MANUAL

GPS180AMC

AdvancedMC Satellite Clock

15th May 2014

Meinberg Radio Clocks GmbH & Co. KG

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1 Impressum

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2 Content of the USB stick

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

http://www.meinbergglobal.com/english/sw/

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

3 General information

The satellite clocks made by Meinberg have been designed to provide extremely precise time to their users. The clocks have been developed for applications where conventional radio clocks can´t meet the growing requirements in precision. High precision available 24 hours a day around the whole world is the main feature of the new system which receives its information from the satellites of the 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 Department of Defense and provides two levels of accuracy: The Standard Positioning Service (SPS) and the Precise Positioning Service (PPS). While PPS is encrypted and only available for authorized (military) users, SPS has been made available to the general public.

GPS is based on accurately measuring the propagation time of signals transmitted from satellites to the user´s receiver. A nominal constellation of 24 satellites together with some active spares in six orbital planes 20,000 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.

4 AdvancedMC

The AdvancedMC (AMC) standard defines the mechanical and electronical requirements of a board for integration onto a carrier board or an independent slot card for MicroTCA (Micro Telecommunications Computing Architecture) systems.

4.1 Form Factors

An AMC module can be realized in different sizes. Specified are three variants of the front panel's width and two of the board's hight. From this six possibilities are available:

	Compact-Size (3HP)	Mid-Size (4HP)	Full-Size (6HP)
Single Modules	73,8 x 13,88 x 181,5mm	73,8 x 18,96 x 181,5mm	73,8 x 28,95 x 181,5mm
Double Modules	148,8 x 13,88 x 181,5mm	148,8 x 18,96 x 181,5mm	148,8 x 28,95 x 181,5mm

The assembly group GPS180AMC is available as „Single, Mid-Size AMC module“ by default.

4.2 Management

Complete units, as defined in the AMC standard, e.g. MicroTCA, are extremely flexible when it comes down to the data- and clock pulse interfaces used in-between the assembly groups. To ensure correct management of all resources, every system comes with a "Shelf Management Controller" (ShMC), or "MicroTCA Carrier Hub" (MCH), who ensures error-free functioning of the overall system, as well as of each assembly group. To do so the MCH communicates with a "Module Management Controller" (MMC) when the system is turned on or an AMC card is plugged into an operating system. The MMC is mandatory for every card, as specified in the AMC standard. In addition to providing the data- and/or clock pulse paths requested by the AMC card, the Management Controller also ensures trouble-free plug and remove of modules in an operating system (Hot Swap).

4.3 Sensors

It is possible to connect digital or analog sensors to a module's Management Controller. The sensors' state can be transmitted to the MCH. For that matter two temperature sensors are required. As specified in the AMC standard the temperature sensors have to be positioned on the board that both the temperature at the front panel (Inlet Temperature) as well as the temperature at the AMC Connector (Outlet Temperature) is measured. In addition to these sensors the GPS180AMC detects the level of the local operating voltage (Payload Power). Sensors can report more or less critical states to the system management, which can then take appropriate measures:

- Upper non-recoverable
- Upper critical
- Upper non-critical
- Lower non-critical
- Lower critical
- Lower non-recoverable

The limit values of the GPS180AMC are listed in the technical data.

4.4 Data Transmission

Each AMC Connector provides up to 20 communication channels (Fabric Interface) which can be connected with the MCH's (module-to-carrier) data lines or another slot (module-to-module) via a switching matrix. The requirements of the connections necessary for an AMC module's operation, are part of the communication between the MCH and the AMC Module's Management Controller while performing a "Hot Swap".

The fabric interface is divided into three data line sectors. The PCI Express connection needed by the GPS180AMC assembly group is realized via the "Fat Pipe Region". This area includes eight channels (Port 4-11), which can be used for the interfaces Advanced Switching (AS), Ethernet (Gig-E), PCI Express (PCI-E) or serial Rapid IO (SRIO).

To communicate with a system's CPU, the GPS180AMC uses an "x1 PCI Express Interface (PCI Express r1.0a)" in the "Fat Pipe Region, Port 4".

4.5 Clock Pulse System

AdvancedMC defines a system to distribute (reference-) clock pulses and allows the construction of hierarchical clock pulse structure which is important especially in the telecommunication field. The GPS180AMC Module realizes the topology "SONET/SDH/PDH System Timing Module" as defined in the AMC standard:

Clock Name	Frequency	Module default	Direction
TCLKA	8kHz/1,544MHz/2,048MHz/19,44MHz	2,048MHz	In to Module
TCLKB	19,44MHz	19,44MHz	Out from Module
TCLKC	8kHz/1,544MHz/2,048MHz/19,44MHz	2,048MHz	In to Module
TCLKD	8kHz	8kHz	Out from Module

The clock pulse signals (Direction: Out from Module) provided by the GPS180AMC are derived from the assembly group's master oscillator. At GPS synchronization the master oscillator is being adjusted to it's nominal frequency and determines the free running qualities in case of a failure of the GPS receiver.

