MANUAL

IMS-M4000
Modular Sync. System and NTP Server

21st August 2019

Meinberg Funkuhren GmbH & Co. KG
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13 Declaration of Conformity
1 Imprint

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Date: 2019-08-16

Version: 1.11
2 Safety instructions for building-in equipment

This building-in equipment has been designed and tested in accordance with the requirements of Standard IEC 60950-1 “Safety of Information Technology Equipment, including Electrical Business Equipment”.

During installation of the building-in equipment in an end application (i.e. rack) additional requirements in accordance with Standard IEC60950-1 have to be taken into account.

NOTE: First attach the case to protective earth - before you connect the M4000 with the power line (see chapter Grounding connection M4000).

General Safety instructions

- The building-in equipment has been evaluated for use in office environment (pollution degree 2) and may be only used in this environment. For use in rooms with a higher pollution degree more stringent requirements are applicable.
- The equipment/building-in equipment was evaluated for use in a maximum ambient temperature of 40°C.
- The building-in equipment may not be opened.
- Protection against fire must be assured in the end application.
- The ventilation opening may not be covered.

For AC Supply 100-240 V AC

- The building-in equipment is a class 1 - equipment and must be connected to an earthed outlet (TN Power System).
- For safe operation the building-in equipment must be protected by max 16 A fuse in the power installation system.
- Disconnection of the equipment from mains is done by pulling the mains plug at the outlet. Don’t use the connector at the module for disconnection from mains.

For DC Supply 100-200 V DC

- The device can be disconnected outside the unit in accordance with the regulations as in IEC 60950-1 (e.g. through primary side line protection).
- Assembling and disassembling of the power connector is only allowed if the device is disconnected from power supply (e.g. trough primary side line protection).
- All feed lines are sufficiently protected and dimensioned.

Fuse: T2.5A
Connector Diameter: 1mm² - 2,5mm² / 17AWG - 13AWG
2.1 Additional Safety Hints

This manual contains important information for the installation and operation of this device as well as for your safety. Make sure to read carefully before installing and commissioning the device.

Certain operating conditions may require the observance of additional safety regulations not covered by this manual. Nonobservance of this manual will lead to a significant abatement of the security provided by this device. Security of the facility where this product is integrated lies in the responsibility of the installer.

The device must be used only for purpose named in this manual, any other use especially operation above the limits specified in this document is considered as improper use.

Keep all documents provided with the device for later reference.

This manual is exclusively for qualified electricians or by a qualified electrician trained personnel who are familiar with the applicable national standards and specifications, in particular for the construction of high voltage devices.

2.2 Supply Voltage

WARNING!
This device is powered by a dangerous voltage. Nonobservance of the safety instructions of this manual may lead to serious damage to persons and property and to danger to life! Installation, commissioning, maintenance and operation of this device are to be carried out by qualified personnel only.

The general safety instructions and standards (e.g. IEC, DIN, VDE, EN) for installation and work with high voltage equipment as well as the respective national standards and laws must be observed.

NONOBSERVANCE MAY LEAD TO SERIOUS DAMAGE TO PERSONS AND PROPERTY AND TO DANGER TO LIFE!

The device may not be opened. Repair services may only be carried out by the manufacturer.

Supply lines for this device must be equipped via an appropriate switch that must be mounted close to the device and must be marked as a mains switch for the device.

To ensure safe operation supply mains connected to this device must be equipped with a fuse and a fault-current circuit breaker according to the applicable national standards for safe operation.

The device must be connected to a protective earth with low grounding resistance according to the applicable national rules.
2.3 Cabling

**WARNING!**
DANGER TO LIFE BY ELECTRICAL SHOCK! NO LIVE WORKING!
Wiring or any other work done the connectors particularly when connectors are opened may never be carried out when the installation is energized. All connectors must be covered to prevent from accidental contact to life parts.

ALWAYS ENSURE A PROPER INSTALLATION!

2.4 Safety Hints Antenna

**WARNING!**
DANGER TO LIFE BY ELECTRICAL SHOCK!

Make sure to comply with the occupational health and safety standards when installing the antenna. Never work without a proper fall protection device!

Do not carry out any installation or maintenance work on the antenna system or cabling when there is a potential risk of lightning.

**Surge Voltage Protector**
Due to extremely high currents associated with lightning no surge protection device can provide absolute safety from the impacts caused by lightning!
2.5 Replacing the Lithium Battery

Skilled/Service-Personnel only: Replacing the Lithium Battery
The life time of the lithium battery on the receiver boards is at least 10 years. If the need arises to replace the battery, the following should be noted:

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

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

2.6 Grounding connection M4000

To ensure a safe operation and to fulfil the requirements in accordance with IEC 60950-1, the system must be correctly connected to an equipotential grounding bus. On the upper left side of the chassis a grounding connector is provided. The mounting components (without a cable) are included.

