MANUAL

IMS LANTIME M1000

Modular Sync. System and NTP Server

25th February 2020

Meinberg Funkuhren GmbH & Co. KG
DEUTSCH
1. LANTIME Bedienfeldanzeige mit LC-Display, Status LEDs und Funktionstasten
2. Terminal / VT100, 38400 Baud, 8N1, 9pol. D-SUB Stecker
3. USB Anschluss

ENGLISCH
1. LANTIME control panel with LC-Display, Status LEDs and function keys
2. Terminal / VT100, 38400 Baud, 8N1, 9pin D-SUB connector
3. USB connector
DEUTSCH
1. Netzteil: 100-240 V AC (50-60Hz) / 100-200 V DC oder 
   Netzteil: 20-60 V DC
2. GNSS Zeitcode Empfänger (GPS/GLONASS/Galileo/BeiDou)
3. LAN-CPU mit USB-Schnittstelle, Terminal (RS-232) RJ45, 
   LAN 0 - RJ45, LAN 1 - SFP Anschluss
4. ACM - Active Cooling Module

ENGLISCH
1. Power Supply: 100-240 V AC (50-60Hz) / 100-200 V DC or 
   Power Supply: 20-60 V DC
2. GNSS timecode receiver (GPS/GLONASS/Galileo/BeiDou)
3. LAN-CPU with USB interface, serial Terminal (RS-232), 
   LAN 0 - RJ45, LAN 1 - SFP connector
4. ACM - Active Cooling Module
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1 Imprint

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Manual
Version: 1.17
2 Important Safety Information

2.1 Important Safety Instructions and Protective Measures

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

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


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

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

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

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

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

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Beschreibung / Description</th>
</tr>
</thead>
</table>
| ⚡️      | IEC 60417-5031  
|         | Gleichstrom / Direct current |
| ⚤       | IEC 60417-5032  
|         | Wechselstrom / Alternating current |
| ⚡️      | IEC 60417-5017  
|         | Erdungsanschluss / Earth (ground) terminal |
| ⚡️      | IEC 60417-5019  
|         | Schutzleiteranschluss / Protective earth (ground) terminal |
| ⚠️      | ISO 7000-0434A  
|         | Vorsicht / Caution |
| ⚠️      | IEC 60417-6042  
|         | Vorsicht, Risiko eines elektrischen Schlages / Caution, risk of electric shock |
| ⚠️      | IEC 60417-5041  
|         | Vorsicht, heiße Oberfläche / Caution, hot surface |
| ⚠️      | IEC 60417-6056  
|         | Vorsicht, Gefährlich sich bewegende Teile / Caution, moving fan blades |
| ⚠️      | IEC 60417-6172  
|         | Trennen Sie alle Netzstecker / Disconnection, all power plugs |
| ⚠️      | IEC 60417-5134  
|         | Elektrostatisch gefährdete Bauteile / Electrostatic Sensitive Devices |
| ⚡️      | IEC 60417-6222  
|         | Information generell / Information general |
| ⚠️      | 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.
2.3 Security during Installation

WARNING!

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

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

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

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

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

The fire protection must be ensured in the installed state.

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

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

The device must be protected against mechanical stress such as vibration or shock.
Connecting Data Cables
During a thunderstorm, data transmission lines must not be connected or disconnected (risk of lightning).

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

Install the cables in a 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.
### Important Safety Information

<table>
<thead>
<tr>
<th>AC Power Supply</th>
<th>DC Power Supply</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>• Outside the assembly group the device must be disconnectable from the power supply in accordance with the provisions of IEC 60950-1 (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>• 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>• 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><strong>Connection Cross Section:</strong></td>
</tr>
</tbody>
</table>
| • 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. | 1 mm² – 2.5 mm²  
17 AWG – 13 AWG |
| • 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. |  |
2.4 Protective Conductor- / Ground-Terminal

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!
2.5 Safety during Operation

**WARNING!**

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

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

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

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

Follow the steps below:
- Switch off the device
- Disconnect all power plugs
- Inform the service
- Devices that are connected via one or more uninterruptible power supplies (UPS) remain operational even when the UPS power cord is disconnected. Therefore, you must put the UPS out of operation according to the documentation of the corresponding user documentation.
2.6 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.

2.7 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.

Whendisposingusedbatteries,observe therelocalregulationsfor the disposal of hazardous waste.
2.8 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.

2.9 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.
2.10 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.
3 The Modular System LANTIME

LANTIME is a set of equipment composed of a reference clock GNSS, a single-board computer (LAN-CPU) with integrated network card, and a power supply unit, all installed in a metal desktop case and ready to operate. The interfaces provided by LANTIME are accessible via connectors in the rear panel of the case. Details of the components are described below.

The implemented NTPD distributes the reference time from the GNSS receiver cyclic in the network. Information on the NTPD is monitored on the LC-Display or can be inquired via the network.

The installation of LANTIME is very easy for the system/network administrator. The network address, the netmask and the default gateway have to be configured from the front panel of LANTIME. The network address or the equivalent name of LANTIME has to be shown to all NTP clients in the TCP/IP network.

As well as NTP the Linux system also supports a number of further network protocols: HTTP(S), FTP, SSH and Telnet. Because of this remote configuration or status requests can come from any WEB browser. This access via the network can be deactivated. Changes in the receiver status, errors or other important events are logged either on the local Linux system or on an external SYSLOG-Server. In addition messages can be sent to a data center via SNMP traps or automatically generated e-mails where they can be recorded. Furthermore all alarm messages can be displayed by the large display VP100/20/NET that is accessed via network connection.

In order to avoid a service interruption several LANTIME NTP servers can be installed in the same network to obtain redundancy.
4 Network Timeserver with GNSS synchronized time base

The LANTIME (Local Area Network Time Server) provides a high precision time base to a TCP/IP network (Stratum-1-Server). The NTP (Network Time Protocol) is used to synchronize all NTP clients with the reference. The several LANTIME variants differ from each other by the time reference and output configuration. A GNSS receiver (GPS, GLONASS, Galileo or BeiDou), a long wave receiver (like DCF77, MSF or WWVB) or an IRIG time code receiver can be integrated as an internal reference as well as a combination of these references (hybrid system). External references are also possible.

The LANTIME system is a set of equipment composed of an internal receiver, a single-board computer and a power supply, all installed in a metal 19 inch modular chassis and ready to operate. A simplified LINUX operating system is installed on the single-board computers flash disk. Eight push buttons and a display can be used to configure and monitor the time server.

After the network connection has been established the time server can also be configured and monitored remotely from a workstation via TELNET or FTP. An integrated web server enables access to the LANTIME by using an ordinary web browser.
5 Mounting the Antenna

5.1 GNSS Signal Reception

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

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

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

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

Meinberg provides their own GPS receivers which operate with an antenna/converter unit and thus allow for very long antenna cables, but some devices also include GNSS receivers which support other satellite systems like GLONASS, or Galileo in addition to GPS. These receivers usually require a different type of antenna equipment which is described in chapter (4.1.2).
5.1.1 Meinberg GPS Antenna/Converter

5.1.1.1 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.
5.1.1.2 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. Mount the antenna at a distance of at least 50 cm from other antennas.

**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.
5.1.2 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.

5.1.2.1 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

![Schematic diagram of mounting the Multi GNSS Antenna](image-url)
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.
5.1.2.2 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.

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.

Figure: Installation drawing RV-76G antenna
5.1.3 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.

On the frontpanel ("Reference Time → Info GPS → GPS Satellites") as well as via the Web GUI ("Clock → Receiver Information") 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).
5.2 Long Wave Signal Reception

5.2.1 Introduction

The longwave antenna AW02 is a weatherproof and temperature resistant active antenna for outdoor use. It includes a ferrite antenna for reception of the longwave signal, and an amplifier, both assembled in a plastic housing. The standard version has been designed to receive the signal from the German longwave transmitter DCF77 whose carrier frequency is 77.5 kHz. The DCF77 transmitter is operated by the German Physikalisch-Technische Bundesanstalt (PTB), and is located in Mainflingen near Frankfurt / Main. Its signal can be received in Germany and adjacent countries.

The variant AW02-MSF is available for the longwave transmitter MSF which is located in Anthorn / U.K., and transmits the time and frequency maintained by the U.K. National Physical Laboratory (NPL). The signal can be received throughout the U.K., and in wide parts of Northern and Western Europe.

Another variant is the AW02-WWVB which has been adapted for the WWVB radio station which is located in the United States near Fort Collins, Colorado, and is maintained by U.S. National Institute of Standards and Technology (NIST).

Even though these antenna variants are slightly different according to the characteristics of the associated transmitter, the basic requirements for installation are identical.

The longwave antennae can be operated with a cable length up to 300 meters (1000 ft) if standard RG58 coaxial cable is used. They are remotely powered by the receiver via the antenna cable, so no external power supply is required near the location of the antenna if a direct coaxial cable is used.

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.

For longer distances from the antenna to the receiver an optional amplifier can be used, which requires an extra power supply. The BLV device is an amplifier with integrated surge protector.

Alternatively there is a DCF Optical Antenna Link (DOAL) available which uses a fiber optic connection between the antenna and the receiver which allows for a length up to 2000 meters (6500 ft), providing a high level of insulation and surge protection due to the optical transmission. Again, the default device has been designed for DCF77, but there are also variants for MSF and WWVB available. 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.

Longwave receiver equipment from Meinberg has specifically been designed for Meinberg devices and is not necessarily compatible with receivers from 3rd party manufacturers.
5.2.2 Mounting and Installation of a Longwave Antenna

The careful selection of the antenna location should be at the beginning of each antenna installation. It determines the reception quality and therefore the availability of the DCF77 reception signal decisively. In principle, a DCF77 reception within buildings is possible, however, the DCF77 reception may deteriorate due to metallic objects (e.g. reinforced concrete walls, metal facades, heat protection glazing etc.) that shield or attenuate the reception.

For this reason we always recommend to mount the antenna outside of buildings. This has the advantage that the signal interference distance to electronic devices in buildings is usually enhances and the reliability of the synchronisation is thus significantly increased.

Proper installation of an antenna for DCF77, MSF, or WWVB is illustrated in the figure below:

Figure: Longwave antenna mounted on a wall. The optional surge protector keeps high voltage strikes through the antenna cable away from the receiver.
Mounting the Antenna

The antenna has to be aligned horizontally in longitudinal direction to the transmitter, i.e. in direction to Mainflingen near Frankfurt / Main in case of DCF77, or in direction to the location of the MSF or WWVB receiver accordingly.

If the antenna is not aligned properly then signal reception is degraded, which can result in a limited time accuracy. The antenna should be installed with a minimum distance of 30 cm away from all metal objects and possibly any microcomputers and electrical devices (engines, electricity, etc.). A distance of several meters from TV and computer monitors should be considered as well.

The best method to align a longwave antenna is to turn the antenna slowly until the monitored signal level is minimized, and then turn the antenna by 90° to achieve maximum reception. However, a high signal level alone is not a guarantee for good reception since it can even be caused by electrical noise in the associated frequency range. For standard longwave receivers it is important that the modulation mark is blinking exactly once per second, without intermediate flickering.

DCF77/PZF receivers use correlation techniques to decode the phase modulation provided by DCF77, and with these types of receiver the maximum interference immunity can be found by looking at the autocorrelation parameter displayed in the display menu "PZF-STATE". The displayed value should be as close as possible to 100 % for best reception.

---

**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.
5.2.3 DCF77 / PZF Receiver

If both the antenna and the power supply have been connected the system is ready to operate. After power up it takes up to three minutes for the receiver to synchronize, if reception is good enough. A high "Correlation & Field" is an indicator for a good signal quality.

To check the field strength and the signal correlation value, select in the Front Panel "Reference Time → Info PZF → Correlation & Field".

The correlation "State" starts in a "raw" mode, when the receiver tries to find the initial correlation. When good correlation has been found the receiver checks it 20 times: this state is labeled "check" and the correlation value is increased from 1 to 20. If the correlation quality stays good the state changes to the "fine" mode. The signal strength should be 100 or higher.

If no correlation with the incoming signal is possible then the clock changes automatically to DCF77 AM reception mode and tries to decode the second marks.

For further detailed clock configuration, please refer to the Chapter ??.

5.3 Cable Types

<table>
<thead>
<tr>
<th>Antenna Type</th>
<th>Cable Type</th>
<th>Maximum Cable Length</th>
</tr>
</thead>
<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
6 Quick Start

When the unit is switched on, the following message appears on the display, which counts up a number of points during the boot process:

```
LANTIME OS7
[7.00.006-STD]
HW Init ...
```

The NTP time server is then ready for operation and the display switches to the main menu where some important status information will be displayed:

```
MRS: Sync to GNS
NTP: Offs. 2us
Thu, 23.01.2020
UTC 12:00:00
```

If the GNSS receiver has not synchronized (Reflock LED still red after 12 minutes), check the number of visible/good satellites by pressing ↓, →, ↓ from the main menu.

```
SV CONSTELLATION
SVs in view: 10
Good Svs   : 9
Sel:09 30 29 0
```

At least four satellites must be found for the GNSS clock to synchronize. The antenna must have free view to the horizon.

For first time installation enter TCP/IP address, netmask and default gateway. To get an overview of the current configuration press F2 from main menu. Press F2 again to enter setup configuration page. Please ask your administrator for proper TCP/IP configuration:

```
->Interfaces <
  Global Cfg.
  Services
  Add Interf.
OK
Use Up and Dow
   to select Port
   lan0:0   #1of5
  >172.100.100.10
```

Then select “Interfaces” → “Lan Port”, and press the OK button 3 times. Then use the arrow keys to enter the TCP/IP address, netmask and a default gateway if necessary.

```
>IPv4 Parameter
IPv6 Parameter
Link Mode
OK

> LAN Address
  LAN Netmask
  Gateway
OK
Set LAN Address
  IPv4 lan0:0
  ->DHCP: enable
  >172.28.8.7
```

After this all further settings can be done via network interface, either by using a WEB browser or a Telnet Session.

Default user: root
Default password: timeserver
7 Booting the GNSS receiver

If both the antenna and the power supply have been connected, the system is ready to operate. About 2 minutes after power-up the receiver’s oscillator has warmed up and operates with the required accuracy. If the receiver finds valid almanac and ephemeris data in its battery buffered memory and the receiver’s position has not changed significantly since its last operation, the receiver can determine which satellites are presently in view. Only a single satellite must be received to synchronize and generate output pulses, so synchronization can be achieved within one minute after power-up.

