver is forced to another mode of operation by the user.

3.3 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.

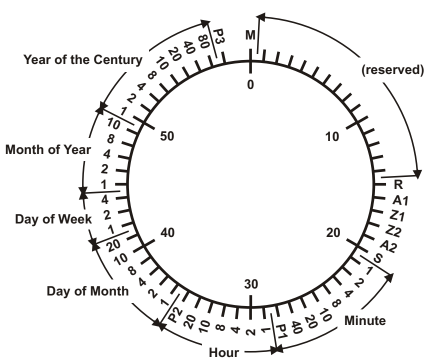
The format of the output string is ASCII, see the technical specifications at the end of this document for details. If the capture buffer is full a message "** capture buffer full" is transmitted, if the interval between two captures is too short the warning "** capture overrun" is being sent.

3.4 Asynchronous Serial Ports (optional 4x COM)

Four asynchronous serial RS232 interfaces (COM0 ... COM3) are available to the user. In the default mode of operation, the serial 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. 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. A separate document with programming instructions can be requested defining a binary data format which can be used to exchange parameters with GPS180 via COM0.

3.5 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	
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.

3.6 Programmable pulse

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

3.7 Time Code (Option)

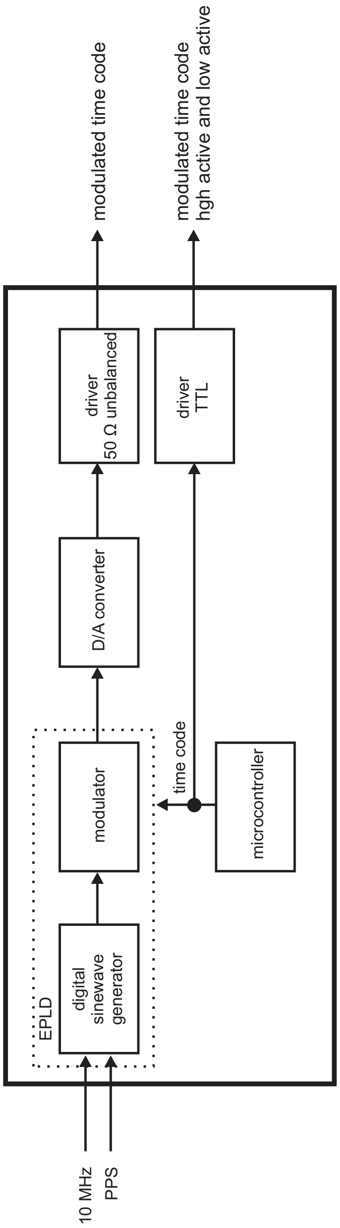
3.7.1 Abstract of Time Code

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.

