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1 The microSync System

1.1 microSync - Brand and Device Type

The registered trademark microSync describes a product family of Meinberg radio clocks for the synchronization of time and frequency signals in networks and directly connected systems such as signal distributors.

The microSync system is offered in two housing variants (HR = 9.5 inch half-rack chassis, RX = 19 inch full-rack chassis) with different input and output options. The system name describes the exact hardware configuration.

The available configurations are optimized for the different application areas.

1.2 Device Manufacturer

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Fax: + 49 (0) 52 81 / 93 09 – 230

Internet: https://www.meinbergglobal.com
Mail: info@meinberg.de

Date: 2020-06-19

Manual Version: 1.0

1.3 Target Audience

This manual is intended for professionals responsible for the installation, commissioning, maintenance, troubleshooting or operation of any of the equipment within the specified product range.

The structure and spelling of this manual assumes that the installation and commissioning technicians have knowledge of the use of network components.
1.4 Return of Equipment

All parts and components of your Meinberg system may only be repaired by Meinberg. In the event of a malfunction, the customer must contact our support service and never attempt to repair the device himself.

To request a device repair service, call Meinberg Technical Support to check shipping options and obtain the Return Material Authorization (RMA) number for shipping. You can also obtain the RMA number from our website. Please visit our RMA request page at: https://www.meinbergglobal.com/english/support/rma.htm.

The device must be packed in its original packaging or suitable packaging to protect it from shock and moisture. Send your device to the manufacturer's address, including sender identification and RMA number.

What must be included with the shipment?
Please return the device complete with accessories such as antenna or cable. This may be important for troubleshooting.
2 microSync System Description

2.1 Device Design, Functions and Area of Application

The microSync product family is a range of high-performance synchronization systems available in 9.5-inch (Half-Rack) and 19-inch models.

All microSync models offer a wide range of output signals including 1PPS, 10 MHz, IRIG timecodes, programmable pulses, and fiber optic signals. Furthermore, the Gigabit network ports enable network synchronization of NTP clients and PTP slaves.

The microSync systems have an integrated embedded network processor with the sync-optimized firmware meinbergOS. The firmware supports NTP, as well as all common PTP IEEE 1588 profiles and numerous network protocols for management and monitoring tasks.

The variety of outputs and interfaces allows the use of microSync models in several industries and applications. Depending on the system requirements, customers can choose from different variants that are best suited to their needs. The variants are defined via the BNC connectors, which can provide several I/O options. The following variants are currently available:

10 series
With preconfigured outputs such as Programmable Pulse (TTL), Time Code AM (IRIG, AFNOR) and Frequency Synthesizer (0.1 Hz to 10 MHz).

30 series
With preconfigured I/Os such as PPS input (TTL), 10 MHz input (sine/TTL), 10 MHz output (TTL) and 10 MHz sine output.

31 series
With preconfigured I/Os such as PPS input (TTL), 10 MHz input (sine/TTL), Programmable Pulses (TTL).
2.2 System Variants microSync

The microSync synchronization system is available in different versions. Two housing variants are available - the space-efficient HR housing (Half Rack, 1HE/9.5 inch built-in housing) and the RX housing variant as 1HE/19 inch built-in rackmount chassis. The RX enclosure offers the option of redundant power with a second power supply unit as an option. The HR enclosure can be mounted in any 19-inch server cabinet using a 19-inch mounting bracket. When using multiple HR chassis, it is possible to install two HR devices next to each other in a 19-inch server rack.

In addition, there are various reference signal options as well as input and output signals optimized for special applications. A detailed list of all options and their order codes can be found in the following overview.

Model Codes

The microSync model code (also order code) has the following structure: AA112BB(B)/CC##(CC##)

AA – Chassis Type

<table>
<thead>
<tr>
<th>AA</th>
<th>Chassis Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>Half-Rack (1HE/9,5 inch)</td>
</tr>
<tr>
<td>RX</td>
<td>Full-Rack (1HE/19 inch)</td>
</tr>
</tbody>
</table>

11 – Input and Output Options

| 10, 30, 31 | Status indicators LAN-CPU / Receiver |
|           | Status indicators PP1 - PP8         |
|           | COM 0 Timestring                    |
|           | USB Terminal / USB Host             |
|           | 4x Network interfaces               |
|           | DMC X1 / DMC X2 Terminal            |
|           | 2x programmable pulses – fiber optic|

| 10          | Frequency synthesizer output       |
|            | Timecode AM output (modulated)     |
|            | 2x programmable pulse outputs (PP 1 and PP 2) |

| 30          | 10 MHz input (Sine or TTL)         |
|            | PPS input                          |
|            | 10 MHz sine output                  |
|            | 10 MHz output                       |

| 31          | 10 MHz input (Sine or TTL)         |
|            | PPS input                          |
|            | 2x programmable pulse outputs (PP 1 and PP 2) |

2 – Receiver

| 0           | GNS: L1 Multi-GNSS (GPS, GLONASS, Galileo, BeiDou) |
|            | GPS: Meinberg GPS                     |
|            | GNS-UC: Meinberg Multi-GNSS (GPS, Galileo)  |
### BB(B) – Oscillator

<table>
<thead>
<tr>
<th></th>
<th>OCXO</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQ</td>
<td>SQ</td>
</tr>
<tr>
<td>MQ</td>
<td>MQ</td>
</tr>
<tr>
<td>HQ</td>
<td>HQ</td>
</tr>
<tr>
<td>DHQ</td>
<td>DHQ</td>
</tr>
</tbody>
</table>

### CC##(CC##) – Power Supply *

<table>
<thead>
<tr>
<th></th>
<th>nominal voltage range</th>
<th>max. voltage range</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD10</td>
<td>100-240 V ~, 50-60Hz / 100-200 V ≈</td>
<td>90-265 V ~, 47-63 Hz / 90-250 V ≈</td>
</tr>
<tr>
<td>DC20</td>
<td>24-48 V ≈</td>
<td>20-60 V ≈</td>
</tr>
</tbody>
</table>

The available HR models always have the code part "DC20" for the power supply, as these variants are currently only supplied with a DC power supply.

### microSync Model Code Samples

**HR101HQ/DC20**  
Half rack chassis of I/O-type 10 with Meinberg GPS receiver, OCXO HQ oscillator and DC20 power supply.

**RX300DHQ/AD10DC20**  
Full rack chassis of I/O-type 30 with Multi GNS receiver, OCXO SQ oscillator and redundant power supplies (AD10 and DC20).
2.3 Hardware Specifications

2.3.1 Chassis Specifications

2.3.1.1 HR: Half-Rack Chassis

The microSync\textsuperscript{HR} system is a space-saving synchronization solution in a 9.5-inch/1U half rack housing. It is possible to mount two systems side by side in a 19-inch server rack. A special mounting bracket is available in the supplied mounting kit for mounting a single microSync\textsuperscript{HR} device.

Physical Dimensions:
2.3.1.2 RX: 19 Inch Chassis

The microSync™ RX system from Meinberg is a synchronization solution in a 19-inch/1HE housing, with the option of redundant power supplies with AC/DC or DC voltage.

Physical Dimensions:
### 2.3.2 Available Power Supplies

#### microSyncRX

**100-240 V AC / 100-200 V DC**

- **Nominal Voltage** \( U_N \) 100-240 V ~ 100-200 V
- **Input Voltage Range** \( U_{\text{max}} \) 90-254 V ~ 90-240 V
- **Nominal Current** \( I_N \) 1.0 A ~ 0.6 A
- **Nominal Frequency** \( f_N \) 50-60Hz
- **Max. Frequency Range** \( f_{\text{max}} \) 47-63Hz
- **Power Consumption** \( P_{\text{max}} \) 50 W
- **Thermal Energy** \( E_{\text{therm}} \) 180.00 kJ/h (170.61 BTU/h)

**20-60 V DC**

- **Nominal Voltage** \( U_N \) 24-48 V
- **Input Voltage Range** \( U_{\text{max}} \) 20-60 V
- **Nominal Current** \( I_N \) 2.10 A
- **Power Consumption** \( P_{\text{max}} \) 50 W
- **Thermal Energy** \( E_{\text{therm}} \) 180.00 kJ/h (170.61 BTU/h)

#### microSyncHR

**20-60 V DC**

- **Nominal Voltage** \( U_N \) 48 V
- **Input Voltage Range** \( U_{\text{max}} \) 20-60 V
- **Nominal Current** \( I_N \) 0.63 A
- **Power Consumption** \( P_{\text{max}} \) 30 W
- **Thermal Energy** \( E_{\text{therm}} \) 108.00 kJ/h (102.37 BTU/h)
2.3.3 Available Receiver and Oscillator Options

<table>
<thead>
<tr>
<th>Receiver Type</th>
<th>Signal Type</th>
<th>Value</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS (12 Channel)</td>
<td>IF (Meinberg Antenna)</td>
<td>15 V DC</td>
<td>BNC</td>
</tr>
<tr>
<td>GNS-UC GPS, Galileo (72 Channel)</td>
<td>IF (Meinberg Antenna)</td>
<td>15 V DC</td>
<td>BNC</td>
</tr>
<tr>
<td>GNSS GPS, GLONASS, Galileo, BeiDou (72 Channel)</td>
<td>L1/E1/B1 band</td>
<td>5 V DC</td>
<td>SMA</td>
</tr>
</tbody>
</table>

**Oscillator Options**

<table>
<thead>
<tr>
<th>Type</th>
<th>Holdover Performance (1 Day)</th>
<th>Holdover Performance (1 Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCXO SQ</td>
<td>± 220 µsec</td>
<td>± 4.7 sec</td>
</tr>
<tr>
<td>OCXO MQ</td>
<td>± 65 µsec</td>
<td>± 1.6 sec</td>
</tr>
<tr>
<td>OCXO HQ</td>
<td>± 22 µsec</td>
<td>± 788 msec</td>
</tr>
<tr>
<td>OCXO DHQ</td>
<td>± 4.5 µsec</td>
<td>± 158 msec</td>
</tr>
</tbody>
</table>

2.3.4 Environment

- **Operating Temperature Range:** –20 to 55 °C (–4 to 131 °F)
- **Storage Temperature Range:** –30 to 70 °C (–22 to 158 °F)
- **Relative Humidity:** 5 to 95 % (non-condensing) at 40 °C (104 °F)
- **Operating Altitude:** up to 4,000 m (13,123 ft) above sea level
- **Atmospheric Pressure:** 615 to 1600 hPa
2.4 Type Tests / Compatibilities

2.4.1 Electromagnetic Compatibility - Emission

<table>
<thead>
<tr>
<th>Standard</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>CISPR 16-1-2 and CISPR 16-2-1</td>
<td>Conducted disturbance voltage measurements</td>
</tr>
<tr>
<td>CISPR 16-2-3</td>
<td>Radiated radio disturbance</td>
</tr>
<tr>
<td>CISPR 32</td>
<td>Conducted disturbance current measurements</td>
</tr>
<tr>
<td>FCC 47 CFR Part 15 section 15.107 (b) [3]</td>
<td>Conducted emission</td>
</tr>
<tr>
<td>RSS-Gen Issue 4 section 8.8 [4]</td>
<td></td>
</tr>
<tr>
<td>FCC 47 CFR Part 15 section 15.109 (b) [3]</td>
<td>Radiated emission</td>
</tr>
<tr>
<td>RSS-Gen Issue 4 section 8.9 [4]</td>
<td></td>
</tr>
<tr>
<td>ETSI EN 303 413</td>
<td>Standard for GNSS receiver</td>
</tr>
</tbody>
</table>
2.4.2 Electromagnetic Compatibility - Immunity

The tests were performed according to IEC 61000-6-5 and IEC 61850-3 referring to the following standards:

IEC 61000-4-2  Immunity test to electrostatic discharges  ±6 kV contact discharge  
                 ±8 kV air discharge

IEC 61000-4-3  Immunity test to radiated, radio-frequency, electromagnetic fields  10 V/m

IEC 61000-4-4  Immunity test to electrical fast transients (Burst)  ±4 kV, 100 kHz (microSyncHR)
                 ±2 kV, 100 kHz (microSyncRX)

IEC 61000-4-5  Immunity test to surges  up to ±1 kV line to line  
                 up to ±2 kV line to earth

IEC 61000-4-6  Immunity test to conducted disturbances, induced by radio-frequency fields  10 V

IEC 61000-4-8  Immunity test to power frequency magnetic fields  100 A/m continuous  
                 1000 A/m at 1 s

IEC 61000-4-11 (microSyncRX only) Immunity tests to voltage dips, short interruptions and voltage variations  ∆U 30 % for 1 period  
                                                      ∆U 60 % for 50 periods  
                                                      ∆U 100 % for 5 periods  
                                                      ∆U 100 % for 50 periods

IEC 61000-4-16 Immunity test to conducted, common mode disturbances  30 V continuous  
                                                                  300 V at 1 s