If the receiver position has changed by more than one hundred kilometers since last operation, the satellites’ real elevation and Doppler might not match those values expected by the receiver, and this will force the receiver to start scanning for satellites. This mode is called **Warm Boot** because the receiver can obtain ID numbers of existing satellites from the valid almanac. When the receiver has found four satellites in view it can update its new position and switch to **Normal Operation**. If the almanac has been lost (because the battery has been disconnected) the receiver has to scan for a satellite and read in the current almanac. This mode is called **Cold Boot**. It takes 12 minutes until the new almanac is complete and the system switches to Warm Boot mode, scanning for other satellites.
8 Booting the Single Board Computer

The LINUX operating system is loaded from a packed file on the flash disk of the single board computer to a RAM disk. All files of the flash disk are stored in the RAM disk after booting. This guarantees that the file system is in a defined condition after restart. This boot process takes approximately two minutes.

After starting the LINUX system, the network function is initiated and the communication program with the receiver and the NTPD (NTP daemon) is started. Then NTPD starts synchronization with the reference clocks (usually the hardware clock of the single board computer and the integrated receiver clock).

For the synchronization of the NTPD with the time reference it is necessary that the receiver is synchronous with the incoming time signal.

Because of the internal time of the NTP which is adjusted by a software PLL (phase locked loop) it takes a certain time to optimise this offset. The NTPD tries to keep the offset below +-128 ms; if the offset becomes too large, the system time is set with the receiver’s time. Typically values for the offset are +-5 ms after the NTPD has already synchronized.
9 Configuration User Interface

There are several ways to configure the LANTIME parameters:

- Command Line Interface (CLI) via TELNET
- Command Line Interface via SSH
- Command Line Interface via serial terminal in front panel (38400/8N1/VT100)
- HTTP Interface
- Secure HTTP Interface (HTTPS)
- Front panel LCD/VFD Interface (except LANTIME M100 and IMS S-Chassis variants)
- SNMP Management

In order to be able to configure the time server via the web interface or a telnet/SSH connection, an IP address has to be assigned via the front panel keys and LC/VF display (for automatic assignment possibilities please refer to: DHCP IPv4 or AUTOCONF IPv6). LANTIME variants without a display can be configured using the serial terminal interface (labeled “Term” or “Terminal”). The termin program should be set to 38400Baud / 8N1 – VT100 emulation. Once the IPv4 address, net mask and IPv4 GATEWAY have been set up or the network interface has been automatically configured with DHCP/Autoconf, further configuration changes can be done via a network connection:

To set up a TELNET connection the following commands are entered (replace 198.168.10.10 with the IP of your LANTIME):

telnet 198.168.10.10  // LANTIME IP address
user: root
password: timeserver

With “setup” the configuration program is started.
To set up a SSH connection the following commands are entered:

ssh root@198.168.10.10  // LANTIME IP address
password: timeserver

With “setup” the configuration program is started.
To set up a HTTP connection the following address is to enter in a web browser:

http://198.168.10.10  // LANTIME IP address
password: timeserver

To set up a Secure HTTP (HTTPS) connection the following address is entered in a web browser:

https://198.168.10.10  // LANTIME IP address
password: timeserver
10 The Menues in Detail

10.1 Root Menu

The root menu is shown when the receiver has completed initialization after power-up. With the four arrow buttons and the buttons "OK", "ESC", "F1" and "F2" the navigation and setting of parameters can be managed. Main menu can be reached by pressing "ESC" some times. The main menu reflects some of the main parameters of the time server. First line shows the status of the Reference Clock, the NTP offset and the date and time.

In case of using a GNSS receiver (GPS, GNS, GNM) the text "GNS: NORMAL MODE" might be replaced by "COLD BOOT", "WARM BOOT" or "UPDATE ALMANAC". If the antenna is disconnected or not working properly, the text "ANTENNA FAULTY" is displayed instead.

Current time and date of the timeserver with the name of the time zone (NTP uses UTC time zone) will be monitored in the bottom line. If the "IGNORE LOCK" option is enabled an "*" will be shown behind the time.

The multicolor LEDs will reflect the current state of the device:

„Ref. Time“
green: the reference clock (e.g. integrated GPS) produce valid time.
red: the reference clock produce no valid time (e.g. not synchronized)

„Time Service“
green: NTP has been synchronized to reference clock.
red: NTP is not synchronous to reference clock or sync to "local clock"

„Network“
green: all watched network ports has been "link up" detected
red: at least one of the watched network ports (look at „Setup Device Parameter / Check Network Linkup“) is not connected

„Alarm“
off: no error at moment
red: general error – more information will be shown on display.
When pressing 'F1' from main menu a short description for menu navigation will be displayed:

Use -> and <- to select different main menus. Use ^ and v to enter

When pressing the "OK" button from main menu the version of the LANTIME software, the NTP and the LINUX kernel version will be displayed.

E900      V7.0
SN  : 0608120010
CPU : 0047115827
Bld.: 7.00.006

The following main menus will be displayed when pressing the "↑" and "↓" arrow buttons:
11 LANTIME Web Interface

The LANTIME offers two different options for configuration and status management: An extensive and powerful web interface and SNMP. In order to use the SNMP features of your LANTIME, you need special software like management systems or SNMP clients. In order to use the web interface, all you need is a web browser (LANTIME supports a broad range of browsers, we recommend Mozilla Firefox).

The WEB Interface

The web interface can be used by more than one user in parallel, but the two or more running sessions may influence each other. We explicitly do not recommend the parallel usage of the configuration interfaces.

Connect to the web interface by entering the following address into the address field of your web browser:

http://198.168.10.10

(You need to replace 198.168.10.10 with the IP address of your LANTIME).

Default Login

User: root
Password: timeserver
If you try a secure connection via HTTPS, then your WEB Browser generates an alarm message. You have to accept the HTTPS certificate which the LANTIME provides to you. Modification of this certificate is possible during the first session (see chapter The Web Interface - Security - HTTPS Certificate).

After entering the right password, the main menu page shows up. This page contains an overview of the most important configuration and status parameters for the system.

**System information and Status messages:**

- Information about LANTIME model and software
- Network information - first interface
- Receiver status
- NTP status
- Last messages

By using the navigation on top of the page you can reach a number of configuration menus, which are described in the next chapters.
12 Attachment: Technical Information

12.1 Technical Specifications M1000

Housing: Metal desktop case, Schroff 282T
       Front panel: 1U/84HP (43 mm high / 442 mm wide)

Protection Rating: IP20

Physical Dimensions: 445 mm wide x 44 mm high x 290 mm deep

Ambient Temperature: 0 .. 50 °C

Storage Temperature: -20 .. 70 °C

Humidity: max. 85% (non-condensing) @ 30 °C

Please Note:
To avoid overheating damage during operation, the system is equipped with an active cooling module (ACM – Active Cooling Module). The generated air flow is led through the device as shown in the figure (also see chapter ACM – Active Cooling Module).
# 12.2 Available Modules and Connectors

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<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Signal</th>
<th>Cable</th>
</tr>
</thead>
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<tr>
<td><strong>Front Connectors</strong></td>
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</tr>
<tr>
<td>Terminal</td>
<td>9pin. D-SUB male</td>
<td>RS-232</td>
<td>shielded data line</td>
</tr>
<tr>
<td>USB</td>
<td>USB Port</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rear Connectors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>5pin. DFK male</td>
<td>100-240 V AC (50-60Hz) 100-200 V DC</td>
<td>5pin. MSTB clamp</td>
</tr>
<tr>
<td>GPS Antenna</td>
<td>BNC</td>
<td>10 MHz / 35.4 MHz</td>
<td>shielded coaxial line</td>
</tr>
<tr>
<td>or Multi GNSS Antenna or</td>
<td>SMA</td>
<td>L1 Frequency band</td>
<td>shielded coaxial line</td>
</tr>
<tr>
<td>AW02 (DCF77) Antenna</td>
<td>BNC</td>
<td>LF</td>
<td>shielded coaxial line</td>
</tr>
<tr>
<td>Terminal</td>
<td>RJ45</td>
<td>RS-232 (38400/8N1)</td>
<td>CAB–CONSOLE–RJ45 shielded data line</td>
</tr>
<tr>
<td>USB</td>
<td>USB Port</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network LAN-CPU</td>
<td>RJ-45</td>
<td>10/100 MBit</td>
<td>shielded data line</td>
</tr>
<tr>
<td>SFP</td>
<td></td>
<td>1000Base-T</td>
<td></td>
</tr>
<tr>
<td><strong>Module Options</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC power supply</td>
<td>5pin. DFK male</td>
<td>20-60 V DC or 10-36 V DC</td>
<td>5pin. MSTB clamp</td>
</tr>
<tr>
<td><strong>Network</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNE-GbE</td>
<td>RJ45</td>
<td>10/100/1000 MBit</td>
<td>shielded data line</td>
</tr>
<tr>
<td>SFP</td>
<td></td>
<td>1000BASE-T</td>
<td></td>
</tr>
<tr>
<td>HPS100</td>
<td>RJ45/SFP</td>
<td>10/100/1000 MBit</td>
<td>shielded data line</td>
</tr>
<tr>
<td><strong>Signal Outputs:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPE - configurable</td>
<td>BNC, DFK-2, DSUB9, ST</td>
<td>PPOs, serial TS, TC FO ...</td>
<td>shielded data line</td>
</tr>
<tr>
<td>BPE - fixed</td>
<td>BNC, ST</td>
<td>PPS, 10 MHz, TC ...</td>
<td>shielded data line</td>
</tr>
<tr>
<td>LIU:</td>
<td>RJ45 jack</td>
<td>balanced 120 Ohm (Clock) unbalanced 75 Ohm (Bits)</td>
<td>shielded data line</td>
</tr>
<tr>
<td>BNC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNO</td>
<td>BNC</td>
<td>10 MHz sine</td>
<td>shielded data line</td>
</tr>
<tr>
<td>REL</td>
<td>DFK-3</td>
<td>Error Relay</td>
<td></td>
</tr>
<tr>
<td><strong>Signal Inputs:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESI</td>
<td>BNC, RJ45</td>
<td>E1/T1, var. Freq.</td>
<td>shielded data line</td>
</tr>
<tr>
<td>MRI</td>
<td>BNC</td>
<td>10 MHz, PPS, IRIG, PP</td>
<td>shielded data line</td>
</tr>
</tbody>
</table>
12.3 TERMINAL (Console)

To connect a serial terminal (according to the device model), use the 9pin RS-232 D-Sub connector in the front panel or the RJ45 connector of the LAN-CPU. Via the serial terminal connection it is possible to configure parameters with a command line interface. You have to use a NULL-MODEM cable (D-Sub) or a CAB-CONSOLE-RJ45 cable to establish a connection to your PC or Laptop computer.

You can use e.g. the standard Hyperterminal program shipped with your Windows operating system. Configure your terminal program with 38400 Baud, 8 Databits, no parity and 1 Stopbit. The terminal emulation have to set to VT100. After connecting to the timeserver there will be displayed the login message (press RETURN for first connection; default user: root password: timeserver).

12.4 USB Connector

Most LANTIME M-Series products come with a USB interface for connecting a USB storage device, e.g. a USB stick. This USB stick can be used for different tasks in combination with the LANTIME:

- Transfer configuration parameters
- between different LANTIMEs
- Keypad locking for secure
- using the keypad of the LCD
- Transfer of log files
- Install Software Updates
- Upload and download secure certificates
- (SSL, SSH) and passwords
12.5 Replacement or Installation of a Hot-pluggable IMS Module

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.

Please use a Torx screwdriver (T8 x 60) for removal and installation of the module.

1. Follow the safety instructions at the beginning of this manual!

2. Remove the two marked Torx screws from the module holder plate or the cover plate of the empty slot.

3. (Only for an already built-in module) Pull the module carefully out of the holding rail. Note that the module is firmly anchored in the connector block of the housing. You need a certain amount of force to release the module from this link. Once the connection to the connector block of the system’s backplane is loosened, the module can be easily pulled out.

4. When installing the new IMS module, please ensure that the board is correctly inserted into the two guide rails of the system housing. Non-observance can cause damage to the module and the chassis. Make sure that the module is securely locked into the connector block before you fasten the two screws.

4. Now you can put the installed module into operation.

Attachment points of an 1U IMS system
### 12.5.1 Important Hints for hot-pluggable IMS Modules

The following points should be strictly observed when replacing IMS modules during operation. Not all IMS modules are fully hot-pluggable. Of course, it is not possible to replace a power supply unit of a non-redundant system without first having installed a second power source in operational mode.

The following applies to the individual IMS slots:

**PWR:**  
"hot swappable"  
If you operate your system with only one power supply, a second power supply must be installed before removing/replacing it to keep your system functioning.

**I/O, ESI and MRI Slots:**  
"hot swappable".

**CLK1, CLK2:**  
"hot swappable"  
After the exchange or the installation of a clock module a rescan of the reference clocks (Rescan Refclocks) must be executed in the web interface menu "System".

**CPU**  
*not* "hot swappable"  
The central management unit must be disconnected from mains before replacement.

**RSC/SPT**  
*not* "hot swappable"  
The RSC switching card must be disconnected from the mains before the replacement.
12.6 IMS Module Options

12.6.1 IMS M1000 Slot Assignment

The IMS system LANTIME M1000 is available in two different versions. A standard version with a single receiver module and in a redundant design, which allows the use of two Meinberg receivers. In this case the configuration of the I/O slots is characterized by the availability of the slots for input signals.

In the non-redundant M1000 configuration one MRI Slot, one ESI slot and two additional I/O slots are available. In the redundant receiver configuration of the M1000 chassis two MRI Slots and one I/O slot are available for input and output modules (see figure below).