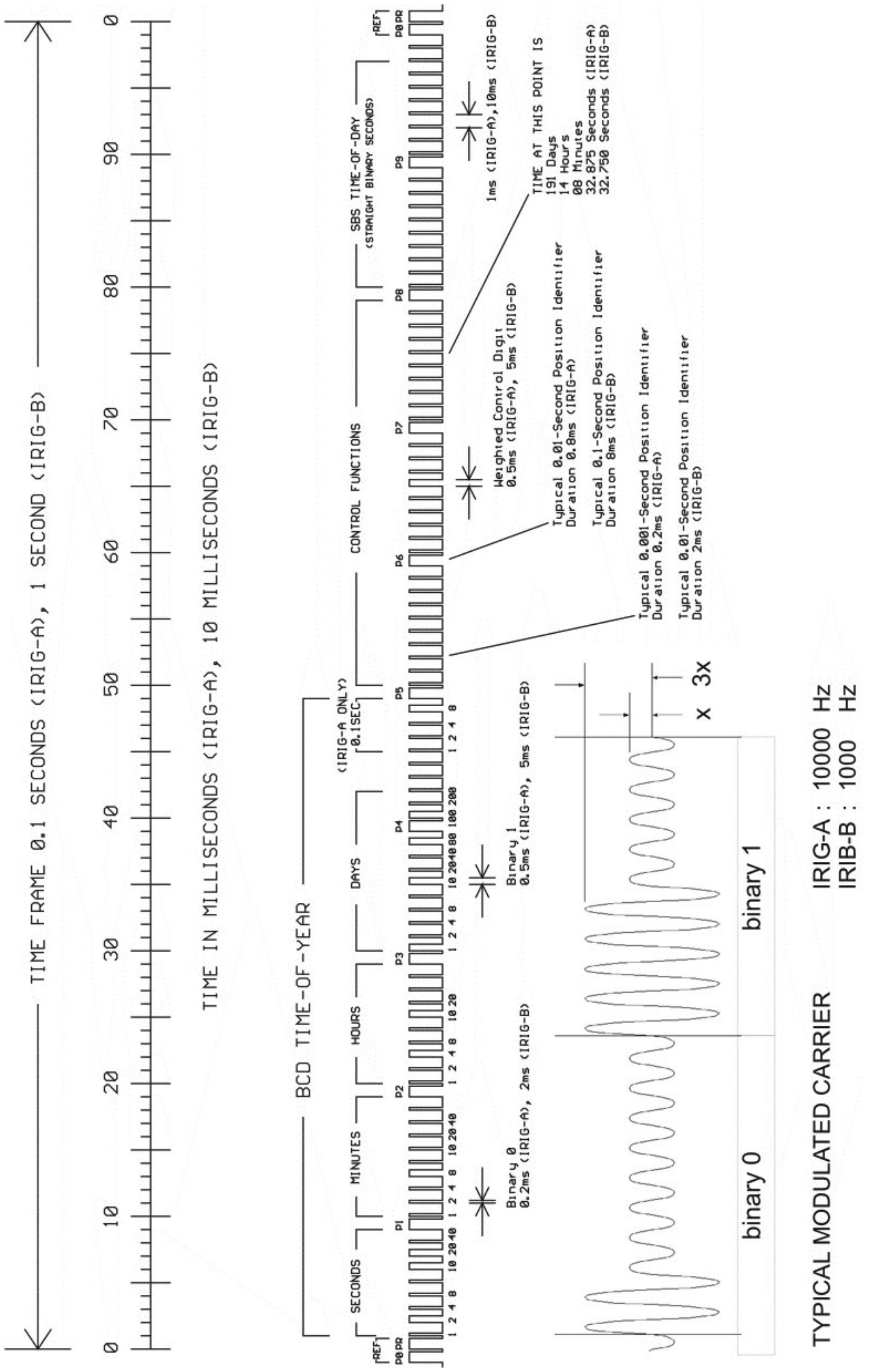
Except these "IRIG Time Codes", other formats like NASA36, XR3 or 2137 are still in use. The board GPS180 however generates the IRIG-B, AFNOR NFS 87-500 code as well as IEEE1344 code which is an IRIG-B123 coded extended by information for time zone, leap second and date. Other formats may be available 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.