IEC 61000-4-17 Immunity test to ripple on d.c. input power ports  10 % of Un

IEC 61000-4-18 Immunity test to damped oscillatory waves  ±1 kV line to line  
                                                                  ±2 kV line to earth

IEC 61000-4-29 Immunity test to voltage dips, short interruptions and voltage variations  ∆U 30 % for 100 ms  
                                                      ∆U 60 % for 100 ms  
                                                      ∆U 100 % for 50 ms

2.4.3 Safety Tests

IEC 62368-1  Overvoltage Category  II
Safety Requirements  Protection Class  1
                     Degree of Pollution  2

IEC 60529  Protection Rating / IP Code  IP30
2.4.4 Environmental Tests

The tests were performed according to IEC 61850-3 referring to the following standards:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Test Description</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60068-2-1</td>
<td>Cold</td>
<td>−40 °C, 16 h</td>
</tr>
<tr>
<td>IEC 60068-2-2</td>
<td>Dry heat</td>
<td>+85 °C, 16 h</td>
</tr>
<tr>
<td>IEC 60068-2-14</td>
<td>Change of temperature</td>
<td>−20 to +55 °C, 5 cycles, (1 °C/min)</td>
</tr>
<tr>
<td>IEC 60068-2-30</td>
<td>Damp heat, cyclic (12 h + 12 h)</td>
<td>+55 °C, 97 % RH, 6 cycles</td>
</tr>
<tr>
<td>IEC 60068-2-78</td>
<td>Damp heat, steady state</td>
<td>+40 °C, 93 % RH, 240 h</td>
</tr>
<tr>
<td>IEC 60255-21-1</td>
<td>Vibration (sinusoidal) Class 2</td>
<td>10–150 Hz, 1$_{gn}$, 2 sweeps, 3 axes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10–150 Hz, 2$_{gn}$, 40 sweeps, 3 axes</td>
</tr>
<tr>
<td>IEC 60255-21-2</td>
<td>Shock Class 2</td>
<td>10$_{gn}$, 11 ms, ±3 shocks, 3 axes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30$_{gn}$, 11 ms, ±3 shocks, 3 axes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20$_{gn}$, 16 ms, ±1000 shocks, 3 axes</td>
</tr>
<tr>
<td>IEC 60255-21-3</td>
<td>Seismic$^1$ Class 2</td>
<td>4–35 Hz, 1$_{gn}$, 1 sweep, hor. axes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4–35 Hz, 2$_{gn}$, 1 sweep, ver. axis</td>
</tr>
</tbody>
</table>

1) In order to withstand the tests for vibration, shock and seismic, special mounting brackets are optionally available.

2) The frequency range deviates from the values required by the standard. In this test, a frequency range of 4–35 Hz instead of 1–35 Hz was used.

2.4.5 Compliance

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CB</td>
<td>✓</td>
<td>CSA</td>
</tr>
<tr>
<td>CE</td>
<td>✓</td>
<td>WEEE</td>
</tr>
<tr>
<td>FCC</td>
<td>✓</td>
<td>RoHS</td>
</tr>
<tr>
<td>UL</td>
<td>✓</td>
<td>REACH</td>
</tr>
</tbody>
</table>
3 Important Safety Information

3.1 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.


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.
3.2 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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Beschreibung / Description</th>
</tr>
</thead>
</table>
| ![image](https://example.com/symbol-1) | IEC 60417-5031  
Gleichstrom / Direct current |
| ![image](https://example.com/symbol-2) | IEC 60417-5032  
Wechselstrom / Alternating current |
| ![image](https://example.com/symbol-3) | IEC 60417-5017  
Erdungsanschluss / Earth (ground) terminal |
| ![image](https://example.com/symbol-4) | IEC 60417-5019  
Schutzleiteranschluss / Protective earth (ground) terminal |
| ![image](https://example.com/symbol-5) | ISO 7000-0434A  
Vorsicht / Caution |
| ![image](https://example.com/symbol-6) | IEC 60417-6042  
Vorsicht, Risiko eines elektrischen Schlages / Caution, risk of electric shock |
| ![image](https://example.com/symbol-7) | IEC 60417-5041  
Vorsicht, heiße Oberfläche / Caution, hot surface |
| ![image](https://example.com/symbol-8) | IEC 60417-6056  
Vorsicht, Gefährlich sich bewegende Teile / Caution, moving fan blades |
| ![image](https://example.com/symbol-9) | IEC 60417-6172  
Trennen Sie alle Netzstecker / Disconnection, all power plugs |
| ![image](https://example.com/symbol-10) | IEC 60417-5134  
Elektrostatisch gefährdete Bauteile / Electrostatic Sensitive Devices |
| ![image](https://example.com/symbol-11) | IEC 60417-6222  
Information generell / Information general |
| ![image](https://example.com/symbol-12) | 2012/19/EU  
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. |
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.
3.3 Security during Installation

WARNING!
Preparing for Commissioning
This built-in unit has been designed and examined according to the requirements of the standard IEC 62368-1 “Audio/video, information and communication technology equipment - Part 1: Safety requirements”.

When the built-in unit is used in a terminal (e.g., housing cabinet), additional requirements according to Standard IEC 62368-1 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.
<table>
<thead>
<tr>
<th><strong>AC Power Supply</strong></th>
<th></th>
<th><strong>DC Power Supply</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• The device is a device of protection class 1 and may only be connected to a grounded outlet (TN system).</td>
<td></td>
<td>• Outside the assembly group the device must be disconnectable from the power supply in accordance with the provisions of IEC 62368-1 (e.g. by the primary line protection).</td>
</tr>
<tr>
<td>• For safe operation, the device must be protected by an installation fuse of max. 16 A and equipped with a residual current circuit breaker in accordance with the applicable national standards.</td>
<td></td>
<td>• Installation and disassembly of the power supply plug is only permitted if the assembly group is switched off (e.g. by the primary line protection).</td>
</tr>
<tr>
<td>• The unit must always be disconnected from the mains and not from the appliance.</td>
<td></td>
<td>• The supply lines must be adequately secured and dimensioned.</td>
</tr>
<tr>
<td>• Devices with mains plugs are equipped with a safety-tested mains cable of the country of use and may only be connected to a grounded shockproof socket, otherwise electric shock may occur.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Make sure that the mains socket on the appliance or the mains socket of the house installation is freely accessible to the user so that the mains cable can be pulled out of the socket in case of emergency.</td>
<td></td>
<td>• The device must be supplied with a suitable disconnector (switch). The separation device must be easily accessible, placed near the device and marked as a separation device for the unit.</td>
</tr>
</tbody>
</table>

*Connection Cross Section:*

- 1 mm² – 2.5 mm²
- 17 AWG – 13 AWG
3.4 Protective Conductor- / Ground-Terminal

![Attention]

**ATTENTION!**

In order to ensure safe operation and to meet the requirements of IEC 62368-1, the device must be correctly connected to the protective earth conductor via the protective earth connection terminal.

If an external earth connection is provided on the housing, it must be connected to the equipotential bonding rail (grounding rail). The mounting parts (without cable) are not included in the scope of delivery.

**Note:**
Please use a grounding cable $\geq 1.5 \text{ mm}^2$
Always pay attention to a correct crimp connection!

---

3.5 Safety during Operation

![Warning]

**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.
3.6 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.

3.7 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.
3.8 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.

3.9 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.
3.10 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.
4 Before you start

4.1 Text and Syntax Conventions

This chapter briefly describes the text and syntax conventions used in this manual.

**Meinberg Device Manager:** Example "Network Settings" menu
- Submenu "Network Settings → Interfaces"
- Tab in a submenu "Monitoring Settings → SNMP → SNMPv3"

Menu navigation is logically separated by the right arrow.

**Services**
The services running on the system are shown in italics.

**Example:** NTP-Deamon: *ntpd*

**Cross references in the document:**
Cross-references in the document are displayed in dark blue font - e.g.: see chapter Support Information

**Selection Options and Logical Groups:**
Selection options, e.g. in a drop-down menu, are underlined and then briefly described. If several parameters are combined in a menu to logical groups, these are also underlined and displayed in bold font - e.g. PTP status → **Parent Datasets**.

**Example:**
Menu PTP (IEEE1588) Settings → Operation Mode

**Multicast Master**
...

**Terminal**

```
# Output via a terminal window is displayed
# in a grey box with monospace font.
```
4.2 Abbreviation List

AFNOR Association Francaise de Normalisation time codes
AC Alternating Current IP Protection Class 20
ASCII American Standard Code for Information Interchange IRIG Inter-range instrumentation group time codes
BMC Best Master Clock LCD Liquid Crystal Display
BNC Bayonet Neil Councilman connector LED Light-Emitting Diode
Bps Bytes per second LINUX Unix-like multi-user computer operating system
bps Bits per second
CAT5 Standard Network Cable LIU Line Interface Unit - an module for generation E1/T1 Signals, both
CET Central European Time LNE Local Network Extention, additional Ethernet Ports
CLI Command Line Interface MBit/s (framed) and Clock (unframed)
DB9 Connector do type D-subminiature
DC Direct Current
DCF77 Is a longwave time signal. DCF77 stands for D=Deutschland (Germany), C=long wave signal, F=Frankfurt, 77=frequency: 77.5 kHz.
DCFMARK Single pulse with a programmable date and time
DHCP Dynamic Host Configuration Protocol MAC Media Access Control
DNS Domain Name Server MD5 Message-Digest cryptographic hash function
DSCP Differentiated Services Code Points MESZ Middle European Summer Time
DST Daylight Saving Time MEZ Middle European Time
E1 European digital transmission signal at 2048 MHz used in telecommunication networks.
E2E End-to-end
ETH Ethernet NTP Network Time Protocol
FTP File Transfer Protocol NTPD NTP Deamon
FW Firmware OSV Original Shipped Version
GE / GbE Gigabit Ethernet OUT Output
GLONASS GLObal NAvigation Satellite System P2P Peer-to-Peer
from Russian Aerospace Defense PLC Programmable Logic Controller
GND Ground (Connector) PLL Phase Locked Loop
GNSS Global Navigation Satellite System PPM Pulse per Minute
(GPS, GLONASS, Galileo, Beidou) PRP Parallel Redundancy Protocol
GOAL GPS Optical Antenna Link PPS Pulse per Second
GPS Global Positioning System (USA) PPH Pulse per Hour
GSM Global System for Mobile PTB Physical - Technical Institute
 Communications
HMI Human-Machine Interface PTP Precision Time Protocol
HP Horizontal Pitch - is a unit measure of the horizontal width of rack mounted electronic equipment
HPS High Performance Synchronization PTP/NTP/SyncE GBit module
PTP/NTP/SyncE GBit module RG58 Standard coaxial cable used to connect an antenna and a receiver
HSR High-availability Seamless Redundancy RJ45 Ethernet Connector with 8 conductors
HTTP Hypertext Transfer Protocol RMC Remote Monitoring Control
HTTPS Hypertext Transfer Protocol Secure RoHS Restriction of Hazardous Substances
IEC International Electrotechnical Commission RPS Redundant Power Supply
Commission RS232/485 Serial port levels
IED Intelligent Electronic Devices RSC Redundant Switch Control unit
IEEE Institute of Electric and RX Receiving Data
Electronic Engineers SBC Single Board Computer
IEEE 1588 Protocol for high-precision SDU Signal Distribution Unit
synchronization in nanosecond SHA-1 Secure Hash Algorithm 1
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMB</td>
<td>Subminiature coaxial connector</td>
</tr>
<tr>
<td>SNMP</td>
<td>Simple Network Management Protocol</td>
</tr>
<tr>
<td>SNTP</td>
<td>Simple Network Time Protocol</td>
</tr>
<tr>
<td>SMTP</td>
<td>Simple Mail Transfer Protocol</td>
</tr>
<tr>
<td>SPS</td>
<td>Standard Positioning System</td>
</tr>
<tr>
<td>SSH</td>
<td>Secure SHell network protocol</td>
</tr>
<tr>
<td>SSU</td>
<td>Synchronization Supply Unit, specific clock used in telecommunication networks</td>
</tr>
<tr>
<td>SSM</td>
<td>Sync Status Messages, clock quality parameters in telecommunication networks.</td>
</tr>
<tr>
<td>ST</td>
<td>Bayonet-lock connector</td>
</tr>
<tr>
<td>Stratum</td>
<td>Value defines the NTP hierarchy</td>
</tr>
<tr>
<td>SYSLOG</td>
<td>Standard for computer data logging</td>
</tr>
<tr>
<td>TACACS</td>
<td>Terminal Access Controller, Access Control System</td>
</tr>
<tr>
<td>TCG</td>
<td>Time Code Generator</td>
</tr>
<tr>
<td>TCR</td>
<td>Time Code Receiver for IRIG A/B, AFNOR or IEEE1344 codes</td>
</tr>
<tr>
<td>T1</td>
<td>North American telecommunication signal at 1.544 MHz frequency</td>
</tr>
<tr>
<td>TCP</td>
<td>Transmission Control Protocol</td>
</tr>
<tr>
<td>TTL</td>
<td>Transistor-to-Transistor Logic</td>
</tr>
<tr>
<td>TX</td>
<td>Data Transmission</td>
</tr>
<tr>
<td>UDP</td>
<td>User Datagram Protocol</td>
</tr>
<tr>
<td>UMTS</td>
<td>Universal Mobile Telecommunications System</td>
</tr>
<tr>
<td>UNIX</td>
<td>Multitasking, multi-user computer operating system</td>
</tr>
<tr>
<td>UTC</td>
<td>Universal Time Coordinate</td>
</tr>
<tr>
<td>VLAN</td>
<td>Virtual Local Area Network</td>
</tr>
<tr>
<td>WWVB</td>
<td>Time signal radio station Fort Collins, Colorado (USA)</td>
</tr>
<tr>
<td>XMR</td>
<td>External Multi-Reference</td>
</tr>
</tbody>
</table>
4.3 Required Tools

<table>
<thead>
<tr>
<th></th>
<th>microSync HR</th>
<th>microSync RX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting Brackets</td>
<td>TORX T10</td>
<td>TORX T10</td>
</tr>
<tr>
<td>Earth Connection</td>
<td>TORX T20</td>
<td>TORX T20</td>
</tr>
<tr>
<td>Power supply</td>
<td>--</td>
<td>TORX T8</td>
</tr>
</tbody>
</table>

Figure: Required tools from left to right: TORX T20, TORX T10, TORX T8
4.4 Required Software

Meinberg Device Manager
For initial start of operation, configuration and monitoring we provide the free Meinberg Device Manager software. This software is a graphical desktop application with which you can configure Meinberg devices via an encrypted network connection. A big advantage of the Meinberg Device Manager is the possibility of simultaneous configuration and monitoring of several different devices in the network.