The following modules can be used in the designated slots:

- **ACM**  Active Cooling Module
- **I/O**  All output modules (BPE, CPE, LIU, LNO, SCG, VSG ...)
  All network modules (LNE, TSU, HPS100 ...)
  TSU and HPS modules can only operate in PTP Grandmaster mode in an I/O slot.
- **CPU**  CPU Management Module
- **CLK**  All available reference clocks (GPS, GNS, GNM, PZF, TCR)
- **ESI**  ESI input module for telecom references
  All output modules and all network modules
  TSU and HPS modules can operate in PTP Grandmaster and Slave mode in an ESI slot.
- **MRI**  MRI standard reference input signals (PPS, 10 MHz, IRIG)
  ESI input module for telecom references
  All output modules and all network modules
  TSU and HPS modules can operate in PTP Grandmaster and Slave mode in a MRI slot.
  Additionaly SyncE can be used as input reference in a MRI Slot.
- **PWR**  All available power supplies (ACDC, DC)
12.6.2 Power Supply 100-240 V AC / 100-200 V DC

Connector Type: 5-pol. DFK

Pin Assignment:
1: N/-
2: not connected
3: PE (Protective Earth)
4: not connected
5: L/+  

Input Parameter

Nominal Voltage Range: \( U_N = 100-240 \text{ V} \sim \)
\( 100-200 \text{ V} \)

Maximum Voltage Range: \( U_N = 90-265 \text{ V} \sim \)
\( 90-250 \text{ V} \)

Nominal Current: \( I_N = 1.0 \text{ A} \sim \)
\( 0.6 \text{ A} \)

Nominal Frequency Range: \( f_N = 50-60 \text{Hz} \)

Maximum Frequency Range: \( f_{\text{max}} = 47-63 \text{Hz} \)

Output Parameter

Maximum Power: \( P_{\text{max}} = 50 \text{ W} \)

Maximum thermal energy: \( E_{\text{therm}} = 180.00 \text{ kJ/h} (170.61 \text{ BTU/h}) \)

**WARNING!**
This equipment is operated at a hazardous voltage.

**Danger to life due to electrical shock!**
- Only qualified personnel (electricians) may connect the device.
- Never work with open terminals and plugs while the power is on.
- All connectors must be protected against touching live parts with a suitable plug housing!

- **Note:** Always ensure safe wiring!
- **Important:** The device must be connected to a proper grounding (PE).
12.6.3 Power Supply 20-60 V DC

Connector: 5pin DFK

Pin Assignment:
1: not connected
2: $V_{IN} -$
3: PE (Protective Earth)
4: $V_{IN} +$
5: not connected

Input Parameter

Nominal voltage range: $U_N = 24-48 \text{V}$
Maximum voltage range: $U_{max} = 20-60 \text{V}$
Nominal current: $I_N = 2.1 \text{A}$

Output Parameter

Maximum power: $P_{max} = 50 \text{W}$
Maximum thermal energy: $E_{therm} = 180.00 \text{kJ/h (170.61 BTU/h)}$

12.6.4 Power Supply 10-36 V DC

Connector: 5pin DFK

Pin Assignment:
1: not connected
2: $V_{IN} -$
3: PE (Protective Earth)
4: $V_{IN} +$
5: not connected

Input Parameter

Nominal voltage range: $U_N = 24 \text{V}$
Maximum voltage range: $U_{max} = 10-36 \text{V}$
Nominal current: $I_N = 2.5 \text{A}$

Output Parameter

Maximum power: $P_{max} = 50 \text{W}$
Maximum thermal energy: $E_{therm} = 180.00 \text{kJ/h (170.61 BTU/h)}$
12.6.5 GPS Clock

**Receiver:** 12 channel GPS C/A-code receiver

**Accuracy of pulse outputs:**
- < +-100 ns (TCXO, OCXO LQ)
- < +-50 ns (OCXO-SQ, -MQ, -HQ, -DHQ)

**Antenna Cable:** shielded coax

**Cable Length:**
- max. 300 m to RG58,
- max. 700 m to RG213

**Antenna Connector:** BNC female

**Input GPS:** Antenna circuit
- 1000 V DC insulated

**Local Oscillator to Converter Frequency:** 10 MHz

**First IF Frequency:** 35.4 MHz

1) these frequencies are transferred via the antenna cable.

**Power Requirements:** 15 V, 100 mA (via antenna cable)

**Figure right:** GPS receiver and GPS with XHE–SPI connector (option)

**LED Indicators**

- **Init:** blue: while the receiver passes through the initialization phase
- green: the oscillator has warmed up

- **Nav.:** green: positioning successfully

- **Ant:** red: antenna faulty or not connected
  yellow: the clock is synchronized by an external Signal – MRS mode (PPS, IRIG ...)

- **Fail:** red: time has not synchronized
Pin Assignment of the DSUB9 Connectors (male):

Pin 2: RxD
Pin 3: TxD
Pin 5: GND

Synchronization with PPS + string:
Pin 1: PPS
Pin 2: String *

* The following timestrings (time telegrams) can be used:
NMEA RMC
NMEA ZDA
Meinberg Standard
Uni Erlangen

Pin Assignment of the optional XHE-SPI Connectors:

A1: PPS In
A2: PPS Out

Pin 1: SCL_Out (SPI Clock)
Pin 2: CS (Chip Select)
Pin 3: MOSI (Master Out, Slave In)
Pin 4: MISO (Master In, Slave Out)
Pin 5: GND

Attention: Use this plug only to connect a MEINBERG IMS-XHE Rubidium expansion chassis.
12.6.6 GNSS Clock

Type of receiver: GPS / GLONASS / Galileo / Beidou receiver
Number of channels: 72
Frequency band: GNSS L1
1575.42 +- 10 MHz / 1602-1615 MHz

Accuracy of Pulses: Dependant on oscillator option
< +-100nsec (TCXO, OCXO-LQ)
< +-50ns (OCXO-SQ, -MQ, -HQ, -DHQ)

Synchronization Time: Max. 1 minute in normal operation mode,
approx. 12 minutes after a cold start

Antenna Cable: shielded coax cable (Belden H155 PE)

Cable Length: max. 70m low-loss cable

Type of Connector: female SMA connector

Power Requirements: 15 V, 100 mA (via antenna cable)

LED Indicators

Init
blue: while the receiver passes through
the initialization phase

green: the oscillator has warmed up

Nav.
green: positioning successfully

Ant
red: antenna faulty or not connected
yellow: the clock is synchronized by an external
Signal - MRS mode (PPS, IRIG ...)

Fail
red: time has not synchronized
Pin Assignment of the DSUB9 Connectors (male):

Pin 2: RxD
Pin 3: TxD
Pin 5: GND

Synchronization with PPS + string:
Pin 1: PPS
Pin 2: String *

* The following timestrings (time telegrams) can be used:
  NMEA RMC
  NMEA ZDA
  Meinberg Standard
  Uni Erlangen

Pin Assignment of the optional XHE-SPI Connectors:

A1: PPS In
A2: PPS Out

Pin 1: SCL_Out (SPI Clock)
Pin 2: CS (Chip Select)
Pin 3: MOSI (Master Out, Slave In)
Pin 4: MISO (Master In, Slave Out)
Pin 5: GND

Attention: Use this plug only to connect a MEINBERG IMS-XHE
tRubidium expansion chassis.
12.6.7 GNS-UC Clock

GNSS receiver with UpConverter for operation on a standard Meinberg GPS antenna/converter unit.

**Type of receiver:** GPS / Galileo receiver  
Number of channels: 72  
GPS: L1C/A  
Galileo: E1B/C

**Accuracy of Pulses:** Dependant on oscillator option  
< ±100ns (TCXO, OCXO-LQ)  
< ±50ns (OCXO-SQ, -MQ, -HQ, -DHQ)

**Synchronization Time:** Max. 1 minute in normal operation mode, approx. 12 minutes after a cold start

**Antenna Cable:** shielded coax cable

**Cable Length:** max. 300m

**Type of Connector:** female BNC connector

**Power Requirements:** 15 V, 100 mA (via antenna cable)

**LED Indicators**

- **Init**  
  blue: while the receiver passes through the initialization phase  
green: the oscillator has warmed up

- **Nav.**  
green: positioning successfully

- **Ant**  
  red: antenna faulty or not connected  
yellow: the clock is synchronized by an external Signal - MRS mode (PPS, IRIG ...)

- **Fail**  
  red: time has not synchronized
Pin Assignment of the DSUB9 Connectors (male):

Pin 2: RxD
Pin 3: TxD
Pin 5: GND

Synchronization with PPS + string:
Pin 1: PPS
Pin 2: String *

* The following timestrings (time telegrams) can be used:
  NMEA RMC
  NMEA ZDA
  Meinberg Standard
  Uni Erlangen

Pin Assignment of the optional XHE-SPI Connectors:

A1: PPS In
A2: PPS Out

Pin 1: SCL_Out (SPI Clock)
Pin 2: CS (Chip Select)
Pin 3: MOSI (Master Out, Slave In)
Pin 4: MISO (Master In, Slave Out)
Pin 5: GND

Attention: Use this plug only to connect a MEINBERG IMS-XHE Rubidium expansion chassis.
12.6.8 GNM Clock

**Receiver Type**
184-channel
GPS, GLONASS, Galileo, Beidou

**Frequency Band:**

**GPS:**
L1C/A (1575.42 MHz)
L2C (1227.60 MHz)

**GLONASS:**
L1OF (1602 MHz + k*562.5 kHz)
L2OF (1246 MHz + k*437.5 kHz)
k = –7, …, 5, 6

**Galileo:**
E1-B/C (1575.42 MHz)
E5b (1207.140 MHz)

**Beidou:**
B1I (1561.098 MHz) B2I (1207.140 MHz)

**Accuracy of Pulses:**
Dependant on oscillator option:
< +–100ns (TCXO, OCXO LQ)
< +–50ns (OCXO-SQ, -MQ, -HQ, -DHQ)

**Synchronization Time:**
<1 minute in normal operation mode,
approx. 1 minutes after a cold start
(12 minutes in GPS only mode)

**Signal Gain**
40 dB

**Antenna Gain:**
≥ 3.5 dBi / ≥ 3 dBic

**Connection Type:**
SMA female / Antenna

**Cable:**
shielded coaxial line (Belden H155)
Cable lenght: deductible up to max. 70 m

**Power Supply**
5 V DC (via antenna cable)

**Nominal Impedance:**
50 Ohm

**Backup Battery Type:**
CR2032 – button cell lithium battery.
The hardware clock and the RAM are battery buffered. When the main power supply fails, the hardware clock runs free on quartz basis and the almanac data is stored in the RAM.
Life time of lithium battery: min. 10 years

**Figure right:**
GNM Multiband receiver and
GNM with XHE-SPI connector (optional)
LED Indicators

**Init**
- blue: while the receiver passes through the initialization phase
- green: the oscillator has warmed up

**Nav.**
- green: positioning successfully

**Ant**
- red: antenna faulty or not connected
- yellow: the clock is synchronized by an external Signal - MRS mode (PPS, IRIG ...)

**Fail**
- red: time has not synchronized

Pin Assignment of the DSUB9 Connectors (male):

Pin 2: RxD
Pin 3: TxD
Pin 5: GND

Synchronization with PPS + string:
Pin 1: PPS
Pin 2: String *

* The following timestrings (time telegrams) can be used:
  NMEA RMC
  NMEA ZDA
  Meinberg Standard
  Uni Erlangen

Pin Assignment of the optional XHE-SPI Connectors:

A1: PPS In
A2: PPS Out

Pin 1: SCL_Out (SPI Clock)
Pin 2: CS (Chip Select)
Pin 3: MOSI (Master Out, Slave In)
Pin 4: MISO (Master In, Slave Out)
Pin 5: GND

Attention: Use this plug only to connect a MEINBERG IMS-XHE Rubidium expansion chassis.
12.6.9 PZF Clock

Receiver: High accuracy DCF77 correlation receiver
Two separate receiver channels for signal conversion and best acquisition and tracking of the DCF77 signal (AM + PZF).

Synchronization Time: 2-3 minutes after correct DCF77 signal reception

Frequency Outputs: Accuracy depends on oscillator
(standard: OCXO-SQ)

Pulse Outputs: Pulse per second (PPS) and pulse per minute (PPM).
TTL level, pulse width: 200msec

Accuracy of pulses: Better than ±50µsec after synchronization and 20 minutes of operation.

Backup Battery Type: CR2032 – button cell lithium battery
When main power supply fails, hardware clock runs free on quartz basis, almanac data is stored in RAM
Life time of lithium battery min. 10 years

Oscillator Options: OCXO-SQ, OCXO-MQ, OCXO-HQ, OCXO-DHQ

Antenna Connector: BNC female

Antenna Cable: shielded Coax cable

Cable Length: 300 m with standard coax cable

Current Consumption: +5 V 1.1 A to 1.4 A (depends on oscillator)

LED Indicators

Init: blue: while the receiver passes through the initialization phase

Field: green: minimum field strength needed for the correlation reception is detected

Ant Fail: red: antenna faulty or not connected

Fail: red: time is not synchronized

Pin Assignment of the DSUB9 Connectors (male):

Pin 2: RxD
Pin 3: TxD
Pin 5: GND

Synchronization with PPS + String:
Pin 1: PPS
Pin 2: RxD
**12.6.10 TCR Clock - Time Code Reader and Generator**

The IMS - TCR180 serves to decode and generate modulated (AM) and unmodulated (DC Level Shift) IRIG-A/B/G, AFNOR, C37.118 or IEEE1344 time codes. AM-codes are transmitted by modulating the amplitude of a sine wave carrier, unmodulated codes by variation of the width of pulses.

As standard the clock module TCR180 is equipped with a OCXO-SQ (Oven Controlled Xtal Oscillator) as master oscillator to provide a high accuracy in holdover mode of $\pm 1E^{-8}$. Optionally an OCXO-MQ or OCXO-HQ is available for better accuracy.

**Receiver:**
Automatic gain control within the receive circuit for modulated codes allows decoding of IRIG-A/B/G, AFNOR, C37.118 or IEEE1344 signals with a carrier amplitude of 600 mV_{pp} to 8 V_{pp}. The input stage is electrically insulated and has an impedance of either 50 Ω, 600 Ω or 5 kΩ, selectable by a jumper.

DC Level Shift Input insulated by optocoupler with internal series resistance of 220 Ω.

**LED Indicators**

- **Init**
  - blue: while the receiver passes the initialization phase
  - off: Oscillator not warmed up
  - green: the internal timing of the TCR180 is synchronized to the received time code (Lock)

- **Data**
  - green: correct time code detected
  - red: no correct time code detected
  - yellow: TCR180 synchronized by external source (MRS)
  - yellow/green (flashing): Holdover mode (MRS), IRIG Code available
  - yellow/red (flashing): Holdover mode (MRS), IRIG Code not available

- **Tele**
  - green: telegramm consistent
  - red: telegramm inconsistent
  - yellow (flashing): Jitter too large

- **Fail**
  - red: the internal timing of the TCR180 is in holdover mode
  - off: the internal timing of the TCR180 is synchronized to the received time code (Lock)
Generator:
The generator of TCR180 is capable of producing time codes in IRIG-A/B/G, AFNOR, C37.118 or IEEE1344 format. The codes are available as modulated (3 $V_{pp}$ / 1 $V_{pp}$ into 50 $\Omega$) and unmodulated (DC Level Shift) signals (TTL into 50 $\Omega$ and RS-422).