4.6 Hot Swap

AMC Modules can either be inserted or removed from the MicroTCA system while operating. The hot swap ability is realized by a lever mechanism (AMC Handle) including a micro switch, a status LED (blue LED), and the communication between the management controllers.

4.6.1 Hot Swap Handle

The "Hot Swap Module Handle" in the front panel of the GPS180AMC has two tasks. When inserting the assembly group the task of the "Hot Swap Module Handle" is a simple mechanical lock to the AMC Rack, as well as the electrical sensoring of the insert/remove process. The Management Controller of the GPS180AMC constantly checks the Handle-Switch and submits a "Hot Swap-Event" to the MCH by any change of state.

The handle can be set in three different positions:

- **Pushed all the way in (IN):** In this position, the MCH will be reported that there is no "Hot Swap-Event" pending. This position signifies normal operation of the module.
- **Half Way (HW):** In this half way position, which means in-between being not yet completely inserted and removed, a micro switch of the GPS180AMC is opened and a "Hot Swap-Event" is being reported to the MCH.
- **Out (OUT):** In the OUT position the handle is completely removed and the mechanical lock open, which means the module can be removed from the system.

4.6.2 Hot Swap Status LED

The blue Hot Swap Status LED as specified in the AMC standard can be found on the right next to the handle on the front panel. It signalizes the present state of the Hot Swap process as described down below:

Blue LED State	Description and Conditions
On	Hot Swap Handle is opened. Payload Power is off. AMC board is ready for extraction (M1 state)
Long Blink (900msec on, 100msec off)	Hot Swap Handle is closed. Payload Power is off. AMC board waits for activation (M2 state)
Off	Hot Swap Handle is closed. Payload Power is on. AMC board is activated (M4 state)
Short Blink (100msec on, 900msec off)	Hot Swap Handle is opened. Payload Power is on. AMC board waits for deactivation (M5 state)

An AMC Module may only be pulled out in the "M1 state" (blue LED is on)!

4.6.3 General Status LEDs

The Status LEDs "LED1" (out of service, red) and "LED2" (Heartbeat/Healthy, green) as specified in the AMC standard are positioned on the upper side of the front panel. When the Management Controller of the GPS180AMC detects a failure, the red "out of service" LED is activated. For example, if the pay load supply voltage is too high/low or if one of the temperature sensors of the GPS180AMC detect a too high ambient temperature.

As long as all cyclical hardware- and firmware audits of the MMC come out positive, the green "Heartbeat-/Healthy" LED blinks. As soon as one of the tests shows a negative result, the LED2 is turned off and the red LED1 glows permanently.

4.7 Hot Swap Sequence

To meet the requirements of the Activation/Deactivation of a module as defined in the AMC standard, using the "Hot Swap Handle" and the blue status LED, you must proceed as follows:

4.7.1 AMC Module Installation

- Pull out the Hot Swap Handle (OUT), when the AMC Module is removed
- Fully insert the AMC Module into the chassis
- Put the Hot Swap Handle in the "IN" position (completely inserted)
- The blue LED will start to blink in the "Long Blink" mode
- After successful activation by the MCH the blue LED is turned off and the load supply (Payload Power) of the module is turned on

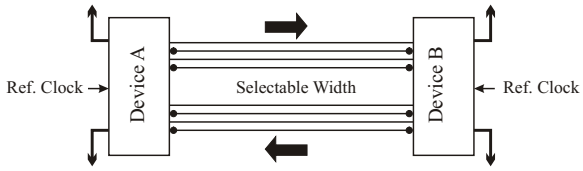
4.7.2 Deinstallation

- Put the Module Handle in the "Half Way" (HW) position
- The blue LED starts to blink in the "Short Blink" mode
- Await the end of the deactivation process
- The blue LED glows permanently
- Remove the module from the chassis

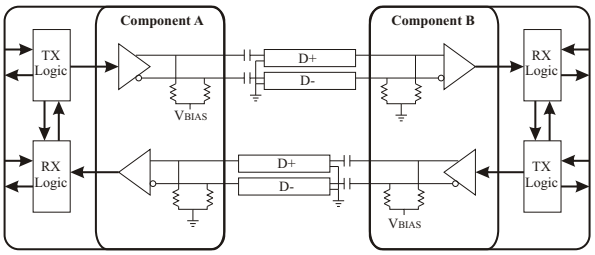
5 PCI Express (PCIe)

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

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



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



This design leads to a full duplex connection clocked with 2.5 GHz capable of transfering a data volume of 250 MB/s per lane in each direction. Higher bandwith is implemented by using multiple lanes silmutaneously. A PCI Express x16 slot for example uses sixteen lanes providing a data volume of 4 GB/s. For comparison: when using conventional PCI the maximum data transfer rate is 133 MB/s, PCI-X allows 1 GB/s but only in one direction respectively.

