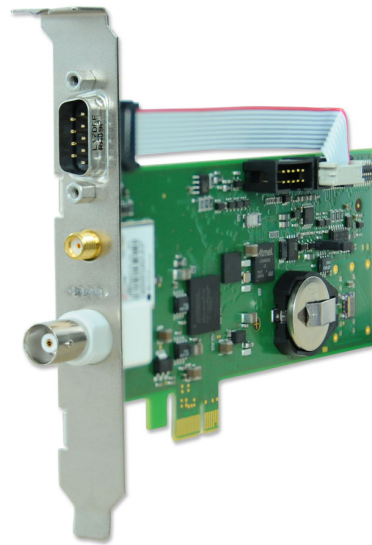




The Synchronization Experts.



MANUAL

GNS181PEX

**Combined GPS/GLONASS/Galileo/BeiDou
Satellite controlled Radio Clock**

5th November 2019

Meinberg Funkuhren GmbH & Co. KG

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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 - 230

Internet: <https://www.meinbergglobal.com>

Mail: info@meinberg.de

Date: 2019-11-05

2 Important Safety Information

2.1 Important Safety Instructions and Protective Measures

The following safety instructions must be respected in all operating and installation phases of the device. Non-observance of safety instructions, or rather special warnings and operating instructions in product manuals, violates safety standards, manufacturer instructions and proper usage of the device. Meinberg Funkuhren shall not be responsible for any damage arising due to non-observance of these regulations.



Depending on your device or the installed options some information is not valid for your device.



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

If a procedure is marked with the following signal words, you may only continue, if you have understood and fulfilled all requirements. In this documentation dangers and indications are classified and illustrated as follows:



DANGER!

The signal word indicates an imminently hazardous situation with a high risk level . This notice draws attention to an operating procedure or similar proceedings, of which a non-observance may result in serious personal injury or death .



WARNING!

The signal word indicates a hazard with a medium risk gradient . This notice draws attention to an operating procedure, a procedure or the like which, if not followed, can lead to serious injuries , possibly resulting in death .



CAUTION!

The signal word indicates a hazard with a low risk gradient . This notice draws attention to an operating procedure, a procedure or the like which, if not followed, can lead to minor injuries .















ATTENTION!

This notice draws attention to an operating procedure, a procedure or the like which, if not followed, can cause damage to the product or loss of important data .

2.2 Used Symbols

The following symbols and pictograms are used in this manual. To illustrate the source of danger, pictograms are used, which can occur in all hazard classes.

Symbol	Beschreibung / Description
	IEC 60417-5031 Gleichstrom / <i>Direct current</i>
	IEC 60417-5032 Wechselstrom / <i>Alternating current</i>
	IEC 60417-5017 Erdungsanschluss / <i>Earth (ground) terminal</i>
	IEC 60417-5019 Schutzleiteranschluss / <i>Protective earth (ground) terminal</i>
	ISO 7000-0434A Vorsicht / <i>Caution</i>
	IEC 60417-6042 Vorsicht, Risiko eines elektrischen Schlages / <i>Caution, risk of electric shock</i>
	IEC 60417-5041 Vorsicht, heiße Oberfläche / <i>Caution, hot surface</i>
	IEC 60417-6056 Vorsicht, Gefährlich sich bewegende Teile / <i>Caution, moving fan blades</i>
	IEC 60417-6172 Trennen Sie alle Netzstecker / <i>Disconnection, all power plugs</i>
	IEC 60417-5134 Elektrostatisch gefährdete Bauteile / <i>Electrostatic Sensitive Devices</i>
	IEC 60417-6222 Information generell / <i>Information general</i>
	2012/19/EU Dieses Produkt fällt unter die B2B Kategorie. Zur Entsorgung muss es an den Hersteller übergeben werden. <i>This product is handled as a B2B category product. In order to secure a WEEE compliant waste disposal it has to be returned to the manufacturer.</i>

The manuals for a product are included in the scope of delivery of the device on a USB stick. The manuals can also be obtained via the Internet. Enter www.meinbergglobal.com into your browser, then enter the corresponding device name in the search field at the top.



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

This device may only be used for the purpose described in this manual. In particular, the given limits of the device must be observed. The safety of the installation in which the unit is integrated is the responsibility of the installer!

Non-observance of these instructions can lead to a reduction in the safety of this device!

Please keep this manual in a safe place.

This manual is intended exclusively for electricians or persons trained by an electrician who are familiar with the applicable national standards and safety rules. Installation, commissioning and operation of this device may only be carried out by qualified personnel.

2.3 Security during Installation



WARNING!

Preparing for Commissioning

This built-in unit, has been designed and examined according to the requirements of the standard IEC 60950-1 „Information Technology Equipment - Safety“.

When the built-in unit is used in a terminal (e.g., housing cabinet), additional requirements according to Standard IEC 60950-1 must be observed and complied with. In particular, the general requirements and the safety of electrical equipment (such as IEC, VDE, DIN, ANSI) as well as the applicable national standards are to be observed.

The device has been developed for use in the industrial sector as well as in residential areas and can only be used in such environments. For environments with higher levels of soiling, additional measures, e.g. Installation in an air-conditioned control cabinet required.

Transport, Unpacking, Installation

If the unit is brought into the operating room from a cold environment, condensation may occur, wait until the unit is temperature-controlled and absolutely dry before operating it.

When unpacking, setting up, and before operating the equipment, be sure to read the information on the hardware installation and the specifications of the equipment. These include, for example, dimensions, electrical characteristics, and necessary ambient and climatic conditions, etc.

The fire protection must be ensured in the installed state.

For mounting, the housing must not be damaged. No holes may be drilled in the housing.

For safety reasons, the device with the highest mass should be installed in the lowest position of the rack. Other devices must be placed from the bottom to the top.

The device must be protected against mechanical stress such as vibration or shock.



Connecting Data Cables

During a thunderstorm, data transmission lines must not be connected or disconnected (risk of lightning).

When wiring the devices, the cables must be connected or disconnected in the order of the arrangement described in the user documentation accompanying the device. Always attach all cables to the plug during connection and removal. Never pull the cable itself. Pulling the cable can cause the cables to disconnect from the plug.

Install the cables in way that they do not constitute a hazard (danger of tripping) and are not damaged, i.e. kinked.

Connecting Power Supply

This equipment is operated at a hazardous voltage. Non-observance of the safety instructions in this manual may result in serious personal injury or property damage.

Before connecting to the power supply, a grounding cable must be connected to the earth connection of the device.

Before operation, check that all cables and lines work properly and are undamaged. Pay particular attention to the facts that the cables do not have kinks or that they are not too short around corners, and no objects are placed on the cables. Also make sure that all connections are secure.

Faulty shielding or cabling will endanger your health (electrical shock) and may destroy other equipment.

Ensure that all necessary safety precautions have been taken. Make all connections to a unit before turning on the power. Observe the safety instructions on the device (see safety symbols).

The metal housing of the device is grounded. It must be ensured that enough air and creepage distances to neighboring voltage-carrying parts are provided during assembly in the control cabinet and no short circuits are caused.