Regarding time code and its offset to UTC, the receiver and the generator can be configured independently. Thus TCR180 can be used for code conversion.

Key Features

- IRIG Generator
- 4 programmable Pulse Outputs
- Frequency Synthesizer
- Battery Type CR2032

Figure 1: Jumper Settings: 600 $\Omega$

Technical Specifications

Receiver Input
AM-input (BNC-connector): insulated by a transformer
impedance settable 50 $\Omega$, 600 $\Omega$, 5 k$\Omega$
600 m$V_{pp}$ to 8 V$V_{pp}$ (Mark)

Input Signal
DC Level Shift input: insulated by photocoupler
internal series resistance: 220 $\Omega$
maximum forward current: 60 mA
diode forward voltage: 1.0 V to 1.3 V

Decoding
Decoding of the following telegrams possible:
IRIG-A132 / A133 / A002 / A003
IRIG-B123 / B122 / B126 / B127 / B002 / B003 / B006 / B007
IRIG-G142 / G146 / G002 / G006
AFNOR NFS 87-500
C37.118
IEEE1344

Accuracy of Time Base
Required Accuracy of Time Code Source: max 100 $\mu$s Jitter / offset 1E-5
Holdover Mode
Automatic switching to crystal time base accuracy approximately 1E-8 if decoder has been synchronous for more than 1h

Backup Battery
If the power supply fails, an onboard realtime clock keeps time and date information important system parameters are stored in the RAM of the system lifetime of the Lithium battery at least 10 years

Generator Outputs
Modulated output: unbalanced sine carrier, 1 kHz
3 V<sub>PP</sub> (MARK), 1 V<sub>PP</sub> (SPACE) into 50 Ω

unmodulated outputs(DCLS):
TTL into 50 Ω, RS-422

Pulse Outputs
Four programmable outputs, TTL level
Default settings: active only 'if sync'

PPO<sub>0</sub> - PPO<sub>3</sub>: Idle (not active)
Timer
Single Shot
Pulse Per Second, Per Minute, Per Hour (PPS, PPM, PPH)
DCF77 Marks
Time Sync
DCLS Time Code
Synthesizer Frequency

Accuracy of Pulses
Better than ± 1 μsec after synchronization and 20 minutes of operation

Serial Port
Configurable RS-232 interface

Baudrates: 300 Bd...115200 Bd
Framing: 7E2, 8N1, 8N2, 8E1, 7N2, 7E1, 801
Mode of operation: string per second
string per minute
string on request

Time telegram: Meinberg Standard, Uni Erlangen, SAT, Meinberg Capture, ION, Computime, SPA, RACAL

Capture Inputs
Triggered by falling TTL slope

Pulse repetition time: 1.5 msec min.
Resolution: 800 nsec
Master Oscillator
OCXO-SQ (Oven Controlled Oscillator)

Accuracy compared to IRIG-reference:
- sync. and 20 min. of operation: $\pm 5 \times 10^{-9}$
- first 20 min. after sync.: $\pm 1 \times 10^{-8}$

- accuracy of oscillator:
  - holdover, 1 day: $\pm 1 \times 10^{-7}$
  - holdover, 1 year: $\pm 1 \times 10^{-6}$

- short term stability:
  - $\leq 10$ sec, synchronized: $\pm 2 \times 10^{-9}$
  - $\leq 10$ sec, holdover: $\pm 5 \times 10^{-9}$

- temperature dependant drift:
  - holdover: $\pm 1 \times 10^{-6}$

Frequency Synthesizer
Output frequency: fixed $\sim 2.048$ MHz

Accuracy:
- like system accuracy
- 1/8 Hz to 10 kHz: Phase synchronous to pulse per second
- 10 kHz to 10 MHz: deviation of frequency $< 0.0047$ Hz

Synthesizer Outputs:
- TTL into $50 \Omega$
- sine wave 1.5 Vrms
- output impedance 200 $\Omega$

Pulse Outputs
- Pulse per second (PPS): TTL- and RS-232 level
  - positive pulse, pulse duration 200 msec
- Pulse per minute (PPM): TTL level
  - positive pulse, pulse duration 200 msec

Pin Assignment of the DSUB9 Connectors (male):

- Pin 2: RxD
- Pin 3: TxD
- Pin 5: GND

Synchronization with PPS + String*:
- Pin 1: PPS
- Pin 2: String *

* The following timestrings (time telegrams) can be used:
  - NMEA RMC
  - NMEA ZDA
  - Meinberg Standard
  - Uni Erlangen
12.6.11 RSC Switch Card

Theory of operation
The RSC- Redundant Switch Control card controls the switchover of the reference clock in redundant systems with two receiver units. The RSC is used to switchover the pulse and frequency outputs and the serial interfaces between the available receivers.

The selection of the reference is done by an internal switch-logic of the RSC. The selection of the active system based on the TIME_SYNC signals which are generated by the receivers. The TIME_SYNC signals are indicate the synchronization of the clocks.

To avoid unnecessary changeovers in case of repeatedly occurring free run operations of one system, the master/backup order is changed with each changeover. For example, let’s suppose the current master system looses its synchronization. Then a changeover is performed to a synchronous slave system and thus the former slave system becomes a new Master. No changeover is done if both systems are asynchronous. In this case the current state stays the same.

Important: To ensure an automatic switchover the remote function in a display-menu should be disabled. "Ref. Time -> Switch Unit": Select Switch Unit -> RSC Cntl -> REMOTE: disable. Otherwise, the system depends on the clock selected by a remote control function and the unit will not switch over to the current active clock.

Display Menu "Remote"
In this operation mode the selection of the reference clock is done by a display menu. A switchover of the reference clock in case of an error does not happen, pulse and frequency outputs and the serial interfaces are always enabled. Deactivation of outputs is possible by a display in the "RSC Cntl" menu.

Display Menu: Switch Unit -> RSC Cntl -> REMOTE : enable
Display menu "Switch Unit -> RSC State"

- SCU State <
  SCU Cntl
  SCU INFO

OK

Mode: automatic
CLK1: CLK2:
MUX: enabled

This menu displays the status information of the RSC:
Mode: manual | automatic | remote
Clock 1 / Clock 2: State of receivers
PSU1/PSU2: State of power supplies
MUX: enabled | disabled | 1/2

enabled/disabled: disabling output signals during a free run
1/2: selected reference clock

Menu "Switch Unit -> RSC Cntl"

->SCU Cntl <
SCU INFO

REMOTE: enabled
>OUTPUT: enab
Selected Clk:

SCU Outputs:
*disabled
*enabled

REMOTE: enable/disable Switching between automatic and remote operation
OUTPUTS: enabled/disabled Disabling outputs during a free run
Selected Clk: 1/2 Selection of the currently active reference clock
12.6.12 LAN-CPU

As the central management and control element, the CPU module in an LANTIME system is responsible for management, configuration and alarm notifications. It additionally provides NTP and SNTP services on its network interface.

Technical specifications IMS LAN CPU C05F1

- **Processor**: AMD Geode™ LX 800 Processor, 400 MT/s memory bus speed
- **Main Memory**: 256 MByte onboard DDR memory
- **Cache Memory**: 128 kByte L2 Cache
- **Flashdisk**: 1 GB
- **Network Connector**: IEEE 802.3u 100Base-Tx via RJ45 jack, Fast Ethernet compatible
- **Power Consumption**: Typ. application 6,9 W @ 5V

Technical Specifications - IMS CPU-C15G2 (LTOS V7 only)

- **Processor**: Intel® Atom™ Processor E Series (2 Cores, 1.33GHz, TDP 3W)
- **Main Memory**: onboard 2MB
- **Cache Memory**: 1MB 2nd Level Cache
- **Flash Disk**: 4 GB
- **Network Connectors**: 1 x 10/100/1000 Base-T with RJ45-Jack 1 x 1000Base-T with SFP-Jack
- **Power Consumption**: Typ. application 6,9 W @ 5V

Interfaces - IMS LAN-CPU

- **Serial Interface**: RJ45 connector console: 38400 / 8N1, connection via CAB-CONSOLE cable
- **USB Port**: install firmware upgrades backup and restore configuration files copy security keys lock / unlock front keys
- **Operating System**: GNU/Linux 4.x
Status LEDs:

LAN 0
LED - Connect, Activity and Speed of the network connection

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

Supported Protocols:

Network Time Protocol (NTP):
  NTP v2 (RFC 1119), NTP v3 (RFC 1305), NTP v4 (RFC 5905)
  SNTP v3 (RFC 1769), SNTP v4 (RFC 4330)

OSI Layer 2 (Data Link Layer):
  PRP (IEC 62439-3)

OSI Layer 3 (Network Layer):
  IPv4, IPv6

OSI Layer 4 (Transport Layer):
  TCP, UDP, TIME (RFC 868), DAYTIME (RFC 867), SYSLOG

OSI Layer 7 (Application Layer):
  HTTP / HTTPS (RFC 2616), DHCP, FTP, NTPv3 / NTPv4, SNTP,
  RADIUS, TACACS, FTP, SSH (incl. SFTP, SCP) - SSH v1.3 /
  SSH v1.5 / SSH v2 (OpenSSH), SNMPv1 (RFC 1157) /
  SNMPv2c (RFC 1901-1908) /
  SNMP v3 (RFC 3411-3418), Telnet (RFC 854-RFC 861)
12.6.13 MRI - Standard Reference Input Signals

If an application requires to use external synchronization sources instead of radio/GNSS signals, an MRI card enables the installed clock module to synchronize to 1PPS, 10 MHz, DCLS and AM time codes (IRIG B, AFNOR, IEEE1344 or C37.118).

Each MRI card is dedicated to one clock module, if a redundant solution requires external synchronization inputs for both clock modules, two MRI cards have to be installed. The MRI card is available with 4x BNC connectors.

<table>
<thead>
<tr>
<th>Reference Inputs:</th>
<th>Time Code unmodulated input (DCLS)</th>
</tr>
</thead>
</table>
| BNC connector, isolated by opto-coupler | Insulation voltage: 3750 Vrms  
Internal series resistor: 330 Ohm  
Max. input current: 25 mA  
Diode forward voltage: 1.0 V - 1.3 V |
| selectable Time Code Inputs, modulated / unmodulated (DCLS): | B122/123 / B002/003 / B126/127 / B006/007  
IEEE1344 (modulated and DCLS)  
AFNOR NFS 87-500 (modulated and DCLS) |

| Time Code modulated input (AM),  |
| BNC connector, isolated by transformer |
| Insulation voltage: 3000 V DC  
Input impedance: 50 Ohm, 600 Ohm, 5 kOhm |
| Internally selectable by jumper (default 600 Ohm) |
| Input signal: 600 mV to 8 V (Mark, peak-to-peak) |

| 10 MHz input, sine (1.5 V_{pp} - 5 V_{pp})  |
| or TTL, female BNC connector |

| PPS input, TTL, pulse duration ≥ 5µs,  |
| active high, female BNC connector |

Figure right: **MRI - standard input signals**  
**via BNC female connectors**
**Status Indicators**

LED St: MRI status
LED In: Status of the backplane’s reference signals
LED A: Status of the input signals (TC-AM/DCLS) at the board
LED B: Status of the input signals (10 MHz/PPS) at the board

**Initialisation:**
LED St: blue until USB is configured
LED In - LED B: off until USB is configured

**USB is configured:**
LED St: blue
LED In - LED B:
0,5 sec. red -> 0,5 sec. yellow -> 0,5 sec. green -> 0,5 sec. off

**Normal Operation:**
LED St + LED In: green
LED A: green, if timecode AM or timecode DCLS
or both signals are available at the same time
LED B: green, if 10 MHz or PPS
or both signals are available at the same time

**Power Requirements:**
5 V +-5%, 50 mA
12.6.13.1 MRI Configuration via the Web Interface

The MRI module is a card for fixed (none configurable) input signals (Time Code AM / DCLS, 10 MHz and PPS). The provided input signals can be monitored and selected in the 'Clock' menu after initializing.

Menu MRS State: Displays the available input signals

MRS settings: selection and prioritization of existing input sources
### 12.6.14 ESI - Telecom Synchronisation References

**Enhanced Synchronisation Inputs**

<table>
<thead>
<tr>
<th>Reference Inputs</th>
<th>PPS and variable frequencies unframed, 1 kHz - 20 MHz 2,048 Mbit/s / 1,544 Mbit/s - E1/T1 framed</th>
</tr>
</thead>
</table>
| Input 1          | 1PPS (BNC female connector)  
TTL, pulse duration $\geq 5\mu s$, active high                                          |
| Input 2          | 1 kHz - 20 MHz (BNC female connector)  
sine (400 mV<sub>pp</sub> - 5 V<sub>pp</sub>) or TTL                                  |
| Input 3          | 1 kHz - 20 MHz (RJ-45)  
400 mV<sub>pp</sub> - 5 V<sub>pp</sub> into 120 Ω, TTL                                      |
| Input 4          | E1 or T1 framed G.703 (RJ-45)  
max. attenuation -12 dB (referred to the signal level) into 120 Ω                         |

**Power Requirements:**  
5 V, $\pm$5%, 250 mA

**Status Indicators**

- **LED St:** ESI status
- **LED In:** Status of the backplane’s reference signals
- **LED A:** Status of the input signals (1 & 2) at the board
- **LED B:** Status of the input signals (1 & 2) at the board

**Operation conditions:**

- **Initialisation:**  
  - LED St: blue until configuration is done
  - LED In: off until configuration is done
  - LED A: off until configuration is done
  - LED B: off until configuration is done

- **Expiration LEDs:**  
  - ALL LEDs: 0,5 sec. red $\rightarrow$ 0,5 sec. yellow $\rightarrow$ 0,5 sec. green $\rightarrow$ 0,5 sec. off

- **Normal Operation:**  
  - LED St: green
  - LED In: green
  - LED A: green, if PPS and Frequency flashing green, if only Frequency flashing yellow, if only PPS off, if no signal
  - LED B: green, if Clock and Framed available flashing green, if only Clock available flashing yellow, if only Framed available off, if no signal
Pin assignment of the RJ-45 jacks (input 3 + 4)

<table>
<thead>
<tr>
<th>Input 3</th>
<th>Input 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1kHz - 10MHz</strong>&lt;br&gt;(2048kHz default)&lt;br&gt;Pin 1: Signal +, Pin 2: Signal -</td>
<td><strong>2048 kB/s - 120 Ohm</strong>&lt;br&gt;Pin 1: BRING, Pin 2: RTIP</td>
</tr>
<tr>
<td><img src="image" alt="RJ-45 3 pin" /></td>
<td><img src="image" alt="RJ-45 4 pin" /></td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>1 2</td>
<td>1 2</td>
</tr>
<tr>
<td>symm. / balanced</td>
<td></td>
</tr>
</tbody>
</table>
12.6.14.1 ESI Configuration via Web Interface

ESI – External Synchronization Input
Menu “IO Config -> Input Configuration -> ESI - External Synchronization Interface”

The ESI (External Synchronization Input) card is capable of adding additional synchronization sources to an IMS system. It accepts E1 and T1 sources as a Bitstream (2.048 MBit/s/1.544 Mbit/s, supporting SSM/BOC).