6 GPS180AMC Features

The satellite radio clock GPS180AMC is a module in the "Single, Mid-Size AMC Module" format, designed in the AdvancedMCTM (AMC) standard. It uses the information of the GPS system to obtain extremely accurate time information and to adjust the master oscillator to its set point. The module GPS180AMC has two possible areas of application: The use as time standard to synchronize the system time of a computer, inside a MicroTCA, and to generate reference clock pulses for the construction of hierarchical clock pulse structures.

In addition to the signals of the AMC bus the GPS180AMC provides different input and output signals via a connector in the front panel. The data transmission with the computer, for example of a MicroTCA system, can be made via a PCI Express connection of the AMC backplane.

The antenna-/converter unit is connected to the receiver with an up to 300m (when a RG58 cable is used) long 50 ohm coax cable. The supply of the antenna-/converter unit occurs galvanically separated via the antenna cable. Optionally, an overvoltage protection and an antenna distributor are available.
The data stream from the satellites is decoded by the microprocessor of the system. By evaluation of the data, the GPS time of the system can be reproduced with a deviation smaller than 250 nsec. Different signal running times, from the satellite to the receiver are automatically compensated by determining the receiver position. By tracking the main oscillator an extremly accurate frequency is achieved. At the same time, the aging-related drift of the quartz is compensated. The current correction value for the oscillator is stored in a non-volatile memory (EEPROM) of the radio clock. Optionally, the module is also available with a higher precision time base.

By using the monitor program, which is delivered with the satellite radio clock, the status of the radio clock can be tested and the radio clock's settings can be changed.

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 GPS180AMC is available with these settings or with UTC as reference. This can be set by the monitor program.

6.2 Serial Interfaces

The microprocessor of the satellite radio clock offers two serial interfaces (UARTs). On the GPS180AMC one of the interfaces (COM0) is transformed into an USB interface that is available via a micro USB socket on the front panel. Although the interface is able to distribute time telegrams, its main function is the optional communication with a monitor program.

The second interface is a RS-232 interface and can be used via a RJ45-socket on the front panel. After turning on the system both interfaces are inactive by default, until the receiver has synchronized. By using the monitor program the radio clock can be configured that the interfaces are being activated when turning on the system. For both interfaces the transmission rate, the data format, as well as the type of the output telegram can be set separately. Each interface is able to deliver time telegrams either every second, every minute or only on request by an ASCII "?". Possible telegram formats are described in the technical data.

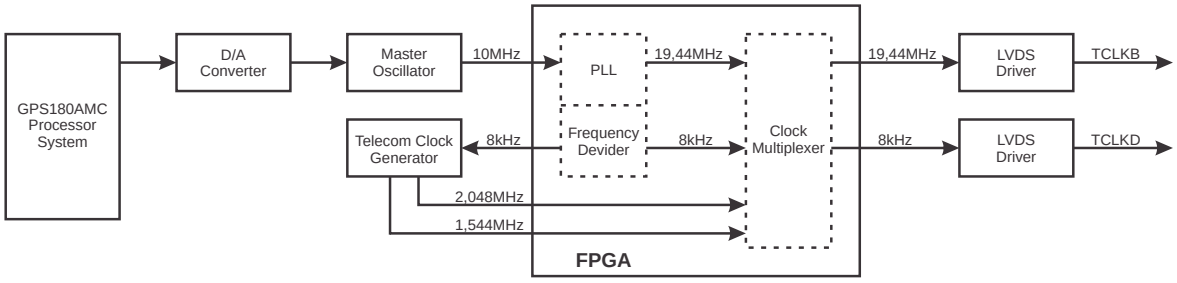
6.3 Standard Frequencies

The assembly group GPS180AMC uses a precise time frame generated from the GPS data to set the module's oscillator to its set point. Besides generating very exact frequencies this procedure also allows the compensation of long-term effects, such as aging of the quartz or frequency instability due to changes of the ambient temperature. As the GPS reception breaks down the characteristics of the module's oscillator determine the free-running mode. To realize an adjustment to different customer requests, the GPS180AMC can have oscillators of different qualities. (See the "technical data").

In relation to the clock pulse structure the GPS180AMC module works in the mode "SONET/SDH/PDH System Timing Module". The configuration specified in the AMC standard defines that an assembly group which is used as a source of clock pulses, provides following clock pulse signals via the AMC pin connector:

- TCLKB: 19,44MHz
- TCLKD: 8kHz

For the GPS180AMC all frequencies rely on the master oscillator as shown in the figure below:



6.4 Pulse Output

The clock GPS180AMC contains a programmable pulse generator. It's TTL output is available via a MMCX connector in the face plate. The pulse generator is able to provide a multitude of different pulses, which are configured with the monitor program. The active state is invertible, the pulse duration settable between 10 msec and 10 sec in steps of 10 msec. In addition, this output can provide the received or generated standard frequencies. In the default mode of operation the pulse output is disabled until the receiver has synchronized after power-up. However, the system can be configured to enable the output immediately after power-up.