1: Screw M4x6
2: Tooth washer M4
3: Plain washer M4
4: Ring or fork lug
5: Nokel washer

Note:
Use a grounding cable with $\geq 1,5\text{mm}^2$
Please ensure a correct crimp-connection!
3 Quick Start

When booting the system the following message will be displayed while dots will be counted up in the lower line:

```
Starting up
please wait ...
..........
```

Main Menu will be displayed with some important status informations after booting has finished:

```
NORMAL OPERATION
NTP: Offs. 2ms
Thu, 01.01.2008
UTC  12:00:00
```

If the GPS receiver remains asynchronous (Refclock LED is still red after 12 minutes) the number of satellites in view and the good satellites are to check (press botttons ↓, →, ↓ from main menu). The antenna has to be installed without any obstructions to the sky.

```
SV CONSTELLATION
SV in view: 10
Good Svs   : 9
Sel:01 21 16 22
```

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
Use Up and Down
to select Port:
lan0:0   #1 of 1
>172.100.000.001
OK
```

Then press 3 times the OK button to change to IPv4 ETH0 configuration page to enter the IP address, netmask and the default gateway:

**NOTE:** These settings are related to the first Ethernet connection (ETH0).

```
> IPv4 Parameter<
IPv6 Parameter
Link Mode
OK
> ETH0 Address <
ETH0 Netmask
Def. Gateway
OK
Set ETH0 Address
IPv4 ETH0
DHCP: enabled
172.000.000.000
OK
```

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
4 The Modular System LANTIME

LANTIME is a set of equipment composed of a reference clock GNSS, a single-board computer SBC ELX800 500 MHz 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.
5 Mounting the GPS Antenna

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

The antenna/converter unit can be mounted on a wall, or on a pole up to 60 mm in diameter. A 50 cm plastic tube, two wall-mount brackets, and clamps for pole mounting are included. A standard RG58 coaxial cable should be used to connect the antenna/downconverter unit to the receiver. The maximum length of cable between antenna and receiver depends on the attenuation factor of the coaxial cable.

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

The optional delivered MBG S-PRO protection kit can also be used for outdoor installation (degree of protection: IP55). However, we recommend an indoor installation, as close as possible to the wall where the antenna cable is entering, to minimize the risk of overvoltage damage, for example by lightning.

---

**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 Antenna Cable:

<table>
<thead>
<tr>
<th>Type of cable</th>
<th>diameter Ø [mm]</th>
<th>Attenuation at 100MHz [dB]/100m</th>
<th>max lenght. [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RG58/CU</td>
<td>5</td>
<td>17</td>
<td>300</td>
</tr>
<tr>
<td>RG213</td>
<td>10.5</td>
<td>7</td>
<td>700</td>
</tr>
</tbody>
</table>

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

5.2 Antenna Short-Circuit

(Systems with front display only)

In case of an antenna line short-circuit the following message appears in the display:

![Antenna Short-Circuit Disconnect Power !!!!]

If this message appears the clock has to be disconnected from the mains and the defect eliminated. After that the clock can be powered-up again. The supply voltage for the antenna/converter unit is approx. 18.5 V DC in idle mode and approx. 16 V DC when the GPS antenna is connected.
5.3 Antenna Assembly with Surge Voltage Protection

Optional a surge voltage protector for coaxial lines is available. The shield has to be connected to earth as short as possible by using the included mounting bracket. Normally you connect the antenna converter directly with the antenna cable to the system.
The GPS, GLONASS, Galileo and BeiDou satellites are not stationary but circle round the globe in a period of about 12 hours. They can only be received if no building is in the line-of-sight from the antenna to the satellite, so the antenna unit must be installed in a location with a free view to the sky. The best reception is given when the antenna has a free view of $8^\circ$ angular elevation above horizon. If this is not possible the antenna should be installed with a mostly free view to the equator because of the satellite courses which are located between latitudes of $55^\circ$ North and $55^\circ$ South. If even this is not possible problems occur especially when at least four satellites for positioning have to be found.

The active L1 timing reference antenna is specifically designed for long lasting, trouble-free deployments for a variety of applications. The low noise, high gain amplifier is well suited to address attenuation issues. The proprietary quadrifiliar helix design, coupled with multistage filtering provides superior out-of-band rejection and lower elevation pattern performance than traditional patch antennas.

- Their unique radome shape sheds water and ice, while eliminating problems associated with bird perching.
- This antenna is made of materials that fully comply with provisions stipulated by EU directives RoHS 2002/95/EC.
- The antenna provides integrated lightning protection capability.
- The antenna also features ESD, reverse polarity protection and transit voltage suppression.

A standard coaxial cable with 50 ohm impedance should be used to connect the antenna to the receiver. The max. length of cable between antenna and receiver is 50 meters (H155 - Low-Loss).

See data sheet “40 dB Multi GNSS Timing Antenna with Integrated Lightning Protection” (pctel_gpsl1gl.pdf) or download this document:

**Active Multi GNSS Antenna**

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

### 6.1 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**
Multi GNSS Antenna

free view to the sky!

Type-N female
Type-N male
MEINBERG GNSS
Type SMA male female
Connection to earth rail
(Protective Earth)
cable diameter ca. 1,5 mm Ø
as short as possible

Figure: Schematic diagram of mounting the Multi GNSS Antenna

WARNING!
Antenna mounting without effective anti-fall protection

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

WARNING!
Working on the antenna system during thunderstorms

Danger to life due to electrical shock!
- Do not carry out any work on the antenna system or the antenna cable if there is a risk of a lightning strike.
- Do not carry out any work on the antenna system if the safety distance to free lines and sequential circuits is exceeded.
6.2 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.

![Installation drawing RV-76G antenna](image)

**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.
7 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. During this time the following message appears on the display:

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). The message "NTP: sync to local" is displayed until synchronization is complete.

For the synchronization of the NTPD with the time reference it is necessary that the receiver is synchronous with the incoming time signal. In this case the following message is monitored on the display:

The second line shows the user that the NTPD is synchronized with the receiver with an offset of 2ms (Figure). 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.
8 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)
- 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
```
9 The Menues in Detail

