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Technical Information

Operating Instructions

GPS-receiver Rubidium Portable

Incl. Windows 9x/NT Software
GPSMON32

Impressum

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General information

The GRP has been designed to provide extremly precise reference clocks for various measurement or synchronization tasks. Examples are:

- **Measurement and test of synchronization quality of Telecom networks**
- **Calibration and synchronization of laboratory equipment**
- **Test of synchronization of radio transmitters / base stations (GSM / CDMA / UMTS / DAB / DVB)**

The module is based on the Meinberg GPS167SV GPS-receiver and a rubidium frequency reference, mounted in a metal desktop case. The integrated GPS-receiver allows the rubidium oscillator to be locked to the extremely precise GPS-system before taking the GRP to the spot of the measurement task. Thus the advantages of precision of GPS and stability of a rubidium reference are combined in a single case.

The clock GPS167SV 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 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 21 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.

The modular system GRP

The module GRP includes a set of equipment composed of a satellite controlled clock GPS167SV together with a rubidium oscillator, an interface unit LIU and a power supply unit SEM2524, all installed in a metal desktop case and ready to operate.

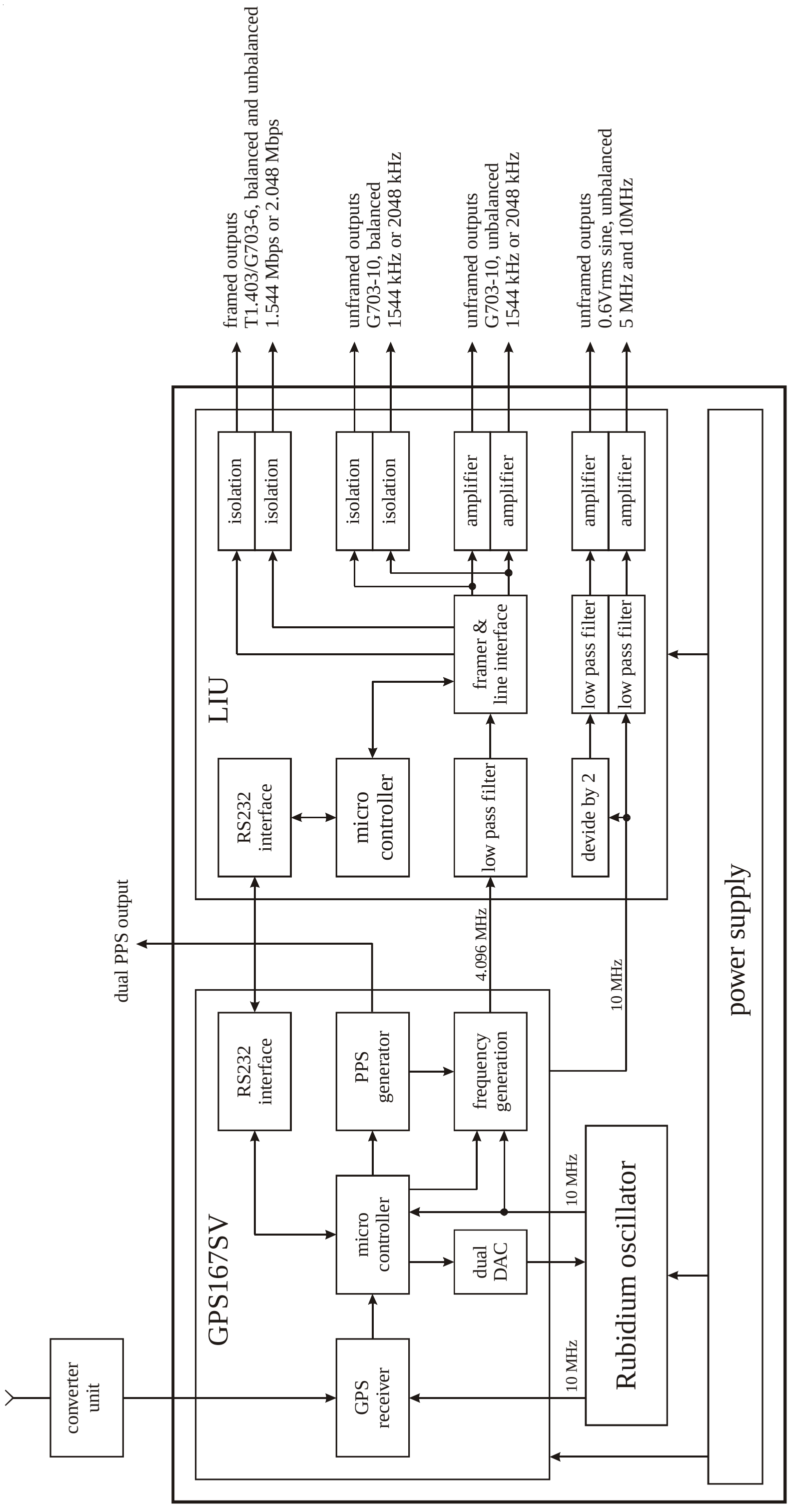
The interfaces provided by GPS167SV and the LIU are accessible via connectors in the front or rear panel of the case. Details of the components are described below.