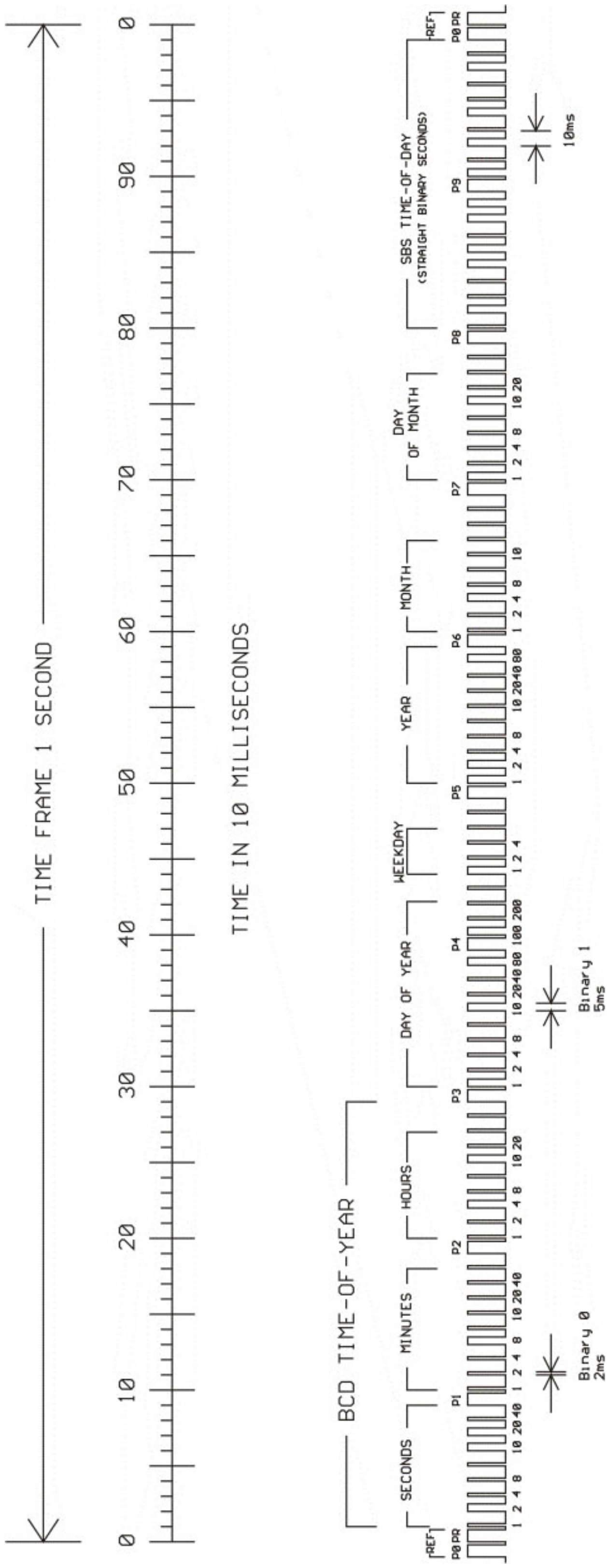
3.7.2 Block Diagram Time Code



3.7.3 IRIG Standard Format



3.7.4 AFNOR Standard Format



3.7.5 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

3.7.6 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

3.7.7 Selection of Generated Time Code

The time code to be generated can be selected by Menu Setup IRIG-settings or the Monitorprogram GPSMON32 (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.

3.7.8 Outputs

The module GPS180 provides modulated (AM) and unmodulated (DCLS) outputs. The format of the timecodes is illustrated in the diagramms "IRIG-" and "AFNOR standard-format".

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

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.

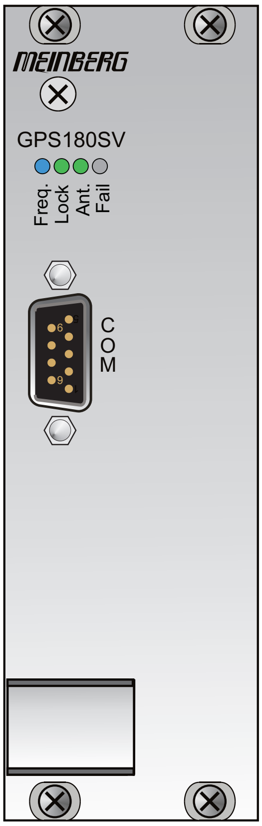
3.7.9 Technical Data

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

DCLS signal: TTL

4 Installation

4.1 The Front Panel Layout



Freq. LED

blue:	Initialisation phase
green:	"warmed up" – oscillator is adjusted
off:	Oscillator not adjusted yet

Lock LED

green:	positioning complete

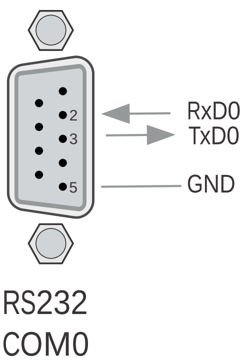
Ant. LED

red:	no synchronization resp. no antenna connected or short circuit on the antenna line
green:	antenna connected and clock is synchronized

Fail LED

red:	no synchronization

4.2 RS232 COM0



The serial port COM0 is accessible via a 9pin DSUB male connector in the frontpanel of the GPS180, parallel hardwired to the COM0 port on the rear VG edge connector.