9.1 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 reflect some of the main parameters of the time server. First line shows the name of the device and the status of the Reference Clock (GPS). The text “GPS: 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:
When pressing the „OK“ button from main menu the version of the LANTIME software, the NTP and the LINUX kernel version will be displayed.

The following main menus will be displayed when pressing the „UP“ and „DOWN“ arrow buttons:
10 The graphical user interfaces

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
11 The WEB Interface

Connect to the web interface by entering the following address into the address field of your web browser.
Example: http://198.168.10.10

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

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 LANTIME M4000 Housing

Housing: 19inch / 4U metal chassis
Optimized for ETSI rackmount (300mm / 21 inch) or 19 inch standard rack

Protection
Rating: IP20

Physical
Dimensions: 483 mm wide x 177 mm high x 274 mm deep

Ambient
Temperature: 0 ... 50 °C
Humidity: 85 % max.
ATTENTION:

Due to potential excessive heat development which may cause an overheating damage during device operation it is necessary to leave space for ventilation of at least 1U height at the top and the bottom of the IMS system. If this is not possible, then the system must be equipped with an active cooling module – ACM. See chapter 'Retrofit the System with an Active Cooling Module – ACM'.

The left Figure shows the expected air flow during device in operation without ACM (active cooling module) and with space between devices for ventilation (1U at the bottom and the top). In the right figure the air flow during device in operation with ACM and no space between devices in a server rack is depicted.
12.2 IMS M4000 Chassis


Die Abbildung unten zeigt die physikalischen Abmessungen des M4000 Gehäuses.
12.3 Retrofitting the Active Cooling Module - ACM

Due to high ambient temperatures and a variety of used IMS modules, the use of active cooling could be necessary. The M4000 system can be upgraded with two ACM modules during operation.

In the upper unit of the device where both display and function keys are located you will find an empty slide-in bay on the right and on the left side. To pull out the empty slide-in bays carefully introduce a tool (e.g. small screwdriver) into the indicated slots and press out the module from its anchoring.

The new Active Cooling Modules are already equipped with a front plate. Simply slide-in the ACM module into the guide rail and push until it locks into the plug in panel. At this point the LED indicator of the ACM module must light-up green.
### 12.4 Available Modules and Connectors

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Signal</th>
<th>Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Connectors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>5pin. DFK male</td>
<td>100-240 VAC / VDC</td>
<td>5pin. MSTB clamp</td>
</tr>
<tr>
<td>GPS Antenna</td>
<td>BNC</td>
<td>10MHz / 35.4MHz</td>
<td>shielded coaxial line</td>
</tr>
<tr>
<td>or GPS/GLONASS Antenne</td>
<td>SMA</td>
<td>L1 Frequency band: 1575.42 +/- 10 MHz / 1602-1615 MHz</td>
<td>shielded coaxial line</td>
</tr>
<tr>
<td><strong>LAN-CPU</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminal</td>
<td>RJ45</td>
<td>10/100 MBit</td>
<td>CAB-CONSOLE-RJ45</td>
</tr>
<tr>
<td>USB</td>
<td>USB Port</td>
<td>shielded data line</td>
<td></td>
</tr>
<tr>
<td>Network LAN-CPU</td>
<td>RJ45</td>
<td>10/100 MBit</td>
<td>shielded data line</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>20-72 VDC</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>TSU-GbE / 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, 10MHz, TC, 2,048kHz ...</td>
<td>shielded data line</td>
</tr>
<tr>
<td>LIU:</td>
<td>RJ45 jack</td>
<td>E1/T1 balanced, 120 Ohm (Clock)</td>
<td>shielded data line</td>
</tr>
<tr>
<td></td>
<td>BNC</td>
<td>E1/T1 unbalanced, 75 Ohm (Bits)</td>
<td>shielded data line</td>
</tr>
<tr>
<td>LNO</td>
<td>BNC</td>
<td>10MHz 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>10MHz, PPS, IRIG, PP</td>
<td>shielded data line</td>
</tr>
</tbody>
</table>
12.5 TERMINAL (Console)

To connect a serial terminal (according to the device model), use the 9pin RS232 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).

12.6 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
12.7 Replacement or Installation of a Hot-pluggable IMS Module

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

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.
12.7.1 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:

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

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

CPU = The central management unit is not "hot swappable", i.e. the system must be disconnected from mains before replacement.