The Meinberg Device Manager for Windows can be used with Windows 7 and all newer versions. Supported Linux distributions include Ubuntu, Mint Linux, Debian, SUSE Linux, CentOS and others.

The software can be downloaded free of charge from our homepage:

![Image: Meinberg Device Manager startscreen]

**Portable Version - Meinberg Device Manager without Setup**
For environments in which no installation of executable programs is possible or for security reasons should be avoided, a microSync system can also be configured and monitored via the portable version of the Meinberg Device Manager. This portable version can be found on the included USB stick in the directory: `/Software/M-bgDevMan/mbgdevman_portable/`. Simply start this program on the delivered USB stick.
4.5 Preparing Installation

Meinberg microSync systems are designed for installation in 19-inch racks. Rack systems come with all necessary accessories (mounting brackets, screws, adapters for power supply ...). For installations in regions outside of Germany that have other standards (e.g. for power supply connections), please specify exactly which adapters or cables you need to put the device into operation when ordering.

Before unpacking the system, make sure that there is sufficient space in the built-in cabinet to ensure safe ventilation of the system. Avoid dirt and dust during installation.

⚠️ It is important that you follow the safety instructions in this manual to avoid damage to the system and personal injury.
4.6 Unboxing the Device

Carefully unpack the system and all accessories and put them aside. Check the scope of delivery with the packing list to ensure that no parts are missing. If any of the listed contents are missing, please contact Meinberg Funkuhren.

Antenna Mounting

1. GNSS antenna
2. Overvoltage protection (optional)
3. Antenna cable
4. Coaxial cable for overvoltage protection (optional)
5. Retaining tube and clips for Meinberg GPS antenna
6. Mounting kit for Meinberg GPS antenna

Rack Mount

7. Mounting bracket for microSyncHR 19-inch extension and mounting screws
8. Mounting bracket (standard) and fixing screws
9. Connector for DMC X1/X2 connection
10. Power cord (microSyncRX only)
11. Adapter cable for 5-pin voltage connection (microSyncRX only)
12. Protection spacer
13. USB stick with software and documentation
Check the system for shipping damage. If the system is damaged or cannot be put into operation, contact Meinberg Funkuhren immediately. Only the recipient (the person or company receiving the system) can assert a claim against freight forwarder for shipping damage.

Meinberg recommends that you keep the original packaging materials for possible future transport.

Please read the safety instructions and the manual carefully to familiarize yourself with the safe and proper handling of electronic devices.

The product documentation can be found on the USB Flash Memory.

### 4.7 Disposal of Packaging Materials

The packaging materials we use are fully recyclable:

<table>
<thead>
<tr>
<th>Material</th>
<th>Use for</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polystyrol</td>
<td>packaging frame/filling material</td>
<td>Recycling Depot</td>
</tr>
<tr>
<td></td>
<td>(polystyrene peanuts, bubble wrap)</td>
<td></td>
</tr>
<tr>
<td>PE-LD Polyethylene</td>
<td>accessories packaging</td>
<td>Recycling Depot</td>
</tr>
<tr>
<td>low density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardboard</td>
<td>shipping packaging, accessories packaging</td>
<td>Paper recycling</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5 System Installation

19 inch Rackmount

Mounting brackets and fixing screws are included in the scope of delivery of a half or full rack system. If the system is supplied with an antenna and antenna cable, it is advisable to first mount the antenna in a suitable location (see chapter Antenna Mounting) and lay the antenna cable. The power supply cable and the network cable should also be available at the installation site before the system is installed. Make sure that all necessary adapters for connecting the device are available. Make sure that the voltage is disconnected from the power source during installation.

Rackmount - microSync\(^\text{HR}\)

For the installation of a microSync\(^\text{HR}\) Half-Rack system in a 19-inch server rack, a special mounting bracket is included in the scope of delivery. Use this bracket to mount your system. The bracket is attached to the microSync\(^\text{HR}\) enclosure at the four green dots (see figure) using the supplied Torx screws.

Figure: microSync\(^\text{HR}\) and microSync\(^\text{RX}\) rack mount. The screws for rack mounting are not included in the scope of delivery.

In order to meet the specified shock and vibration requirements, special mounting brackets are required.
5.1 Connecting the System

Make sure that the system to be connected is connected to your PC or the network via either a serial or a network connection and is on the same physical network.

Figure: Connection scheme microSyncHR with power supply, network connector, serial connection and antenna link

Hint:
Please make sure that only microSyncHR systems receive DC power via the DMC X1 connector. For the microSyncRX models the voltage connection (AC/DC or DC) is made directly at the power supply unit.

Figure: Connection scheme microSyncRX with power supply, network connector, serial connection and antenna link

The following section describes how you can initially put a microSync system into operation with the help of the Meinberg Device Manager Software. The supplied USB stick contains an installation file for the Meinberg Device Manager software. If you do not want to perform an installation on your local PC, you can start the "portable" version of the Device Manager directly from the USB stick.
5.2 Initial Network Configuration

After the system has been connected to the power supply and to the receivers antenna, the initial setup can be started. The device starts immediately after connection to the power supply.

A microSync system is delivered with a static configured IP address. The DHCP service is deactivated. This means that you have to establish a manual network connection to be able to configure system settings.

To configure a microSync system you need the Meinberg Device Manager software. This tool is provided on the supplied USB stick. You can always download the latest version from our website: https://www.meinbergglobal.com/english/sw/devman.htm

If the network settings of your PC do not allow a connection to the microSync system, you have to adjust the settings of your network adapter. At delivery the microSync system has the following network settings:

- IP v4 address: 192.168.19.79
- Netmask: 255.255.255.0
- DHCP: disabled

If you do not have access to the properties of the network adapter due to security restrictions, you can also use an USB - Ethernet adapter (not included in delivery scope), where you can edit and change the network properties.

Change the settings of your network adapter so that you can establish a network connection with the microSync system. All further settings can now be done with our Meinberg Device Manager software.
Serial connection
Another way for initial configuration of the IP address of the microSync is the serial USB interface. You can connect the USB port on the PC with the micro-USB port on the microSync using a standard USB cable, as used for many mobile phones. Via the system settings of your PC you can now find out which COM port is being used. Using a console program (e.g. Putty) you can now establish a serial connection to the system.

Use the following connection parameters:

- **Conn. Type:** Serial
- **Serial Line:** COM X
- **Speed:** 115200
- **Framing:** 8N1

After the connection is detected, you will be prompted to enter a user and password. User: admin / Password: timeserver. Press the Enter key after each entry.

Starting with meinbergOS version 2020.01.0 an installation wizard is available.

### 5.2.1 Network configuration with the mbgOSWizard

After the successful connection via the serial console (as described in chapter Initial Network Configuration), you can now use the Meinberg OS Wizard to configure the IP address for the first time. Select the same subnet mask as for your network adapter and an IP address which is located in the same subnet.

First start the wizard with mbgOSWizard.sh - after confirming the input you will be asked to enter the password again (default: timeserver).

You can now choose the network port you want to use for administrative purposes (LAN 0 as a recommendation). In the next step, enter the desired IPv4 address that you want to assign to the selected port. In the next step, enter the network mask (e.g.: 255.255.255.0) and then confirm the entry with 'y'.

The initial network configuration is now complete, you can exit the Startup Wizard now. For all further configurations you can use our Meinberg Device Manager Software. Please use a version ≥ 2.2.
5.3 Initial Start of Operation

First install the Meinberg Device Manager software supplied on the USB stick. After the setup, start the program. If you do not want to perform a setup on your computer, you can start the portable version of the Meinberg Device Manager software directly on the USB stick: USB Drive/Software/MbgDevMan/mbgdevman_portable/mbgdevman.exe.

By clicking on the Search Devices button, all available microSync systems that have a serial or a network connection are recognized by the Meinberg Device Manager and will be listed then.

- Found systems are displayed with a green dot.
- Modules that are no longer recognized are displayed with a red dot.
- Modules whose password or password/user name combination is unknown will be marked with a red x.

Use the corresponding checkbox to select the device with which you want to establish a connection. With a microSync system you will then be prompted to enter your connection data. At the initial start please use "admin" for user and "timeserver" as password.
If the connected system was not found by the automatic search, a connection can be established manually by Add Device.

Establishing a Network Connection
Select the connection type Network. Then enter the IPv4 address of the system you want to connect to.

TCP Port
The TCP port is used to communicate with your system. Please make sure that the port is not blocked by your firewall configuration.

Authentication
Select the authentication option. The option Username & Password is only supported on systems with MeinbergOS.

Save Credentials
With this checkbox you ensure that the Device Manager has remembered the login for this system. When the program is restarted, the User and Password fields are already filled out.

Silent Login
You have the option that the Meinberg Device Manager does not ask for a user name and password every time you log in.
6 System Operation - Configuration and Monitoring

Meinberg Device Manager: Management and Monitoring Software for Windows and Linux
The Meinberg Device Manager software is available for free download on the Meinberg homepage. You can download the software here:


![Meinberg Device Manager - input and output signals of a microSyncHR system](image)

Figure: Meinberg Device Manager - input and output signals of a microSyncHR system

Documentation
For the documentation about configuration and system monitoring of microSync systems with the Meinberg Device Manager software a comprehensive manual is available on our website. You can download the document (PDF) here:

7 Maintenance, Servicing and Repairing

7.1 Firmware Updates

On our firmware download page under https://www.meinbergglobal.com/english/sw/firmware.htm you can download or request the latest meinbergOS updates free of charge. If you need an older version, you can request it from our support. Select the option "Specified Firmware-Version" and enter the version of the currently used firmware and the desired firmware version (e.g. meinbergOS 2019.08.5).
If you encounter a problem with your microSync system, you can contact our technical support at any time. In order to be able to perform a quick and targeted diagnosis of your system, please provide us with a diagnostic file of the microSync system concerned. You can create this diagnostic file with the Meinberg Device Manager software. Select the menu "Configure Device(s) -> System Settings" and then use the button Get Diagnostics File. With the button Create Snapshot you can also create a text file with the current configuration. This file is also helpful for our employees in solving the problem.

If these files are too big to send by mail, you can also use our upload page: https://www.meinbergglobal.com/upload/

Please enter the serial number of your device again and, if already available, a support ticket number.

Otherwise there are a lot of tools available for self-help. Please also read the chapter Support Information.
8.1 System Error Messages

**Event Log**
In the menu "Show Device(s) Status → Clock → Event Log" you are able to display the last 20 events registered by the receiver. Here you can see the exact time and date when the event occurred. In addition, the severity of the event and the event type is displayed (e.g. Level = Error, Type = Warm Boot).

**Monitoring Status**
In the menu "Monitoring Status" you can read out further system messages with the time of the event and the severity. The individual events are highlighted in color using a tabular overview so that the severity can be recognized immediately (e.g. Network Link | Severity = Error | Descr. = Down | Color = red).


# 9 Support Information

In this chapter you will learn about different levels of support at the Meinberg Company. In general, the Basic Customer Support level is included in the price you pay for your Meinberg product and demands no additional costs. It includes free e-mail, phone support and free lifetime firmware updates for the lifetime of your product, i.e. for as long as you choose to use it.