The following modes can be configured:

GPIO OUT mode: Mode to provide a received or generated standard frequency:
GPIO0 corresponds to TCLKA
GPIO1 corresponds to TCLKC
GPIO2 corresponds to MMCX-input in face plate
GPIO3 corresponds to TCLKB

Timer mode: Three on- and off-times per day per channel programmable

Cyclic mode: Generation of periodically repeated pulses.
A cycle time of two seconds would generate a pulse at
0:00:00, 0:00:02, 0:00:04 etc.

DCF77-Simulation mode: The corresponding output simulates the DCF77 time telegram.
The time marks are representing the local time as configured by the user.

Single Shot Mode: A single pulse of programmable length is generated once a day at a programmable point of time

Per Sec., Per Min. Per Hr. modes: Pulses each second, minute or hour

Synthesizer Frequency output 1/8 Hz up to 10 MHz

Time Codes Generation of Time Codes as described in chapter "Time Codes"

Status: One of three status messages can be emitted:

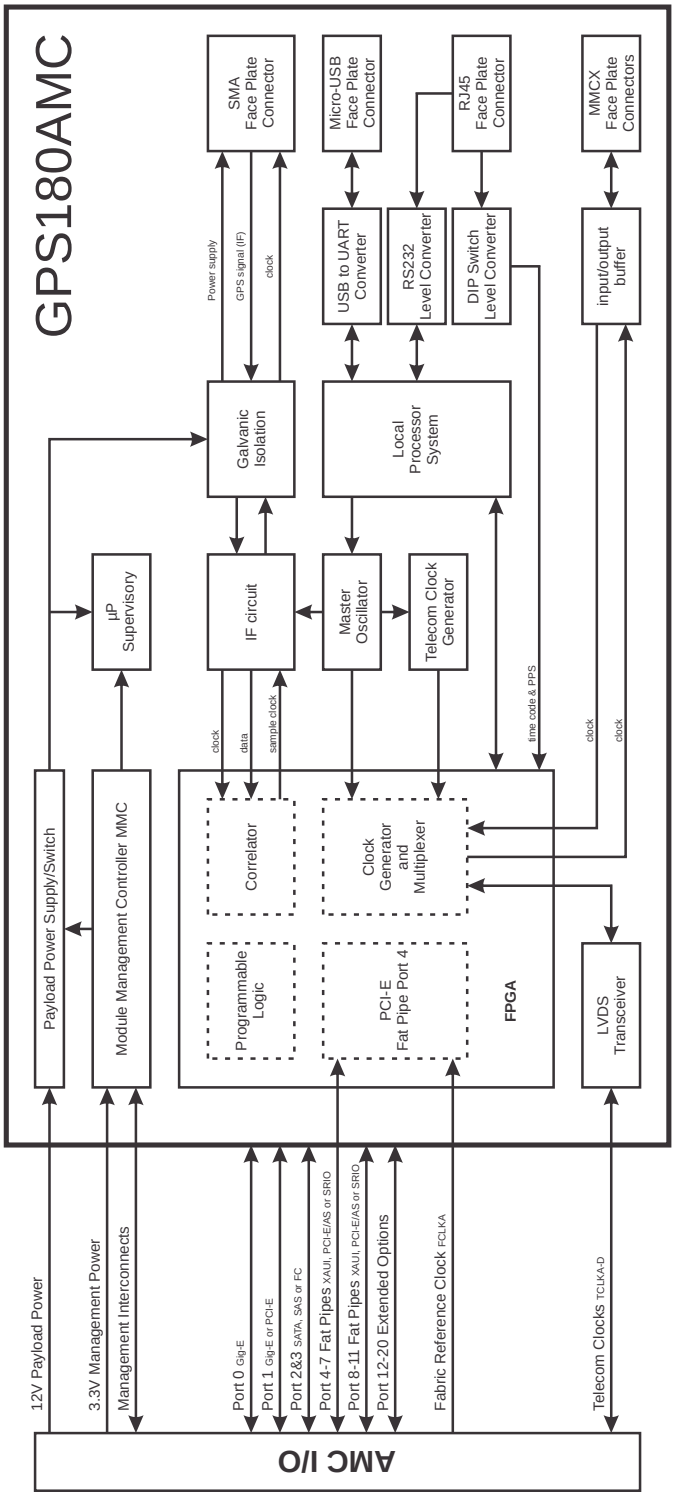
'position OK':	The output is switched on if the receiver was able to compute its position
'time sync':	The output is switched on if the internal timing is synchronous to the GPS-system
'all sync':	Logical AND of the above status messages. The output is active if position is calculated AND the timing is synchronized