It also handles configurable frequencies (1 kHz - 20 MHz) and 1PPS pulse synchronization source, if required. An ESI card is, as the MRI card, dedicated to one specific clock module (depending on the slot it is installed in) and can be installed in both ESI as well as MRI slots.

Configurable Inputs

Input 1: The input 1 is dedicated to 1PPS (Pulse Per Second) synchronization.
Input 2: accepts as input signal configurable frequencies from 1 kHz to 20 MHz.

Type:
Freq. In

Frequency
Fill in a configurable frequency, 10 MHz is set as default value.

Maximum Slip n Cycles
A discontinuity of an integer number of cycles in the measured carrier phase resulting from a temporary loss of input signal. The maximum slip number can be selected in range between 0.5 – 3 cycles, with 1.5 as a default value.

Input 3: accepts as input signal configurable frequencies from 1 kHz to 20 MHz. 2048 kHz is set as default value.
Input 4:
As fixed frequency you can choose between E1 framed or T1 framed

Minimum Quality Levels:
Synchronization Status Message (SSM) in accordance with ITU G.704-1998 standard includes 4 bit long SSM quality messages received via incoming E1 framed signal. The clock source quality levels according to G.704-1998 are as follows:

- QL-STU/UKN: Quality unknown, existing synchronization network
- QL-PRS: Primary Reference Source
- QL-PRC: Primary Reference Clock - Rec. G.811
- QL-INV3: reserved
- QL-SSU-A/TNC
- QL-INV5: reserved
- QL-INV5: reserved
- QL-ST2
- QL-SSU-B
- QL-INV9: reserved
- QL-EEC2/ST3
- QL-EEC1/SEC: Synchronous Equipment Timing Source (SETS)
- QL-SMC
- QL-ST3E
- QL-PROV
- QL-DNU/DUS: Do not use for synchronization

Example:
User configured QL-SSU-B as Minimum Quality Level for his system. E1 input signal coming from PRC (G.811) or TNC will be allowed for synchronization, whereas signal coming from Synchronous Equipment Timing Source (SETS) will not be accepted.

Sa Bits
With Sa Bits you can select one of the Sa4 to Sa8 bits which is allocated for SSM quality messages.
12.6.15 LNE-GbE: Network Expansion with Gigabit Support and SFP Option

Link speed: 10/100/1000 Mbita

Connector Type: 8P8C (RJ45)

Cable: CAT 5.0

Duplex Modes: Half/Full/Autonegotiation

LED Indicators
LED St: Init lights blue during initialisation

LED In - LED B: Shows the state of the four LAN ports after initialisation
  green  normal operation
  red    defective LAN port

Figure right:
LNE-GbE and LNE-GbE with SFP Option

Option: LNE-SFP

Interface: 1000BASE-T SFP

Cable: Multimode Fiber
  GI 50/125µm or GI 62.5/125µm gradient fiber
  Singlemode Fiber
  E9/125µm monomode fiber

Link Speed
  Electrical: 1000 Base-T
  Fiber optical: 1000-FX
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>

LAN interface alignment with several LNE modules in operation:

Basically, the physical network ports are assigned according to the MAC address order. Thus, the uppermost interface on a LNE module has the lowest and the bottommost interface has the highest MAC address, respectively. Let’s take an example where three LNE modules are inserted in a device. Then the logical order of network interfaces assigned in a webinterface follows the MAC address order of LNE modules, disregarding the I/O slot order by which the modules are inserted.

In a factory assembling, LNE modules are sorted in an ascending order starting from left to right (see the corresponding figure above). LAN 0 is therefore always the first network interface of the LAN-CPU.
12.6.15.1 LNE-GBE Configuration via the Web Interface

If the LNE-GBE operates in an LANTIME system, all network settings can be configured via the web interface.

Physical Network Configuration

- **Net Link Mode:** The network interfaces LAN1 - LAN4 (LNE-GBE) can be used in 1000 MBIT HALF / FULL duplex mode.

- **Indicate Link:** LED indication for the selected physical interface, only if a front display with function keys is available.

- **Bonding:** to optimize the reliability and the use of a of higher bandwith.

- **PRP:** As of LANTIME firmware version 7.0, PRP can also be conveniently set via the web interface menu "Network → Physical Network Configuration". Select the same PRP group for at least two interfaces in the drop-down menu "Bonding".

- **IPv6 Mode:** This mode must be activated here.

- **MAC-Address:** Displays the unique MAC address of the physical interface.

- **Assigned Virtual Interfaces:** In the Ethernet Interfaces menu (see below) virtual network interfaces can be added.
Menu Interfaces

IPv4: Manually adjustment of all important parameters such as TCP/IP address, subnet mask and gateway. The DHCP client can also be activated here for automatic network configurations.

Misc: With the tab Misc the virtual interface can be assigned to a physical interface.

VLAN: With VLAN, this function can be enabled and configured.

Cluster: The cluster function can be activated with this submenu and additional Parameters such as multicast or unicast mode, TCP/IP address and subnet mask can be set up here.
12.6.15.2 Adding / Removing an LANTIME Network Extension LNE

An LNE module can be installed in each MRI/ESI or IO Slot of a LANTIME IMS device.

Adding a LANTIME Network Extension

After installing the LNE module, please start the web interface. In the menu "System → Services and Functions" press the button NIC Manager then . With this function you add all new physical network interfaces to the system's network configuration. Now it is ensured that the IMS module is correctly installed and recognized by the system.

Remove a LANTIME Network Extension LNE

To remove a LNE network extension from the LANTIME system, the card must first be removed. However, the removed LNE interfaces are still listed in the network configuration. The "NIC Manager" can be used to update the network configuration in this case as well.

After successfully running the "NIC Manager", only the actually existing interfaces are displayed in the web interface. A system restart is not necessary.
12.6.16 HPS-100: PTP / SyncE / Hardware NTP Interface

IEEE 1588 v2 compatible

Profiles:
- IEEE 1588v2 Default Profile
- IEEE 1588v1 (option)
- 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

NTP Mode:
- NTP Server mode (8 ns time stamp accuracy)
- NTPD Software Service (15,000 req./s)

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

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

Ethernet Interface:
- Combo Port: 1 x 100/1000BASE-T RJ45, 1 x GBit SFP – Slot
- A list of tested and recommended optical transceiver modules can be found in chapter Option LNE-SFP

USB Interface:
- USB 1.1 / USB 2.0 full-speed, Micro USB female connector

Signal Outputs:
- 2x SMA (50 Ohm) connectors
- configurable signals: 1PPS, 10MHz, 2048kHz

CPU:
- 825 MHz Cortex A9 Dual Core on SOC

Time Stamp Accuracy:
- 8 ns
LED Indicators

LED St: Init lights blue during initialisation, off in normal operation mode

LED In: red Error - TSU does not work correctly, PTP services stopped
        yellow No link, but initialized
        green link up
        red stopped

LED A - LED B: Shows the current State of the TSU
        yellow - yellow Listening
        green - off Master Mode
        off - green Slave Mode
        yellow - off Passiv Mode
        off - yellow uncalibrated
        red - red stopped

Performance Level Options:

<table>
<thead>
<tr>
<th>Option</th>
<th>Unicast Clients</th>
<th>Delay Req/s</th>
<th>NTP Req/s</th>
<th>PTPv1 Monitoring</th>
<th>PTP Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL-A</td>
<td>8</td>
<td>1024</td>
<td>1600</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>PL-B</td>
<td>256</td>
<td>32768</td>
<td>51200</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>PL-C</td>
<td>512</td>
<td>65536</td>
<td>102400</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>PL-D</td>
<td>1024</td>
<td>131072</td>
<td>204800</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>PL-E</td>
<td>2048</td>
<td>262144</td>
<td>409600</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
A detailed configuration guide you will find in the corresponding firmware manual of the system. See chapter "The Web Interface -> Configuration: PTP V2".

Figure: Webinterface - PTP Menu → Global Configuration
12.6.17 TSU V3: IEEE-1588 Time Stamp Unit

TSU v3 (IEEE 1588 v2 compatible)

Profiles:                   IEEE 1588v2 Default Profile
                          IEEE C.37.238 Power Profile
                          ITU-T G.8265.1 Telecom Frequency Profile
                          ITU-T G.8275.1 Telecom Phase/Time Profile
                          SMPTE ST 2059-2 Broadcast Profile

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

NTP Mode:                NTP Server mode (10 ns time stamp accuracy)

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

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

Ethernet Interface: Combo Port:
                    1 x 100/1000BASE-T RJ45
                    1 x GBIT SFP - Slot

Signal Outputs: 2x BNC (50 Ohm) connectors
                configurable signals: 1PPS, 10MHz, 2048kHz

CPU: 1 GHz Dual Core ARM

Time Stamp Accuracy: 10 ns
**LED Indicators**

**LED St:**  
Init: lights blue during initialisation,  
off in normal operation mode

**LED In:**  
red: Error - TSU does not work correctly,  
yellow: No link, but initialized  
green: link up  
red: stopped

**LED A - LED B:**  
Shows the current State of the TSU  
yellow - yellow: Listening  
green - off: Master Mode  
off - green: Slave Mode  
yellow - off: Passiv Mode  
off - yellow: uncalibrated  
red - red: stopped
12.6.18 IMS PIO: PPS or 10 MHz I/O Module

Technical Specifications:

Connectors: 4 x BNC female, isolated, individually switchable as input or output

Signal Options: PPS or 10 MHz

Status Indicators

LED St: PIO status
LED In: Status of the backplane’s output signals
LED P: display for preset PPS
LED C: display for preset 10 MHz

Initialisation: LED St: blue until USB is configured
LED In - LED B: off until USB is configured

USB is configured: LED St: blue
LED In:
0,5 sec. red -> 0,5 sec. yellow ->
0,5 sec. green -> 0,5 sec. off

Normal Operation: LED St. + LED In: green
LED P: green, if card is preset to PPS
LED C: green, if card is preset to 10 MHz
12.6.18.1 PIO - Configuration via the Web Interface

The PIO module is pre-configured by a jumper. The default configuration of all ports is PPS (Pulse Per Second). If this pre-configuration needs to be changed to 10 MHz, the card must be removed and the jumper position adjusted.

Via the web interface, each port can be set separately to "Input" or "Output". If a port is set to "Output", the system PPS or the 10 MHz reference frequency is output signal at this port. If a port is set to "Input" the incoming signal is compared to the system PPS or to the 10 MHz reference frequency. The offset values are displayed in the status window.
12.6.19 CPE and BPE Output Modules (Frontend - Backend, Eurocard)

Configurable Port Expander / Backplane Port Expander

The standard output signals like pulses (1PPS, 1PPM and freely programmable pulses) and frequencies (10MHz, 2.048MHz, frequency synthesizer 1kHz-10MHz) are provided by two versatile I/O cards named BPE and CPE. Both of these two modules have been designed to cover a wide range of interface and signal/protocol requirements. They feature a two-tier architecture with a back-end and front-end.

The back-end is responsible for internally routing the backplane IMS synchronization signals (in case of the BPE) or for autonomously generating a wide range of different signals by using a microprocessor (on a CPE). The front-end makes a selection of the signals available on physical connectors.

BPE - Backend

CPE - Backend
12.6.19.1 BPE - Backplane Port Expander

Please Note:
In principle, it should be noted that the signals that are provided via a BPE at the various connectors are always generated by the upstream clock and spread via the backplane of the system. In opposite to the CPE, the signals are not generated by the module and therefore the outputs can only be set via the receiver.

The selection and settings of the signals such as frequency, time code or programmable pulse outputs can be done via the web interface menu "Clock" or "Clock Switch Card" (for redundant systems).

Output Signals:
fixed:
10 MHz, PPS, IRIG DCLS, IRIG AM, 2.048 MHz,
PPOs (selectable via receiver)

Power Requirements:
5 V +/-5%, 150 mA / BNC
5 V +/-5%, 150 mA / FO

Status Indicators
LED St: BPE status
LED In: Status of the backplane’s output signals
LED A: BPE status - output signals (1 + 2)
LED B: BPE status - output signals (3 + 4)

Note:
When pulse trains >= 1.6 s are configured, the LED assigned to the output remains 'red' as these pulse trains are not monitored (e.g. PPM, PPH ...).

Initialisation:
LED St: blue until USB is configured
LED In - LED B: off until USB is configured

USB is configured:
LED St: blue
LED In - LED B:
0.5 sec. red -> 0.5 sec. yellow ->
0.5 sec. green -> 0.5 sec. off

Normal Operation:
LED St. + LED In: green
LED A: green, if the desired signal is present on output 1 and output 2
LED B: green, if the desired signal is present on output 3 and output 4

Figure right: BPE Outputs
BPE-2000 Standard outputs - BNC female:
PPS, 10 MHz, TC DCLS and TC AM

BPE 5000 Fiber Optic ST-Connectors
PPS, 10 MHz, TC DCLS und 2048kHz
### 12.6.19.2 Available BPE Modules

<table>
<thead>
<tr>
<th>BPE Type</th>
<th>Connectors</th>
<th>Signals</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPE-1040</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-1060 ¹</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: DCF77 SIM</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2000</td>
<td>4 x BNC female</td>
<td>Out 1: PPS, Out 2: 10 MHz, Out 3: TC DCLS, Out 4: TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2001</td>
<td>4 x BNC female</td>
<td>Out 1: PPS, Out 2: 10 MHz, Out 3: TC DCLS, Out 4: TC DCLS</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2010</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2014</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 2: PPS, Out 3 - Out 4: 10 MHz</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2016 ²</td>
<td>4 x BNC Buchse</td>
<td>Out 1 - Out 4: progr. Pulses_1 10 Vpp an 50 Ω</td>
<td>4TE</td>
</tr>
<tr>
<td>BPE-2020</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: 10 MHz</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2030</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: TC DCLS</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2050</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 3: TC DCLS, Out 4: TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2080</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: 2048 kHz</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2090</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: progr. Pulses</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2091 ³</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: progr. Pulses_1</td>
<td>4HP</td>
</tr>
</tbody>
</table>

(1) When using the BPE-1060 module, important configuration parameters must be observed. In the web interface, you must set the mode to DCF77 Marks in the "Clock → Programmable Pulse Outputs → Prog. Out 1" menu. In the drop-down box "Signal" the setting Normal is to be selected. In the menu "Clock → Time Zone → Time Zone for external Outputs" the Local Time Zone must be selected.