RSC/SPT = The RSC switching card is not "hot swappable", i.e. the system must be disconnected from the mains before replacement.
## 12.8 IMS Module Options

### 12.8.1 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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal Voltage Range: ( U_n )</td>
<td>100-240 V~ 100-200 V ( \infty )</td>
</tr>
<tr>
<td>Maximum Voltage Range: ( U_N )</td>
<td>90-265 V~ 90-250 V ( \infty )</td>
</tr>
<tr>
<td>Nominal Current: ( I_n )</td>
<td>1.0 A ~ 0.6 A ( \infty )</td>
</tr>
<tr>
<td>Nominal Frequency Range: ( f_n )</td>
<td>50-60Hz</td>
</tr>
<tr>
<td>Maximum Frequency Range: ( f_{\text{max}} )</td>
<td>47-63Hz</td>
</tr>
</tbody>
</table>

### Output Parameter

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Power: ( P_{\text{max}} )</td>
<td>50 W</td>
</tr>
<tr>
<td>Maximum thermal energy: ( E_{\text{therm}} )</td>
<td>180.00 kJ/h (170.61 BTU/h)</td>
</tr>
</tbody>
</table>

---

**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).
12.8.2 Power Supply 20-60 V DC

Connector: 5pin DFK
Pin Assignment:
1: not connected
2: \( V_{\text{IN}}^- \)
3: PE (Protective Earth)
4: \( V_{\text{IN}}^+ \)
5: not connected

Input Parameter

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

Output Parameter

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

12.8.3 Power Supply 10-36 V DC

Connector: 5pin DFK
Pin Assignment:
1: not connected
2: \( V_{\text{IN}}^- \)
3: PE (Protective Earth)
4: \( V_{\text{IN}}^+ \)
5: not connected

Input Parameter

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

Output Parameter

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

Receiver: 12 channel GPS C/A-code receiver

Accuracy of pulse outputs:
- Depends on oscillator option:
  - < ±100 ns (TCXO, OCXO LQ)
  - < ±50 ns (OCXO-SQ, -MQ, -HQ, -DHQ)

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

Antenna

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 (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 GGA
  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\textsuperscript{Rb} Rubidium expansion chassis.
12.8.5 GNSS Clock

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

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

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

Antenna

Antenna Cable: shielded coax cable (Belden H155 PE)
Cable Length: max. 70m low-loss cable
Type of Connector: female SMA connector
Power Requirements: 5 V, 100 mA (via antenna cable)
Figure right: GNSS Receiver and
GNSS 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 GGA
  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 RB Rubidium expansion chassis.
12.8.6 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
- < +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

**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 GGA  
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$^{\text{Rb}}$ Rubidium expansion chassis.
12.8.7 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
12.8.8 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 ± 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 mVpp to 8 Vpp. 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

<table>
<thead>
<tr>
<th>Init</th>
<th>blue: while the receiver passes the initialization phase</th>
<th>off: Oscillator not warmed up</th>
<th>green: the internal timing of the TCR180 is synchronized to the received time code (Lock)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>green: correct time code detected</td>
<td>red: no correct time code detected</td>
<td></td>
</tr>
<tr>
<td></td>
<td>yellow: TCR180 synchronized by external source (MRS)</td>
<td>yellow/green (flashing): Holdover mode (MRS), IRIG Code available</td>
<td></td>
</tr>
<tr>
<td></td>
<td>yellow/red (flashing): Holdover mode (MRS), IRIG Code not available</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tele</td>
<td>green: telegramm consistent</td>
<td>red: telegramm inconsistent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>yellow (flashing): Jitter too large</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fail</td>
<td>red: the internal timing of the TCR180 is in holdover mode</td>
<td>off: the internal timing of the TCR180 is synchronized to the received time code (Lock)</td>
<td></td>
</tr>
</tbody>
</table>
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\text{pp} / 1 V\text{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

![Image of Jumper Settings: 600 \Omega](image)

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 mV\text{pp} to 8 V\text{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...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\text{sec 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_{PP} (MARK), 1 V_{PP} (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_0 - PPO_3:
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: ±5E-9
- first 20 min. after sync.: ±1E-8

accuracy of oscillator:
- holdover, 1 day: ±1E-7
- holdover, 1 year: ±1E-6

short term stability:
- ≤10 sec, synchronized: ±2E-9
- ≤10 sec, holdover: ±5E-9

temperature dependant drift:
- holdover: ±1E-6

**Frequency Synthesizer**

Output frequency: fixed - 2.048MHz

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 Ω
- sine wave 1.5 Vrms
- output impedance 200 Ω

**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

**Power Requirement:**

- power supplies provided via VG Connector - 5 V 450 mA

**Dimension:**

- Euro card, 100mm x 160mm, 1.5mm Epoxy

**Ambient Temperature:**

- 0 ... 50°C

**Humidity:**

- max. 85 %

**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
12.8.9 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 controls of the module allow the selection of different modes in which the RSC operates. The status LEDs indicate which receiver is selected as a master clock and the current operating state of the switching module.

Switch Position "Auto/Manual"
This switch selects between automatic and manual mode. In the manual mode the module's internal selection logic is overridden and the current system for signal generation can only be selected manually by the switch Clock 1 /Clock 2. In the manual mode outputs are always enabled, regardless of the synchronization state of the clocks.