Key features

GPS-receiver		
6 channel C/A-code receiver		
Pulse per second (PPS)	2 outputs TTL into 50 Ω, accuracy +/- 100 nsec, pulse duration 200 msec	
Status indication		
RS232 interface for configuration and monitoring		
Antenna cable max. 250 m (RG58C)		
Rubidium reference		
Accuracy GPS-locked	+/- 2×10^{-12} (τ=100 sec)	
Accuracy free run	+/- 1.5×10^{-11} / day	
	+/- 5×10^{-11} / month	
Unframed outputs		
1 x 5 MHz sinewave	0.6 Vrms, 50 Ω unbalanced, BNC	
1 x 10 MHz sinewave	0.6 Vrms, 50 Ω unbalanced, BNC	
2 x 1544/2048 kHz	G703, 75 Ω unbalanced, BNC	1)
2 x 1544/2048 kHz	G703, 120 Ω balanced, BNC Twinax	1)
Framed outputs		
1 x 1.544/2.048 Mbps	T1.403/G703, B8ZS/HDB3, 75 Ω unbalanced, BNC	1)
1 x 1.544/2.048 Mbps	T1.403/G703, B8ZS/HDB3, 120 Ω balanced, BNC Twinax	1)
Power supply		
100-240 VAC, 50-60 Hz		
1) Selection of E1- or T1-mode possible by switch		

Block diagram

The following block diagram illustrates the functional principle of the module GRP:



GPS167SV features

The eurocard (100 mm x 160 mm) GPS167SV includes a GPS-receiver circuit, a microcontroller system, pulse and frequency generators and interface circuits. The 40.6 mm wide front panel integrates two LED indicators, two hidden push buttons and a ninepole SUB-D-connector. The receiver circuit of the GPS167SV is connected to the antenna/converter unit by a 50 Ω coaxial cable (refer to "Mounting the antenna"). GPS167SV provides a DC insulated voltage for supplying the antenna/ converter unit via the antenna cable. An optional antenna diplexer allows the connection of up to four GPS-receivers to one antenna/converter unit.

GPS167SV is using the "Standard Positioning Service" SPS. The altitude with its variation of ±180m is the most inaccurate component of the position. This inaccuracy is caused by the operator (United States Departement of Defense) and not by the GPS167SV, but it has no influence on the accuracy of the generated time. The navigation message coming in from the satellites is decoded by GPS167SV´s microprocessor in order to track the GPS system time. Compensation of the RF signal´s propagation delay is done by automatical determination of the receiver´s position on the globe. A correction value computed from the satellites´ navigation messages increases the accuracy of the master oscillator (rubidium) and automatically compensates the oscillators aging and temperature depending drift. The last recent value is restored from the battery-backed memory at power-up.

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 GPS167SV´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 if the corresponding parameters are set up by the GPSMON32 (included Windows software).

Pulse and frequency outputs

The pulse generator of GPS167SV 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 rubidium oscillator. All these TTL-pulses are available at the rear connector. **The 10 MHz standard frequency is phase-locked to the precise pulse per second. The pulse per second (TTL into 50Ω) is available via two BNC-connectors in the rear panel of the system GRP.**

Frequency synthesizer

The onboard synthesizer is able to generate a frequency from 1/8 Hz up to 10 MHz. **Within the system GRP this output is fixed to 4.096 MHz for synchronization of the Framer and Line Interface of the board LIU. The output frequency of the synthesizer is derived from the rubidium oscillator and is automatically phase-locked to the pulse per second (PPS) therefore.** The 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).

In the default mode of operation, pulse outputs and the synthesizer output are disabled until the receiver has synchronized its timing to the GPS-system after power-up. However, the system can be configured to enable those outputs immediately after power-up by setting the appropriate parameters with GPSMON32.

Time capture inputs (not used)

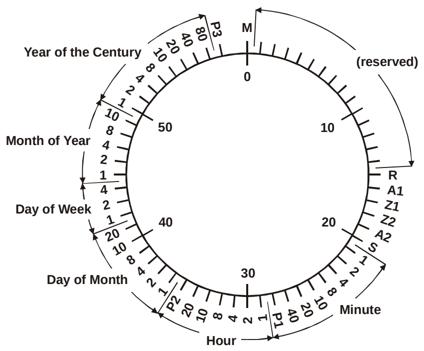
Two time capture inputs called User Capture 0 and 1 are provided at the rear connector (CAP0 and CAP1) to measure asynchronous time events. A falling TTL slope at one of these inputs lets the microprocessor save the current real time in its capture buffer. From the buffer, capture events are transmitted via COM0, is set-up by GPSMON32. 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 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 via COM0.

Asynchronous serial ports

GPS167SV provides two asynchronous serial interfaces (RS232) called COM0 and COM1. 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 of GPS-MON32. COM0, on the rear VG connector or via the ninepole D-SUB-connector in the frontpanel, is compatible with other radio remote clocks made by Meinberg. It sends Meinberg´s standard time string either once per second, once per minute or on request with ASCII ´?´ only. **Within the system GRP the interface COM1 is reserved for communication with the board LIU and is not available for the user therefore.** The format of the output strings is ASCII, see the technical specifications at the end of this document for details. The corresponding parameters can be set up by the GPSMON32 (included Windows software) via the serial port COM0.