Depending on the product this level also includes a 3 year hardware warranty. You can extend the hardware warranty period after the standard warranty of your Meinberg product ends.

The chapter includes:

- Basic Customer Support
- Support Ticket System
- How to download a Diagnostic File
- Self-Help Online Tools
- NTP and IEEE 1588-PTP online tutorials.
- The Meinberg Academy introduction and offerings.
- Meinberg Newsletter
- How-To-Videos on our YouTube channel

## 9.1 Basic Customer Support

Contact Meinberg via e-mail or phone.

<table>
<thead>
<tr>
<th>Technischer Support</th>
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<tbody>
<tr>
<td>E-Mail</td>
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<td>Service-Hotline</td>
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| Service-Zeiten | Mo. – Do. 8:00 – 17:00, Fr. 8:00 – 16:00 (MEZ/MESZ)  
Nicht erreichbar an Sa./So. und an gesetzl. Feiertagen |

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<td>Service-Hotline</td>
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</tbody>
</table>
| Bürozeiten | Mo. – Do. 7:30 – 17:00, Fr. 07:30 – 15:00 (MEZ/MESZ)  
Nicht erreichbar an Sa./So. und an gesetzl. Feiertagen |

**MEINBERG Remote Support**

In order to assist you with configuration, installation, monitoring and diagnostics of your Meinberg products, you can download a remote support software that allows Meinberg technical support to remote control your computer.

By following this link;

[https://www.meinbergglobal.com/english/support/remote.htm](https://www.meinbergglobal.com/english/support/remote.htm)
you can find all necessary information and to download the support.

**Firmware Updates**

To check if an update is available for your system, please visit:


Available firmware updates will be provided as downloadable package. On request we can also send you older firmware versions.

### 9.2 Support Ticket System

Meinberg assists you quickly and directly on questions regarding the initial setup of your devices, troubleshooting or if you want to update the hard- or software. We offer free support for the whole lifetime of your Meinberg product.

- You can request a support ticket online: https://www.meinbergglobal.com/english/support/tech-support.htm. Choose either the option **Support Ticket Request** or **Advanced Customer Support** if you have purchased an ACS contract from us and wish to use this service.
- Or send a mail to techsupport@meinberg.de with a description of your issue. A support ticket will automatically be opened. Our support engineers will contact you as soon as possible. It is always helpful for our engineers to receive a diagnostic file when you send a ticket. The diagnostic file includes all status data of a microSync system logged since the last reboot and can be downloaded from all microSync devices. The file format of the diagnostic file is a tar.gz archive (also see chapter How to download a Diagnostic File how to generate this file on your system.
9.3 How to download a Diagnostic File

In most support cases the first action is to ask the customer to download the diagnostic file, because it is very helpful at identifying the current state of your microSync System and finding possible errors. Therefore we recommend that you attach your Diagnostic File when sending a ticket request to our support department.

The diagnostic file includes all status data of a microSync system logged since the last reboot. It can be downloaded from all microSync devices by using the Meinberg Device Manager Software. The file format of the diagnostic file is a tar.gz. archive. The archive contains all the important configuration and logfiles in Text and JSON format.
9.4  Self-Help Online Tools

Here is the list of some informative websites where you can query different information about the Meinberg Systems.

1. Meinberg Homepage – general:  
   https://www.meinbergglobal.com/

2. NTP Download – at Meinberg:  
   https://www.meinbergglobal.com/english/sw/

3. NTP Client Download for Windows (NTP-time-server-monitor):  
   https://www.meinbergglobal.com/english/sw/ntp-server-monitor.htm

4. microSync firmware update request online form:  

5. Download page for Meinberg software, drivers and software:  
   https://www.meinbergglobal.com/english/sw/

6. All Meinberg manuals (ENG, German versions):  
   https://www.meinbergglobal.com/english/docs/

7. Meinberg Newsletter and subscription page:  

8. NTP / IEEE 1588-PTP online tutorials from Meinberg:  
   http://blog.meinbergglobal.com/

9. Meinberg Knowledgebase:  
   https://kb.meinbergglobal.com/

10. FAQs about Meinberg Products:  
    https://www.meinbergglobal.com/english/faq/

11. Selection of the Meinberg white-papers:  
    https://www.meinbergglobal.com/english/info/#whitepaper

12. GPS / GNSS Antenna Installation and mounting:  

13. NTP support page and documentation:  
    http://support.ntp.org/bin/view/Support/WebHome

9.5  NTP and IEEE 1588-PTP online tutorials

A team of Meinberg engineers are writing online tutorials covering topics on IEEE 1588 PTP, NTP, synchronization setups and configurations used in different industries.

The tutorials can be found at: https://blog.meinbergglobal.com/

The blog provides you also the opportunity to write a comment or a question to our experts and get their reply.

9.6 The Meinberg Academy Introduction and Offerings

Meinberg Sync Academy (MSA) is an institution within the Meinberg Company which takes care for education and expert knowledge dissemination in the field of time and frequency synchronization. The academy offers tutorials and courses on the latest synchronization technologies such as NTP, IEEE 1588-PTP, synchronization networks for different industries: telecom, power, broadcasting, professional audio/video, finance, IT and Enterprise Networks. The MSA courses include both, theoretical lectures and practical hands-on labs.

If you are planning or re-designing synchronization for your networks and you need additional knowledge, see our agenda for the upcoming courses.

Courses: MBG Product Training, NTP Complete, PTP Complete
Customized Trainings, Online Trainings and Course Calendar.

Contact Phone: +49 (0) 5281 93093-0
E-Mail: info@meinberg.de
Internet: https://www.meinberg.academy/

9.7 Meinberg Newsletter

Meinberg publishes regularly up-to-date information, technical news, firmware updates and security advisory by the Meinberg Newsletter in both the English and German language.

Subscribe to the newsletter here:

https://www.meinbergglobal.com/english/contact/newslett.htm

9.8 How-to Videos on our YouTube Channel

We provide you with some useful videos on our YouTube channel (https://www.youtube.com/c/meinberg). For our microSync systems you can find two videos here, which show you the initial installation via serial interface and network.

https://youtu.be/NzCo5ia8QYE
Configuration via the serial Interface (USB)
https://youtu.be/drEN7Psw88o
Configuration with the Meinberg Device Manager Software
10 Technical Appendix

10.1 meinbergOS Software Specifications

Network Protocols:
- IPv4, IPv6
- NTPv3, NTPv4
- PTPv2
- IEC 62439-3 (PRP)
- DHCP, DHCPv6
- DSCP
- IEEE 802.1q VLAN filtering/tagging
- IEEE 802.1p QoS
- SNMPv1/v2/v3
- Remote Syslog Support (UDP)

PTP Profiles:
- IEEE 1588v2 Default Profile
- IEEE C.37.238-2011 Power Profile
- IEEE C.37.238-2017 Power Profile
- IEC/IEEE 61850-9-3 Power Utility Profile
- Enterprise Profile
- ITU-T G.8265.1, ITU-T G.8275.1, ITU-T G.8275.2 Telecom Profiles
- SMPTE ST 2059-2 Broadcast Profile
- IEEE 802.1AS TSN/AVB Profile
- AES67 Media Profile
- DOCSIS 3.1
10.2 Antenna and Receiver Information

There are 2 types of radio signals commonly used for timing applications: satellite signals from Global Navigation Satellite Systems (GNSS), and long wave signals from specific time code transmitters operated by some countries.

Most GNSS signals can be received world-wide, while long wave signals can only be received up to a certain distance around the transmitting station. Also, GNSS receivers can usually track the signals from several satellites at the same time, so the signal propagation delay can be determined and compensated automatically, while long wave receivers usually receive only the signal from a single station. Last but not least the available bandwidths and signal propagation characteristics are another reason why GNSS reception usually yields a higher degree of time accuracy than long wave reception.

10.2.1 Reference Time Sources

10.2.1.1 Meinberg GPS Receiver

The satellite radio clock was developed with the aim of providing users with a highly accurate time and frequency reference. High accuracy and the possibility of worldwide use, 24 hours a day, are the main features of this system, which receives its time information from the satellites of the Global Positioning System. The Global Positioning System (GPS) is a satellite-based system for radio-positioning, navigation, and time-transfer.

This system has been installed by the United States Department of Defense (Defense Department) and provides two levels of accuracy: the Standard Positioning Services (SPS) and the Precise Positioning Services (PPS).

The structure of the sent data of the PLC has been released and the reception has been made available for general use, while the time and navigation data of the even more accurate PPS are transmitted encrypted and therefore only accessible to certain users (mostly military). The principle of location and time determination with the aid of a GPS receiver is based on the most possible accurate measurement of the signal propagation time from the individual satellites to the receiver.

The GPS satellites orbit the earth on six orbital tracks in 20,000 km of altitude once in about 12 hours. This ensures that at any time at least four satellites are in sight at any point on the earth. Four satellites must be received at the same time so that the receiver can determine its spatial position (x, y, z) and the deviation of its clock from the GPS system time.

Control stations on earth measure the orbits of the satellites and record the deviations of the atomic clocks carried on board from the GPS system time. The determined data are sent to the satellites and sent to earth as navigation data by the satellites. The highly precise track data of the satellites, called ephemerides, are needed so that the receiver can calculate the exact position of the satellites in space at any time. A set of track data with reduced accuracy is called almanac. With the aid of the almanacs, the receiver calculates at approximately known position and time, which of the satellites are visible from its location. Each of the satellites transmits its own ephemerides as well as the almanacs of all existing satellites. The GPS clock operates with the “Standard Positioning Service”. The data stream of the satellites are decoded and evaluated by the microprocessor of the system, like that the GPS system time is reproduced with a deviation of less than 100 nsec.

Different running times of the signals from the satellites to the receiver are automatically compensated by determining the receiver position. By tracking the main oscillator, a frequency accuracy of 1e-12 is achieved, depending on the oscillator type. At the same time, the age-related drift is compensated. The current correction value of the oscillator is stored in a non-volatile memory of the system.
10.2.1.2 Meinberg GNSS Receiver (GPS, GLONASS, Galileo, BeiDou)

High accuracy and the possibility of the world wide operation around the clock are the main features of the system, which receive his time information from the satellites of the American GPS (Global Positioning System), the European Galileo, the Russian GLONASS (Global Navigation Satellite System) and the Chinese BeiDou.

The Global Positioning System (GPS) is a GNSS operated by the US department of defense. Its purpose is to provide position, velocity and time for civilian and defense users on a global basis. The system currently consists of 32 medium earth orbit satellites and several ground control stations.

GLONASS is a GNSS operated by Russian Federation department of defense. Its purpose is to provide position, velocity and time for civilian and defense users on a global basis. The system consists of 24 medium earth orbit satellites and ground control stations. The GLONASS satellites circle the earth once on three orbital lanes in height of 19100km in about 12 hours.

Galileo is a GNSS operated by the European Union. Its purpose is to provide position, velocity and time for civilian users on a global basis. The system is currently not fully operational. It is eventually expected to consist of 30 medium earth orbit satellites. At the time of writing (early 2016), the Galileo system was still under development with only a few fully operational SVs. Therefore, the precise performance and reliability of u-blox receivers when receiving Galileo signals is effectively impossible to guarantee.

BeiDou is a GNSS operated by China. Its purpose is to initially provide position, velocity and time for users in Asia. In a later stage when the system is fully deployed it will have worldwide coverage. The full system will consist of five geostationary, five inclined geosynchronous and 27 medium earth orbit satellites, as well as control, upload and monitoring stations.

Characteristics

The GNS module is a combined GPS / Galileo / GLONASS / BeiDou receiver and operates with the "Standard Positioning Service" (GPS) or "Standard Precision" (Galileo, GLONASS, BeiDou). The data stream from the satellites is decoded by the microprocessor of the system. By analyzing the data, the GNSS system time can be reproduced very precisely. Different running times of the signals from the satellites to the receiver are automatically compensated by determining the receiver position. By tracking the main oscillator (Oven Controlled Xtal Oscillator, OCXO) a high frequency accuracy is achieved. At the same time, the aging-induced drift of the quartz is compensated. The current correction value for the oscillator is stored in a non-volatile memory of the system. This receiver is suitable not only for stationary operation but also for mobile use.
10.2.1.3 Meinberg GNS-UC Receiver (GPS and Galileo)

microSync - GPS/Galileo based Time Synchronization for Stationary and Mobile Applications using Meinberg Antenna/Converter Technology

The microSync unit has a special receiver concept which is able to capture GPS and Galileo signals using a standard Meinberg antenna/converter unit. The configuration supports to select one of these to be used exclusively or the combination of the sources.

The receiver is capable of operating during high speed movement and delivers reliable and highly precise synchronization solutions in stationary installations and on fast moving vehicles, such as aircraft, ships or trucks.