Idle-mode: The output is inactive

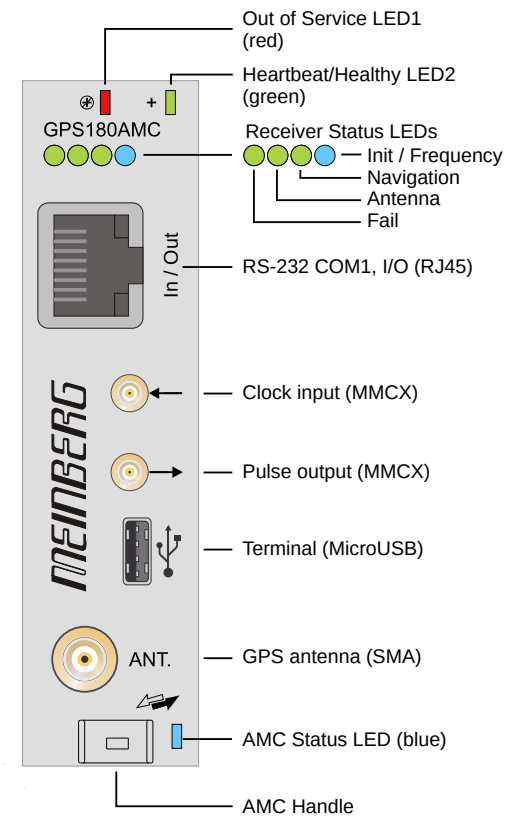
The default configuration for the pulse output is:

PPO0: Pulse each second (PPS), active HIGH, pulse duration 200 msec

6.5 Block Diagram GPS180AMC



7 Connectors and LEDs of the Front Panel



The socket for the antenna cable, the plug-in connectors for the input/output clock pulses and communication interfaces, as well as four status LEDs are recessed into the front panel. The states of the LEDs have the following meaning:

Init/Frequency
Lights-up blue after power on until the hardware initialization of the module is completed and the accuracy of the master oscillator is sufficient for receiving the satellite signals. Green means the oscillator regulation settled and the base accuracy is reached.

Navigation
Green if the radio clock was able to receive at least four satellites after power on and thus determines their position. Normally the receiver position is continuously checked, as long as at least four satellites can be received.

Antenna
Red, when no antenna is connected or a short circuit is detected in the connection to the antenna. Green if the antenna connection is correct.

Fail
Lights red after switching on the satellite radio clock until the time synchronization with the GPS system is achieved.
The RJ45 jack carries the connections of the serial interface COM1 of the radio clock to the outside. This interface cannot be used as serial interface of the AMC system, but is used exclusively for the communication between the satellite radio clock and other devices.

Some connections of the RJ45 jack can be assigned via a DIL-switch on the card with signals that have only TTL level (0...5V). In this case, you should pay attention to the assignment of the cable when connecting a device, as a standard RS-232 interface voltage from -12V...+12V on any of these connectors, can cause damage to the radio clock.

7.1 Assignment of the RJ45 Connector

When the radio clock is delivered only signals of the serial RS-232 interface COM1 are led to the ports of the connector. If an additional signal needs to be led out, the corresponding switch must be switched from DIL1 to ON. The chart below shows the pin assignment of the individual switches in block DIL1.

All signals without associated switch are always available on the connector:

RJ45 Pin	Signal	Signal Level	DIP Switch
1	+RS-422 in	RS-422	1
2	-RS-422 in	RS-422	2
3	TxD out	RS-232	-
4	GND	-	-
5	GND	-	-
6	RxD in	RS-232	-
7	PPS in	TTL	4
8	-	-	-

8 Technical Data GPS180AMC

AMC Standards:

AMC.0 R2.0 Advanced Mezzanine Card Base Specification
AMC.1 R1.0 PCI Express
MicroTCA.0 R1.0
IPMI v1.5

Interoperation of IPMI-Firmware testet with:
Kontron and NAT MCH in Schroff μTCA chassis
Test procedures with Polaris Tester in Advantech μTCA system

ATCA LEDs:

Specified status LEDs in the front panel:

LED0 (blue)	Ready for Hot Swap
LED1 (red)	Out of Service
LED2 (green)	Healthy

AMC Clock Configuration:

According to mode „SONET/SDH/PDH System Timing Module“:

TCLKA (ATCA CLK3A)	2.048MHz (default) clock receiver
TCLKB (ATCA CLK2)	19.44MHz (default) clock source
TCLKC (ATCA CLK3B)	2.048MHz (default) clock receiver
TCLKD (ATCA CLK1)	8kHz (fixed) clock source
FCLKA	100MHz PCIe clock reference receiver

Programmable clock frequencies for TCLKA, TCLKB and TCLKC:
8kHz, 1.544MHz, 2.048MHz or 19.44MHz