DCF77 emulation (not used)

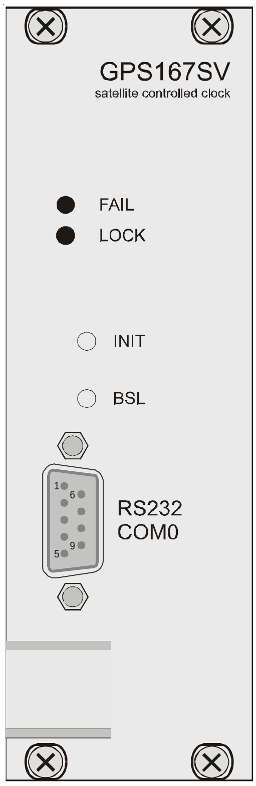
The GPS167SV satellite controlled clock generates TTL level time marks (active HIGH) which are compatible with the time marks spread by the German long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic 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, GPS167SV 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.

The front panel layout



FAIL LED

The FAIL LED is turned on whenever the timing of the receiver is not synchronized to the GPS-system.

LOCK LED

The LOCK LED is turned on when after power-up the receiver has acquired at least four satellites and has computed its position. In normal operation the receiver position is updated continuously as long as at least four satellites can be received. When the receivers position is known and steady only a single satellite needs to be received to synchronize and generate output pulses.

BSL key

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

If the BootStrapLoader key behind the front panel is pressed while the system is switched on, a bootstrap-loader is activated and waits for instructions from the serial port COM0. The new firmware can be sent to GPS167SV from any standard PC with serial interface. A loader program will be shipped together with the file containing the image of the new firmware.

The contents of the program memory will not be modified until the loader program has sent the command to erase the flash memory. So if the BSL key is pressed unintentionally while the system is switched on, the firmware will not be changed accidentially. After the next power-up, the system will be ready to operate again.

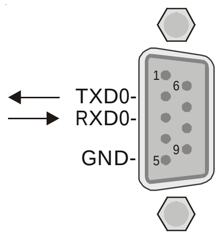
GPS INIT key

The GPS INIT key behind the front panel lets the user initialize all GPS data, i.e. all saved satellite data will be cleared. The system starts operating in the COLD BOOT mode and seeks for a satellite to read its actual parameters.

If the key is pressed while the system is powered up the battery-backed memory is also cleared and user definable parameters are reset to factory defaults.

RS232 COM0

The serial port COM0 is accessible via a ninepole female D-SUB connector in the frontpanel of the GPS167SV. This RS-232 interface can be connected to a computer (PC) by using a standard modem cable (straight through cable). TxD describes the sending, RxD the receiving line of the GPS167SV. The pin assignment is shown below.



RS232
COM0

Features of the rubidium oscillator

The rubidium oscillator makes use of the atomic resonance property of rubidium (^{87}Rb) to control the frequency of an unheated quartz crystal oscillator via a frequency-locked loop. It provides a 10 MHz frequency output that is used for synchronization of all timing tasks within the system GRP.

Frequency control

If the GPS167SV is synchronous to GPS, the rubidium frequency is compared to the extremely precise timing of the GPS-system. The calculated deviation of the oscillator frequency results in a correction value that is used to generate a control voltage. This voltage is applied to a special input of the rubidium oscillator, which allows the regulation of the output frequency to its nominal value. This procedure compensates temperature and aging dependant drift of the oscillator frequency as well as the frequency deviation at shipment.

If the system GRP runs without GPS-synchronization, the rubidium is controlled by the last calculated correction value in synchronous state. This value is stored in a battery backed memory of the GPS167SV and is available after power-up even without GPS-synchronization therefore. In this constellation, the system accuracy only depends on the characteristics of the rubidium oscillator.

Status indication

The rubidium-board includes two LEDs indicating the status of the oscillator. The LED ‘Operating’ is switched on after power-up, if the oscillator of the rubidium reference is frequency-locked to the atomic resonance of the atoms of the internal rubidium spectral lamp. At this point, the accuracy of the output frequency is approximately +/- 5 $*10^{-8}$ (10 MHz +/- 0.5 Hz).

The status of LED ‘Adjusted’ depends on the calculated deviation of the rubidium output frequency compared to the GPS-system. It can only signal an accuracy of at least +/- 5 $*10^{-11}$ (10 MHz +/- 0.0005 Hz) with GPS-reception therefore. Without GPS-synchronization the last correction value calculated with GPS-reception is applied to the frequency tuning input of the rubidium and the accuracy of the output frequency only depends on the performance of the rubidium oscillator. Thirty minutes after power-up an accuracy of +/- 3 $*10^{-11}$ (10 MHz +/- 0.0003 Hz) is achieved although it can’t be signalled by LED ‘Adjusted’ in this mode of operation.