If the corresponding time zone does not exist in this drop-down box, the time zone can be added manually in the menu "System → Display → Edit Time Zone Table".

See BPE-1060 4 x SIM77

(2) The outputs can be set by jumpers. Possible options are: PPS, Time Code DCLS, PPO_0, PPO_1, PPO_2 and PPO_3. Default jumper setting of this card is 4 x PPO_0 (Progr. Output 1 in the web interface).

(3) All four outputs of this BPE module have to be configured via the upstream receiver. In the web interface, the configuration of the output signals can be carried out via the menu "Clock → Programmable Pulse → Prog. Out 1". Here the option "PTTI 1PPS" must be selected to get a pulse length of 20µs.
<table>
<thead>
<tr>
<th>BPE Type</th>
<th>Connectors</th>
<th>Signals</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPE-2110</td>
<td>8 x BNC female</td>
<td>Out 1 - Out 8: PPS</td>
<td>8HP</td>
</tr>
<tr>
<td>BPE-2120</td>
<td>8 x BNC female</td>
<td>Out 1 - Out 8: 10 MHz</td>
<td>8HP</td>
</tr>
<tr>
<td>BPE-2180</td>
<td>8 x BNC female</td>
<td>Out 1 - Out 8: 2048 kHz</td>
<td>8HP</td>
</tr>
<tr>
<td>BPE-2500</td>
<td>4 x 2pin DFK, PhotoMOS, 1 x BNC female</td>
<td>Out 1 - Out 4: Progr. Pulse, Out 5 - TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2600</td>
<td>4 x 2pin DFK</td>
<td>Out 1: PPS, Out 2: 10 MHz, Out 3: TC DCLS, Out 4: TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2700</td>
<td>4 x 2pin DFK, Opto Coupler, 1 x BNC female</td>
<td>Out 1 - Out 4: Progr. Pulses, Out 5 - TC AM</td>
<td>4HP</td>
</tr>
</tbody>
</table>

**BPE modules with serial ports (D-SUB9 jacks)**

<table>
<thead>
<tr>
<th>BPE Type</th>
<th>Connectors</th>
<th>Signals</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPE-3014</td>
<td>2 x D-SUB9 female</td>
<td>Out 1, Out 2: TC DCLS, RS-422 Level</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-3050</td>
<td>2 x D-SUB9 female</td>
<td>Out 1, Out 2: Progr. Pulse, RS-422 Level</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-3412</td>
<td>1 x D-SUB9 female, 2 x BNC female</td>
<td>Out 1: Progr. Pulses, RS-422, Out 2, Out 3: TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-3422</td>
<td>4 x D-SUB9 female</td>
<td>Out 1 - Out 4: 1MHz, RS-422 Pegel</td>
<td>8HP</td>
</tr>
<tr>
<td>BPE-3424</td>
<td>4 x D-SUB9 female</td>
<td>Out 1 - Out 4: TC DCLS, RS-422 Pegel</td>
<td>8HP</td>
</tr>
<tr>
<td>BPE-3082</td>
<td>4 x D-SUB9 female</td>
<td>Out 1 - Out 4: 2048 kHz sine</td>
<td>8HP</td>
</tr>
</tbody>
</table>

(4) The outputs COM A and COM B are configured via the upstream receiver in the web interface (Menu "Clock → Programable Pulses → Prog. Out 1"). The programable pulses PP_0 of the clock are connected to both outputs of the BPE-3050 via the backplane.
<table>
<thead>
<tr>
<th>BPE Type</th>
<th>Connectors</th>
<th>Signals</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPE-4043</td>
<td>4 x RJ45</td>
<td>RS422, Pin_3 T-, Pin_6 T+</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-6042</td>
<td>2 x DMC 16-pin</td>
<td>10 x PPO - RS-422 galvanic isolated</td>
<td>4HP</td>
</tr>
</tbody>
</table>

**Fiber-Optical Outputs**

<table>
<thead>
<tr>
<th>BPE Type</th>
<th>Connectors</th>
<th>Signals</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPE-5000</td>
<td>4 x FST</td>
<td>PPS, 10 MHz, TC-DCLS, 2048 kHz FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5010</td>
<td>4 x FST</td>
<td>PPS / FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5014</td>
<td>4 x FST</td>
<td>2 x PPS + 2 x 10 MHz / FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5020</td>
<td>4 x FST</td>
<td>10 MHz / FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5030</td>
<td>4 x FST</td>
<td>TC DCLS / FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5032</td>
<td>4 x FST</td>
<td>TC DCLS / FO Singlemode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5080</td>
<td>4 x FST</td>
<td>2048 kHz / FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5082</td>
<td>4 x FST</td>
<td>PPS, 10 MHz, 2 x 2048 kHz FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5090</td>
<td>4 x FST</td>
<td>PPO / FO Multimode</td>
<td>4HP</td>
</tr>
</tbody>
</table>
12.6.19.3 Configuring an BPE expansion card via the Web Interface

A simple BPE expansion card usually gets its signals directly from the internal backplane of the system. The output signals of the card are pre-configured according to customer requirements.

If an output signal has to be changed, this must be done via the pre-connected receiver - in the menu "Clock → Switch Card" if you have a redundant system or in the menu "Clock → Receiver" in systems with only a single receiver. The BPE modules have no direct configuration options. This information is also displayed in the "IO Config" menu.

![Figure: menu "Clock → Switch Card → IRIG Settings"

![Figure: menu "Clock → Programmable Pulses → Selection of Idle mode"]
12.6.19.4 BPE-8000 - Switchable Backplane Port Expander

Output Signals:
- adjustable via the web interface (TTL or Fiber Optical):
  - PPS, 10 MHz, 2048 kHz, TC-DCLS, Progr. Pulses
  - 2048 kHz (ITU G.703-15), TC-AM

- fixed:
  - 2048 kHz (ITU G.703-15), TC-AM

Power Requirements:
- 5 V ±5%, 150 mA / BNC
- 5 V ±5%, 150 mA / FO

Status Indicators
- LED St: BPE status
- LED In: Status of the backplane’s output signals
- LED A: BPE status - output signals (1 + 2)
- LED B: BPE status - output signals (3 + 4)

Initialisation:
- LED St: blue until USB is configured
- LED In - LED B: off until USB is configured

USB is configured:
- LED St: blue
- LED In - LED B:
  - 0,5 sec. red -> 0,5 sec. yellow ->
  - 0,5 sec. green -> 0,5 sec. off

Normal Operation:
- LED St. + LED In: green
- LED A: green, if the desired signal is present on output 1 and output 2
- LED B: green, if the desired signal is present on output 3 and output 4
Available BPE-8000 Models

<table>
<thead>
<tr>
<th>BPE Module</th>
<th>Connectors</th>
<th>Signal Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPE-8000</td>
<td>4x BNC female</td>
<td>TTL</td>
</tr>
<tr>
<td>BPE-8100</td>
<td>4x ST</td>
<td>Fiber Optic – Multimode</td>
</tr>
<tr>
<td>BPE-8200</td>
<td>2x ST, 2x BNC female</td>
<td>2x Fiber Optic – Multimode, 2x TTL</td>
</tr>
<tr>
<td>BPE-8300</td>
<td>4x ST</td>
<td>Fiber Optic – Singlemode</td>
</tr>
<tr>
<td>BPE-8400</td>
<td>2x ST, 2x BNC female</td>
<td>2x Fiber Optic – Singlemode, 2x TTL</td>
</tr>
<tr>
<td>BPE-8500</td>
<td>4x ST</td>
<td>2x Fiber Optic – Multimode, 2x Fiber Optic – Singlemode</td>
</tr>
<tr>
<td>BPE-8600</td>
<td>4x BNC female</td>
<td>2048 kHz (ITU G.703-15 – 75 Ω unbalanced) *</td>
</tr>
<tr>
<td>BPE-8700</td>
<td>4x BNC female</td>
<td>3x TTL, 1x Modulated Time Code – TC-AM **</td>
</tr>
</tbody>
</table>

* Fixed outputs, no signal selection possible.
** BNC sockets Out 1 - Out 3 are freely programmable, Out 4 is permanently set to TC AM.
12.6.19.5 Configuring an BPE-8000 expansion card via the Web Interface

Via the web interface or the Meinberg Device Manager (MDU), the following signals can be distributed to the BNC connectors (TTL) or fiber optical connectors (ST) according to your choice: PPS, 10MHz, Time Code DCLS, 2048 kHz and programmable pulse outputs PP 1 - PP 4 of the upstream reference source. With the programmable pulse outputs, each output channel of the pulse generator (IMS receiver) can now also be switched through to all available connectors of the BPE (for example PP 1 to Out 1 - Out 4 of the BPE).

*Figure: Web interface menu “IO Config → Output Configuration”*
12.6.19.6 BPE-1060 4 x SIM77

Backplane Port Expander (Frontend / Backend)

Output Signals: fixed: Out 1 - Out 4: SIM77 (DCF77 compatible Signal) via isolated female BNC connectors (-60dBm)

Power Requirements: 5 V +-5%, 150 mA / BNC
5 V +-5%, 150 mA / FO

Status Indicators
LED St: BPE status
LED In: Status of the backplane’s output signals
LED A: BPE status - output signals (1 + 2)
LED B: BPE status - output signals (3 + 4)

Initialisation: LED St: blue until USB is configured
LED In - LED B: off until USB is configured

USB is configured: LED St: blue
LED In - LED B:
0,5 sec. red -> 0,5 sec. yellow ->
0,5 sec. green -> 0,5 sec. off

Normal Operation: LED St. + LED In: green
LED A: green, if the desired signal is present on output 1 and output 2
LED B: green, if the desired signal is present on output 3 and output 4
**SIM77 - amplitude-modulated time signal**
The amplitude-modulated time signal is compatible with the DCF77 signal, transmitted by the German long-wave transmitter. The SIM77 signal is provided via four DC insulated BNC sockets.

![Programmable Output](image)

**Note:**
Important configuration parameters must be observed when using the BPE-1060 module in an IMS system. In the Web Interface, in the menu "Clock → Programmable pulse outputs → Prog. Out 1", the mode must be set to *DCF77 Marks*. In the "Signal" drop-down box, select *Normal* (see figure right).

The local time zone must be selected in the menu "Clock → Time Zone → Time Zone for External Outputs".

![Switch Card](image)

If the corresponding time zone is not available in this drop-down box, the time zone can be added manually in the menu "System → Display → Edit time zone table".
In the example below, several time zones are entered with the changeover rule for summer and winter time.

<table>
<thead>
<tr>
<th>Time Zone ID</th>
<th>Time Zone</th>
<th>Changeover Rule</th>
<th>Summer Time</th>
<th>Winter Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>(UTC-10)</td>
<td>HST/MDT</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC-9)</td>
<td>AST/ADT</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC-8)</td>
<td>PST/PDT</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC-7)</td>
<td>MST/MDT</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC-6)</td>
<td>CST/CDT</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC-5)</td>
<td>EST/EDT</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC)</td>
<td>UTC/UCT</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC+1)</td>
<td>CET/CEST</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC+2)</td>
<td>EET/EST</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC+3)</td>
<td>EET/EST</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC+4)</td>
<td>CET/CET</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC+5)</td>
<td>CST/CST</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC+6)</td>
<td>CST/CST</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
<tr>
<td>(UTC+7)</td>
<td>CST/CST</td>
<td>±01:00</td>
<td>02:00:00</td>
<td>01:00:00</td>
</tr>
</tbody>
</table>

Please note, that these settings will also affect other output modules which provide the programmable pulse output “Prog. Out 1”.
12.6.19.7 CPE - Configurable Port Expander (Frontend)

CPE (Configurable Port Expander)
The CPE is a configurable IO card that can autonomously generate additional output signals from the integrated system clock. This module consists of a half-size standard controller card (back-end) and a dockable port expander card (front-end), like this a wide variety of available programmable output signals and physical connections are possible, including various electrical and optical interfaces.

This enables the CPE, in combination with the front end COI TS2 (CPE 3000 ...), to support up to 4 more configurable interfaces that can optionally be led out as RS-232, RS-422 or RS-485 signal type. Furthermore, up to 8 programmable outputs (PPO) can be generated and configured in the web interface. The settings of the desired output configuration are selected in the IO Config -> Output Configuration.

It should be noted that the desired signals can be realized only with the corresponding front card.

Output Signals: configurable:
10 MHz, PPS, IRIG DCLS, IRIG AM, PPO

Capture-Input: active high or active low,
permitted input level +5 V (DC)

Power Supply: +5 V (DC), 150-300 mA,
depending on the selected frontend

Environmental: Temperature 0-50 °C
Humidity max. 85 %, non condensing

Status Indicators
LED St: CPE status
LED In: Status of the backplane's output signals
LED A: currently not used
LED B: currently not used

LED Indicators
LED St: blue during initialisation
green normal operating mode

LED In: red no signal
yellow signal available / not sync
green flash time sync but not accurate
green time sync and accurate

LED A: green currently not used
LED B: green currently not used

Figure: CPE Frontends
CPE-1000: 4 config. outputs via BNC female
CPE-5000: 4 config. outputs / FO - ST connectors
CPE-2500: 4 x prog. Pulses (DFK-2) / 1 x TC AM (BNC)
### 12.6.19.8 Available CPE Modules

<table>
<thead>
<tr>
<th>BPE Type</th>
<th>Connectors</th>
<th>Signals</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPE-1000</td>
<td>4 x BNC female</td>
<td>prog. pulses</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-1002</td>
<td>1 x D-SUB9, 2 x BNC female</td>
<td>Time Telegram, RS232 Capture Inputs</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-1040</td>
<td>4 x BNC female</td>
<td>TC AM / BNC</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-1050</td>
<td>4 x BNC female</td>
<td>3 x progr. pulses, 1 x TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-2500</td>
<td>4 x DFK 2-pin PhotoMos, 1 x BNC female</td>
<td>progr. Pulse, TC AM</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3000</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS-232 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3010</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS-422</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3020</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS-422 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3030</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS-485</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3040</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS-485 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3050</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS-422</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3060</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS-422 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-4020</td>
<td>2 x RJ45</td>
<td>serial timestring RS-422 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-5000</td>
<td>4 x FST female</td>
<td>prog. pulses / fiber optical</td>
<td>4HP</td>
</tr>
</tbody>
</table>
12.6.19.9 CPE-3000: Programmable Outputs via serial Interface

The CPE-3000 module has two serial ports (COM A and B) for various output signals. The two interfaces can also be used for communication with other devices.