The variety of inputs/outputs makes this receiver the first choice for a broad range of applications, including time and frequency synchronization tasks and the measurement of asynchronous time events.

The microSync with its integrated GNSS receiver provides accurate time with ultimate precision both in stationary and mobile environments by supporting long antenna cables because of the Meinberg antenna/converter technology.

Key Features

- 2 RS-232 interfaces (4 optional)
- 10 MHz reference frequency output
- Pulses per second and per minute
- 4 Programmable pulse outputs (option)
- Frequency Synthesizer
- 2 Time capture inputs

Description

The microSync offers satellite based time synchronization at the highest accuracy standards for fixed or mobile applications. It is suitable to be deployed in data centers or on board of cars, trucks, aircrafts, ships and other moving platforms. The satellite receiver can determine its position even at a maximum acceleration of up to 4 g, at a maximum speed of 500 m/s and at an altitude of up to 18,000 meters.

The microSync is used to manage high accurate timing and measurement tasks. The board is able to generate fixed and programmable standard frequencies with very high accuracy and stability. Various oscillator options allow to meet different requirements concerning the accuracy of the outputs in the most cost efficient way. The pulse generator of the GNS181-UC generates pulses per second and per minute. As an option four programmable outputs are available. The pulses are synchronized to the UTC second.

The module provides two inputs for measurement of asynchronous time events. These capture events can be read via a serial interface. The board uses a binary interface protocol to receive configuration parameters and exchange status information with external equipment via its RS-232 interfaces.

MRS capability

The oscillator of the GNS181-UC can be disciplined by an external reference source (e.g. 1PPS, 10 MHz, IRIG, PPS + String).
10.2.2 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 \(8^\circ\) 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 \(55^\circ\) North and \(55^\circ\) 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 (4.1.2).
10.2.2.1 Meinberg GPS Antenna/Converter

10.2.2.2 Introduction

The Meinberg GPS antenna/converter unit combines a standard GPS patch antenna with a frequency converter which translates the original 1.5 GHz signal received from the GPS satellites to an intermediate frequency, so a standard coaxial cable type like RG58 can be used for antenna cable lengths up to 300 meters (1000 ft). If a low-loss cable type like RG213 is used then even 700 meters (2300 ft) between receiver and antenna are possible without requirement for an additional amplifier.

Surge protectors are optionally available and should be used in the antenna line to protect the receiver from high voltages spikes e.g. due to lightning strikes close to the antenna. The antenna/converter unit is remotely powered by the connected GPS receiver via the antenna cable, so no external power supply is required near the location of the antenna if a coaxial cable is used.

If more than a single GPS receiver are to be operated then a GPS antenna splitter can be used to distribute the GPS signal from a single antenna. The GPS antenna splitter provides 4 outputs and can be cascaded to supply even more than 4 receivers with the GPS signal.

Alternatively there is also a GPS Optical Antenna Link (GOAL) available which uses a fiber optic connection between the antenna and the receiver which allows for a length up to 2000 meters (6500 ft), and provides a high level of insulation and surge protection due to the optical transmission. Since the fiber optic connection is unable to provide the antenna with DC current, an extra power supply is required in this case at the location of the antenna.

Due to the specific requirements for remote powering and frequency conversion the Meinberg GPS equipment is not necessarily compatible with GPS equipment from 3rd party manufacturers.
10.2.2.3 Mounting and Installation of the GPS Antenna

Proper installation of the GPS antenna/converter unit is illustrated in the figure below:

Figure: GPS Antenna mounted on a pole with a free view of the sky. The optional surge protector keeps high voltage strikes through the antenna cable away from the receiver.

Mounting material (plastic pole and holders, clamps for wall or pole mounting) is shipped with all Meinberg GPS antennae for easy installation. A standard RG58 antenna cable of 20 meters length is included by default. If a different cable length is required then this can be ordered accordingly.

Surge protectors should be installed indoors, directly where the antenna cable comes in. The optionally delivered protection kit is not for outdoor usage. The ground lead should be kept as short as possible and has to be connected to building’s ground rod.

Up to four GPS receivers can be fed by a single antenna/down-converter unit by using an antenna splitter which can optionally be cascaded. The total length of an antenna cable from the antenna to each receiver must not exceed the specified maximum length according to the cable type. The position of the splitter in the antenna line does not matter.

Note:
If the antenna cable is assembled locally instead of using a cable shipped with the GPS receiver it has to be made sure that the connectors have been soldered and assembled properly, and that there is no short-circuit in the cable or in one of the connectors. Otherwise GPS reception may be degraded, or the GPS receiver can even be damaged.
10.2.2.4 General GNSS Antennae

Some Meinberg devices use alternate GNSS receivers which support other satellite systems like GLONASS, Galileo or BeiDou, in addition to GPS. These receivers can’t be operated directly with the standard Meinberg antenna/converter unit described in chapter "Meinberg GPS Receiver", so they require a different kind of antenna.

There are two different antenna versions available, one of which is more suited for stationary installation, while the other one should be preferred for mobile applications.

10.2.2.5 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

\[\text{Figure: Schematic diagram of mounting the Multi GNSS Antenna}\]
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.
10.2.2.6 GNSS Antenna for Mobile Applications

The RV-76G is an active GNSS antenna which can receive the signals of the GPS, GLONASS, and Galileo satellite systems. It operates with a 5V DC supply voltage provided by the receiver, and should be preferred for mobile applications. However, the maximum length of the antenna cable is limited depending on the cable type, e.g. 5 meters with RG174/U cable, so this antenna is less suitable for stationary installations.

Figure: Installation drawing RV-76G antenna

<table>
<thead>
<tr>
<th>WARNING!</th>
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<tr>
<td>Antenna mounting without effective anti-fall protection</td>
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<table>
<thead>
<tr>
<th>Danger to life due to fall!</th>
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<tr>
<td>- Pay attention to effective working safety when installing antennas!</td>
</tr>
<tr>
<td>- Never work without an effective anti-fall equipment!</td>
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</table>

<table>
<thead>
<tr>
<th>Danger to life due to electrical shock!</th>
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</thead>
<tbody>
<tr>
<td>- Do not carry out any work on the antenna system or the antenna cable if there is a risk of a lightning strike.</td>
</tr>
<tr>
<td>- Do not carry out any work on the antenna system if the safety distance to free lines and sequential circuits is exceeded.</td>
</tr>
</tbody>
</table>
10.2.2.7 Powering up a GNSS Receiver

If both the antenna and the power supply have been connected the system is ready to operate. Depending on the type of oscillator installed in the receiver it takes about 10 seconds (OCXO-LQ) until 3 minutes (OCXO-MQ / HQ) until the oscillator has warmed up and reached the required frequency accuracy.

If the receiver has some valid almanac data in its battery buffered memory and the receiver’s position has not changed significantly since its last operation the receiver can determine which satellites are in view. Only a single satellite needs to be received to synchronize and generate output pulses, so synchronization can be achieved at least one minute (OCXO-LQ) until 10 minutes (OCXO-MQ / HQ) after power-up. After 20 minutes of operation the OCXO is fully adjusted and the generated frequencies are within the specified tolerances.

If the receiver position has changed by some hundred kilometers since last operation, the expected satellites may not be in view after power-up. In this case the receiver switches to **Warm Boot** mode where it starts scanning for all possible satellites one after the other. Once the receiver can track at least 4 satellites at the same time it updates its own position and switches to **Normal Operation**.

If no valid data can be found in the battery buffered memory, e.g. because the battery has been disconnected or replaced, the receiver has to scan for satellites and collect the current almanac and ephemeris data first. This mode is called **Cold Boot**, and it takes at least 12 minutes until all required data have been collected. The reason is that the satellites send all data repeatedly once every 12 minutes. After data collection is complete the receiver switches to **Warm Boot** mode to scan for more satellites, and finally enters **Normal Operation**.

In the default configuration neither pulse and synthesizer outputs, nor the serial ports are 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 has been installed) it can take some minutes until the oscillator’s output frequency has been adjusted properly. In this case the accuracy of the output frequency and pulses is also reduced until the receiver’s control loops have settled again.

Via the Meinberg Device Manager software (menu "Status → Clock → Satellites") you can check the number of satellites that are in view (i.e. above the horizon) and considered good (i.e. are healthy and can be tracked).
### 10.2.3 Cable Types

<table>
<thead>
<tr>
<th>Antenna Type</th>
<th>Cable Type</th>
<th>Maximum Cable Length</th>
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<tbody>
<tr>
<td>Meinberg GPS Antenna</td>
<td>RG58</td>
<td>300 m / 1000 ft</td>
</tr>
<tr>
<td>Meinberg GPS Antenna</td>
<td>RG213</td>
<td>700 m / 2300 ft</td>
</tr>
<tr>
<td>Multi GNSS Antenna</td>
<td>Belden H155</td>
<td>70 m / 230 ft</td>
</tr>
<tr>
<td>Long Wave Antenna *</td>
<td>RG58</td>
<td>300 m / 1000 ft</td>
</tr>
<tr>
<td>Fiber Optic **</td>
<td>Fiber Optic</td>
<td>2000 m / 6500 ft</td>
</tr>
</tbody>
</table>

* DCF77 (Germany, Middle Europe), MSF (GB), WWVB (US), JJY (Japan)
** Fiber Optic – GOAL – GPS Optical Antenna Link; DOAL – DCF Optical Antenna Link
10.3 Technical Specifications of used Modules

10.3.1 Technical Specifications - CPU

CPU: 825 MHz Cortex A9 Dual Core on SOC

Ethernet Interfaces: 4 x GBit SFP - Slot

USB Interfaces:
- USB to serial console
- Micro-USB type B
- USB Host
- USB connector CPU management
- USB type A

Profiles:
- IEEE 1588v2 Default Profile
- Enterprise Profile
- IEC 61850-9-3 Power Profile
- IEEE C.37.238-2011 Power Profile
- IEEE C.37.238-2017 Power Profile
- ITU-T G.8265.1 Telecom Frequency Profile
- ITU-T G.8275.1 Telecom Phase / Time Profile (full timing support)
- ITU-T G.8275.2 Telecom Phase / Time Profile (partial timing support)
- SMPTE ST 2059-2 Broadcast Profile
- IEEE 802.1AS TSN/AVB Profile
- AES67 Media Profile
- DOCSIS 3.1

PTP Modes:
- Multicast/Unicast Layer 2 (IEEE 802.3)
- Multicast/Unicast Layer 3 (UDP IPv4/IPv6)
- Hybrid Mode
- E2E / P2P Delay Mechanism
- Up to 128 messages/second per client

1588 Clock Mode: 1-Step, 2-Step for both Master and Slave operation

Time Stamp Accuracy: 8 ns

NTP Req./Sec: 10,000

NTP Mode: NTP Server mode

Synchronous Ethernet: Master and Slave Capability
- Compliant to ITU-T G.8261, G.8262 and G.8264
- Ethernet Synchronization Messaging Channel (ESMC)

Network Protocols:
- IPv4, IPv6
- DHCP, DHCPv6
- DSCP
- IEEE 802.1q VLAN filtering/tagging
- IEEE 802.1p QOS
LED Indicators

R (Receiver)
green: the reference clock (e.g. build-in GNSS) provides a valid time
red: the reference clock does not provide a valid time

T (Time Service)
green: NTP is synchronized to the reference clock, e.g. GNSS
red: NTP is not synchronized or switched to the ‘local clock’

N (Network)
green: all monitored network interfaces are connected (‘Link up’)
red: at least one of the monitored network interfaces is faulty

A (Alarm)
off: no error
red: general error

Available Client Licenses:

<table>
<thead>
<tr>
<th>License</th>
<th>Unicast Clients</th>
<th>Delay Req./s</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL-A</td>
<td>8</td>
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<tr>
<td>PL-B</td>
<td>256</td>
<td>32768</td>
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<tr>
<td>PL-C</td>
<td>512</td>
<td>65536</td>
</tr>
</tbody>
</table>

Recommended and tested Transceivers from other Vendors

<table>
<thead>
<tr>
<th>Mode</th>
<th>Vendor/Type</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>MULTI MODE:</td>
<td>AVAGO AFBR-5710PZ</td>
<td>550 m</td>
</tr>
<tr>
<td></td>
<td>FINISAR FTLF8524P3BNL</td>
<td>500 m</td>
</tr>
<tr>
<td>SINGLE MODE:</td>
<td>AVAGO AFCT-5710PZ</td>
<td>10 km</td>
</tr>
<tr>
<td></td>
<td>FINISAR FTLF1318P3BTL</td>
<td>10 km</td>
</tr>
<tr>
<td></td>
<td>SMARTOPTICS SO-SFP-L120D-C63</td>
<td>80 km</td>
</tr>
<tr>
<td>RJ-45:</td>
<td>AVAGO ABCU-5740RZ</td>
<td>100 m</td>
</tr>
<tr>
<td></td>
<td>FINISAR FCLF8521P2BTL</td>
<td>100 m</td>
</tr>
</tbody>
</table>
10.3.2 Technical Specifications GPS Receiver