4.3 Mounting the GPS Antenna

The GPS satellites are not stationary, but circle round the globe with 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/downconverter unit must be installed in a location that has as clear a view of the sky as possible. The best reception is achieved when the antenna has a free view of 8° angular elevation above the horizon. If this is not possible, the antenna should be installed with the clearest free view to the equator, because the satellite orbits are located between latitudes 55° North and 55° South. If this is not possible, you may experience difficulty receiving the four satellites necessary to complete the receiver's position solution.

The antenna/converter unit can be mounted on a wall, or on a pole up to 60 mm in diameter. A 50 cm plastic tube, two wall-mount brackets, and clamps for pole mounting are included. A standard RG58 coaxial cable should be used to connect the antenna/downconverter unit to the receiver. The maximum length of cable between antenna and receiver depends on the attenuation factor of the coaxial cable.

Up to four GPS180SV receivers can be run with one antenna/downconverter unit by using an optional antenna splitter. The total length of an antenna line from antenna to receiver must not be longer than the max. length shown in the table below. The position of the splitter in the antenna line does not matter.

The optional delivered MBG S-PRO protection kit can also be used for outdoor installation (degree of protection: IP55). However, we recommend an indoor installation, as short as possible after wall entering of the antenna cable, to minimize the risk of overvoltage damage by lightning for example.

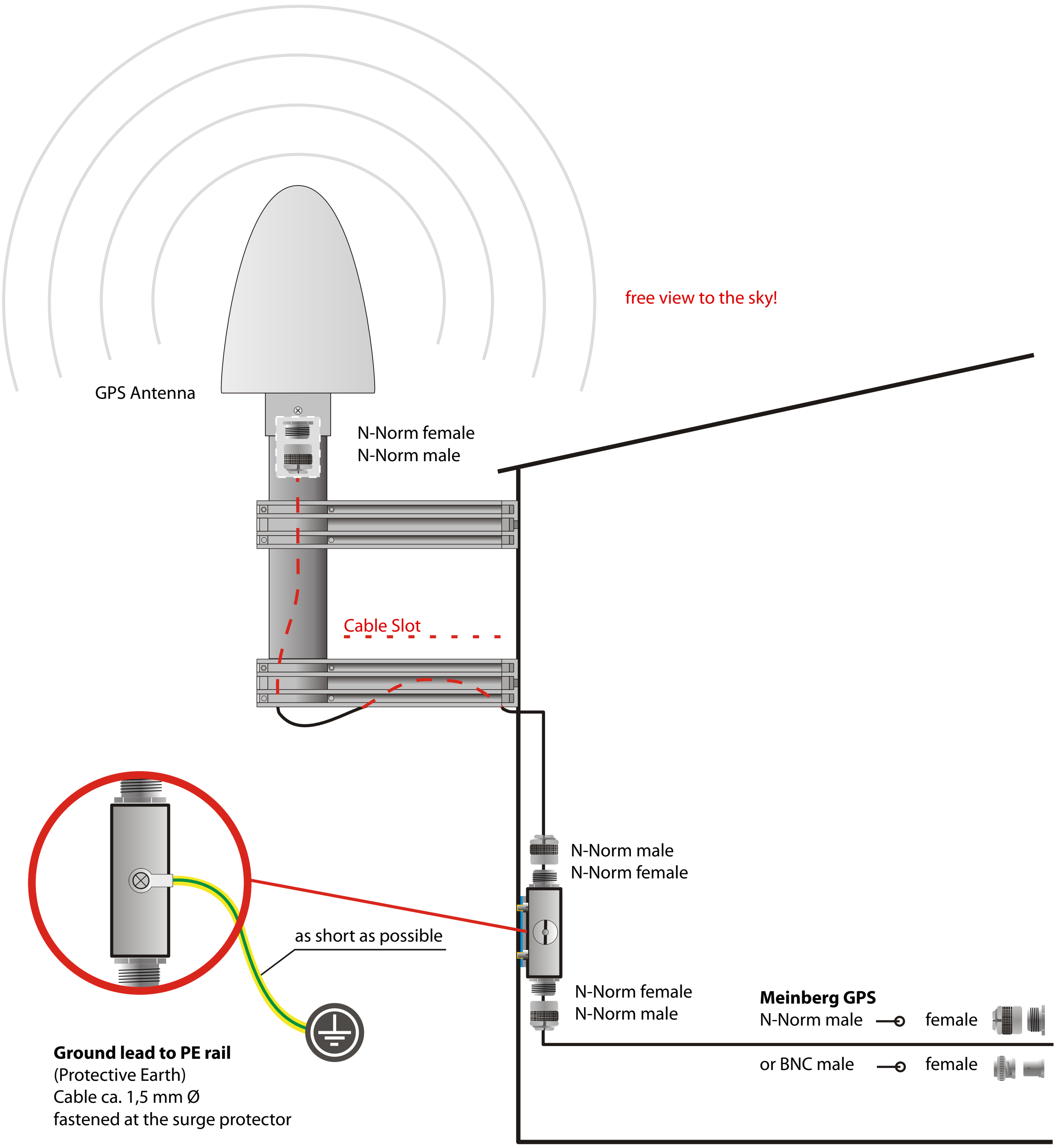
4.3.1 Example:

Type of cable	diameter Ø [mm]	Attenuation at 100MHz [dB]/100m	max lenght. [m]
RG58/CU	5mm	17	300 (1)
RG213	10.5mm	7	700 (1)

(1)This specifications are made for antenna/converter units produced after January, 2005
The values are typically ones; the exact ones are to find out from the data sheet of the used cable

4.3.2 Antenna Assembly with Surge Voltage Protection

Optional a surge voltage protector for coaxial lines is available. The shield has to be connected to earth as short as possible by using the included mounting bracket. Normally you connect the antenna converter directly with the antenna cable to the system.



4.4 Power Supply

The power supply used with a GPS180 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.

4.5 Powering Up the System

If both the antenna and the power supply have been connected the system is ready to operate. About 10 seconds after power-up the receiver´s (OCXO-LQ) until 3 minutes (OCXO-MQ / HQ) has warmed up and 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 maximally one minute after power-up (OCXO-LQ) until 10 minutes (OCXO-MQ / HQ) . After 20 minutes of operation the OCXO is full adjusted 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 and synthesizer 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 OCXO´s output frequency has been adjusted. Up to that time accuracy of frequency drops to 10-8 reducing the accuracy of pulses to +-5μs.

5 Safety Instructions

5.1 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, following should be noted:

ATTENTION!
Danger of explosion in case of inadequate replacement of the lithium battery. Only identical batteries or batteries recommended by the manufacturer must be used for replacement. The waste battery must be disposed as proposed by the manufacturer of the battery.

6 Technical Specifications GPS180SV

Receiver: 12 - channel C/A code receiver with external antenna/converter unit

Antenna: antenna/converter unit with remote power supply
refer to chapter "Technical specifications of antenna"

Power Supply for Antenna: 15 V DC, continuous short circuit protection, automatic recovery
isolation voltage 1000 VDC, provided via antenna cable

Antenna Input: antenna circuit dc-insulated; dielectric strength: 1000V
length of cable: refer to chapter "Mounting the Antenna

Time to Sychronization: one minute with known receiver position and valid almanac
12 minutes if invalid battery buffered memory

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

Accuracy of Pulses: after synchronization and 20 minutes of operation

TCXO, OCXO LQ:	better than +-100 nsec
OCXO SQ/MQ/HQ:	better than +-50 nsec
OCXO DHQ, Rubidium:	better than +-50 nsec

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

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:	2 asynchronous serial ports RS-232 (optional max. 4 serial ports)	
	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.	