AMC Fabric Interface:

Single lane (x1) PCI Express (PCIe) interface
PCI Express r1.0a compatible
Fat Pipe Region, Port 4
Data format: binary, byte serial

Sensors:

Payload Power	
nominal voltage	12.00V
upper non recoverable threshold	13.20V (+10%)
upper critical threshold	12.96V (+8%)
upper non critical threshold	12.60V (+5%)
lower non recoverable threshold	10.80V (-10%)
lower critical threshold	11.04V (-8%)
lower non critical threshold	11.40V (-5%)

Temperature	**INLET**	**OUTLET**
nominal temperature	45°C	45°C
upper non recoverable threshold	85°C	85°C
upper critical threshold	65°C	65°C
upper non critical threshold	55°C	55°C
lower non recoverable threshold	0°C	0°C
lower critical threshold	0°C	0°C
lower non critical threshold	0°C	0°C

Receiver:

Twelve channel C/A code receiver with external antenna/converter unit

Antenna input:

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

Antenna:	Female SMA connector Antenna/converter unit,remote supply - refer to chapter "Technical specifications of antenna"
Power supply for antenna:	15VDC provided via antenna cable, continuous short circuit protection isolation voltage 1000 VDC
Time to synchronization:	One minute with known receiver position and valid almanac 12 minutes if invalid battery buffered memory
Clock input:	1 x 10MHz, 5Vpp max., AC-coupled, female MMCX connector in the front panel
Pulse Output:	Programmable output, TTL level default settings: active only ‚if sync' PPO0: change of second (PPS) pulse duration 200 msec valid on rising edge
Accuracy of time:	Better than +/- 100 nsec after synchronization and 20 minutes of operation better than +/- 2 μsec during the first 20 minutes of operation
Accuracy of frequency:	Depends on master oscillator, see http://www.meinberg.de/german/specs/gpsopt.htm possible oscillators: OCXO SQ (standard)/MQ/HQ/DHQ
Terminal interface:	USB 1.1 / USB 2.0 full-speed, Micro USB connector
Serial interface:	Asynchronous serial interface (RS-232) COM1 Baud rate: 300 to 19200 Data format: 7N2, 7E1, 7E2, 8N1, 8N2, 8E1 Default: 19200, 8N1 Meinberg Standard Telegramm, per second
Power supply:	12V Payload Power, 3.3V Management Power, 8W typ.
Battery:	Integrated Lithium primary button cell, 3.0V, IEC-Type CR 2032
Board dimensions:	Single, Mid-Size AMC Module, 181.5mm x 73.5mm x 18.96mm
Ambient temperature:	0...55° C
Humidity:	85% max.

9 Mounting the GPS Antenna

The GPS satellites are not stationary, but circle round the globe with a period of about 12 hours. They can only be received if no building is in the line-of-sight from the antenna to the satellite, so the antenna/downconverter unit must be installed in a location that has as clear a view of the sky as possible. The best reception is achieved when the antenna has a free view of 8° angular elevation above the horizon. If this is not possible, the antenna should be installed with the clearest free view to the equator, because the satellite orbits are located between latitudes 55° North and 55° South. If this is not possible, you may experience difficulty receiving the four satellites necessary to complete the receiver's position solution.

The unit can be mounted using a pole with a diameter up to 60 mm. A standard coaxial cable with 50 Ω impedance (e.g. RG58C) should be used to connect the antenna/converter unit to the receiver. Cable thinner than RG58 should be avoided due to its higher DC resistance and RF attenuation. When using the optional antenna diplexer the total length of one antenna line between antenna, diplexer and receiver must not be longer than 300 m. If a cable with less attenuation is used its length may be increased accordingly (e.g. 700 m with RG213).

Up to four GPS180 receivers can be run with one antenna/downconverter unit by using an optional antenna splitter. The total length of one antenna line between antenna, splitter and receiver must not be longer than the max. length shown in the table above. The position of the splitter in the antenna line does not matter.

High voltage protectors must be installed directly after reaching the indoors. The optional delivered protection kit is not for outdoor usage.