Features LIU

The board LIU (**L**ine **I**nterface **U**nit) was designed to convert the GPS-locked standard frequency of the rubidium oscillator into several timing signals that can be used for various synchronization or measurement tasks. The outputs of the LIU are accessible via BNC- or BNC-Twinax-connectors in the front panel of the board.

There are two seperate signal paths on the board LIU. One is for providing the standard frequencies, the second path is for generation of the ‘telecom-signals’. The ‘telecom-signals’ are disabled until the oscillator of the rubidium reference is locked and the accuracy of the output signals is approximately +/- 5 $*10^{-8}$.

Standard frequencies

The 5 MHz and 10 MHz standard frequencies are derived directly from the rubidium oscillator. Because of the locking of the rubidium oscillator to the precise PPS-signal (pulse per second generated from GPS-receiver), the standard frequencies are also locked to the PPS. After passing an additional filter and an amplifier circuit, they are fed to the BNC-connectors.

Telecom signals

These signals can be devided into two groups, the ‘unframed’ and the ‘framed’ outputs. They are provided by a framer and line interface unit on the board LIU. All clock signals needed for generation of the ‘telecom outputs’ are phase locked to a 4.096 MHz reference clock, which is generated by a frequency synthesizer on the board GPS167SV. This synthesizer is phase locked to the PPS-signal and frequency locked to the rubidium oscillator. The LIU is able to generate signals for the American T1- or the European E1-system. The mode of operation depends on the position of a switch in the rear panel of the GRP.

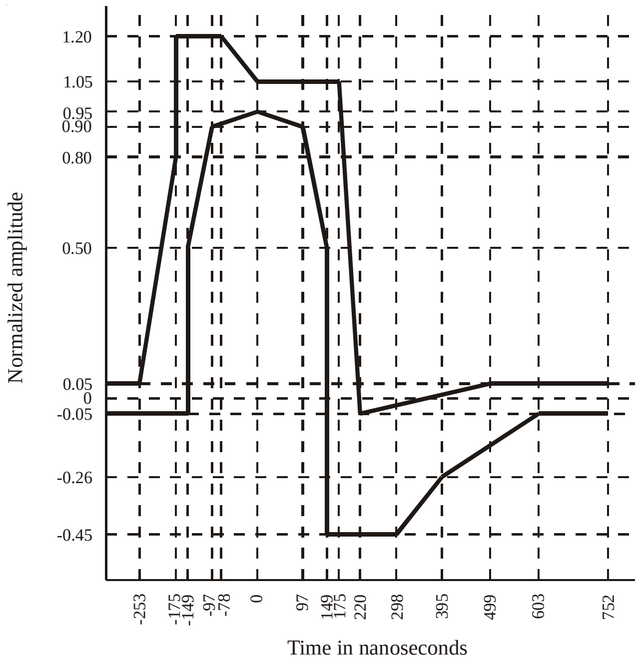
The ‘unframed’ outputs are standard frequencies of either 1544 kHz (T1) or 2048 kHz (E1). Two unbalanced and two balenced outputs according to ITU-T G703-10 (CCITT recommendation ‘Physical/electrical characteristics of hierarchical digital interfaces) are available via BNC- and BNC-Twinax-connectors.

The ‘framed’ outputs are consisting of data signals known from digital telephony, which are distributed by using a special frame structure. As a synchronization unit, the GRP only generates a ‘framed all ones’ signal (data byte 0xFF hex) with a transmission speed of either 1.544 Mbps (T1) or 2.048 Mbps (E1). An unbalanced and a balanced output according to ANSI T.403 (T1-mode) or ITU-T G703-6 (E1-mode) are available via BNC- and BNC-Twinax-connectors. Two different line codes used for error correction are known for the transmission of framed signals. The board LIU however generates B8ZS- (T1-mode) or HDB3-coded (E1-mode) output signals only.

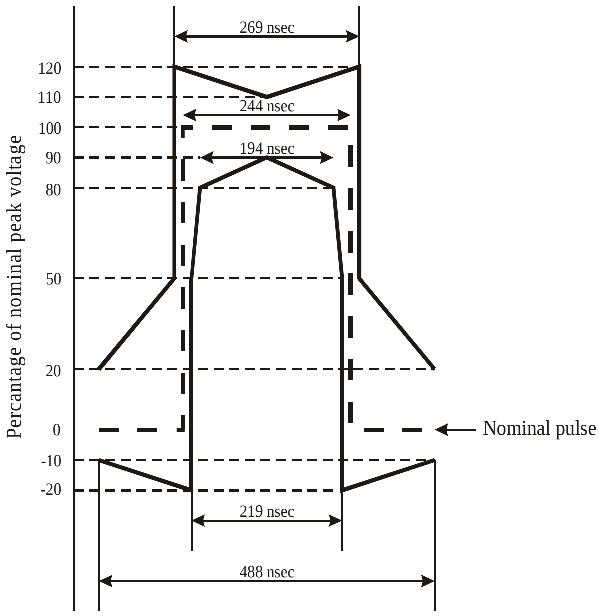
Pulse templates

The following pulse templates are required ANSI (T1-mode) and CCITT (E1-mode) for output signals in telecom applications:

T1 (T.403):



E1 (G.703):



The board LIU of the module GRP meets these recommendations.