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

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

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

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

**Time to Synchronization:**
one minute with known receiver position and valid almanac

**Pulse Outputs:**
eight programmable outputs (PP 1 - PP 8)
DC-insulated by optocouplers
\( U_{C_{E_{\text{max}}}} = 55 \text{ V}, I_{C_{\text{max}}} = 50 \text{ mA}, P_{\text{tot}} = 150 \text{ mW}, V_{\text{iso}} = 5000 \text{ V} \)
pulse delay:
\( t_{\text{on}} \text{ e.g. } 20 \mu\text{sec} (I_{C} = 10\text{mA}) \)
\( t_{\text{off}} \text{ e.g. } 3 \mu\text{sec} (I_{C} = 10\text{mA}) \)
change of second (P_SEC, TTL level)
change of minute (P_MIN, TTL level)

**Accuracy of Pulses:**
after synchronization and 20 minutes of operation
better than \( \pm 2 \mu\text{sec} \) during the first 20 minutes of operation

**Frequency Outputs:**
10 MHz, TTL level into 50 Ohm
1 MHz, TTL level
100 kHz, TTL level

**Frequency Synthesizer:**
1/8 Hz up to 10 MHz

**Accuracy of Synthesizer:**
base accuracy depends on system accuracy

1/8 Hz to 10 kHz Phase syncron with pulse output P_SEC
10 kHz to 10 MHz frequency deviation < 0.0047 Hz

**Synthesizer Outputs:**
\( F_{\text{SYNTH}}: \) TTL level
\( F_{\text{SYNTH}_\text{OD}}: \) open drain
\( \text{drain voltage: } < 100 \text{ V} \)
\( \text{sink current to GND: } < 100 \text{ mA} \)
\( \text{dissipation power at } 25^\circ \text{C: } < 360 \text{ mW} \)
\( F_{\text{SYNTH}_\text{SIN}}: \) sine-wave
\( \text{output voltage: } 1.5 \text{ V eff.} \)
\( \text{output impedance: } 200 \text{ Ohm} \)

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

Baud Rate:
300, 600, 1200, 2400, 4800, 9600, 19200 Baud

Framing:
7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8N1, 8N2, 8O1

default setting:
COM0: 19200, 8N1
Meinberg Standard time string, per second

**Time Code Outputs:**

- **Unbalanced modulated sine wave signal:**
  - $3 \, V_{pp}$ (MARK), $1 \, V_{pp}$ (SPACE) into 50 ohm

- **DCLS-signal:** TTL into 50 ohm, active-high or -low
10.3.3 Technical Specifications GNS Receiver

Type of receiver: GPS/GLONASS/Galileo/BeiDou receiver
Number of channels: 72
Frequency band: GNSS L1
GPS: 1575.42 ±10 MHz
GLONASS: 1602-1615 MHz
Galileo: 1542.5 MHz
BeiDou: 1561.09 MHz

Antenna: Combined GPS/GLONASS antenna
3dB Bandwidth: 1590 ±30 MHz
Impedance: 50 Ω
Gain: 40 ±4 dB
Supply Voltage: 5 V
Cable: max. 70m low-loss cable (Belden H155)
Connector: SMA female

Power Supply for Antenna: 5 V, 100 mA - continuous short circuit protection, automatic recovery
power supply via antenna cable

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

Pulse Outputs: eight programmable outputs (PP 1 - PP 8)
DC-insulated by optocouplers
$U_{\text{CE max}} = 55 \text{ V, } I_{\text{C max}} = 50 \text{ mA, } P_{\text{tot}} = 150 \text{ mW, } V_{\text{iso}} = 5000 \text{ V}$

pulse delay:
$\text{ton e.g. } 20 \mu\text{sec (I}_C = 10\text{mA)}$
$\text{toff e.g. } 3 \mu\text{sec (I}_C = 10\text{mA)}$

change of second (P_SEC, TTL level)
change of minute (P_MIN, TTL level)

Accuracy of Pulses: after synchronization and 20 minutes of operation
OCXO SQ/MQ/HQ/DHQ: better than ±50 nsec
better than ±2 μsec during the first 20 minutes of operation

Frequency Outputs:
10 MHz, TTL level into 50 Ohm
1 MHz, TTL level
100 kHz, TTL level

Frequency Synthesizer: 1/8 Hz up to 10 MHz
Accuracy of Synthesizer: base accuracy depends on system accuracy
1/8 Hz to 10 kHz Phase synchro with pulse output P_SEC
10 kHz to 10 MHz frequency deviation < 0.0047 Hz

Synthesizer Outputs:
$F_{\text{SYNTH}}$: TTL level
$F_{\text{SYNTH OD}}$: open drain
drain voltage: < 100 V
sink current to GND: < 100 mA
dissipation power at 25 °C: 360 mW
F_SYNTH_SIN: sine-wave
output voltage: 1.5 V eff.
output impedance: 200 Ohm

Serial Ports: asynchronous serial port RS-232
Baud Rate: 300, 600, 1200, 2400, 4800, 9600, 19200 Baud
Framing: 7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8N1, 8N2, 8O1
default setting:
COM 0: 19200, 8N1
Meinberg Standard time string, per second

Time Code Outputs: Unbalanced modulated sine wave signal:
3 V_{pp} (MARK), 1 V_{pp} (SPACE) into 50 ohm
DCLS-signal: TTL into 50 ohm, active-high or -low
10.3.4 Technical Specifications GNS-UC Receiver

**Type of receiver:** 72 channel receiver
GPS/Galileo

**Frequency band:**
GPS: L1C/A
Galileo: E1B/C

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

**Cable Length:**
max. 300 m (RG58 coax-cable)

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

**Pulse Outputs:**
eight programmable outputs (PP 1 - PP 8)
DC-insulated by optocouplers
\[ U_{CE_{max}} = 55 \text{ V}, \ I_{C_{max}} = 50 \text{ mA}, \ P_{tot} = 150 \text{ mW}, V_{iso} = 5000 \text{ V} \]

pulse delay:
\[ t_{on} \text{ e.g. } 20 \mu\text{sec} (I_C = 10\text{mA}) \]
\[ t_{off} \text{ e.g. } 3 \mu\text{sec} (I_C = 10\text{mA}) \]

change of second (P_SEC, TTL level)
change of minute (P_MIN, TTL level)

**Accuracy of Pulses:**
after synchronization and 20 minutes of operation
OCXO SQ/MQ/HQ/DHQ: better than ±50 nsec
better than ±2 \( \mu \text{sec} \) during the first 20 minutes of operation

**Frequency Outputs:**
10 MHz, TTL level into 50 Ohm
1 MHz, TTL level
100 kHz, TTL level

**Frequency Synthesizer:**
1/8 Hz up to 10 MHz

**Accuracy of Synthesizer:**
base accuracy depends on system accuracy

1/8 Hz to 10 kHz  Phase synchron with pulse output P_SEC
10 kHz to 10 MHz  frequency deviation < 0.0047 Hz

**Synthesizer Outputs:**
F_SYNTH: TTL level
F_SYNTH_OD: open drain
\[ \text{drain voltage: } < 100 \text{ V} \]
\[ \text{sink current to GND: } < 100 \text{ mA} \]
\[ \text{dissipation power at } 25 \degree \text{C: } 360 \text{ mW} \]
F_SYNTH_SIN: sine-wave
\[ \text{output voltage: } 1.5 \text{ V eff.} \]
\[ \text{output impedance: } 200 \text{ Ohm} \]

**Serial Ports:**
asynchronous serial port RS-232
Baud Rate: 300, 600, 1200, 2400, 4800, 9600, 19200 Baud
Framing: 7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8N1, 8N2, 8O1
default setting:
COM 0: 19200, 8N1
Meinberg Standard time string, per second

**Time Code Outputs:**
- Unbalanced modulated sine wave signal:
  3 Vpp (MARK), 1 Vpp (SPACE) into 50 ohm
- DCLS-signal: TTL into 50 ohm, active-high or -low
10.4 Network Time Protocol (NTP)

The public domain software package called NTP (Network Time Protocol) is an implementation of the same named TCP/IP network protocol. NTP has been initiated in the 1980's by Dave L. Mills who was trying to achieve a high accuracy time synchronization for computers across the network. The protocol and related algorithms have been specified in several RFCs. Since then NTP has continuously been optimized and is at present time widely used around the world. The protocol supports an accuracy of time down to nanoseconds. However, the maximum achievable accuracy also depends on the operating system and the network performance.

Currently there are two versions of NTP which can be used intermixed: NTP v3 is the latest released version which runs very stable on many operating systems. NTP v4 has some improvements over NTP v3 and has better support for some operating systems. Additionally, there’s also a simplified version of the protocol called SNTP (Simple Network Time Protocol). SNTP uses the same TCP/IP packet structure like NTP but due to the simpler algorithms, it provides only very reduced precision. The NTP package contains a background program (daemon or service) which synchronizes the computer’s system time to one or more external reference time sources which can be either other devices on the network, or a radio clock which is connected to the computer.

Additionally, the NTP distribution contains programs which can be used to control or monitor the time synchronization status, and a complete set of documentation in HTML format.

More information about the Network Time Protocol can be found at:
https://www.meinbergglobal.com/english/info/ntp.htm
**10.5 The Precision Time Protocol (PTP) / IEEE 1588**

Precision Time Protocol (PTP or IEEE 1588) is a time synchronization protocol that offers sub-microsecond accuracy over a standard Ethernet connection. This accuracy can be achieved by adding a hardware timestamping unit to the network ports that are used for PTP time synchronization. The timestamping unit captures the exact time when a PTP synchronization packet is sent or received. These timestamps are then taken into account to compensate for transfer delays introduced by the Ethernet network.

In PTP networks there is only one recognized active source of time, referred to as the Grandmaster Clock. If two or more Grandmaster Clocks exist in a single network, an algorithm defined in the PTP standard is used to determine which one is the „best“ source of time. This „Best Master Clock“ algorithm must be implemented on every PTP/IEEE1588 compliant system to insure that all clients („Slave Clocks“) will select the same Grandmaster. The remaining deselected Grandmaster Clocks will „step back“ and enter a passive mode, meaning that they do not send synchronization packets as long as that is being done by the designated Grandmaster.

The existing network infrastructure components play a big role in a PTP network and directly influence the level of accuracy that can be achieved by the clients. Asymmetric network connections degrade the accuracy, therefore classic layer 2 and 3 Ethernet switches with their “store and forward” technology are not suitable for PTP networks and should be avoided. With activating the HQ-Filter (see chapter HQ-Filter) the Jitter can be eliminated. Simple Ethernet hubs with fixed pass-through times are not a problem. In large networks, special switches with built-in PTP functionality help to maintain high accuracy even over several subnets and longer distances. These components act as ‘Boundary Clocks’ (BC) or “Transparent Clocks” (TC). They compensate their internal packet processing times by using timestamping units on each port. When acting as a Boundary Clock, they synchronize to the Grandmaster clock, and in turn act as a Master to the other subnets they are connected to. When acting as a Transparent Clock, then the „residence time“ of the Masters’ Sync-Packet is measured and added to the packet as a correction value. Internally the PTP timescale TAI (see chapter Timescale in Global Parameters).
10.5.1 Functionality in Master Systems

After power up, the module accepts the absolute time information (PTP seconds) of a reference time source (e.g., GNSS reference clock) only once, and the PTP nanoseconds are set to zero. If the oscillator frequency of the reference time source has reached its nominal value, the nanoseconds are reset again. This procedure leads to a maximum deviation of 20 nsec of the pulse per second (1PPS) of the PTP Master compared to the 1PPS of the GNSS reference clock. The reference clock of the PTP board's time stamp unit (50 MHz) is derived from the GNSS disciplined oscillator of the reference time source using a PLL (Phase Locked Loop) of the FPGA. This achieves a direct coupling of the time stamp unit to the GNSS system.

10.5.2 Functionality in Slave Systems

After decoding valid time information from a PTP Master, the system sets its own PTP seconds and nanoseconds accordingly. The PTP offset calculated by the PTP driver software is used to adjust the master oscillator of the PTP Slave. This allows the PTP Slave to generate very high accuracy output signals (10 MHz/1PPS/IRIG).
10.5.3 PTPv2 IEEE 1588-2008 Configuration Guide

Setting up all devices in a PTP synchronization infrastructure is one of the most important parts in a network time synchronization project. The settings of the involved Grandmaster clocks as the source of time and the end devices ("Slaves") have to match in order to allow them to synchronize and avoid problems later, when the PTP infrastructure is deployed to production environments. In addition to that, the use of PTP aware network infrastructure components, namely network switches, introduces another set of parameters that have to be harmonized with the masters and slaves in a PTP setup.