Switch Position "Auto"
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.
**Switch Position "Clock 1 / Clock 2"
**
Selects the active clock system in manual mode which has no effect in automatic mode.

Mode selection by a switch position in "AUTO":
Display Menu: **Switch Unit -> RSC Cntl -> REMOTE : enable**

**Display menu "Switch Unit -> RSC State"**

![SCU State](image)

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 State](image)

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
12.8.9.1 RSC180 - DIP Switch

Various modes of the board can be additionally configured by an on-board DIP-Switch.

Configuration of a DIP-Switch

<table>
<thead>
<tr>
<th>SW</th>
<th>NAME</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DIS_ENA</td>
<td>enable / disable activation of signals if both clocks are async</td>
</tr>
<tr>
<td>2</td>
<td>DIS_MAN</td>
<td>enable / disable a manual override by front panel switches</td>
</tr>
<tr>
<td>3</td>
<td>DIS_REM</td>
<td>enable / disable the remote control</td>
</tr>
<tr>
<td>4</td>
<td>FUNCTION</td>
<td>RSC board functionality: either in an IMS system or LAN interface is activated</td>
</tr>
<tr>
<td>5</td>
<td>Reserve</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Reserve</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Reserve</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DIS_MST</td>
<td>enables / disables the priority master clk selection</td>
</tr>
<tr>
<td>9</td>
<td>Clk1_Clk2</td>
<td>selects between the priority master clk 1 or clk 2</td>
</tr>
<tr>
<td>10</td>
<td>EN_CLK</td>
<td>activates the clock with a sync event after reset (only if DIP 1 is ON).</td>
</tr>
</tbody>
</table>

![DIP-Switch of RSC180](image)

Description of DIP_SW positions:

Switch No. 1. Positions:
- (0) OFF: In the case that both clock are async, all output signals are disabled.
- (1) ON: Even if both clocks are async, outputs are activated from one of the clocks.

Switch No. 2. Positions:
- (0) OFF: Front panel switch functions activated.
- (1) ON: Front panel switch functions disabled.

Switch No. 3. Positions:
- (0) OFF: Remote control activated.
- (1) ON: Remote control disabled.

Switch No. 4. Positions:
- (0) OFF: The RSC board is used in an IMS system.
- (1) ON: LAN Interface is activated.

Switch No. 5-7 Reserves.

Switch No. 8. Positions:
- (0) OFF: The Priority master mode is disabled.
- (1) ON: Priority master mode is enabled.
IF Switch No. 8 is ON:
Switch No. 9. Positions:
(0) OFF: The Priority master is clock 1.
(1) ON: The Priority master is clock 2.

IF Switch No. 1 is ON:
Switch No. 10. Positions:
(0) OFF: Even async, one clock is always enabled.
(1) ON: A clock is enabled after the first sync event since a reset.
12.8.10 SPT - Single Path Through

The SPT (Single Path Through) ensures that in systems with only one reference clock, the generated signals are distributed on the backplane.

The module has a microcontroller for registering the card in the system and managing the LEDs by evaluating the signals displayed on the front panel. There are no configuration settings for the SPT via front panel display and function keys of the system or in the web interface or CLI.

### Status-LEDs

The status of the SPT is indicated by the four LEDs:

- **PPS:**
  - red: the signal was not provided to the system by the receiver, yet.
  - green: the signal is generated by the receiver and distributed in the system.

- **10MHz:**
  - red: the signal was not provided to the system by the receiver, yet.
  - green: the signal is generated by the receiver and distributed in the system.

- **Clock:**
  - red: as long as the receiver is not synchronized, yet.
  - green: when the receiver is synchronized.

- **Status:**
  - blue: during the initialization phase.
  - green: after initialization of the receiver.

### Current Consumption: 40 mA
12.8.11 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, SNMP, 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)
12.8.12 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, 10MHz, 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.

**Reference Inputs:** 10MHz, PPS, IRIG, TC-AM / TC-DCLS

**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 (10MHz/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
12.8.12.1 MRI Configuration via the Web Interface

The MRI module is a card for fixed (none configurable) input signals (Time Code AM / DCLS, 10MHz 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

1 x PPS input: TTL, pulse duration $\geq 5\mu s$, active high, female BNC connector

1 x 10 MHz input: sine (1.5Vpp - 5Vpp) or TTL, female BNC connector

1 x Time Code modulated input: BNC connector, isolated by transformer
Insulation voltage 3000 VDC
Input signal: 600mV to 8 V (Mark, peak-to-peak)

1 x Time Code unmodulated input: 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
12.8.13 ESI - Telecom Synchronisation References

Enhanced Synchronisation Inputs

Reference Inputs: E1 / T1 framed/unframed, variable frequencies (1 kHz - 10 MHz)

Power Requirements: 5 V, ±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 → 0.5 sec. yellow → 0.5 sec. green → 0.5 sec. off

**Normal Operation:**
- LED St: green
- LED In: green
- LED A: green, if PPS and 10 MHz
  - flashing green, if only 10 MHz
  - 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)
12.8.13.1 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, both as a Bitstream (2.048MBit/s/1.544Mbit/s, supporting SS-M/BOC) or Frequency (2.048MHz/1.544MHz).