Power supply SEM2524

The SEM2524 provides two regulated outputs for supplying GPS167SV, LIU and the rubidium oscillator. A LED in the front panel indicates the correct function of the module.

Technical data

MAINS VOLTAGE:	100 ... 240 VAC +/- 10%, 47 ... 63 Hz	
MAINS NOMINAL CURRENT:	1.32A (@ 90 VAC)	
INTERNAL FUSE:	4 A slow blow/ 250 V	
OUTPUT-VOLTAGES:	5 V / 7 A (50^0C)	ΔV: (4.95 - 5.05 V)
	24 V / 2 A (50^0C)	ΔV: (22 - 26 V)
OUTPUT-POWER:	max. 84 W	
AMBIENT-TEMPERATURE:	0 - 70 °C	
CE:	Interference emission:	EN50081-1, EN55011 class B
	Interference immunity:	EN50082-2, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN61000-4-5, EN61000-4-6
INERNATIONAL APPROVALS:	EN60950, UL	
POWER FACTOR CORRECTION:	in accordance with EN61000-3-2	

Installation of GRP

Power Supply

The integrated power supply delivers the +5 V and +24 V needed for the operation of GPS167SV, LIU and the rubidium oscillator. The power cord is connected via a power cord receptacle (according to EN60320 – C13) in the rear panel.

Mounting the Antenna

The GPS 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/converter unit must be installed in a location from which as much of the sky as possible can be seen. 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 occure especially when at least four sattelites for positioning have to be found.

The antenna/converter unit can be mounted on a pole with a diameter up to 60 mm or at a wall. A 50 cm plastic tube, two holders for wall-mounting and clamps for pole-mounting are part of the scope of supply of every GPS167SV. A standard coaxial cable with 50 Ω impedance should be used to connect the antenna/converter unit to the receiver. The maximum lenght of cable between antenna and receiver depends on the attenuation factor of the used coaxial cable.

Example:

Type of cable	diameter Ø [mm]	Attenuation at 100MHz [dB]/100m	max. lenght [m]
RG58/CU	5mm	15.9	250 [1]
RG213	10.5mm	6.9	500 [1]

The values are typically ones; the exact ones are to find out from the data sheet of the used cable.

[1] This specifications are made for antenna/converter units produced after May, 1999. Older devices amount to 200m resp. 400m.

Up to four GPS167SV receivers can be run with one antenna/converter unit by using the optional antenna diplexer. The total length of one antenna line between antenna, diplexer and receiver must not be longer than the max. lenght shown in the table above. The position of the diplexer in the antenna line does not matter.

Powering Up the System

If both, the antenna and the power supply have been connected the system is ready to operate. About 2 minutes after power-up the receiver´s master oscillator (rubidium) has warmed up and operates with the required accuracy. If the receiver finds valid almanac and ephemeris data in its battery-backed 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.

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 rubidium´s output frequency has been adjusted. Up to that time accuracy of frequency drops to 10^{-8} reducing the accuracy of pulses to ±5µs.

Skilled/Service-Personnel only: Replacing the Lithium Battery

The life time of the lithium battery on the board GPS167SV is at least 10 years. If the need arises to replace the battery, the 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.

Technical specifications GRP

HOUSING:	Metal desktop case, Schroff Propac Front panel: 3 U / 42 HP (128 mm high / 213 mm wide)
PROTECTION RATING:	IP20
PHYSICAL DIMENSIONS:	257 mm wide x 157 mm high x 316 mm deep
WEIGHT:	5.8 kg
FUSE:	2A, slow blow

Rear panel connectors

Name	Type	Signal	Cable
Antenna	Coax type N	35.4 MHz / 10 Mhz	shielded coaxial line
Power supply	power cord receptacle EN60320 – C13	90-254 V~	power supply cord

Front/rear panel connectors

Name	Type	Signal	Cable
COM0	9 pin female SUB-D	RS-232	shielded data line
10 MHz, 5 MHz	BNC	0.6 Vrms, sine	shielded coaxial line
unframed outputs 1544/2048 kHz	BNC, BNC-Twinax	G703-10	shielded coaxial line
framed outputs 1.544/2.048 Mbps	BNC, BNC-Twinax	T.403/G703-6	shielded coaxial line
PPS	BNC	TTL into 50Ω	shielded coaxial line

CE Label

CE

This device conforms to the directive 89/336/EWG on the approximation of the laws of the Member States of the European Community relating to electromagnetc compatibility.

Rear View GRP

The rear panel of the module GRP includes the antenna connector for the GPS-receiver, the mode-switch for selecting T1- or E1-operation, the BNC-connectors for the pulse per second (PPS) and a power entry module with fuse and switch.