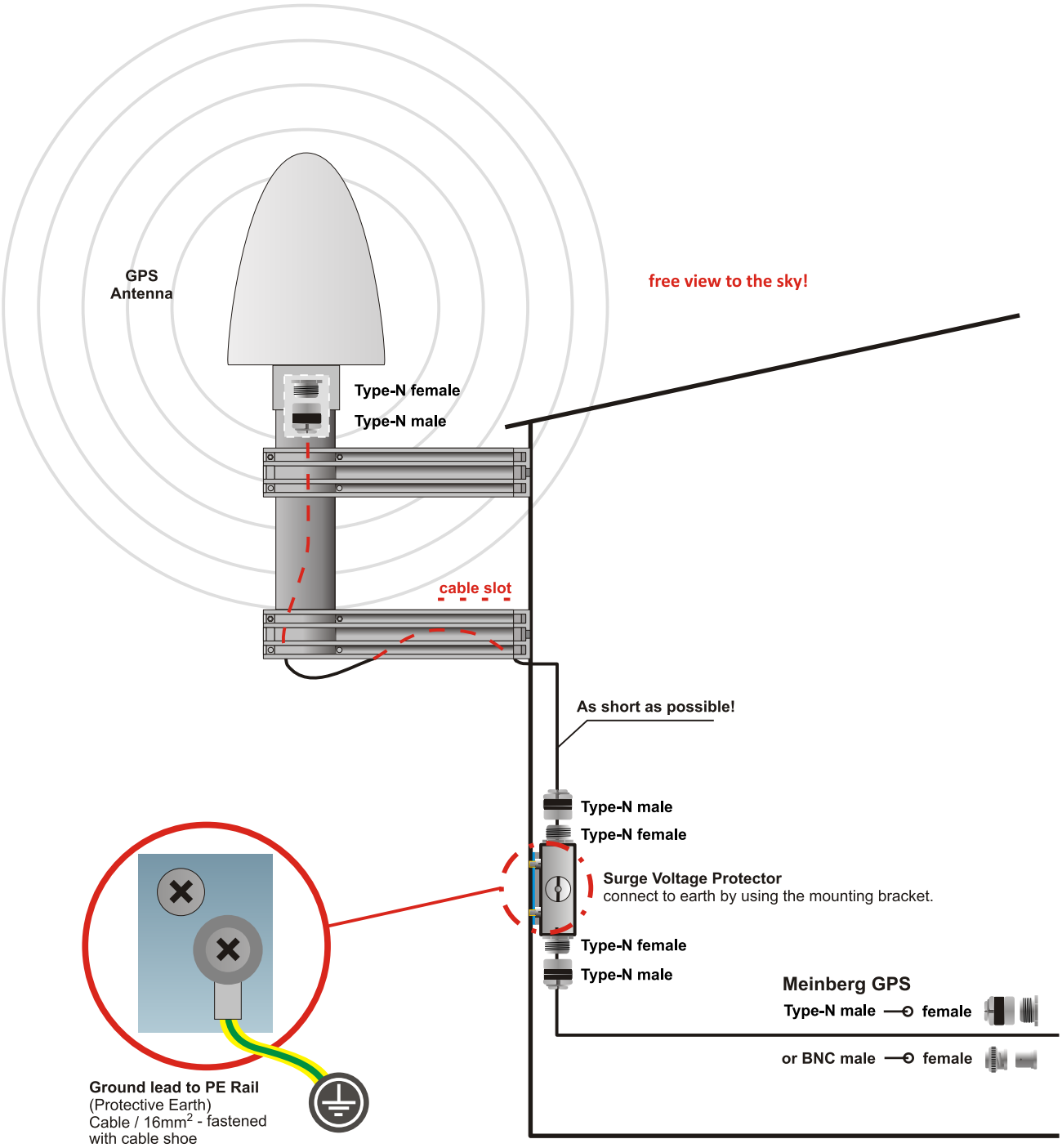
9.1 Example:

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

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

9.2 Antenna Short-Circuit Assembly with surge voltage protection

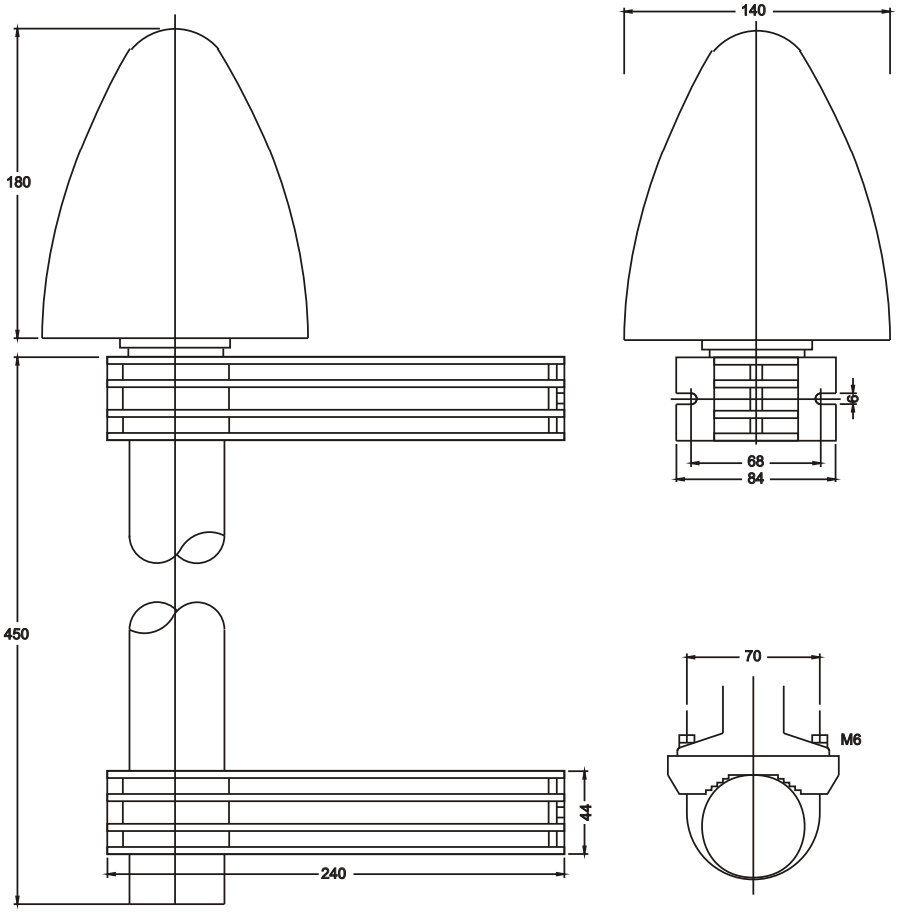
Optional a surge voltage protector for coaxial lines is available. The shield has to be connected to earth as short as possible by using the included mounting bracket. Normally you connect the antenna converter directly with the antenna cable to the system.