It also handles a configurable frequency (1 kHz - 10 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 synchronization.
Input 2: The input 2 accepts as input either 2048 kHz frequency or configurable frequency in range between 1kHz and 10 MHz, also 1.544kHz if required.

Type:
Freq. In

Frequency
Fill in a configurable frequency in range: 1 kHz - 10 MHz of input signal, 2048 kHz is set as default.

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: see Input 2.
Input 4:
As fixed frequency you can choose between E1 framed or T1 framed

<table>
<thead>
<tr>
<th>Configurable Inputs</th>
<th>Input 1</th>
<th>Input 2</th>
<th>Input 3</th>
<th>Input 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input 4:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fixed Frequency</strong></td>
<td>E1 framed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Minimum Quality Level</strong></td>
<td>QL-PRS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sa Bits Group</strong></td>
<td>Sa4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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: reserved
- QL-INV5: reserved
- QL-ST2: reserved
- QL-SSU-B: reserved
- QL-INV9: reserved
- QL-ECC2/ST3: Synchronous Equipment Timing Source (SETS)
- QL-SMC: Synchronous Equipment Timing Source (SETS)
- QL-PROV: Do not use for synchronization
- 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.
12.8.14 LNE-GbE: Network Expansion with Gigabit Support and SFP Option

Link speed: 10/100/1000 Mbit/s

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.
12.8.14.1 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 then.

**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 bandwidth.

- **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.
12.8.14.2 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 the LNE has been installed to a slot, please start a SSH, TelNet or serial connection to the lantime. As soon as you are logged in, please execute the following command.

```
ifconfig | grep eth
```

This should give you an output with at least four entries for each installed LNE module. The output should look like similar to the following one.

```
eth0 Link encap:Ethernet HWaddr ec:46:70:00:8b:8c
eth1 Link encap:Ethernet HWaddr ec:46:70:00:8b:8d
eth2 Link encap:Ethernet HWaddr ec:46:70:00:8b:8e
eth3 Link encap:Ethernet HWaddr ec:46:70:00:8b:8f
```

We are now sure, that the LNE module is installed properly. But as you can see in the lower figure, the module is not implemented into the LTOS yet. The figure shows the "PHYSICAL NETWORK INTERFACES" chapter of the "NETWORK" tab.

Therefore we have to use the "nicmgr" command. This will implement the interfaces into the system that way, that the lantime can use them.

```
nicmgr autoassign ; saveconfig network
```

After the nicmgr has finished it’s procedure, have a look again at the web UI of the LANTIME. You should now be able to see the interfaces of the LNE module.
For further information how to configure a virtual network interface, take a look at the LANTIME manual.

Removing the Network Extension from the LANTIME

In order to remove the LNE, simply remove the module from the slot it is installed at. As you will see, the "PHYSICAL INTERFACES" will still show the LNE interfaces, even if they already have been removed. Now log in to the LANTIME Command-Line-Interface using SSH, Telnet or a serial connection. Once you are logged in, execute the following command.

```
nicmgr autoremove ; saveconfig network
```

This will delete the interface out of the LANTIME configuration files. After that the webinterface should display the "old" state again.
12.8.15 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)

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

**Client Licenses:**

<table>
<thead>
<tr>
<th>License</th>
<th>Unicast Clients</th>
<th>Delay Req/s</th>
<th>NTP Req/s</th>
<th>PTPv1 Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL-A</td>
<td>8</td>
<td>1024</td>
<td>1600</td>
<td>NO</td>
</tr>
<tr>
<td>PL-B</td>
<td>256</td>
<td>32768</td>
<td>51200</td>
<td>NO</td>
</tr>
<tr>
<td>PL-C</td>
<td>512</td>
<td>65536</td>
<td>102400</td>
<td>YES</td>
</tr>
<tr>
<td>PL-D</td>
<td>1024</td>
<td>131072</td>
<td>204800</td>
<td>YES</td>
</tr>
<tr>
<td>PL-E</td>
<td>2048</td>
<td>262144</td>
<td>409600</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
12.8.16 TSU V3: IEEE-1588 Time Stamp Unit

TSU v3 (IEEE 1588 v2 compatible)

Profiles: IEEE 1588v2 Default 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  
- **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:  
- **yellow - yellow**: Listening  
- **green - off**: Master Mode  
- **off - green**: Slave Mode  
- **yellow - off**: Passiv Mode  
- **off - yellow**: uncalibrated  
- **red - red**: stopped
12.8.17 IMS PIO: PPS oder 10MHz I/O Module

Technical Specifications:

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

Signal Options: PPS or 10MHz

**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 10MHz

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 10MHz
12.8.17.1 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 10MHz, 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 10MHz reference frequency. The offset values are displayed in the status window.
12.8.18 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.
12.8.18.1 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:
  - 10MHz, 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)