Technical Specifications GPS167SV

RECEIVER:	6 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"
ANTENNA INPUT:	antenna circuit dc-insulated; dielectric strength: 1000V⎓ length of cable: refer to chapter "Mounting the antenna"
TIME TO SYNCHRO-NIZATION:	one minute with known receiver position and valid almanac 12 minutes if invalid data in battery backed memory
PULSE OUTPUTS:	change of second (P_SEC, TTL level) change of minute (P_MIN, TTL level)
ACCURACY OF PULSES:	better than ±100 nsec after synchronization and 20 minutes of operation better than ±2 µsec during the first 20 minutes of operation
FREQUENCY OUTPUTS:	10 MHz, 1 MHz, 100 kHz (TTL level)
TIME_SYN OUTPUT:	TTL HIGH level if synchronized
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 COM1: 9600, 8N1
TIME CAPTURE INPUTS:	triggered on falling TTL slope Interval of events: 1.5msec min. Resolution: 100ns

FREQUENCY SYNTHESIZER:	1/8 Hz up to 10 MHz (fixed to 4.096 MHz in this application)		
ACCURACY OF SYNTHESIZER:	see ‘Technical specification rubidium’		
SYNTHESIZER OUTPUTS:	F_SYNTH:	TTL level	
	F_SYNTH_OD:	open drain	
		drain voltage:	< 100 V
		sink current to GND:	< 100 mA
		output power at 25 °C:	< 360 mW
	F_SYNTH_SIN	sine-wave	
		output voltage:	1.5 Vrms
		output impedance:	200 Ω
POWER REQUIREMENTS:	5 V ± 5%, @700 mA		
PHYSICAL DIMENSIONS:	Eurocard, 100mm x 160mm, 1.5mm Epoxy		
FRONT PANEL:	3U / 8HP (128 mm high x 40.5 mm wide), Aluminium		
REAR EDGE CONNECTOR:	according to DIN 41612, type C 64, rows a+c (male)		
RF CONNECTOR:	coaxial SMB connector (male)		
AMBIENT TEMPERATURE:	0 ... 50 °C		
HUMIDITY:	85% max.		

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)

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:

u: ‘#’ clock has not synchronized after reset
‘ ‘ (space, 20h) clock has synchronized after reset

v: different for DCF77 or GPS receivers:

‘*’ DCF77 clock currently runs on XTAL
GPS receiver has not checked its position

‘ ‘ (space, 20h) DCF77 clock is sync'd with transmitter
GPS receiver has determined its position

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)

Format of the GPS167 Capture String

The Meinberg GPS167 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		
	'L'	leap second is actually inserted (active only in 60th sec.)	
	' '	(space, 20h) no leap second is inserted	

Technical specification rubidium

OUTPUT FREQUENCY:	10 MHz sine wave	
OUTPUT LEVEL:	0.55 Vrms into 50 Ω	
PHASE NOISE:	1 Hz	-75 dBc / √Hz
	10 Hz	-89 dBc / √Hz
	100 Hz	-128 dBc / √Hz
	1 kHz	-140 dBc / √Hz
	10 kHz	-147 dBc / √Hz
AGING:	month	$< 5 \cdot 10^{-11}$
	10 years	$< 1 \cdot 10^{-9}$
SHORT TERM STABILITY:	$< 2.5 \cdot 10^{-11}$	$\tau = 1$ sec
	$< 0.8 \cdot 10^{-11}$	$\tau = 10$ sec
	$< 0.2 \cdot 10^{-11}$	$\tau = 100$ sec

ACCURACY: GPS-synchronized, averaged 24h: $+/- 1 \cdot 10^{-12}$ (+/- 0.01 mHz)

warm-up without GPS-reception @ 25°C:

$+/- 5 *10^{-8}$	after t < 5.4 min.
$+/- 1 *10^{-9}$	after t < 7.3 min.
$+/- 4 *10^{-10}$	after t < 10.6 min.
$+/- 3 *10^{-11}$	after t = 30 min. („retrace“ accuracy)

without GPS-synchronization @ 20 °C:
$+/- 1.5 \cdot 10^{-11}$ (+/- 0.2 mHz) / day
$+/- 5 \cdot 10^{-10}$ (+/- 5 mHz) / year

RETRACE: $+/- 3 \cdot 10^{-11}$
(after 24h power on @ 25°C and up to 48h power off)

TEMPERATURE-DRIFT:	-25°C / 70°C	$< 6 \cdot 10^{-10}$
	0°C / 50°C	$< 3 \cdot 10^{-10}$

STATUS: indicated by LED (LED ‘Adjusted’ only with GPS-reception):

‘Operating’	: accurracy:	$+/- 5 *10^{-8}$
‘Adjusted’	: accurracy:	$+/- 5 *10^{-11}$

POWER REQUIREMENTS: 24 V (19...32 V), < 13 W @25 °C

PHYSICAL DIMENSIONS:	Eurocard, 100 mm x 160 mm, 1.5 mm Epoxy
FRONT PANEL:	3U / 16HP (128 mm high x 81.3 mm wide), Aluminium
REAR EDGE CONNECTOR:	according to DIN 41612, type C 64, rows a+c (male)
AMBIENT TEMPERATURE:	-20 ... 70 °C
HUMIDITY:	80% max.