It is therefore very important to start with making decisions how the to-be-installed PTP synchronization solution should operate, e.g. should the communication between the devices be based on multicast or unicast network traffic or how often should the masters send SYNC messages to the slaves.

This chapter lists the most important options and their implications on a synchronization environment in general. A detailed explanation of the configuration settings within the Meinberg Device Manager configuration menu can be found later within this documentation.

10.5.3.1 General Options

The following general mode options have to be decided before deploying the infrastructure:

1) Layer 2 (Ethernet) or Layer 3 (UDP/IPv4) connections
2) Multicast or Unicast
3) Two-Step or One-Step Operation
4) End-to-End or Peer-to-Peer Delay Mechanism

The above options need to be defined for the whole setup, if devices do not stick to the same settings, they will not be able to establish a working synchronization link.

10.5.3.2 Network Layer 2 or Layer 3

PTP/IEEE 1588-2008 offers a number of so-called mappings on different network communication layers. For Meinberg products you can choose between running PTP over IEEE 802.3 Ethernet connections (network Layer 2) or UDP/IPv4 connections (Layer 3).

Layer 3 is the recommended mode, because it works in most environments. For Layer 2 mode the network needs to be able to provide Ethernet connections between master and slave devices, which is often not the case when your network is divided into different network segments and you have no layer 2 routing capabilities in your network infrastructure.

The only benefit of using Layer 2 mode would be a reduced traffic load, because the transmitted network frames do not need to include the IP and UDP header, saving 28 bytes per PTP packet/frame. Due to the fact that PTP is a low traffic protocol (when compared to other protocols), the reduced bandwidth consumption only plays a role when low-bandwidth network links (e.g. 2Mbit/s) have to be used or in pay-per-traffic scenarios, for example over leased-line connections.
10.5.3.3 Multicast or Unicast

The initial version of PTP (IEEE 1588-2002 also known as PTPv1) was a multicast-only protocol. Multicast mode has the great advantage that the master clock needs to send only one SYNC packet to a Multicast address and it is received by all slave devices that listen to that multicast address.

In version 2 of the protocol (IEEE 1588-2008) the unicast mode was introduced in addition to the multicast mode. In unicast mode, the master has to send one packet each to every slave device, requiring much more CPU performance on the master and producing orders of magnitudes more traffic.

On the other hand, some switches might block multicast traffic, so that in certain environments, Unicast mode has to be used.

10.5.3.4 Two-Step or One-Step

The PTP protocol requires the master to periodically send SYNC messages to the slave devices. The hardware time stamping approach of PTP requires that the master records the exact time when such a SYNC packet is going on the network wire and needs to communicate this time stamp to the slaves. This can be achieved by either sending this time stamp in a separate packet (a so-called FOLLOW-UP message) or by directly manipulating the outgoing SYNC message, writing the hardware time stamp directly into the packet just before it leaves the network port.
10.5.3.5 End-To-End (E2E) or Peer-To-Peer (P2P) Delay Measurements

In addition to receiving the SYNC/FOLLOWUP messages a PTP slave device needs to be able to measure the network delay, i.e. the time it took the SYNC message to traverse the network path between the master and the slave. This delay is required to correct the received time information accordingly and it is measured by the slave in a configured interval (more about the message intervals later). A delay measurement is performed by sending a so-called DELAY_REQUEST to the master which timestamps it and returns the timestamp in a DELAY_RESPONSE message.

IEEE 1588-2008 offers two different mechanisms for performing the delay measurements. A slave can either measure the delay all the way to the master, this is called End-To-End (or E2E in short) or to its direct network neighbors (which would in almost all cases be a switch – or two in a redundant setup), using the Peer-To-Peer delay measurement mechanism (P2P). The delay measurements of all links between the master and the slave are then added and accumulated while a SYNC packet is traversing the network.

The advantage of this method is that it can dramatically reduce the degradation of accuracy after topology changes. For example: in a redundant network ring topology the network delay will be affected when the ring breaks open and network traffic needs to be redirected and flows into the other direction. A PTP slave in a sync infrastructure using E2E would in this case apply the wrong delay correction calculations until it performs the next delay measurement (and finds out that the network path delay has changed). The same scenario in a P2P setup would see much less time error, because the delay of all changed network links were already available.

The drawback: the P2P approach requires that all involved PTP devices and all switches support this mechanism. A switch/hub without P2P support would in the best case simply pass the so-called PDELAY messages through and as a result degrade the accuracy of the delay measurements. In the worst case it would block/drop the PDELAY messages completely, which effectively would result in no delay measurements at all.

So, E2E is the only available choice if you are running PTP traffic through non-PTP-aware switches. It is a reasonable choice if you are not using redundant network topologies or can accept that the delay measurements are wrong for a certain amount of time.

10.5.3.6 Mode Recommendations

Meinberg recommends to set up your PTP infrastructure to use Layer 3, Multicast, Two-Step and End-To-End Delay measurements if that is possible. This will provide the largest possible compatibility and reduces interoperability problems.
10.5.3.7 Message Rate Settings

The decision between the different general mode options is mainly dictated on the network environment in which the PTP infrastructure is installed. In addition to the mode selection, a number of intervals for certain types of PTP network messages needs to be defined. In most cases, the default values as defined in the standard are a safe bet, but there are applications and scenarios where a custom message rate is required.

A possible example is a situation where the PTP infrastructure is integrated within an environment with high network load. In this case, the PTP packets can be affected by the effect of packet delay variation (PDV). An increase of the PTP message rate(s) can avoid synchronization problems due to packet queuing within non-PTP compliant switches which might cause false measurements. At higher rates, these false measurements can be detected and corrected faster as compared to lower rates at the cost of increased traffic.

The message rates for the following message types can be changed:

1) ANNOUNCE messages  
2) SYNC/FOLLOWUP messages  
3) (P)DELAY_REQUEST messages

10.5.3.8 ANNOUNCE Messages

These PTP messages are used to inform the PTP network participants about existing and available master clock devices. They include a number of values that indicate the potential synchronization accuracy.

The procedure used to decide which of the available devices (that could become masters) is selected is called the “best master clock algorithm” (BMCA). The values that are used in this BMCA are read from the ANNOUNCE messages that potential masters send out periodically.

The procedure used to decide which of the available devices (that could become masters) is selected is called the "best master clock algorithm" (BMCA). The values that are used in this BMCA are read from the ANNOUNCE messages that potential masters send out periodically.

The rate at which these messages are sent out are directly affecting the time that is required by a slave device to select a master and to switch to a different master in case the selected one fails.

Multiple devices can simultaneously transmit ANNOUNCE messages during periods in which no master has been selected (yet). This happens for example when a PTP network is powered up, i.e. all devices are starting to work at the same time. In this case all devices that consider themselves (based on their configuration and status) being capable of providing synchronization to all the other PTP devices will start to send out ANNOUNCE messages. They will receive the other candidates’ ANNOUNCE messages as well and perform the BMCA. If they determine that another candidate is more suitable to become the master clock, they stop sending ANNOUNCE messages and either become slave devices or go into “PASSIVE” mode, waiting for the selected master to stop sending ANNOUNCE messages. This is determined to be the case when no ANNOUNCE message is received within 3 ANNOUNCE message intervals.

As an example, if the ANNOUNCE interval has been configured to be 2 seconds (one message every 2 seconds, the default value), the master is considered to have failed when no message has been received for 6 seconds.

In order to choose a master (a backup master clock or the primary one during initialization) the devices require to receive at least two consecutive ANNOUNCE messages. Continuing our example, it would take the 6 seconds to determine that the current master has failed and another 4 seconds to select the new one. That means an ANNOUNCE interval of 2 seconds translates into at least 10 seconds of “switching time” and 4 seconds of “initial master clock selection time”. So, choosing a shorter ANNOUNCE message interval will allow a faster switching to a backup master clock, but it can lead to false positives when the chosen interval is too short for the network environment.
10.5.3.9 SYNC/FOLLOWUP Messages

The selected master clock sends out SYNC (and, in Two-Step environments, the corresponding FOLLOWUP) messages in a configured interval. This interval (default value is one SYNC/FOLLOWUP packet every second) determines how often the slave devices receive synchronization data that allows them to adjust their internal clocks in order to follow the master clock time. Between receiving two SYNC messages, a slave clock runs free with the stability determined by its own internal time base, for example a crystal oscillator. One important factor for deciding on the SYNC interval is the stability of this oscillator. A very good oscillator requires a lower SYNC message rate than a cheaper, low-accuracy model. On the other hand you directly affect the required network bandwidth by changing the SYNC interval.

For Meinberg slave devices, the default one-SYNC-every-second setting is more than enough to achieve the highest possible synchronization accuracy.

10.5.3.10 (P)DELAY_REQUEST Messages

As explained in the General Mode Options chapter (see the “End-To-End or Peer-to-Peer” section), the delay measurements are an important factor for achieving the required accuracy. Especially in E2E mode, the network path delay measurements play a crucial part in the synchronization process. Per default, the slaves will perform delay measurements every 8 seconds, resulting in sending and receiving one packet. This can be increased in case the network path delay variation in the network is relatively large (i.e. the time it takes for the SYNC message to reach the slave varies a lot) or the slave devices have to tightly follow the master and adjust their time base (oscillator) very often due to its instability.

Meinberg slave devices will limit the effect of an outdated path delay measurement by using filters and optimized PLL algorithms. This avoids that a clock “jumps around” and basically monitors the time difference to the master clock carefully for a certain amount of time before adjusting its own clock. With a low cost time base this is not possible, because the instability (i.e. temperature-dependent drift and overall short term stability/aging effects) and therefore these slaves would require to perform as many delay measurements and receive as many SYNC/FOLLOWUP messages as possible.

For P2P mode the delay request interval is not as critical, simply because the delay variation on a single-hop link (i.e. from your slave device to its switch) is very stable and does not change dramatically in typical environments.

Current firmware versions of Meinberg Grandmaster clocks (V5.32a and older) do not offer changing the Delay message rate in Multicast mode, it is fixed to one delay request every 8 seconds. Since this is actually a value that is transmitted in the DELAY_RESPONSE message as a maximum value, the slave devices are not allowed to perform delay measurements more often.
10.6 Programmable Pulse Outputs

In microSync systems the following modes are available for the programmable pulse outputs:

Idle
Selecting "Idle" deactivates the output.

Timer
This mode simulates a programmable day assigned timer. Three turn-off and turn-on times are programmable for each output. If you want to program a switchtime, change the turn-on time "On" and the corresponding turn-off time "Off". A turn-off time later than the turn-off time would cause a switch program running over midnight. For example a program "On"10:45.00, "Off" 9.30.00 would cause an active output from 10.45 to 9.30 (the next day!). If one or more of the three switching times are unused just enter the same time into the values "On" and "Off". In this case the switch time does not affect the output.

Single Shot
Selecting Single Shot generates a single pulse of defined length once per day. You can enter the time when the pulse is generated with the 'Time' value. The value 'Length' determines the pulse duration. The pulse duration can vary from 10 msec to 10 sec in steps of 10 msec.

Cyclic Pulse
The value of 'Time' determines the time between two consecutive pulses. This cycle time must be entered as hours, minutes and seconds. The pulse train is synchronized at 0:00 o'clock local time, so the first pulse of a day always occurs at midnight. A cycle time of 2 seconds for example, would cause pulses at 0:00:00, 0:00:02, 0:00:04 etc. Basically it is possible to enter any cycle time between 0 and 24 hours, however usually a cycle times that cause a constant distance between all consecutive pulses make sense.

For example: a cycle time of 1 hour 45 minutes would cause a pulse every 6300 seconds (starting from 0 o'clock). The appearing distance between the last pulse of a day and the first pulse of the next day (0:00:00 o'clock) would be only 4500 sec. The value in entry field 'Cycle' turns red, when entering a time that causes this asymmetry.

Pulses Per Second, Per Min, Per Hour
These modes generate pulses of defined length once per second, once per minute or once per hour. "Length" determines the pulse duration (10 msec...10 sec).

DCF77 Marks
In "DCF77 Marks" mode the selected output simulates the telegram as transmitted by german time code transmitter DCF77. The generated time code is related to the local time zone. If you want DCF simulation to be disabled when the clock is in free running mode, you can enter the delay (given in minutes) for deactivating the DCF-Simulation with the 'Timeout' value. DCF Simulation is never suspended, if the delay value is zero.

Position OK, Time Sync and All Sync
Three different modes are selectable for output of the clocks synchronization state. The Mode 'Position OK' activates the output when the receiver has sufficient satellites in view to calculate its position. In "Time Sync" mode the respective output is activated when the clocks internal timebase is synchronized to the GPS timing. The 'All Sync' Mode performs a logical AND operation of the both states previously mentioned, i.e. the output is activated if the position can be calculated AND the internal timebase is synchronized to the GPS timing.

DCLS Time Code
DC Level Shift Time Code. The selection of the time code is done by the Meinberg Device Manager menu "Outputs Settings".