In the case of malfunctions or servicing (e.g. in the event of a damaged housing or power cable or when fluids or foreign objects enter), the current flow can be interrupted. Questions about the house installation, need to be clarified with your house administration.

The power supply should be connected with a short, low-inductance line.

2.4 Safety during Operation



WARNING!

Avoiding Short-Circuits

Make sure not to get any objects or liquids inside the unit. Electric shock or short circuit could result.

Ventilation Slots

Make sure that the ventilation slots are not covered or dusty, as there is a danger of overheating during operation. Disturbances during operation can result.

Normal Operation

The normal operation and the observance of the EMC limits (electromagnetic compatibility) are only ensured if the housing cover is properly installed and when the doors are closed (cooling, fire protection, shielding against electrical, magnetic and electromagnetic fields).



Switch off in fault / service case

By switching off, the devices are not disconnected from the power supply. In the event of a fault or service case, the devices must be immediately disconnected from all power supplies.

Follow the steps below:

- Switch off the device
- Disconnect all power plugs
- Inform the service
- Devices that are connected via one or more uninterruptible power supplies (UPS) remain operational even when the UPS power cord is disconnected. Therefore, you must put the UPS out of operation according to the documentation of the corresponding user documentation.

2.5 Safety during Maintenance



WARNING!

When you are expanding the device, use only device parts that are approved for the system. Non-observance may result in injury to the EMC or safety standards and cause malfunction of the device.

If device parts, which are released for the system, are extended or removed there may be a risk of injury in the area of the hands, due to the pull-out forces (approx. 60 N).

The service informs you which device parts may be installed.

The device must not be opened, repairs to the device may only be carried out by the manufacturer or by authorized personnel. Improper repairs can result in considerable danger to the user (electric shock, fire hazard).

Unauthorized opening of the device or of individual parts of the device can also lead to considerable risks for the user and result in a loss of warranty as well as an exclusion of liability.



- Danger due to moving parts - keep away from moving parts.



- Device parts can become very hot during operation. Do not touch these surfaces! If necessary, switch off the unit before installing or removing any equipment, and allow it to cool down.

2.6 Handling Batteries



CAUTION!

The lithium battery on the receiver modules has a service life of at least 10 years. If an exchange is necessary, the following notes must be observed:

The device is equipped with a lithium battery. The battery must not be short-circuited or recharged. Replacement of the lithium battery may only be carried out by the manufacturer or authorized personnel.

Risk of explosion if the battery is not replaced correctly. Replace only with the same or equivalent type recommended by the manufacturer.

When disposing used batteries, observe the local regulations for the disposal of hazardous waste.

2.7 Cleaning and Care



ATTENTION!

Do not wet clean the appliance! Penetrating water can cause considerable dangers to the user (e.g., electric shock).

Liquid can destroy the electronics of the device! Liquid penetrates into the housing of the device and can cause a short circuit of the electronics.

Only clean with a soft, dry cloth. Never use solvents or cleaners.

2.8 Prevention of ESD Damage



ATTENTION!

The designation ESD (Electrostatic Sensitive Devices) refers to measures which are used to protect electrostatically endangered components from electrostatic discharge and thus to prevent destruction. Systems and assemblies with electrostatically endangered components usually have the following characteristics:



Indicator for assemblies with electrostatic endangered components

The following measures protect electrostatically endangered components from destruction:

Prepare removal and installation of assemblies

Unload yourself (for example, by touching a grounded object) before touching assemblies.

Ensure that you wear a grounding strap on the wrist when working with such assemblies, which you attach to an unpainted, non-conductive metal part of the system.

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

Transporting Assemblies

Assemblies may only be touched at the edge. Do not touch any pins or conductors on assemblies.

Installing and Removing Assemblies

Do not touch persons who are not grounded while removing or installing components. This could result in a loss of grounding protection from your electrostatic discharge.

Storing Assemblies

Always keep assemblies in ESD protective covers. These protective covers must be undamaged. ESD protective covers, which are extremely wrinkled or even have holes, no longer protect against electrostatic discharge.

ESD protective covers must not be low-resistance and metallically conductive if a lithium battery is installed on the assembly.

2.9 Return of Electrical and Electronic Equipment



ATTENTION!

WEEE Directive on Waste Electrical and Electronic Equipment 2012/19 / EU
(WEEE Waste Electrical and Electronic Equipment)

Separate Collection

Product Category: According to the device types listed in the WEEE Directive, Appendix 1, this product is classified as an IT and communication device.



This product meets the labeling requirements of the WEEE Directive. The product symbol on the left indicates that this electronic product must not be disposed of in domestic waste.

Return and Collection Systems

For returning your old equipment, please use the country-specific return and collection systems available to you or contact Meinberg.

The withdrawal may be refused in the case of waste equipment which presents a risk to human health or safety due to contamination during use.

Return of used Batteries

Batteries marked with one of the following symbols may not be disposed of together with the household waste according to the EU Directive.

3 GPS/GLONASS/Galileo/BeiDou satellite controlled clock

GNSS Signal Reception

The satellites of most Global Navigation Satellite Systems (GNSS) like GPS, GLONASS, and Galileo are not stationary but circle round the globe in periods of several hours. Only few GNSS systems like the Chinese Beidou system work with stationary satellites. Such systems can only be received in certain regions of the Earth.

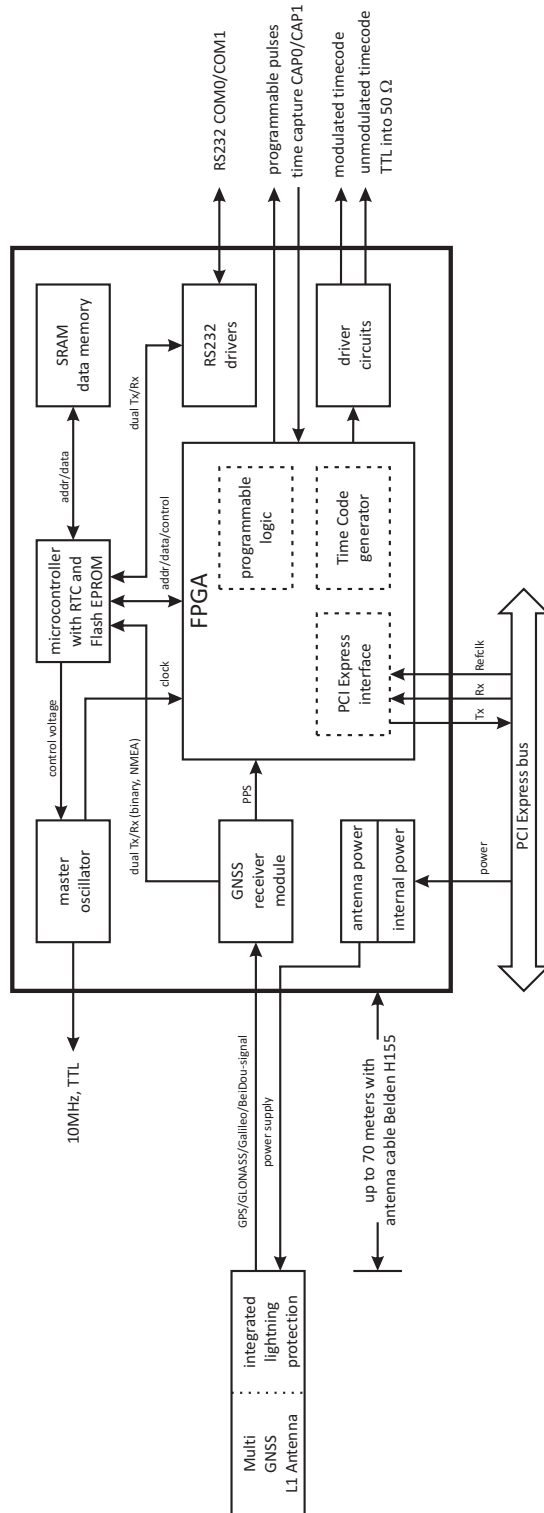
GNSS receivers need to track at least four satellites to determine their own position in space (x, y, z) as well as their time offset from the GNSS system time (t). Only if the receiver can determine its own position accurately the propagation delay of the satellite signals can also be compensated accurately, which is requirement to yield an accurate time. If the receiver position can only be determined less accurately then the accuracy of the derived time is also degraded.