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, 10MHz, TC DCLS and TC AM
- BPE 5000 Fiber Optic ST-Connectors
  - PPS, 10MHz, TC DCLS and 2048kHz
### 12.8.18.2 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</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: 10MHz, 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: 10MHz, 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: 10MHz</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2016</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: 10MHz</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-2070</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: 2.048kHz</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-2080</td>
<td>4 x BNC female</td>
<td>Out 1 - Out 4: progr. Pulses</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: 10MHz</td>
<td>8HP</td>
</tr>
<tr>
<td>BPE-2180</td>
<td>8 x BNC female</td>
<td>Out 1 - Out 8: 2048kHz</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: 10MHz 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 RS422 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 RS422 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, RS422 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 RS422 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 RS422 Pegel</td>
<td>8HP</td>
</tr>
<tr>
<td>BPE-3082</td>
<td>4 x D-SUB9 female</td>
<td>Out 1 - Out 4: 2,048 MHz 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 - RS422 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, 10MHz, TC-DCLS, 2048kHz 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 10MHz / FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5020</td>
<td>4 x FST</td>
<td>10MHz / 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>2048kHz / FO Multimode</td>
<td>4HP</td>
</tr>
<tr>
<td>BPE-5082</td>
<td>4 x FST</td>
<td>PPS, 10MHz, 2 x 2048kHz 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>
12.8.18.3 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 Pulse per Second"
12.8.18.4 BPE-8000 - Switchable Backplane Port Expander

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

or fixed:
- 2.048 MHz (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>2.048 MHz (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.
12.8.18.5 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, 2048kHz 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).

![Output Configuration](image)

Figure: Web interface menu 'IO Config → Output Configuration'
12.8.18.6 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.

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).

![Programmable Output](image.png)

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

![Time Zone](image.png)

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, a time zone is entered with the changeover rule for summer and winter time. The time zone IST (India / Sri Lanka) in the example does not consider a changeover of summer / winter time.

Please note, that these settings will also affect other outputs which provide the programmable pulse output “Prog. Out 1” (eg: BPE-2090 with 4 x BNC female connectors PPO_1 - PPO_4).
12.8.18.7 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 RS232, RS422 or RS485 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:
10MHz, 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)
### 12.8.18.8 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 RS232 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3010</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS422</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3020</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS422 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3030</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS485</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3040</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS485 + PPS</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3050</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS422</td>
<td>4HP</td>
</tr>
<tr>
<td>CPE-3060</td>
<td>2 x D-SUB9</td>
<td>serial timestring RS422 + 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>
12.8.18.9 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>PPO +</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>TxD -</td>
<td>PPO -</td>
<td>TxD - / RxD -</td>
<td>PPO -</td>
<td>PPO -</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
12.8.18.10 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.

**Configuration: M4000**

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 - 10MHz
- **IRIG Code**: Generated IRIG output codes (B002+B122 ...)
- **Prog. Out**: Programmable output POUT 1 - POUT 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**
12.8.19 LIU - Line Interface Unit

Input signal: 2.048 MHz reference clock, TTL level

Clock: T1 - 1.544 MHz
       E1 - 2.048 MHz

BITS: 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: $\pm 5 \cdot 10^{-10}$
OCXO-MQ: $\pm 2 \cdot 10^{-10}$
OCXO-HQ: $\pm 5 \cdot 10^{-12}$
OCXO-DHQ: $\pm 2 \cdot 10^{-12}$
Rubidium: $\pm 2 \cdot 10^{-11}$

LED Indicators

Power T1 E1

Power: Ini: 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
12.8.19.1 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.
12.8.19.2 Block Diagram LIU

The following block diagram illustrates the functional principle of the board LIU:
12.8.19.3 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 kBits (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.
12.8.19.4 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):

E1 (G.703):
12.8.19.5 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

12.8.19.6 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-A4040</td>
<td>8TE</td>
<td>BITS (4/0)</td>
<td>4 x RJ45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (4/0)</td>
<td>4 x RJ45</td>
</tr>
<tr>
<td>LIU-A4004</td>
<td>8TE</td>
<td>BITS (4/0)</td>
<td>4 x RJ45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (0/4)</td>
<td>4 x BNC</td>
</tr>
<tr>
<td>LIU-A0404</td>
<td>8TE</td>
<td>BITS (0/4)</td>
<td>4 x BNC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (0/4)</td>
<td>4 x BNC</td>
</tr>
<tr>
<td>LIU-A0044</td>
<td>8TE</td>
<td>Clock (4/0)</td>
<td>4 x RJ45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (0/4)</td>
<td>4 x BNC</td>
</tr>
<tr>
<td>LIU-A2222</td>
<td>8TE</td>
<td>BITS (2/2)</td>
<td>2 x RJ45, 2 x BNC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clock (2/2)</td>
<td>2 x RJ45, 2 x BNC</td>
</tr>
<tr>
<td>LIU Model</td>
<td>Size</td>
<td>Signal (bal./unbal.)</td>
<td>Connectors</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>----------------------</td>
<td>------------</td>
</tr>
<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-A0400</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>

![Image of LIU models with connectors and signal types]
Output Configuration of a LIU module (Line Interface Unit):

In this menu one can select between E1 or T1 mode for the LIU outputs. The selected mode is the same for all outputs.

**T1 or E1?**

T1 is a digital carrier signal that transmits the DS-1 signal. It has a data rate of about 1.544 Mbit/second. It contains 24 digital channels and therefore requires a device that has a digital connection.