The possible pin assignments and module types are listed below:

<table>
<thead>
<tr>
<th>PIN</th>
<th>CPE-3000</th>
<th>CPE-3010</th>
<th>CPE-3020</th>
<th>CPE-3030</th>
<th>CPE-3040</th>
<th>CPE-3050</th>
<th>CPE-3060</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PPO</td>
<td>RxD +</td>
<td>RxD +</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>PPO</td>
</tr>
<tr>
<td>2</td>
<td>TxD</td>
<td>RxD -</td>
<td>RxD -</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>TxD</td>
</tr>
<tr>
<td>3</td>
<td>RxD</td>
<td>-</td>
<td>TxD +</td>
<td>-</td>
<td>TxD + / RxD +</td>
<td>-</td>
<td>RxD</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>TxD -</td>
<td>-</td>
<td>TxD - / RxD -</td>
<td>-</td>
<td>TxD</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>TxD +</td>
<td>PPO +</td>
<td>TxD + / RxD +</td>
<td>PPO +</td>
<td>-</td>
<td>PPO +</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>TxD -</td>
<td>PPO -</td>
<td>TxD - / RxD -</td>
<td>PPO -</td>
<td>-</td>
<td>PPO -</td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
12.6.19.10 CPE-4020: Programmable Outputs via serial Interface

The module CPE-4020 has two interfaces with RJ45-connector (COM A and B). These provide Time String + PPS with RS422 level. The following configurations must be performed to correctly output the signals.

**Baud Rate**
19200

**Framing**
8N1

**String Type**
Meinberg GPS

**Mode**
per second (PPS)

**Pin assignment**

- **Pin 3:** TXD_P, serial interf. transmit pos.
- **Pin 5:** GND (Ground)
- **Pin 6:** TXD_N, serial interf. transmit neg.
- **Pin 7:** SYNC_P, PPS transmit, pos.
- **Pin 8:** SYNC_N, PPS transmit, neg.

**Current Consumption:**
5 V +-5%, 150 mA

**Connection type:**
8P8C (RJ45)

**Cable:**
Copper twisted pair, e.g. CAT 5.0
12.6.19.11 CPE-4020 Configuration via Web Interface

If the CPE-4020 operates in an IMS system, the output configuration can easily be done via the web interface then.

With the "Common" tab the time zone with the corresponding offset can be selected.

**Configuration: CPE-4020**

In the "IO Config" menu you can select the following values for the output connectors:

- **Common:** Time zone with the corresponding UTC offset value
- **Synthesizer:** Frequency Synthesizer range 1 Hz - 10 MHz
- **IRIG Code:** Generated IRIG output codes (B002+B122 ...)
- **Serial:** Serial connection parameters
- **Prog. Out:** Programmable outputs Prog. Out 1 and Prog. Out 2

![Serial connection parameter settings](image)

Figure: Serial connection parameter settings

The following programmable pulse outputs can be selected:

- **Idle** (not in use)
- **Timer** (3 switching-times On – Off)
- **Single Shot** (pulse length and start time)
- **Cyclic Pulse** (pulse length and cycle time)
- **Pulse Per Second** (pulse length)
- **Pulse Per Minute** (pulse length)
- **Pulse Per Hour** (pulse length)
- **DCF77 Marks** (timeout)
- **Position OK** (position determined)
- **Time Sync** (clock synchronized)
- **All Sync** (position determined and clock synchronized)
- **DCLS Time Code**
- **Synthesizer Frequency**
### Figure: Selection of programmable pulse outputs

The image shows the configuration settings for a Configurable Port Expander 1 (CPE) with programmable pulse outputs. The interface includes options for setting parameters such as pulse length, on time, off time, and signal mode. The diagram highlights the selection of programmable pulse outputs for specific applications like time, single-shot, cyclic pulse, and more.
12.6.19.12 CPE - Configuration via Web Interface

If the CPE operates in an IMS system, the output configuration can easily be done via the web interface then.

With the "Common" tab the time zone with the corresponding offset can be selected.

CPE Configuration

In the "IO Config" menu you can select the following values for the output connectors:

- **Common**: Time zone with the corresponding UTC offset value
- **Synthesizer**: Frequency Synthesizer range 1Hz - 10 MHz
- **IRIG Code**: Generated IRIG output codes (B002+B122 ...)
- **Prog. Out**: Programmable output Prog. Out 1 - Prog. Out 4

*Figure: Menu Tab "Synthesizer" Frequency for selecting the Frequency Synthesizer option in the menu "Prog. Out"*
The following programmable pulse outputs can be selected:

- **Idle** (not in use)
- **Timer** (3 switching-times On - Off)
- **Single Shot** (pulse length and start time)
- **Cyclic Pulse** (pulse length and cycle time)
- **Pulse Per Second** (pulse length)
- **Pulse Per Minute** (pulse length)
- **Pulse Per Hour** (pulse length)
- **DCF77 Marks** (timeout)
- **Position OK** (position determined)
- **Time Sync** (clock synchronized)
- **All Sync** (position determined and clock synchronized)
- **DCLS Time Code**
- **Synthesizer Frequency**
12.6.20 LIU - Line Interface Unit

Input signal: 2.048 MHz reference clock, TTL level

Clock:
- T1 - 1.544 MHz
- E1 - 2.048 MHz

BITS:
- Framed Outputs 1544 kBit/s
  or 2048 kBit/s (ESF - Extended Superframe)
- T1 - 1.544 MBit/s
- E1 - 2.048 MBit/s

Outputs:
- balanced - RJ45 jack - 120 Ω (Clock)
- unbalanced - BNC connector 75 Ω (Bits)

Short term stability and Accuracy:
depends on oscillator of the reference clock
- OCXO-SQ: \(\pm 5 \times 10^{-10}\)
- OCXO-MQ: \(\pm 2 \times 10^{-10}\)
- OCXO-HQ: \(\pm 5 \times 10^{-12}\)
- OCXO-DHQ: \(\pm 2 \times 10^{-12}\)
- Rubidium: \(\pm 2 \times 10^{-11}\)

LED Indicators

Power T1 E1

Power: Init blue during initialisation, green in normal operation mode

T1:
- green: selected mode T1
- red: output disabled
- yellow: signal quality unknown

E1:
- green: selected mode E1
- red: output disabled
- yellow: signal quality unknown
12.6.20.1 IMS-LIU Telecom Output Signals

The board LIU (Line Interface Unit) was designed to convert the GNSS-locked standard frequency of a pre-connected Meinberg satellite controlled clock (GPS or GPS/GLONASS/Galileo/BeiDou) into several timing signals that can be used for various synchronization or measurement tasks.

Typical applications are:

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

There are two separate signal paths on the board LIU. One is for providing the standard frequencies, the second path is for generation of the "telecom-signals". All output signals have high accuracy and stability because they are derived from the internal receiver’s disciplined standard frequencies generated by the pre-connected satellite clock. Depending on the oscillator option of the internal receiver, the accuracies which are described in chapter LIU - Line Interface Unit can be achieved.
12.6.20.2 Block Diagram LIU

The following block diagram illustrates the functional principle of the board LIU:

LIU V3

- USB/IMS interface
- RS232 interface
- micro controller
- low pass filter
- framer & line interface

- framed outputs T1.403/G703-9, balanced (or unbalanced), 1.544 Mbps or 2.048 Mbps
- clock outputs G703-13, balanced 1544 kHz or 2048 kHz
- clock outputs G703-13, unbalanced 1544 kHz or 2048 kHz

4.096 MHz
12.6.20.3 Telecom Signals

These signals can be divided into two groups: the "clock" outputs and the "framed" outputs, that are provided by a framer and line interface device on the board LIU. All clock signals needed for generation of the 'telecom outputs' are derived from a 2048 kHz reference clock, which is generated by a frequency synthesizer on the preconnected GPS- or GLN-clock. This synthesizer is phase locked to the PPS signal and frequency locked to the master oscillator of the clock.

The module LIU is able to generate signals for the American T1- or the European E1-system. The mode of operation can be configured via the web interface of the IMS management module (LAN-CPU).

The clock outputs are standard frequencies of either 1544 kHz (T1) or 2048 kHz (E1). Four unbalanced and four balanced outputs according to ITU-T G703-13 (CCITT recommendation 'Physical/electrical characteristics of hierarchical digital interfaces') are available via BNC female and RJ45 connectors.

The 'framed' outputs are consisting of data signals known from digital telephony, which are distributed by using a special frame structure (EFS Framing Mode - Extended Superframe). As a synchronization unit, LIU only generates a "framed all ones" signal (data byte 0xFF hex) with a transmission speed of either 1544 kBit/s (T1) or 2048 kBit/s (E1). Four outputs according to ANSI T.403 (T1-mode) or ITU-T G703-9 (E1-mode) are available either unbalanced via BNC connectors or balanced via RJ45 connectors. Two different line codes used for error correction are known for the transmission of framed signals. The board LIU generates B8ZS- (in T1-mode) or HDB3-coded (in E1-mode) output signals by standard.
12.6.20.4 Pulse templates

The following pulse templates are required by ANSI (T1-mode) and CCITT (E1-mode) for output signals in telecom applications. The board LIU meets these recommendations.

**T1 (T.403):**

![T1 Pulse Template Diagram]

**E1 (G.703):**

![E1 Pulse Template Diagram]
12.6.20.5 LIU - Configuration Samples

The Line Interface Unit (LIU) is available in two different sizes and different output / connector options. All outputs of a module can be operated in either the E1 or T1 mode. Signal output settings can be done during operation via the web interface. The selected mode is indicated by the LEDs in the retainer plate.

Signal Types

- 2048 kHz (E1 mode) or 1.544 MHz (T1 mode), G.703, 120 Ω, balanced, RJ45 socket
- 2048 kHz (E1 mode) or 1.544 MHz (T1 mode), G.703, 75 Ω, unbalanced, BNC connector
- 2048 kBit/s (E1 mode) or 1.544 MBit/s (T1 mode), 120 Ω, balanced, RJ45 socket
- 2048 kBit/s (E1 mode) or 1.544 MBit/s (T1 mode), 75 Ω, unbalanced, BNC connector

12.6.20.6 Overview - LIU Modules for IMS Systems

<table>
<thead>
<tr>
<th>LIU Model</th>
<th>Size</th>
<th>Signal (bal./unbal.)</th>
<th>Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIU-A0040</td>
<td>4TE</td>
<td>Clock (4/0)</td>
<td>4 x RJ45</td>
</tr>
<tr>
<td>LIU-A0004</td>
<td>4TE</td>
<td>Clock (0/4)</td>
<td>4 x BNC</td>
</tr>
<tr>
<td>LIU-A2020</td>
<td>4TE</td>
<td>BITS (2/0)</td>
<td>2 x RJ45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (2/0)</td>
<td>2 x RJ45</td>
</tr>
<tr>
<td>LIU-A2002</td>
<td>4TE</td>
<td>BITS (2/0)</td>
<td>2 x RJ45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (0/2)</td>
<td>2 x BNC</td>
</tr>
<tr>
<td>LIU-A0100</td>
<td>4TE</td>
<td>BITS (0/4)</td>
<td>4 x BNC</td>
</tr>
<tr>
<td>LIU-A1111</td>
<td>4TE</td>
<td>BITS (1/1)</td>
<td>1 x RJ45, 1 x BNC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (1/1)</td>
<td>1 x RJ45, 1 x BNC</td>
</tr>
</tbody>
</table>
12.6.21 LNO - 10 MHz Sinus Output Module

The LNO180 is a 10 MHz generator card, which provides sine signals with low phase noise to 4 external outputs. The card has a microprocessor system, which monitors the output signals and generates status signals for the upper-level management system accordingly.

Function of Operation
The card has a high quality oscillator, which is locked to an external 10 MHz signal. The microprocessor monitors the lock status of the PLL and the warm up phase of the oscillator. It activates the outputs only after the phase is locked. This condition is signalized by all LEDs switched from green to red. In the phase locked state the output levels of the four outputs are monitored and in case of a failure signalized by an associated red LED.

Technical Specifications:
Frequency Input: 10 MHz, sine (1Vp-p, min.) or TTL
Output Level: 5 dBm +/- 1 dBm at 50Ω
Option: LNO-12dB with 12 dBm output level
Warm-up time: < 3 @ 25 °C within accuracy of < +1 x 10^-7
Electrical Connectors: BNC female
Harmonics: -60 dBc
Phase Noise: OCXO SQ
1 Hz -70 dBc/Hz
10 Hz -105 dBc/Hz
100 Hz -125 dBc/Hz
1 kHz -140 dBc/Hz
OCXO HQ:
1 Hz < -85 dBc/Hz
10 Hz < -115 dBc/Hz
100 Hz < -130 dBc/Hz
1 kHz < -140 dBc/Hz
Terminal Connector: 96-pin VG-rail DIN 41612
Power Supply: 5 dBm +5V @ 550 mA (steady state),
+5V @ 670 mA (warm up)
12 dBm: +5V @ 970 mA (steady state),
+5V @ 620 mA (warm up)
Quartz Filter: Bandwidth 1 kHz
Ambient Temperature: 0 ... 50 °C / 32 ... 122 °F
Storage Temperature: -20 ... 70 °C / -4 ... 158 °F
Humidity: max 85%
**LED Status Indicators:**

All LEDs red
- Outputs disabled
- PLL not locked
- OCXO in warm up phase
- 10 MHz reference not available
- Quality of the reference signal is not sufficient

All LEDs green:
- Normal operation, outputs activated

Associated LED red:
- Defect output or short circuit during normal operation
12.6.22 FDM - Frequency Deviation Monitoring

The module FDM180 was designed to calculate and monitor the frequency and its deviation in 50/60Hz power line networks.

A preconnected reference is necessary that provides a serial time string and a PPS (pulse per second). The accuracy of the measurements is derived from these signals. The module calculates the frequency as well as the time, based on the mains frequency. The time deviation (TD) is the difference of this calculated time (PLT) to the reference time (REF). This time deviation as well as the frequency itself is sent out via serial interface or is being converted to an analog voltage output provided by a DAC.