GNSS satellite signals can only be received directly if no building is in the line-of-sight from the antenna to the satellite. The signals can eventually be reflected at buildings, etc., and the reflected signals can then be received. However, in this case the true signal propagation path is longer than expected, which causes a small error in the computed position, which in turn yields less accurate time.

Since most of the satellites are not stationary, the antenna has to be installed in a location with as much clear view of the sky as possible (e.g. on a rooftop) to allow for continuous, reliable reception and operation. Best reception is achieved when the antenna has a free view of 8° angular elevation above the horizon. If this is not possible then the antenna should be installed with the best free view to the sky in direction of the equator. Since the satellite orbits are located between latitudes 55° North and 55° South, this allows for the best possible reception.

Meinberg provides their own GPS receivers which operate with an antenna/converter unit and thus allow for very long antenna cables, but some devices also include GNSS receivers which support other satellite systems like GLONASS, or Galileo in addition to GPS. These receivers usually require a different type of antenna equipment. which is described in chapter xxx.

4 Blockdiagram GNS181PEX



5 Master oscillator

By default the GNS181PEX is equipped with a TCXO (Temperature Compensated Xtal Oscillator) as master oscillator to provide a good time accuracy and frequency stability. As long as an input signal is supplied the frequency of the oscillator is adjusted from the input signal, and if the input signal is disconnected afterwards the card can still provide accurate time for a certain holdover interval. Optionally the card can be ordered with an OCXO (Oven Controlled Xtal Oscillator) which provides even better frequency stability, and thus provides more accuracy over a longer holdover interval than the TCXO.

All internal timing as well as the output signals are derived from the oscillator. The last known good oscillator adjustment value is stored in non-volatile memory, and is used as default after power-up.

The oscillator's 10 MHz output frequency is also available with TTL level via a ribbon cable connector.

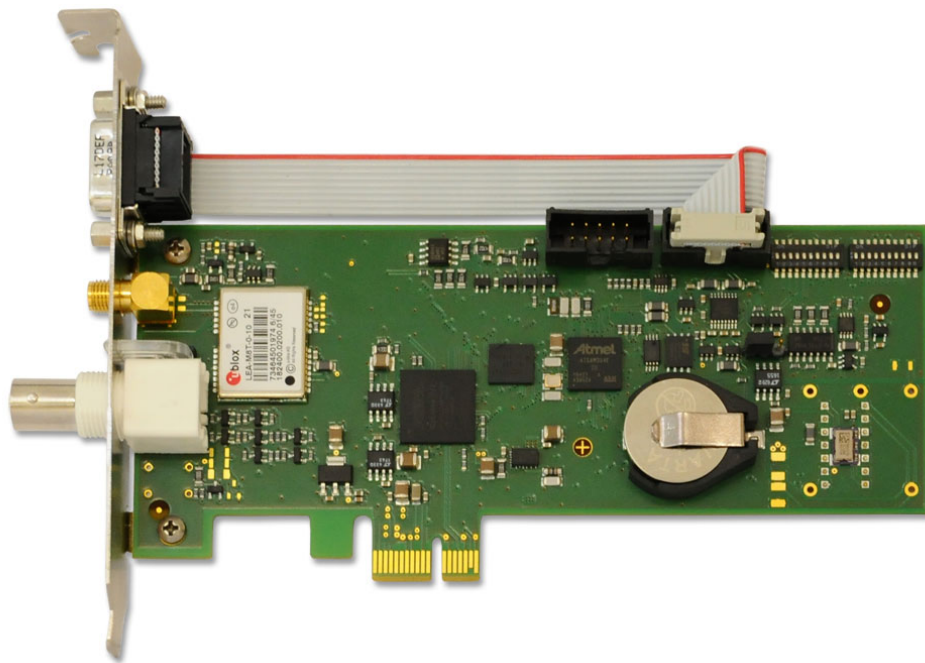


Figure: GNS181PEX with TCXO Oscillator

6 GNS181PEX Features

The board GNS181PEX 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 50 Ω 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 GNS181PEX 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 GNS181PEX 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 DIP 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 generate 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 $+360^\circ$ for frequencies less than 10 kHz.

The following modes can be configured for each channel independently:

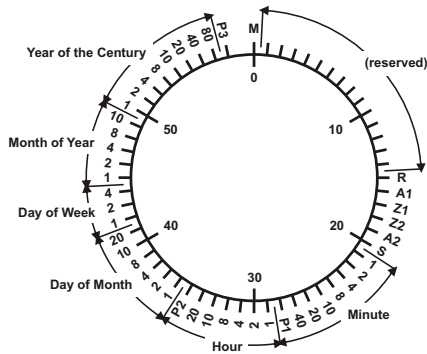
Timer mode:	Three on- and off-times per day per channel programmable
Cyclic mode:	Generation of periodically repeated pulses. A cycle time of two seconds would generate a pulse at 0:00:00, 0:00:02, 0:00:04 etc.
DCF77-Simulation mode:	The corresponding output simulates the DCF77 time telegram. The time 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 GNSS-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

6.5 DCF77 Emulation

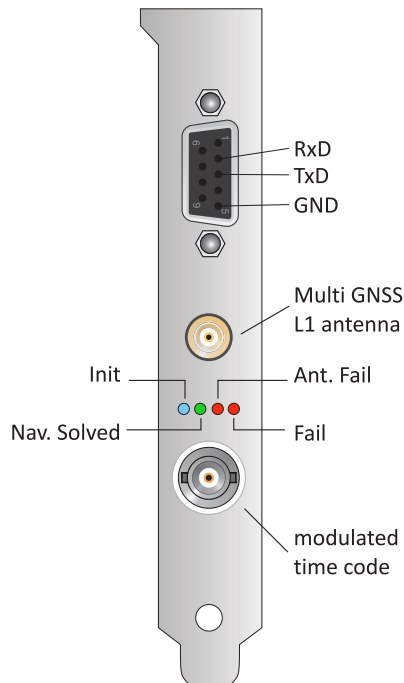
The clock generates TTL level time marks (active HIGH) which are compatible with the time marks spread by the German long wave transmitter DCF77. This long wave transmitter installed in Mainflingen near Frankfurt/Germany transmits the reference time of the Federal Republic of Germany: time of day, date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