ACCURACY OF FREQUENCY AND PULSE OUTPUTS:

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

	TCXO	OCXO LQ	OCXO SQ	OCXO MQ	OCXO HQ	OCXO DHQ	Rubidium (only available for 3U models)
short term stability (τ = 1 sec)	$2 \cdot 10^{-9}$	$1 \cdot 10^{-9}$	$5 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
accuracy of PPS (pulse per sec)	< ±100 ns	< ±100 ns	< ±50 ns	< ±50 ns	< ±50 ns	< ±50 ns	< ±50 ns
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	1Hz -75dBc/Hz 10Hz -89dBc/Hz 100Hz -128dBc/Hz 1kHz -140dBc/Hz
accuracy free run, one day	$\pm 1 \cdot 10^{-7}$ ±1Hz (Note1)	$\pm 2 \cdot 10^{-8}$ ±0.2Hz (Note1)	$\pm 5 \cdot 10^{-9}$ ±50mHz (Note1)	$\pm 1.5 \cdot 10^{-9}$ ±15mHz (Note1)	$\pm 5 \cdot 10^{-10}$ ±5mHz (Note1)	$\pm 1 \cdot 10^{-10}$ ±1mHz (Note1)	$\pm 2 \cdot 10^{-11}$ ±0.2mHz (Note1)
accuracy, free run, 1 year	$\pm 1 \cdot 10^{-6}$ ±10Hz (Note1)	$\pm 4 \cdot 10^{-7}$ ±4Hz (Note1)	$\pm 2 \cdot 10^{-7}$ ±2Hz (Note1)	$\pm 1 \cdot 10^{-7}$ ±1Hz (Note1)	$\pm 5 \cdot 10^{-8}$ ±0.5Hz (Note1)	$\pm 1 \cdot 10^{-8}$ ±0.1Hz (Note1)	$\pm 5 \cdot 10^{-10}$ ±5mHz (Note1)
accuracy GPS-synchronous, average 24h	$\pm 1 \cdot 10^{-11}$	$\pm 1 \cdot 10^{-11}$	$\pm 1 \cdot 10^{-11}$	$\pm 5 \cdot 10^{-12}$	$\pm 1 \cdot 10^{-12}$	$\pm 1 \cdot 10^{-12}$	$\pm 1 \cdot 10^{-12}$
accuracy of time free run, 1 day	± 4.3 ms	± 865 µs	± 220 µs	± 65 µs	± 22 µs	± 4.5 µs	± 1.1 µs
accuracy of time free run, 1 year	± 16 s	± 6.3 s	± 4.7 s	± 1.6 s	± 788 ms	± 158 ms	± 8 ms
temperature dependant 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)	$\pm 6 \cdot 10^{-10}$ (-25...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 $\pm 1 \cdot 10^{-7} \cdot 10MHz = \pm 1$ HZ

The given values for the accuracy of frequency and time (not short term accuracy) are only valid for a constant ambient temperature!
A minimum time of 24 hours of GPS-syncronicity is required before free run starts.

Steckerbelegung / Pin Assignment GPS180

	a	b (IMS)	c
1	VCC in (+5V)	VCC in (+5V)	VCC in (+5V)
2	VCC in (+12V)	VCC in (+12V)	VCC in (+12V)
3	VDD in (TCXO/OCXO)		VDD in (TCXO/OCXO)
4	(reserved, FreqAdjust out)	PPS out	ProgPulse3 out
5	FIXED FREQUENCY out	GND	10MHz in
6	PPS in	PPS in	PPS out
7	TIME CODE DC in	GND	PPS2 in
8	(reserved, 10 MHz_OSC in)	TC_DCLS in	PPM out
9	10 MHz SINE out	TC_AM in	
10	100 kHz out	Reserve 0	ProgPulse0 out
11	1 MHz out	GND	ProgPulse1 out
12	10 MHz out	-4.096MHz in	ProgPulse2 out
13	TIME CODE DC out	+4.096MHz in	SCL
14	TIME CODE AM out	GND	COM4 RxD in
15	COM2 RxD in	Board_ID0	SDA
16	COM2 TxD out	Board_ID1	(reserved, P7.5)
17	COM3 RxD in	Board_ID2	DCF_MARK out
18	COM3 TxD out	Board_ID3	(reserved, Vref/TxD2 TTL)
19	GND	Time Sync in	TIME_SYN out
20	GND	GND	(reserved, P7.6)
21	GND	10MHz in	F_SYNTH out
22	GND	GND	F_SYNTH_OD out
23	GND	Reserve 1	F_SYNTH_SIN out
24	GND	RxD in	COM1 TxD out
25	GND	Slot_ID0	COM4 TxD out
26	GND	Slot_ID1	COM0 TxD out
27	GND	Slot_ID2	CAP1 in
28	GND	Slot_ID3	CAP0 in
29	GND	+USB	COM1 RxD in
30	GND	-USB	COM0 RxD in
31	GND	GND	GND
32	GND	GND	GND