9.3 Technical Specifications GPS Antenna

ANTENNA:	dielectrical patch antenna, receive frequency:	25 x 25 mm 1575.42 MHz
BANDWITH:	9 MHz	
CONVERTER:	local oscillator to converter frequency: first IF frequency:	 10 MHz 35.4 MHz
POWER REQUIREMENTS:	12V ... 18V, @ 100mA (provided via antenna cable)	
CONNECTOR:	N-Type, female	
AMBIENT TEMPERATURE:	-40 ... +65°C	
HOUSING:	ABS plastic case for outdoor installation (IP66)	

Physical Dimension:



10 Putting the System into Operation

As soon as the radio clock slot card is integrated in correspondence with the specifications of the chapter "AMC Module Installation" and the antenna is installed and connected, the device is ready for operation. About 30 seconds after switching-on the computer the master oscillator has reached its basic precision, which is necessary for the reception of the satellite signal. When there are valid almanacs and ephemeris in the battery backed memory of the receiver and the receiver position has not changed since the last operation, the microprocessor of the device can calculate which satellites can be received at this moment. Under these conditions only one satellite has to be received, to synchronize the receiver and to create the outgoing impulses. That is why it only takes a maximum of a minute until the outgoing impulses will be activated. After more or less 20 minutes of operation the master oscillator is totally adjusted and the activated frequency lies within the specified tolerance.

If the location of the receiver has changed of several hundred kilometers, since the last operation, the Elevation and the Doppler of the satellite do not correspond to the calculated values. In this case the device runs in the mode "Warm Boot" and searches systematically for satellites, which are receivable. Due to the valid almanacs the receiver recognizes the identification numbers of existing satellites. As soon as four satellites can be received the new receiver position can be determined and the device changes to the mode "Normal Operation". If there are no almanacs available, maybe because the battery backed has been interrupted, the GPS180AMC starts in the "Cold Boot" mode. The receiver searches for a satellite and takes the whole almanac from it. After round about 12 minutes this procedure is completed and the mode of operation changes into Warm Boot.

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

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

ATTENTION!

There is a Danger of explosion if the lithium battery is replaced incorrectly. Only identical batteries or batteries recommended by the manufacturer must be used for replacement.

The waste battery has to be disposed as proposed by the manufacturer of the battery.

12 CE-Label

Low-Voltage guideline	**EN 60950-1** Safety of Information Technology Equipment, including Electrical Business Equipment
Electromagnetic compatibility	**EN50081-1** Electromagnetic compatibility (EMC). Generic emission standard. Part 1: Residential, commercial and light industry
	EN50082-2 Electromagnetic compatibility (EMC). Generic immunity standard. Part 2: Industrial environment

CE

13 Declaration of Conformity

Konformitätserklärung

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

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

Produktbezeichnung *Product Designation*	**GPS180AMC**

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

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

gemäß den Richtlinien 2004/108/EG (Elektromagnetische Verträglichkeit), 2006/95/EG (Niederspannungsrichtlinie), 2011/65/EU (Beschränkung der Verwendung bestimmter gefährlicher Stoffe) und 93/68/EWG (CE Kennzeichnung) sowie deren Ergänzungen.
following the provisions of the directives 2004/108/EC (electromagnetic compatibility), 2006/95/EC (low voltage directive), 2011/65/EU (restriction of the use of certain hazardous substances) and 93/68/EEC (CE marking) and its amendments.

Bad Pyrmont, 2014-03-03

Günter Meinberg
Managing Director