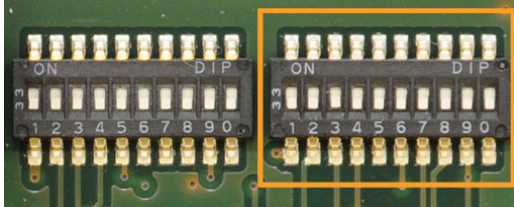
The coaxial antenna connector, four status LEDs, a male BNC connector for modulated time code and a 9 pin sub D connector can be found in the rear slot cover. (see figure). The "Nav. Solved" LED lights green when the receiver has computed its position. In normal operation the receiver position is updated 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 GNS181PEX. 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 ports) 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 DIP switch in the ON position. The table below shows the pin assignments for the connector and the DIP 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: DIP 1 or DIP 8 ON
Pin 4: DIP 5 or DIP 10 ON
Pin 7: DIP 3 or DIP 7 ON
Pin 9: DIP 6 or DIP 9 ON

The picture on the left shows all DIP switches on position "OFF". Please use the highlighted block on the right.

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

9pin D-SUB	Signal	Signal Level	DIP-Switch	
1	VCC out	+5 V	1	<i>DIP 8 must be OFF</i>
1	PPO_0	RS232	8	<i>DIP 1 must be OFF</i>
2	RxD 0 in	RS232	-	
3	TxD 0 out	RS232	-	
4	PPO_1	TTL	5	<i>DIP 10 must be OFF</i>
4	10 MHz out	TTL	10	<i>DIP 5 must be OFF</i>
5	GND	-	-	
6	CAP 0 in	TTL	2	
7	CAP 1 in	TTL	3	<i>DIP 7 must be OFF</i>
7	IRIG DC out	TTL into 50 ohm	7	<i>DIP 3 must be OFF</i>
8	PPO_0	TTL	4	
9	PPO_2	TTL	9	<i>DIP 6 must be OFF</i>
9	PPO_3	TTL	6	<i>DIP 9 must be OFF</i>

The default settings of the programmable pulse outputs of the GNS181PEX are set as follows:

PPO_0: PPS Out - Pulse Per Second
PPO_1: PPM Out - Pulse Per Minute
PPO_2: DCF Out - DCF77 Simulation
PPO_3: DCF Out - DCF77 Simulation

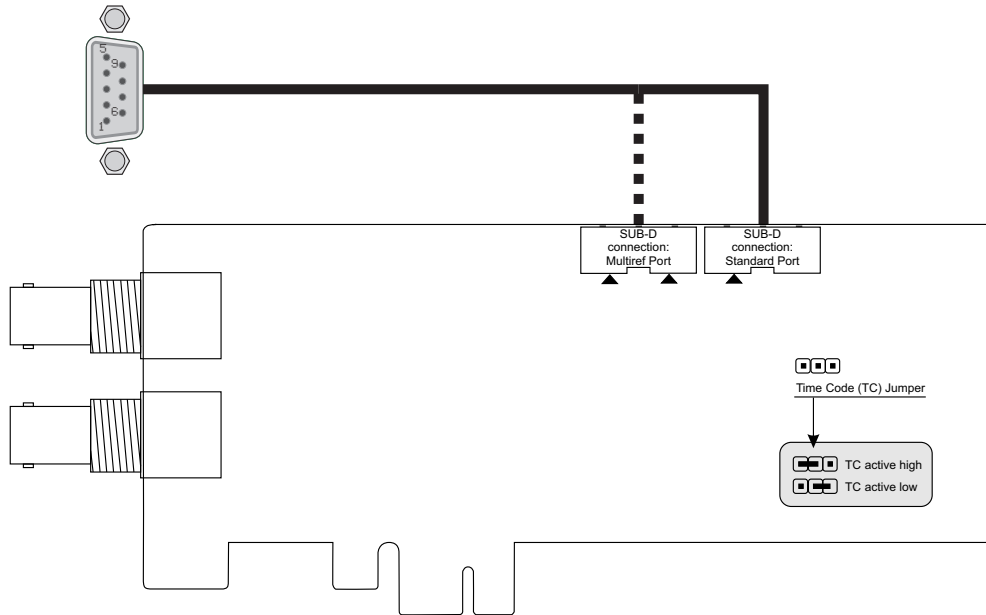
The following output signals can be selected using the supplied monitor program: Idle, Timer, Single Shot, Cyclic Pulse, Pulse Per Second, Pulse Per Minute, Pulse Per Hour, DCF77 Marks, Position OK, Time Sync, All Sync, DCLS Time Code and Synthesizer Frequency.

A detailed description of these signals can be found in the technical appendix of this manual.

7.2 SUB-D Pin Assignments of Multiref Port

Connection of ribbon cable

To lead the „Multiref“ signals through the SUB-D connector, the ribbon cable must be plugged to the appropriate boxed header:



SUB-D pin assignment

The following list shows the pin assignment of the SUB-D connector with ribbon cable in the „Multiref“ position. Some signals are only connected to the SUB-D if the specified DIP-switch is „ON“.

Multiref Port

D-SUB-PIN	Signal	Signal Level	DIP-Switch	
1	VCC out	+5V	1	
2	RxD1 in	RS232	-	
3	TxD1 out	RS232	-	
4	PPO_1 (PPM)	TTL	5	<i>DIP 10 must be OFF</i>
4	10MHz out	TTL	10	<i>DIP 5 must be OFF</i>
5	GND	-	-	
6	CAP0 in	TTL	2	
7	PPS in	TTL	7	<i>DIP 3 must be OFF</i>
8	PPO_0 (PPS)	TTL	4	
9	CLK in	TTL	6	<i>DIP 9 must be OFF</i>
7	CAP1 in	TTL	3	<i>DIP 7 must be OFF</i>
9	PPO_2 DCF out	TTL	9	<i>DIP 6 must be OFF</i>

8 Powering up the system

Installing the GNS181PEX 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 $\pm 2\mu\text{s}$.

8.1 40dB Multi GNSS Timing Antenna with Integrated Lightning Protection

GPS L1 / GLONASS L1 / GALILEO E1 / BeiDou B1 Frequency Band

The GPS, GLONASS, Galileo and BeiDou 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 quadrifilar 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 Multi GNSS Timing Antenna with Integrated Lightning Protection" (pctel_gpsl1gl.pdf) or download this document:

[Multi GNSS Antenna](#)

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

8.2 GNSS Antenna for Stationary Installation

The **Multi GNSS Antenna** is an active GNSS antenna which can receive the signals of the GPS, GLONASS, Galileo and Beidou satellite systems. It is very well suited for stationary installations, operates with a 5V DC supply voltage provided by the receiver, and has an integrated surge protection.