Technical specification LIU

OUTPUT FREQUENCIS:	10 MHz and 5 MHz sine wave, 0.6 Vrms into 50 Ω
UNFRAMED OUTPUTS:	1544 kHz or 2048 kHz according to G703-10 2 outputs 75 Ω unbalanced , BNC 2 outputs 120 Ω balanced , BNC-Twinax
FRAMED OUTPUTS:	1.544 Mbps or 2.048 Mbps 1 output 75 Ω unbalanced , BNC 1 output 120 Ω balanced , BNC-Twinax B8ZS or HDB3 line coding Framer and line interface meets following recommendations: T1-mode: ITU I.431 AT&T PUB43801 TR-62411 ANSI T1.102, T.403, T.408 E1-mode: ITU-T G.703, G.704, G.706, G.775, G.796, G.732, G.823 I.431
SHORT TERM STABILTTY:	see ‘Technical specification rubidium’
ACCURACY:	see ‘Technical specification rubidium’
POWER REQUIREMENTS:	5 V ± 5%, @470 mA
PHYSICAL DIMENSIONS:	Eurocard, 100mm x 160mm, 1.5mm Epoxy
FRONT PANEL:	3U / 14HP (128 mm high x 71.1 mm wide), Aluminium
REAR EDGE CONNECTOR:	according to DIN 41612, type C 64, rows a+c (male)
CONNECTORS:	BNC- and BNC-Twinax-connectors (male)
AMBIENT TEMPERATURE:	0 ... 50 °C
HUMIDITY:	85% max.

Technical specifications of antenna

ANTENNA: dielectrical patch antenna, 25 x 25mm
receive frequency: 1575.42 MHz, bandwidth 9 MHz

CONVERTER: local oscillator to converter frequency: 10 MHz
first IF frequency: 35.4 MHz

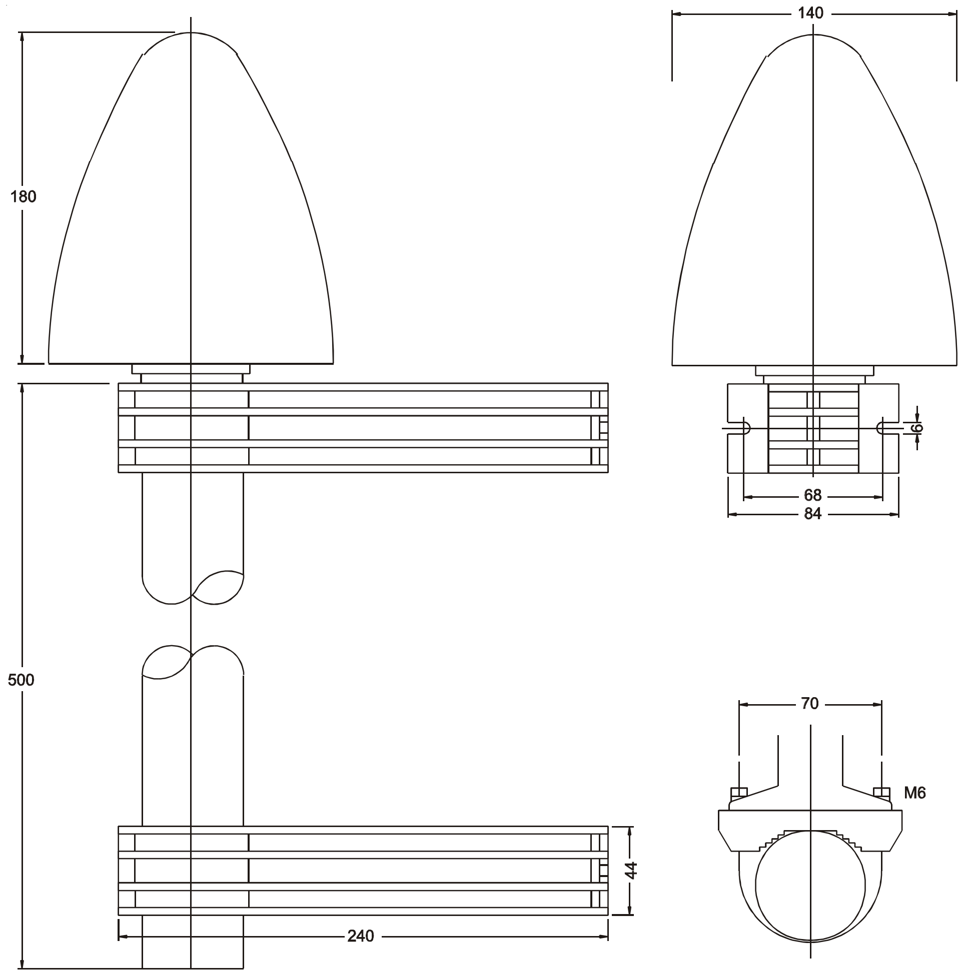
POWER REQUIREMENTS: 12V ... 18V, @ 100mA (provided via antenna cable)