Synth. Frequency
The output of the frequency synthesizer is also done via the 'Outputs Settings' menu.

PTTI 1PPS
In this mode, a non-inverted PPS of 20 microseconds pulse length is available at the selected output.
10.7 Available Time Telegrams

10.7.1 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:

\[<\text{STX}>D:dd.mm.yy;T:w;U:hh.mm.ss;uvxy<\text{ETX}>\]

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:

\(<\text{STX}>\) 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

\(<\text{ETX}>\) End-Of-Text, ASCII Code 03h
10.7.2 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)

\( tt.mm.jj \) the current date:
- \( tt \) day of month \((01..31)\)
- \( mm \) month \((01..12)\)
- \( jj \) year of the century \((00..99)\)

\( w \) the day of the week \((1..7, 1 = \text{monday})\)

\( hh.mm.ss \) the current time:
- \( hh \) hours \((00..23)\)
- \( mm \) minutes \((00..59)\)
- \( ss \) seconds \((00..59, \text{or} 60 \text{while leap second})\)

\( uv \) clock status characters:
- \( u: \#\) clock is running free (without exact synchr.)
- \( \quad \text{(space, 20h)}\)
- \( u: \) clock is synchronous (base accuracy is reached)

- \( v: \*\) receiver has not checked its position
- \( \quad \text{(space, 20h)}\)
- \( v: \) receiver has determined its position

\( G \) time zone indicator ‘GPS-Time’

\( y \) announcement of discontinuity of time, enabled during last hour before discontinuity comes in effect:
- \( 'A' \) announcement of leap second insertion
- \( ' ' \) (space, 20h) nothing announced

\( lll \) number of leap seconds between UTC and GPS-Time
\((\text{UTC} = \text{GPS-Time} + \text{number of leap seconds})\)

<ETX> End-Of-Text, (ASCII Code 03h)
10.7.3 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:

\[ \text{CH}_x \text{.tt.mm.jj.hh:mm:ss.fffffff}<\text{CR}><\text{LF}> \]

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

\[ \begin{array}{ll}
\text{dd.mm.yy} & \text{the capture date:} \\
\text{dd} & \text{day of month} \quad (01..31) \\
\text{mm} & \text{month} \quad (01..12) \\
\text{yy} & \text{year of the century} \quad (00..99)
\end{array} \]

\[ \begin{array}{ll}
\text{hh:mm:ss.fffffff} & \text{the capture time:} \\
\text{hh} & \text{hours} \quad (00..23) \\
\text{mm} & \text{minutes} \quad (00..59) \\
\text{ss} & \text{seconds} \quad (00..59, or 60 while leap second) \\
\text{fffffff} & \text{fractions of second, 7 digits}
\end{array} \]

\(<\text{CR}>\quad \text{Carriage Return, ASCII Code 0Dh}\]

\(<\text{LF}>\quad \text{Line Feed, ASCII Code 0Ah}\]
10.7.4 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:

\[ <\text{STX}>dd.mm.yy/w/hh:mm:ssxxxxuv<\text{ETX}> \]

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:

\(<\text{STX}>\) Start-Of-Text, ASCII Code 02h
sending with one bit accuracy at change of second

dd.mm.yy the current date:
- dd day of month (01..31)
- mm month (01..12)
- yy year of the century (00..99)
- w the day of the week (1..7, 1 = Monday)

hh:mm:ss the current time:
- hh hours (00..23)
- mm minutes (00..59)
- ss seconds (00..59, or 60 while leap second)

xxxx time zone indicator:
- ‘UTC’ Universal Time Coordinated, formerly GMT
- ‘CET’ European Standard Time, daylight saving disabled
- ‘CEST’ European Summertime, daylight saving enabled

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

v 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

\(<\text{CR}>\) Carriage Return, ASCII Code 0Dh

\(<\text{LF}>\) Line Feed, ASCII Code 0Ah

\(<\text{ETX}>\) End-Of-Text, ASCII Code 03h
10.7.5 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:

\[
<\text{STX}>tt.mm.jj; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.llle hhhhm<\text{ETX}>
\]

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:

\[
<\text{STX}> \quad \text{Start-Of-Text, ASCII Code 02h}
\]

\[
\text{sending with one bit accuracy at change of second}
\]

\[
\text{dd.mm.yy} \quad \text{the current date:}
\]

\[
\begin{align*}
\text{dd} & \quad \text{day of month (01..31)} \\
\text{mm} & \quad \text{month (01..12)} \\
\text{yy} & \quad \text{year of the century (00..99)} \\
\text{w} & \quad \text{the day of the week (1..7, 1 = Monday)}
\end{align*}
\]

\[
\text{hh:mm:ss} \quad \text{the current time:}
\]

\[
\begin{align*}
\text{hh} & \quad \text{hours (00..23)} \\
\text{mm} & \quad \text{minutes (00..59)} \\
\text{ss} & \quad \text{seconds (00..59, or 60 while leap second)}
\end{align*}
\]

\[
v \quad \text{sign of the offset of local timezone related to UTC}
\]

\[
\text{oo:oo} \quad \text{offset of local timezone related to UTC in hours and minutes}
\]

\[
\text{ac} \quad \text{clock status characters:}
\]

\[
\begin{align*}
\text{a:} & \quad \text{'#' clock has not synchronized after reset} \\
& \quad \text{(space, 20h) clock has synchronized after reset}
\end{align*}
\]

\[
\begin{align*}
\text{c:} & \quad \text{'*' GPS receiver has not checked its position} \\
& \quad \text{(space, 20h) GPS receiver has determined its position}
\end{align*}
\]

\[
\text{d} \quad \text{time zone indicator:}
\]

\[
\begin{align*}
'S' & \quad \text{CEST European Summertime, daylight saving enabled} \\
' ' & \quad \text{CET European Standard Time, daylight saving disabled}
\end{align*}
\]

\[
f \quad \text{announcement of discontinuity of time, enabled during last hour}
\]

\[
\text{before discontinuity comes in effect:}
\]

\[
\begin{align*}
'!' & \quad \text{announcement of start or end of daylight saving time} \\
& \quad \text{(space, 20h) nothing announced}
\end{align*}
\]

\[
g \quad \text{announcement of discontinuity of time, enabled during last hour}
\]

\[
\text{before discontinuity comes in effect:}
\]

\[
\begin{align*}
'A' & \quad \text{announcement of leap second insertion} \\
& \quad \text{(space, 20h) nothing announced}
\end{align*}
\]

\[
i \quad \text{leap second insertion}
\]

\[
\begin{align*}
'\text{L}' & \quad \text{leap second is actually inserted} \\
& \quad \text{(active only in 60th sec.)} \\
' ' & \quad \text{(space, 20h) no leap second is inserted}
\end{align*}
\]

\[
\text{bbb.bbbbn} \quad \text{latitude of receiver position in degrees}
\]

\[
\text{leading signs are replaced by a space character (20h)}
\]

\[
n \quad \text{latitude, the following characters are possible:}
\]

\[
'N' \quad \text{north of equator}
\]
‘S’  south d. equator

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
10.7.6 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:

\[
$GPRMC, \text{hhmmss.ss}, \text{A}, \text{bbbb.bb}, \text{n}, \text{lllll.ll}, \text{e}, \text{0}, \text{0}, \text{0}, \text{0}, \text{ddmmmyy}, \text{0}, \text{0}, a^*\text{hh}<\text{CR}><\text{LF}>
\]

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)
  - 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' north of equator
  - 'S' south of equator

- **n**: latitude, the following characters are possible:
  - 'N' north of equator
  - 'S' south of equator

- **lllll.ll**: longitude of receiver position in degrees
  - leading signs are replaced by a space character (20h)
  - 'E' east of Greenwich
  - 'W' west of Greenwich

- **ddmmmyy**: 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
### 10.7.7 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,lllll.ll,e,A,vv,hhh.h,aaa.a,M,ggg.g,M,,0*cs
```

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
- **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*: north of equator
  - *S*: south d. equator
- **lllll.lllll**: longitude of receiver position in degrees
  - Leading signs are replaced by a space character (20h)
  - *e*: east of Greenwich
  - *W*: west of Greenwich
- **vv**: Satellites used (0..12)
- **hhh.h**: HDOP (Horizontal Dilution of Precision)
- **aaa.a**: 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
10.7.8 Format of the NMEA 0183 String (ZDA)

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

$GPZDA,hhmmss.ss,dd,mm,yyyy,HH,II*cs<CR><LF>

ZDA - Time and Date: UTC, day, month, year and local timezone.

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

$ Start character, ASCII Code 24h

sending with one bit accuracy at change of second

hhmmss.ss the current UTC time:

hh  hours  (00..23)
mm  minutes  (00..59)
ss  seconds  (00..59 or 60 while leap second)

HH,II the local timezone (offset to UTC):

HH  hours  (00..±13)
II  minutes  (00..59)

dd,mm,yy the current date:

dd  day of month  (01..31)
mm  month  (01..12)
yyyy  year  (0000..9999)

cs checksum (EXOR over all characters except ‘$’ and ‘*’)

<CR> Carriage Return, ASCII Code 0Dh

<LF> Line Feed, ASCII Code 0Ah
10.7.9 Format of the ABB SPA Time String

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

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

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

yy-mm-tt the current date:
  yy year of the century (00..99)
  mm month (01..12)
  dd day of month (01..31)

  Space (ASCII code 20h)

hh.mm;ss.fff the current time:
  hh hours (00..23)
  mm minutes (00..59)
  ss seconds (00..59, or 60 while leap second)
  fff milliseconds (000..999)

cc Check sum. EXCLUSIVE-OR result of the previous characters, displayed as a HEX byte (2 ASCII characters 0..9 or A..F)

<CR> Carriage Return, ASCII Code 0Dh
10.7.10 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:

\[ T:yy:mm:dd:ww:hh:mm:ss\text{<CR>}<\text{LF}> \]

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
10.7.11 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

\(<G>\) Control character code 47h

\(<U>\) Control character code 55h

\(yymmdd\) the current date:

- \(yy\) year of the century \((00..99)\)
- \(mm\) month \((01..12)\)
- \(dd\) day of month \((01..31)\)

\(hh:mm:ss\) 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

Interface parameters: 7 Databits, 1 Stopbit, odd. Parity, 9600 Bd
10.7.12 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:

- `<SOH>` Start of Header (ASCII control character)
  - sending with one bit accuracy at change of second
- **ddd** day of year (001..366)
- **hh:mm:ss** 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)
- `<CR>` Carriage-return (ASCII code 0Dh)
- `<LF>` Line-Feed (ASCII code 0Ah)
10.7.13 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:

\(<\text{SOH}>\text{ddd}:\text{hh}:\text{mm}:\text{ss}\text{q}<\text{CR}><\text{LF}>\)

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:

\(<\text{SOH}>\)
- Start of Header (ASCII control character)
- sending with one bit accuracy at change of second

\(\text{ddd}\)
- day of year
- (001..366)

\(\text{hh}:\text{mm}:\text{ss}\)
- the current time:
  - \(\text{hh}\) hours
  - \(\text{mm}\) minutes
  - \(\text{ss}\) seconds
  - (00..23)
  - (00..59)
  - (00..59, or 60 while leap second)

\(\text{q}\)
- Quality indicator
  - (space) Time Sync (GPS lock)
  - (?) no Time Sync (GPS fail)

\(<\text{CR}>\)
- Carriage-return (ASCII code 0Dh)

\(<\text{LF}>\)
- Line-Feed (ASCII code 0Ah)
10.7.14 Format of the ION Blanked Time String

The ION Blanked 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>

Attention: Intervall of the String: 2min. 30 seconds every 5 minutes.

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:

<SOH> Start of Header (ASCII control character)
    sending with one bit accuracy at change of second

ddd day of year (001..366)

hh:mm:ss 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)

<CR> Carriage-return (ASCII code 0Dh)

<LF> Line-Feed (ASCII code 0Ah)
10.7.15 Format of the IRIG J Time String

The time code consists of ASCII characters, send in the format 701

- 1 start bit
- 7 data bits
- 1 parity bit (odd)
- 1 stop bit

The on-time marker is represented by the leading edge of the start bit. The time code consists of 15 characters, sent once per second at a baud rate of 300 or greater. The format is:

<SOH>D0D: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:

SOH ASCII code „Start of Heading“ (0x01h)

DDD ordinal date, day of year (1 to 366)

HH, MM, SS time of the start bit given in hour (HH), minute (MM), second (SS)

CR ASCII code „Carriage Return“ (0x0Dh)

LF ASCII code „Line Feed“ (0x0Ah)
10.8 Third Party Software

10.8.1 Network Time Protocol Version 4 (NTP)

The NTP project, lead by David L. Mills, can be reached in the internet at www.ntp.org. There you will find a wealthy collection of documentation and information covering all aspects of the application of NTP for time synchronization purposes. The distribution and usage of the NTP software is allowed, as long as the following notice is included in our documentation:

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