The antenna cable length can be up to 70 meters if a H155 low-loss coaxial cable is used.

Mounting and Installation of the GNSS/L1 Antenna

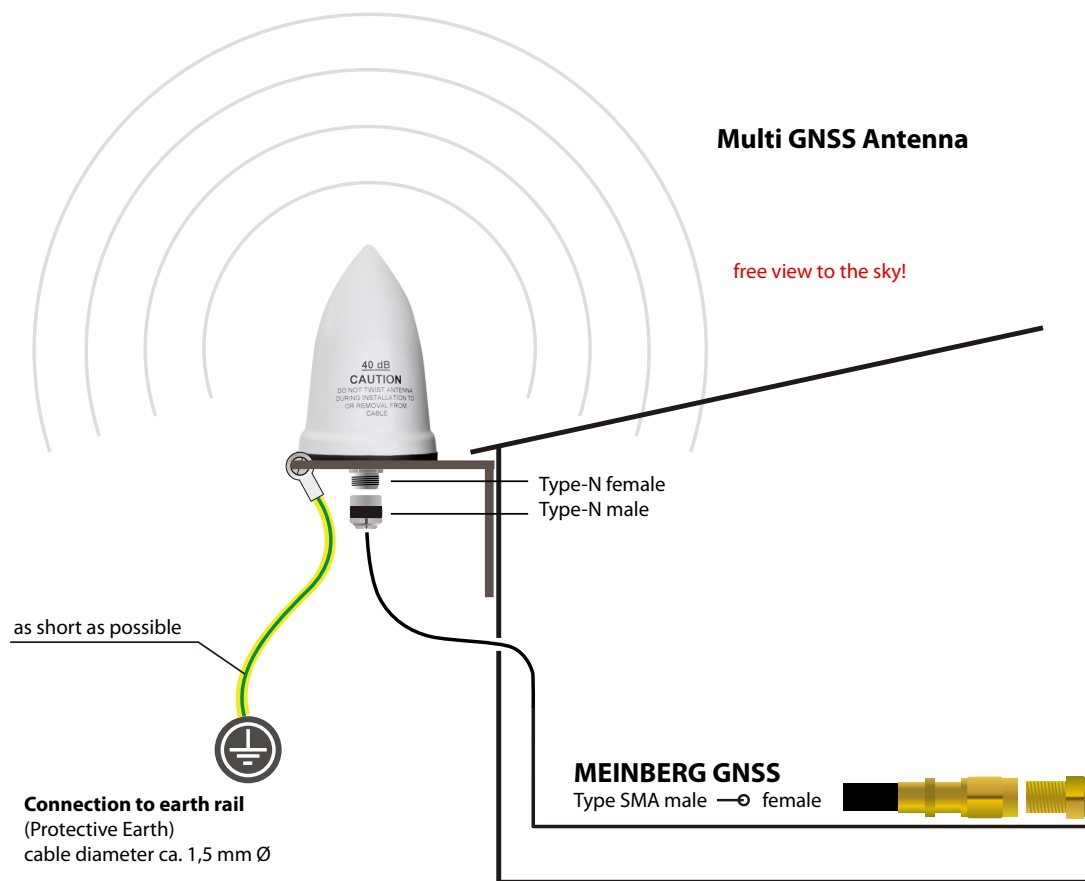



Figure: Schematic diagram of mounting the Multi GNSS Antenna




WARNING!

Antenna mounting without effective anti-fall protection

Danger to life due to fall!

- Pay attention to effective working safety when installing antennas!
- Never work without an effective anti-fall equipment!




WARNING!

Working on the antenna system during thunderstorms

Danger to life due to electrical shock!

- Do not carry out any work on the antenna system or the antenna cable if there is a risk of a lightning strike.
- Do not carry out any work on the antenna system if the safety distance to free lines and sequential circuits is exceeded.



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 Technical Specifications GNS181

RECEIVER:	Combined GPS/GLONASS/Galileo/BeiDou receiver Number of channels: 72 Frequency band: GNSS L1
ANTENNA:	Multi GNSS antenna 3dB Bandwidth: 1590+-30 MHz Impedance: 50 Ω Gain: 40+-4 dB Supply Voltage: 5 V Max length of antenna cable: 70 meters (Belden H155) 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 μ sec 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 15 μ W
 Optical Connector: ST connector for GI 50/125 μ m
 or GI 62,5/125 μ m gradient fiber

POWER SUPPLY: +3.3 V: 250 mA
 +12 V: 60 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 ($\tau = 1$ 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 μ s	+/- 65 μ s	+/- 22 μ s
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.				