CONNECTOR: coax type N, female

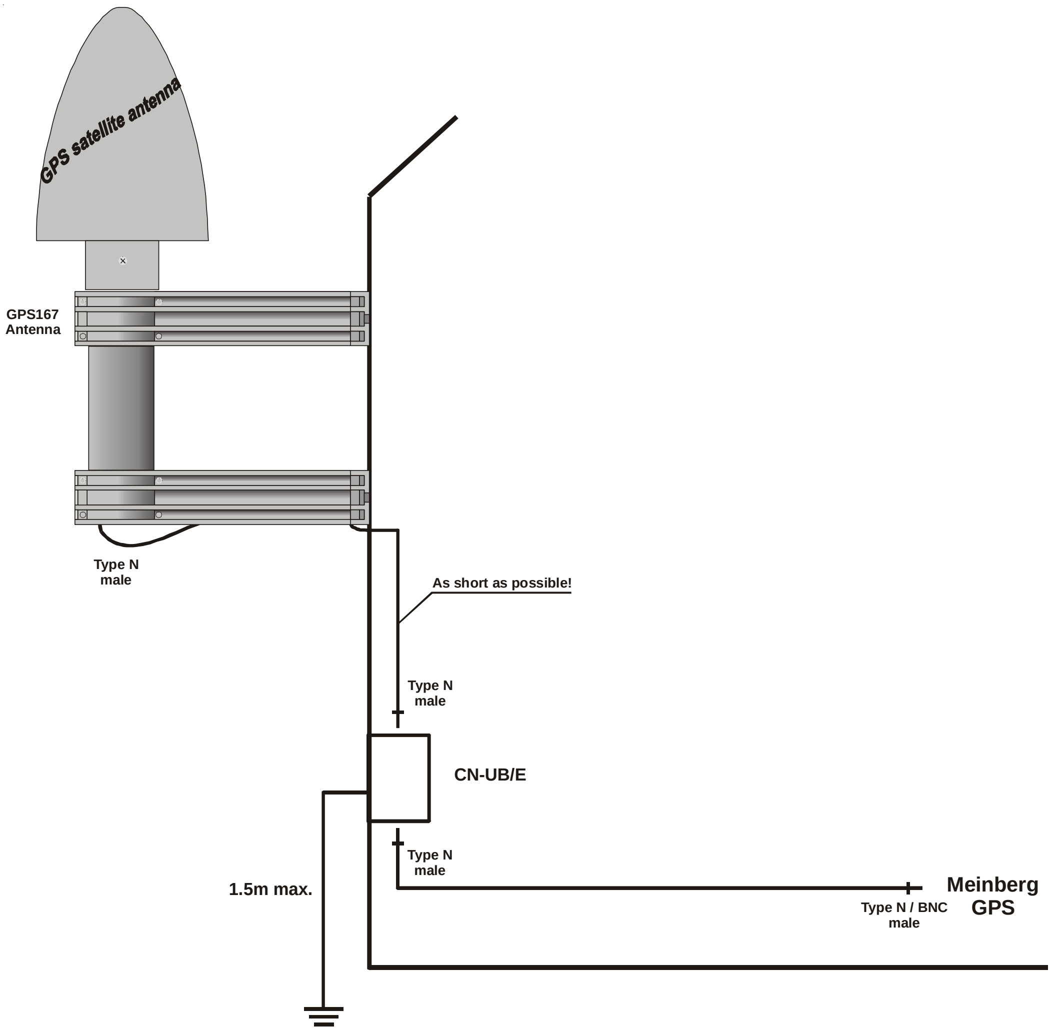
AMBIENT TEMPERATURE: -40 ... +65°C

HOUSING: ABS plastic case for outdoor installation (IP56)

PHYSICAL DIMENSION:



Assembly with CN-UB/E (CN-UB-280DC)

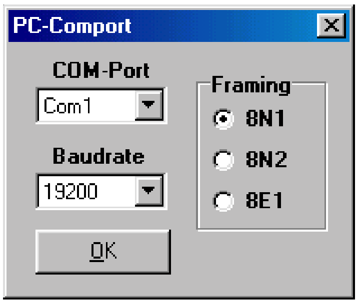


Diskette with Windows Software GPSMON32

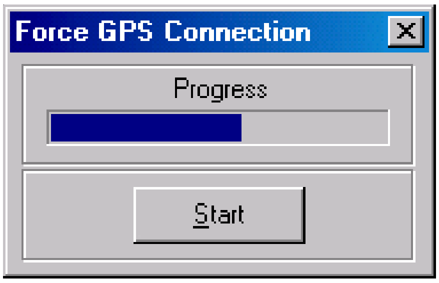
The program GPSMON32

The program GPSMON32 can be used to monitor and program all essential functions of Meinberg GPS-Receivers. The Software is executable under Win9x/2k/ NT. To install GPSMON32 just run Setup.exe from the included diskette and follow the instructions of the setup program.

To obtain a connection between your PC and the GPS-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 GPS serial port is configured in the same way as the PCs comport. You can enforce an access, if the GPS serial port is not configured with appropriate parameters for communication. Select the menu item '**Enforce Connection**' in menu **'Connection'** and click **'Start'** in the appearing window. Some firmware versions of GPS167 do not support this way of setting up a connection. If '**Enforce Connection**' doesn't succeed apparently, please change the serial port parameter of GPS COM0 manually to the PCs parameters.



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 Deutsch/ Englisch in the Help Menu.