(yellow)	**IMS** Signale / Signals
(green)	Hier verwendete Signale / used Signals

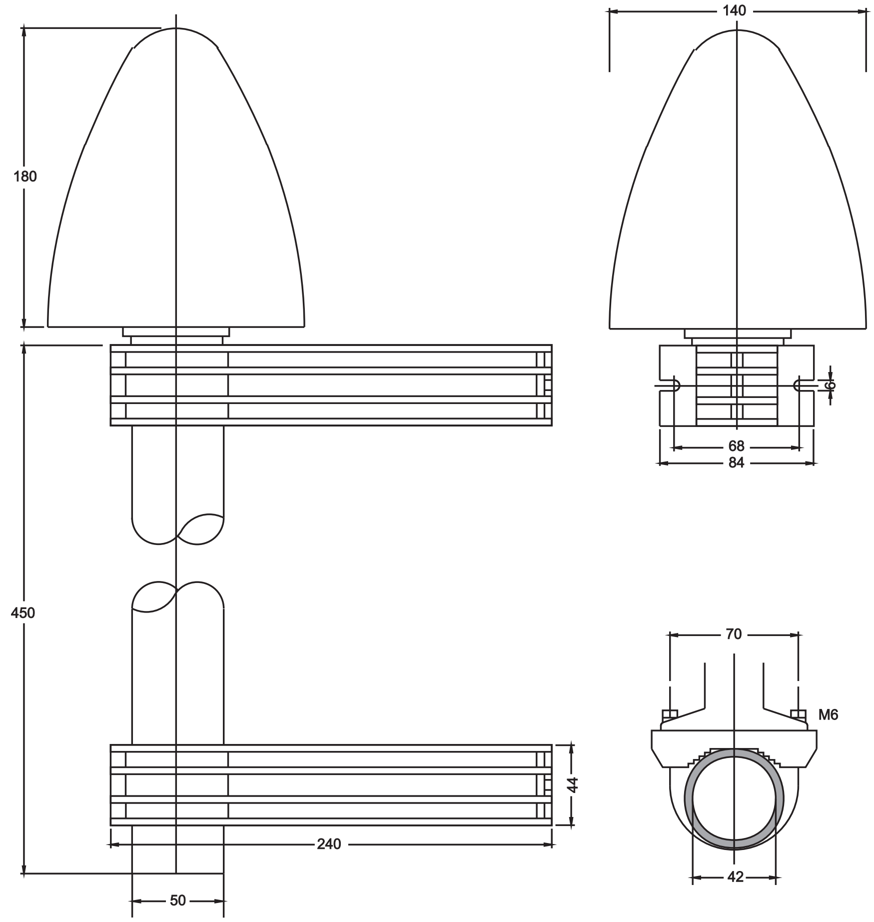
Stecker: 96-polige VG-Leiste DIN 41612 a+b+c
Connector: 96-pin VG-male DIN 41612 a+b+c

IdentNr.: GPS180_V140_CON

6.1 Technical Specifications GPS Antenna

Antenna:	dielectrical patch antenna, receive frequency:	25 x 25 mm 1575.42 MHz
Bandwith:	9 MHz	
Converter:	local oscillator to converter frequency: first IF frequency:	 10 MHz 35.4 MHz
Power Requirements:	12V ... 18V, @ 100mA (provided via antenna cable)	
Connector:	N-Type, female	
Ambient Temperature:	-40 ... +65°C	
Housing:	ABS plastic case for outdoor installation (IP66)	

Physical Dimension:



7 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.

7.1 Serial Connection

To obtain a connection between you PC and the receiver, connect the receivers COM0 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 COM0 manually to the PCs parameters.

7.2 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.

7.3 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