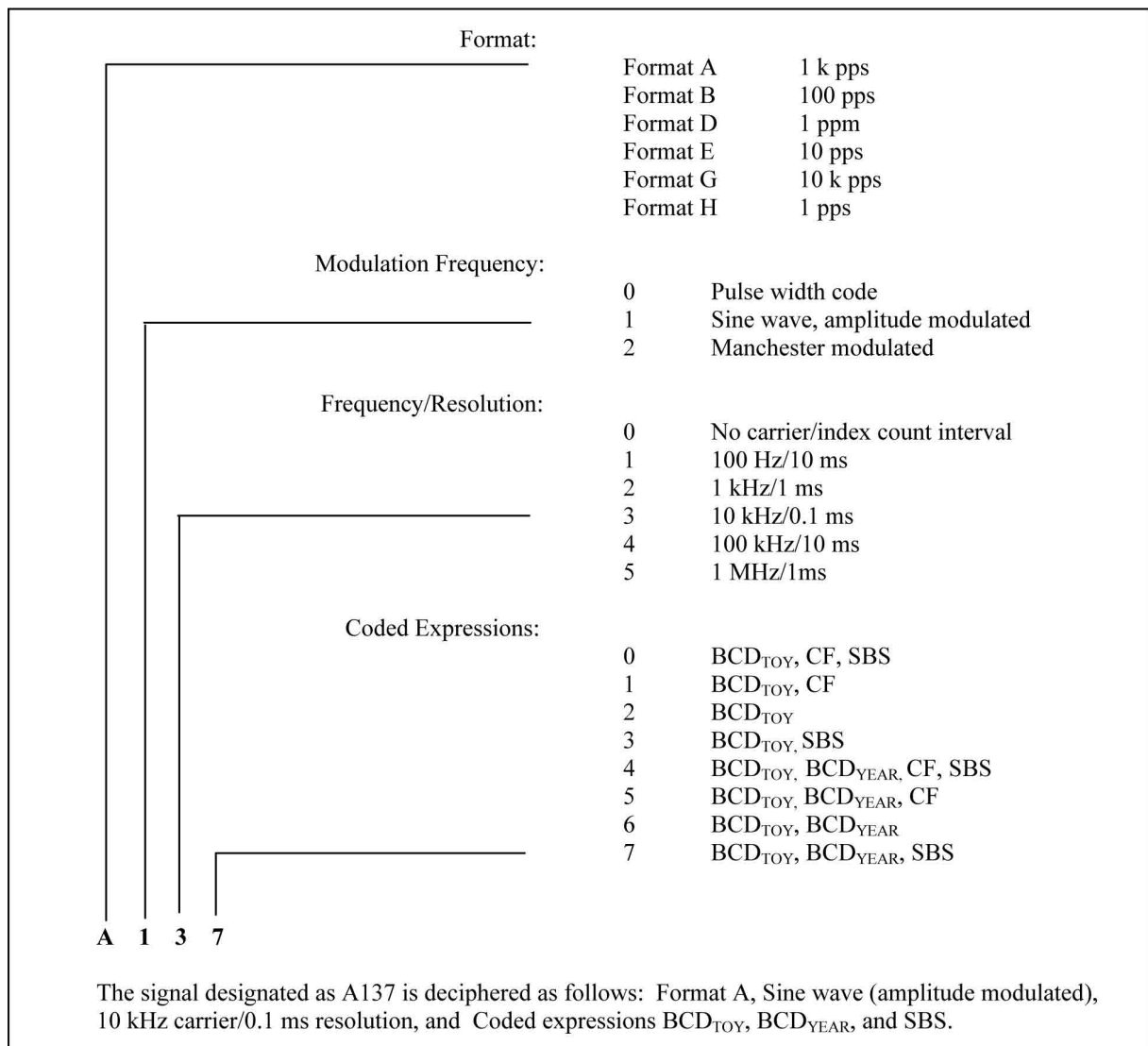
11 Technical appendix GNS181PEX

11.1 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.

The GNS181PEX supports decoding and generating of IRIG-A, IRIG-B, IRIG-G, AFNOR NF S87-500, IEEE C37.118 and IEEE 1344.

11.1.1 Description of IRIG-Codes



11.1.2 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

11.1.3 Generated Time Codes

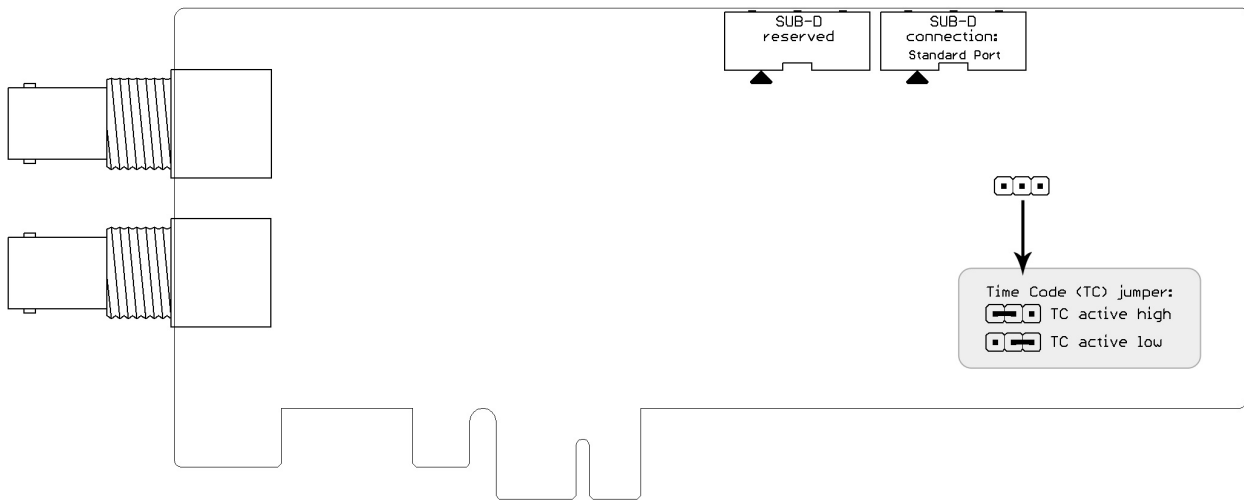
Besides the amplitude modulated sine wave signal, the board also provides unmodulated DC-Level Shift TTL output in parallel. Thus six time codes are available.

- 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

11.1.4 Selection of time code

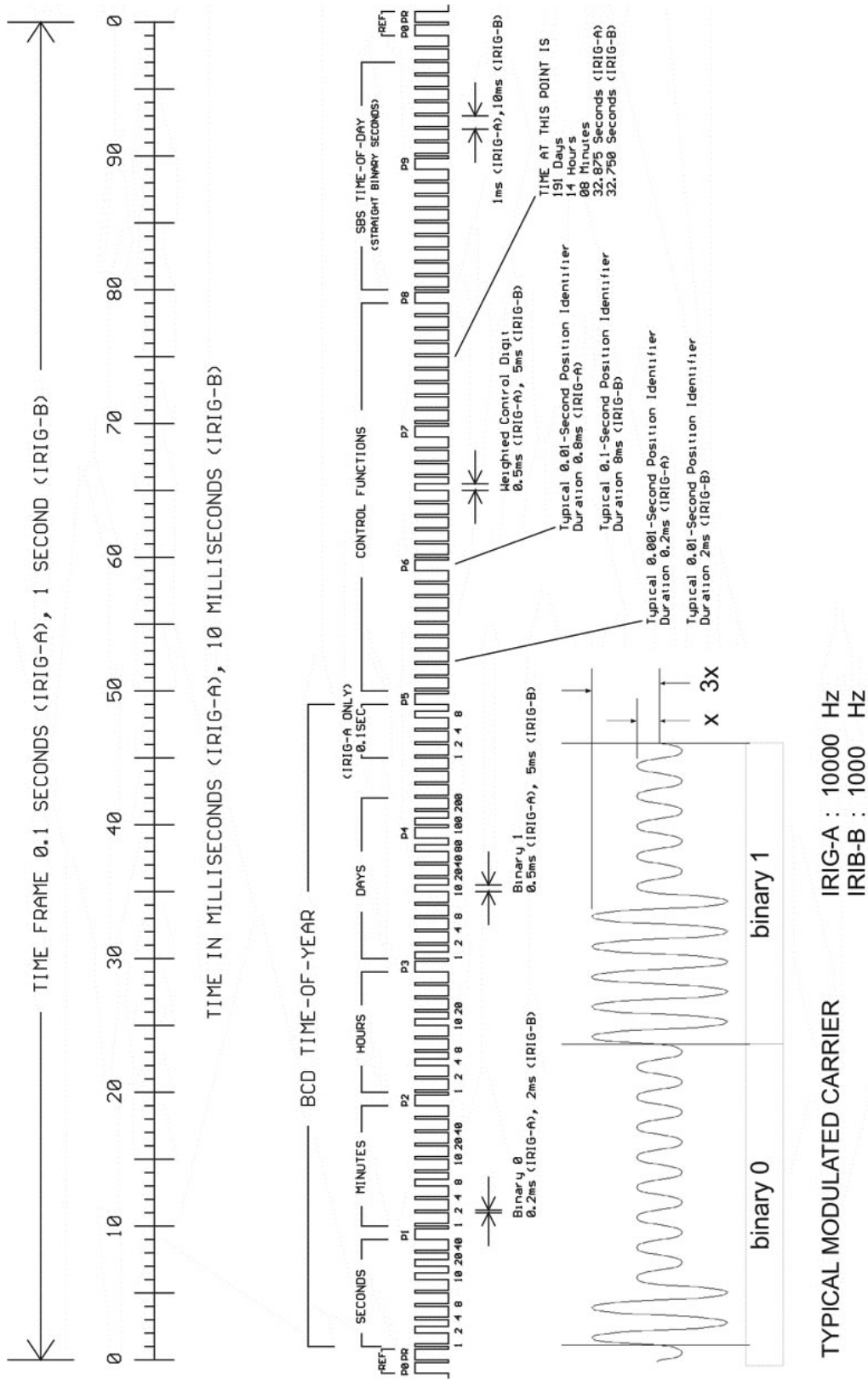
The selection of timecode is done by the monitor software.