Pin Assignement: 16-pin DMC Phoenix Connector

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>A0</td>
</tr>
<tr>
<td>Pin 2</td>
<td>A1</td>
</tr>
<tr>
<td>Pin 3</td>
<td>GND</td>
</tr>
<tr>
<td>Pin 4</td>
<td>n.c.</td>
</tr>
<tr>
<td>Pin 5</td>
<td>n.c.</td>
</tr>
<tr>
<td>Pin 6</td>
<td>GND</td>
</tr>
<tr>
<td>Pin 7</td>
<td>COM 0 RxD in</td>
</tr>
<tr>
<td>Pin 8</td>
<td>COM 0 TxD out</td>
</tr>
<tr>
<td>Pin 9 – Pin 14</td>
<td>GND</td>
</tr>
<tr>
<td>Pin 15</td>
<td>COM 1 RxD in</td>
</tr>
<tr>
<td>Pin 16</td>
<td>COM 1 TxD out</td>
</tr>
</tbody>
</table>

LED Indicator

**LED St:**
- Init: blue during initialisation
- green - normal operation

**LED In:**
- red: ref not connected / FDM not sync
- yellow: ref. signal not useable
- green blinking: Timesync
- green: Accurate (≤ 200 ns to reference)

**LED A:**
- green: FD (Frequency Deviation) within the configured limits
- red: FD Overflow

**LED B:**
- green: TD (Time Deviation) within the configured limits
- red: TD Overflow
Input signal: Serial time string, PPS
mains frequency, 70 - 270VAC, 50Hz or 60Hz

Interface: Two asynchronous serial RS-232 ports, COM0 and COM1
Baudrate: 600, 1200, 2400, 4800, 9600, 19200 Baud
Framing: 7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 7O2, 8O1
output and average: once per second or 100ms

Output string: The frequency, frequency deviation, reference time, power line time
and the time deviation are send out in different available formats.

The formats are:

STANDARD FDM String:
F:49.984 FD:-00.016 REF:15:03:30 PLT:15:03:30.378 TD:+00.368[CR][LF]

SHORT FDM String:
FD:-00.016 TD:+00.368[CR][LF]

AREVA FDM String:
[STX]
02049.984[CR][LF]
021-00.016[CR][LF]
022+00.378[CR][LF]
02315 03 30.368[CR][LF]
024068 15 03 30 [CR][LF]
[ETX]

Resolution of Measurement:
frequency: accuracy the oscillator (10 MHz) +-100 µHz
time deviation: accuracy of reference (PPS) +- 1ms

Analog outputs: 2 analog outputs for longtime-recording (time deviation and/or frequency deviation),
range: -2.5 V ... +2.5 V, resolution: 16 Bit

Electrical connectors: 96-pin VG-rail DIN 41612, X1, Power Line In

Power supply: +5 V DC

Current consumption: 0.4 A - 1 A

Ambient temperature: 0 ... 50 °C / 32 ... 122 °F

Humidity: Max. 85%

More detailed information about FDM - Frequency Deviation Monitoring can be found in the current LANTIME firmware manual, chapter "LTOS6 Management and Monitoring → FDM".
12.6.23 REL1000: Error Relay Module

The REL1000 error relay module can be switched by various operating states (e.g.: Clock Not Sync). If the internal hardware clock is running synchronous to the source, the relay is switched to NO (Normally Open) mode. In case of an error, the relay switches to NC (Normally Closed) mode.

Depending on the hardware configuration of the IMS system, i.e. redundant with RSC module and two integrated reference clocks or with SPT module and only one reference clock, different relay states can be switched.

In redundant operation, the two clocks and the changeover unit are monitored as standard (CLK1 - relay A, CLK2 - relay B, RSC - relay C). This jumper setting is supplied per default in redundant systems.

Possible configurations of Error Output:
Relay A: Clock 1 / Notification Events → Relays
Relay B: Clock 2 / PPS
Relay C: RSC / 10 MHz / Notification Events → Relay

In redundant mode, the jumpers on the REL1000 are set as shown below:
State of LED Indicators:

Initialisation Phase:
- **St:** blue
- **A:** off
- **B:** off
- **C:** off

Boot Phase:
- **St:** blue
- **A:** 1s red, 1s yellow, 1s green, 1s off
- **B:** 1s red, 1s yellow, 1s green, 1s off
- **C:** 1s red, 1s yellow, 1s green, 1s off

Normal Operation Mode:
- **St:** green (Status)
- **A:** green, red in case of error (Clock 1)
- **B:** green, red in case of error (Clock 2)
- **C:** green, red in case of error (Notification Event)

Technical Specification ERROR Relays:
- **Switching Voltage:** 220 V DC\(_{\text{max}}\) / 250 V AC\(_{\text{max}}\)
- **Switching Load:** 60 W\(_{\text{max}}\) / 62.5 VA\(_{\text{max}}\)
- **UL/CSA:** 0.3 A 125 V AC, 0.3 A 110 V DC, 1 A 30 V DC
- **Response Time:** ca.3 ms
12.6.23.1 Configuration of the REL1000 via the Web Interface

The relays A + C of the REL1000 module can be switched via notifications events. If the jumpers and hardware configuration are set accordingly, a checkbox can be activated in the web interface menu "Notification → Notification Events" for various events, so that the selected relay is switched to error mode on this event.

Selectable events are "NTP not Sync" or "Clock not Sync" for example.

In this figure there are no selection options - the relays are switched in redundant operation via the reference clocks and the RSC switch unit.

This figure shows the menu in a non-redundant system. Relay C can be controlled via notification events.
12.6.24 SCG-U: Studio Clock Generator

Add-On module for generating various audio frequencies (12 kHz, 32 kHz, 44.1 kHz, 48 kHz, 64 kHz, 88.2 kHz and 96 kHz), with only one 10 MHz input clock, for studio applications. The SCG Module provides four outputs with different frequencies.

The SCG provides a wide range of programmable word clock rates between 24 Hz – 12.288 MHz.

Technical Specifications:

- **Outputs:** 4 x BNC (2.5 V TTL into 75 Ohm) outputs with configureable frequencies
- **Input Signal:** 10 MHz, sinewave or square pulse
- **Current Consumption:** 5 V +/- 5%, @400 mA
- **Ambient Temperature:** 0 ... 50 °C / 32 ... 122 °F
- **Humidity:** 85% max.
12.6.24.1 SCG-U: Configuration via Web Interface

(Firmware version 6.19 or later)

If the SCG-U operates in an IMS system, the module can be easily configured via the web interface then.

Configuration Sample: SCG Output 3
In the "IO Configuration" menu each output frequency can be adjusted separately. In the figure above the following value is set:

\[
\text{Frequency Out 3} = \text{Base Frequency} \times \text{Scale}
\]

Frequency Out 3 = 44.1 kHz \times \frac{1}{4}

\[
\text{Frequency Out 3} = 11.025 \text{ kHz}
\]

Overview Configuration SCG-U Sound Clock Generator Outputs 1-4

Output Type: Studio Clock Out

State: Disabled

Enabled

Base Frequency: 32 kHz

44.1 kHz

48 kHz

Scale: 1/8 to 256
12.6.25 SCG-B: Studio Clock Generator Balanced

The M1000 is an additional card for generating "Digital Audio Reference Signals" for studio applications. The 25pin D-Sub female connector provides four DARS outputs, which can be configured via the web interface.

Technical Specifications:

**Outputs:**

1 x 25pin female connector, 4 x DARS, IEC 60958-4 format resolution 24 bits, sampling frequency 48 kHz transformer-balanced

**Input Signals:**

10 MHz (sine wave or square pulse), 1PPS, Time String

**Power Consumption:**

5 V +- 5%, @400 mA

**Environmental Temperature:**

0 ... 50 °C / 32 ... 122 °F

**Humidity:**

max. 85%

---

**Pin Assignment of the 25pin D-SUB female connector**

<table>
<thead>
<tr>
<th>DARS 1</th>
<th>Hot 1</th>
<th>Pin 18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cold 1</td>
<td>Pin 6</td>
</tr>
<tr>
<td></td>
<td>GND 1</td>
<td>Pin 19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DARS 2</th>
<th>Hot 2</th>
<th>Pin 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cold 2</td>
<td>Pin 17</td>
</tr>
<tr>
<td></td>
<td>GND 2</td>
<td>Pin 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DARS 3</th>
<th>Hot 3</th>
<th>Pin 15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cold 3</td>
<td>Pin 3</td>
</tr>
<tr>
<td></td>
<td>GND 3</td>
<td>Pin 16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DARS 4</th>
<th>Hot 4</th>
<th>Pin 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cold 4</td>
<td>Pin 14</td>
</tr>
<tr>
<td></td>
<td>GND 4</td>
<td>Pin 2</td>
</tr>
</tbody>
</table>
12.6.25.1 SCG-B: Configuration via the Web Interface

If the SCG-B is used in an IMS system you can easily configure the Studio Clock Generator via the Web Interface.

Sample Configuration: Output 1

In the menu “IO Configuration” you can set the output on DARS for every output of the M1000. The four available outputs can optionally be switched off.
12.6.26 VSG - Video Sync Generator

The VSG is a video signal reference for Studio Equipment with four BNC female output connectors. The Module generates 1x bi-level sync (Black Burst), 1x Tri-Level Sync, 1x video sync signals (H-Sync, V-Sync or LTC) and 1x digital video output (DARS). The LANTIME Web Interface can be used for output signal configuration and to query the state of the VSG.

Functionality
The board is synchronized by an external 10 MHz signal. It generates configurable video signals in different formats. The generated signals have a phase reference to 1PPS.

Generated Signals:

**SMPTE standards:**
- PAL Blackburst with VITC Support
- NTSC Blackburst

**Tri Level Sync:**
- 720p/50 Hz (SMPTE296M3)
- 1080i/25 Hz (SMPTE274M6)
- 720p/59.94 Hz (SMPTE296M1)
- 1080i/29.97 Hz (SMPTE274M7)

**V-, H-, Frame-Sync for HD and SD formats**
- (VSG FW ≤ 2.05)

**LTC (25 fps)** (VSG FW ≥ 2.06)

**Digital Audio Signal**
- DARS (AES3id via BNC 75Ω)

**Status Info:**
- ST: Status of VSG
- In: Status of reference input
- A: Status Out 1 + 2
- B: Status Out 3 + 4

**Electrical Connectors:**
- 96-pin VG-rail DIN 41612

**Power Consumption:**
- 5 V +- 5%, 250 mA

**BNC Connectors:**
- 2x BNC female, unbalanced, 300 mV<sub>pp</sub> @ 75Ω
- 2x BNC female, unbalanced, 2.5 V TTL @ 75 Ω

**Ambient Temperature:**
- 0 .. 55°C

**Humidity:**
- Max. 85%
12.6.26.1 VSG Configuration via Web Interface

If the VSG operates in an IMS system, the module can be easily configured via the web interface.

Overview Configuration VSG Video Sync Generator Outputs 1-4

Output 1

Output Type: Video Out

Epoch: 
- TAI D1970-01-01 T00:00:00
- UTC D1972-01-01 T00:00:00
- GPS D1980-01-06 T00:00:00

Format: 
- 720p/50 Hz (SMPTE296M3)(HD)
- 1080i/25 Hz (SMPTE274M6)(HD)
- 720p/59.94 Hz (SMPTE296M1)(HD)
- 1080i/29.97 Hz (SMPTE274M7)(HD)

Phase Offset: [Offset Value]
Output 2:

<table>
<thead>
<tr>
<th>Output Type:</th>
<th>Video Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epoch:</td>
<td>like Output 1</td>
</tr>
</tbody>
</table>
| Format:     | NTSC (525i)  
               PAL (625i) |
| Phase Offset: | [Offset Value] |
Output 3: ($\leq$ VSG FW 2.05)

Output Type: Video Sync Out

Signal Type: SD H-Sync
SD V-Sync
SD Frame
HD H-Sync
HD V-Sync
HD Frame
HD Blank

Output 3: (VSG FW $\geq$ 2.06 - LTOS V7 required)

Output Type: LTC Out

Signal Type: LTC 25FPS (Frames Per Second)
Output 4:

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Digital Audio Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal Type</td>
<td>DARS (AES3id)</td>
</tr>
</tbody>
</table>

With the menu tab "Misc", the configuration of the VSG can be stored directly in the EEPROM of the card.
12.6.27 ACM - Active Cooling Module

The Active Cooling Module allows the installation of the M1000 safely within the temperature specification. The ACM is easily field-replaceable and allows for a hot-plug replacement without the need to power down the unit.

The active cooling and the system temperature can be monitored via the web interface in the menu "System → Fan Control".
13 RoHS and WEEE

Compliance with EU Directive 2011/65/EU (RoHS)

We hereby declare that this product is conform to the European Directive 2011/65/EU and its delegated directive 2015/863/EU “Restrictions of Hazardous Substances in Electrical and Electronic Equipment”. We ensure that electrical and electronic products sold in the EU do not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), and polybrominated diphenyl ethers (PBDEs), Bis (2-ethylhexyl)phthalat (DEHP), Benzylbutylphthalat (BBP), Dibutylphthalat (DBP), Diisobutylphthalat (DIBP), above the legal threshold.

WEEE status of the product

This product is handled as a B2B (Business to Business) category product. In order to secure a WEEE compliant waste disposal it has to be returned to the manufacturer. Any transportation expenses for returning this product (at its end of life) have to be incurred by the end user, whereas Meinberg will bear the costs for the waste disposal itself.
14 Declaration of Conformity

Konformitätserklärung

Hersteller
Manufacturer

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

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

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

RED – Richtlinie
RED – Directive

ETSI EN 303 413 V1.1.1 (2017-06)

EMV – Richtlinie
EMC – Directive

Draft ETSI EN 301 489-1 V2.2.0 (2011-09)

Draft ETSI EN 301 489-19 V2.1.0 (2011-09)

DIN EN 61000-6-2:2005

DIN EN 61000-6-3:2007 + A1:2011

DIN EN 55032:2015

DIN EN 55024:2010

DIN EN 61000-3-2:2014

DIN EN 61000-3-3:2013

Niederspannungsrichtlinie
Low-voltage Directive


2014/35/EU

RoHS – Richtlinie
RoHS – Directive

DIN EN 50581:2012

2011/65/EU + 2015/863/EU

Bad Pyrmont, den 2020-02-25

Stephan Meinberg
Production Manager