The unmodulated time code can be delivered as an active-high (default) or active-low signal by setting a jumper on the board GNS181PEX into the appropriate position:

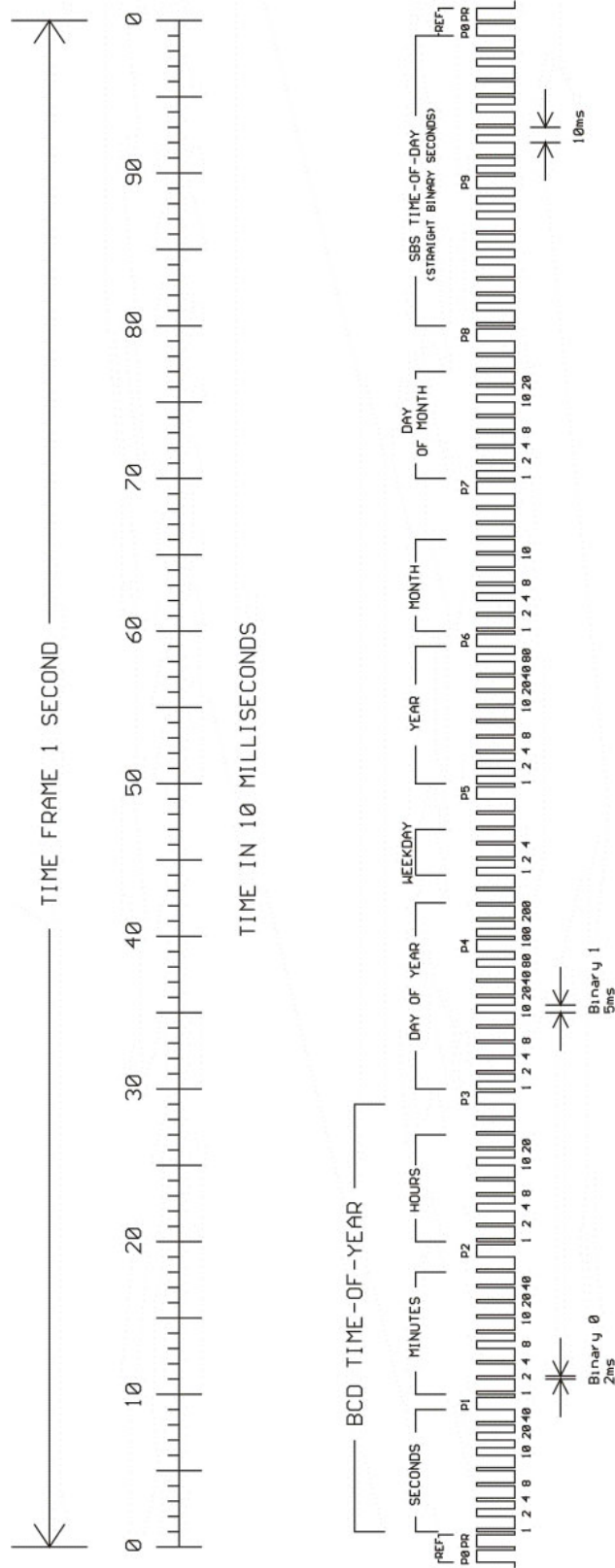


11.2 Time code Format

11.2.1 IRIG Standard Format



11.2.2 AFNOR Standard Format



11.3 Time Strings

11.3.1 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 synchronized 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	announcement 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		

11.3.2 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:ssxxxuv<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:

<code><STX></code>	Start-Of-Text, ASCII Code 02h sending with one bit accuracy at change of second
<code>dd.mm.yy</code>	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)
<code>hh:mm:ss</code>	the current time:
hh	hours (00..23)
mm	minutes (00..59)
ss	seconds (00..59, or 60 while leap second)
<code>xxxx</code>	time zone indicator:
'UTC'	Universal Time Coordinated, formerly GMT
'CET'	European Standard Time, daylight saving disabled
'CEST'	European Summertime, daylight saving enabled
<code>u</code>	clock status characters:
'#'	clock has not synchronized after reset
' '	(space, 20h) clock has synchronized after reset
<code>v</code>	announcement 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
<code><CR></code>	Carriage Return, ASCII Code 0Dh
<code><LF></code>	Line Feed, ASCII Code 0Ah
<code><ETX></code>	End-Of-Text, ASCII Code 03h

11.3.3 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,llll.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
llll.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

11.3.4 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 ll.Lllle hhhhm<ETX>

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

<i><STX></i>	Start-Of-Text, ASCII Code 02h sending with one bit accuracy at change of second
<i>dd.mm.yy</i>	the current date:
<i>dd</i>	day of month (01..31)
<i>mm</i>	month (01..12)
<i>yy</i>	year of the century (00..99)
<i>w</i>	the day of the week (1..7, 1 = Monday)
<i>hh.mm.ss</i>	the current time:
<i>hh</i>	hours (00..23)
<i>mm</i>	minutes (00..59)
<i>ss</i>	seconds (00..59, or 60 while leap second)
<i>v</i>	sign of the offset of local timezone related to UTC
<i>oo:oo</i>	offset of local timezone related to UTC in hours and minutes
<i>ac</i>	clock status characters:
<i>a:</i>	'#' clock has not synchronized after reset
	' ' (space, 20h) clock has synchronized after reset
<i>c:</i>	'*' GPS receiver has not checked its position
	' ' (space, 20h) GPS receiver has determined its position
<i>d</i>	time zone indicator:
	'S' CEST European Summertime, daylight saving enabled
	' ' CET European Standard Time, daylight saving disabled
<i>f</i>	announcement 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
<i>g</i>	announcement of discontinuity of time, enabled during last hour before discontinuity comes in effect:
	'A' announcement of leap second insertion
	' ' (space, 20h) nothing announced
<i>i</i>	leap second insertion
	'L' leap second is actually inserted (active only in 60th sec.)
	' ' (space, 20h) no leap second is inserted
<i>bbb.bbbb</i>	latitude of receiver position in degrees leading signs are replaced by a space character (20h)
<i>n</i>	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

11.3.5 Format of the Computime Time String

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

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

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

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

11.3.6 Format of the SYSPLEX-1 Time String

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

Please note:

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

The format is:

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

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

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

11.3.7 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:

CHx_{tt}.mm.jj_hh:mm:ss.ffffff <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.ffffff the capture time:

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

<CR> Carriage Return, ASCII Code 0Dh

<LF> Line Feed, ASCII Code 0Ah

11.3.8 Format of the SPA Time String

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

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

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

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

11.3.9 Format of the RACAL standard Time String

The RACAL standard Time String is a sequence of 16 ASCII characters terminated by a X (58h) character and ending with the CR (Carriage Return, ASCII Code 0Dh) character. The format is:

<X><G><U>*yymmddhhmmss*<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:

<X>	Control character sending with one bit accuracy at change of second	code 58h
<G>	Control character	code 47h
<U>	Control character	code 55h
<i>yymmdd</i>	the current date:	
yy	year of the century	(00..99)
mm	month	(01..12)
dd	day of month	(01..31)
<i>hh:mm:ss</i>	the current time:	
hh	hours	(00..23)
mm	minutes	(00..59)
ss	seconds	(00..59, or 60 while leap second)
<CR>	Carriage Return, ASCII code 0Dh	

Interface
parameters: 7 Databits, 1 Stopbit, odd. Parity, 9600 Bd

11.3.10 Format of the Meinberg GPS Time String

The Meinberg Standard Time String is a sequence of 36 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. Contrary to the Meinberg Standard Telegram the Meinberg GPS Timestring carries no local timezone or UTC but the direct GPS time without conversion into UTC. The format is:

<STX>D:*tt.mm.jj*;T:w;U:*hh.mm.ss*;uvGy;lll<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)
<i>tt.mm.jj</i>	the current date: <i>tt</i> day of month (01..31) <i>mm</i> month (01..12) <i>jj</i> year of the century (00..99)
<i>w</i>	the day of the week (1..7, 1 = monday)
<i>hh.mm.ss</i>	the current time: <i>hh</i> hours (00..23) <i>mm</i> minutes (00..59) <i>ss</i> seconds (00..59, or 60 while leap second)
<i>uv</i>	clock status characters: <i>u</i> : '# ' clock is running free (without exact synchr.) (space, 20h) clock is synchronous (base accuracy is reached) <i>v</i> : '* ' receiver has not checked its position (space, 20h) receiver has determined its position
<i>G</i>	time zone indicator 'GPS-Time'
<i>y</i>	announcement of discontinuity of time, enabled during last hour before discontinuity comes in effect: 'A' announcement of leap second insertion ' ' (space, 20h) nothing announced
<i>lll</i>	number of leap seconds between UTC and GPS-Time (UTC = GPS-Time + number of leap seconds)
<ETX>	End-Of-Text, (ASCII Code 03h)

11.3.11 Format of the NMEA 0183 String (GGA)

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

\$GPGGA,*hhmmss.ss,bbbb.bbbbb,n,llll.ll,e,A,vv,hhh.h,aaa.a,M,ggg.g,M,,0cs<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.bbbbb	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
llll.lllll	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
A	Position fix (1 = yes, 0 = no)
vv	Satellites used (0..12)
hhh.h	HDOP (Horizontal Dilution of Precision)
aaa.h	Mean Sea Level altitude (MSL = altitude of WGS84 - Geoid Separation)
M	Units, meters (fixed value)
ggg.g	Geoid Separation (altitude of WGS84 - MSL)
M	Units, meters (fixed value)
cs	checksum (EXOR over all characters except '\$' and '*')
<CR>	Carriage Return, ASCII Code 0Dh
<LF>	Line Feed, ASCII Code 0Ah

11.3.12 Format of the NMEA 0183 String (GGA)

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

\$GPGGA,*hhmmss.ss,bbbb.bbbbb,n,llll.ll,e,A,vv,hhh.h,aaa.a,M,ggg.g,M,,0cs<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.bbbbb	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
llll.lllll	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
A	Position fix (1 = yes, 0 = no)
w	Satellites used (0..12)
hhh.h	HDOP (Horizontal Dilution of Precision)
aaa.h	Mean Sea Level altitude (MSL = altitude of WGS84 - Geoid Separation)
M	Units, meters (fixed value)
ggg.g	Geoid Separation (altitude of WGS84 - MSL)
M	Units, meters (fixed value)
cs	checksum (EXOR over all characters except '\$' and '*')
<CR>	Carriage Return, ASCII Code 0Dh
<LF>	Line Feed, ASCII Code 0Ah

11.3.13 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, IIcs<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

11.3.14 Format of the ION Time String

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

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

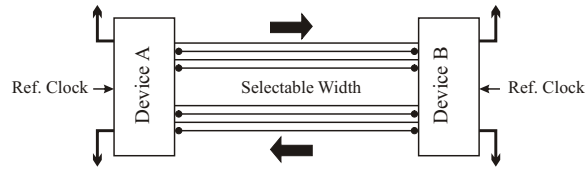
The letters printed in italics are replaced by ASCII numbers whereas the other characters are part of the time string. The groups of characters as defined below:

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

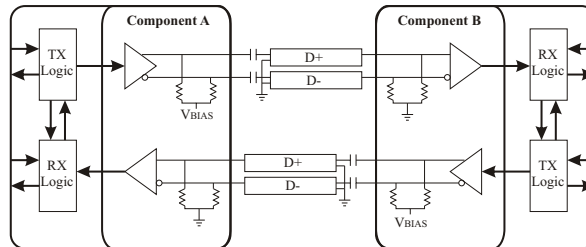
11.4 PCI Express (PCIe)

The main technical innovation 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 transferring a data volume of 250 MB/s per lane in each direction. Higher bandwidth is implemented by using multiple lanes simultaneously. 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.

11.5 Content of the USB stick

Besides this manual, the provided USB stick includes a setup program for the monitor software MBGMON. This utility can be used to configure Meinberg receivers via their serial ports and to display status information of the module.



If the USB storage device is lost, the installation program can be downloaded free of charge from the Internet at: <https://www.meinbergglobal.com/english/sw/>

12 EU Declaration of Conformity

Konformitätserklärung

Doc ID: GNS181PEX-2019-11-05

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

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

Produktbezeichnung GNS181PEX
Product Designation

auf das sich diese Erklärung bezieht, mit den folgenden Normen und Richtlinien übereinstimmt:
to which this declaration relates is in conformity with the following standards and provisions of the directives:

RED – Richtlinie	ETSI EN 300 440-1 V1.6.1 (2010-08)
<i>RED – Directive</i>	ETSI EN 300 440-2 V1.4.1 (2010-08)

2014/53/EU

EMV – Richtlinie	ETSI EN 301 489-1 V1.9.2 (2011-09)
<i>EMC – Directive</i>	DIN EN 61000-6-2:2005
	DIN EN 61000-6-3:2007 + A1:2011

2014/30/EU

DIN EN 55032:2012
DIN EN 55024:2010

Niederspannungsrichtlinie	DIN EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 +
<i>Low-voltage Directive</i>	AC:2011 + A2:2013

2014/35/EU

RoHS – Richtlinie	DIN EN 50581:2012
<i>RoHS – Directive</i>	

2011/65/EU

Bad Pyrmont, den 2019-11-05


Stephan Meinberg
Production Manager