E1 is the European equivalent to T1. T1 is the North American term whereas E1 is a European term for digital transmission. The data rate of E1 is about 2 Mbit/second. It has 32 channels at the speed of 64 Kbit/second. 2 channels among 32 are already reserved. One channel is used for signaling while the other is used for controlling. The difference between T1 and E1 lies in the number of channels here.

**Sa Bits**

ITU-T Recommendations allow for bits Sa4 to Sa8 to be used in specific point-to-point applications (e.g., transcoder equipment) within national borders. When these bits are not used and on links crossing an international border they should be set to 1.

The Sa4 bit may be used as a message-based data link for operation, maintenance and performance monitoring. The SSM Bit (Synchronization Status Message) can be selected in the Web GUI for clock quality information. Sa4 is selected as per default.
12.8.20 LNO - 10MHz Sinus Output Module

The LNO180 is a 10MHz 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 10MHz 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 (1V<sub>pp</sub> min.) or TTL
- **Output Level:** 5 dBm +/- 1 dBm at 50\ohm
  - 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
    - 1Hz: -70dBc/Hz
    - 10Hz: -105dBc/Hz
    - 100Hz: -125dBc/Hz
    - 1kHz: -140dBc/Hz
  - OCXO HQ:
    - 1Hz: < -85dBc/Hz
    - 10Hz: < -115dBc/Hz
    - 100Hz: < -130dBc/Hz
    - 1kHz: < -140dBc/Hz
- **Terminal Connector:** 96-pin VG-rail DIN 41612
- **Power Supply:**
  - 5dBm: +5V @ 550mA (steady state), +5V @ 670mA (warm up)
  - 12dBm:
    - +5V @ 970mA (steady state), +5V @ 620mA (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

10MHz 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
12.8.21 REL1000: Error Relay Module

The REL1000 error relay output is connected to the TTL TIME_SYNC output of the reference clock (GPS, GLONASS ...). If the internal reference clock has been synchronized by its source, the relay will switch to mode "NO" (Normally Open). In error case the relay switches to mode "NC" (Normally Closed).

If the system isn’t equipped with a second clock and RSC switch unit, the relay can be switched by 10MHz or PPS to monitor these signals.

**Error Output:**
- Relay A: Clock 1 / Notification Events → Relays
- Relay B: Clock 2 / PPS
- Relay C: Notification Events → Relay / 10MHz

In redundant mode, the jumpers on the REL1000 are set as follows:

![Diagram](image)

Please note: The REL1000 can only be used for the IMS system M500 in the following jumper setting:

**IMS-M500:**
- Relais A: Clock 1
- Relais B: PPS
- Relais C: 10MHz
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

Normal Operation: CO - NO connected
Error: CO - NC connected

96 Date: 21st August 2019 IMS-M4000
12.8.22 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 Assignment:** 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 (≤ 200ns 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 RS232 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:15:03:30.368 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 (10MHz) +-100µHz
time deviation: accuracy of reference (PPS) +-1ms

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

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

Power supply: +5V DC

Current consumption: 0.4 A - 1 A (depending on oscillator type)

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."
12.8.23 SCG-U: Studio Clock Generator

Add-On module for generating various audio frequencies (12kHz, 32kHz, 44.1kHz, 48kHz, 64kHz, 88.2kHz and 96kHz), with only one 10MHz 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 24Hz – 12.288MHz.

Technical Specifications:

Outputs: 4 x BNC (2.5V TTL into 75 Ohm) outputs with configurable frequencies

Input Signal: 10MHz, sinewave or square pulse

Current Consumption: 5 V ± 5%, @400 mA

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

Humidity: 85% max.
12.8.23.1 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:

\[
\text{Frequency Out 3} = \text{Base Frequency} \times \text{Scale} \\
\text{Frequency Out 3} = 44.1 \text{ kHz} \times \frac{1}{4} \\
\text{Frequency Out 3} = 11,025 \text{ kHz}
\]

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

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Studio Clock Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Disabled</td>
</tr>
<tr>
<td>Base Frequency</td>
<td>32kHz</td>
</tr>
<tr>
<td></td>
<td>44.1kHz</td>
</tr>
<tr>
<td></td>
<td>48kHz</td>
</tr>
<tr>
<td>Scale</td>
<td>1/8 to 256</td>
</tr>
</tbody>
</table>
12.8.24 SCG-B: Studio Clock Generator Balanced

The M4000 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 24bits, sampling frequency 48kHz transformer-balanced

**Input Signals:**
10MHz (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>
12.8.24.1 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

![Output Configuration](image)

In the menu "IO Configuration" you can set the output on DARS for every output of the M4000. The four available outputs can optionally be switched off.
12.8.25 VSG - Video Sync Generator

The VSG is a video signal reference for Studio Equipment with four BNC outputs. The Module generates 1x bi-level sync (Black Burst) and 1x Tri-Level Sync and 2x Sync Signals (H-Sync, V-Sync, ..). 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 10MHz signal. It generates configurable video signals in different formats. The generated signals have a phase reference to 1PPS.

Generated Signals:
- SMPTE standards: PAL Blackburst
  - NTSC Blackburst
  - 720p/50Hz (SMPTE296M3)
  - 1080i/25Hz (SMPTE274M6)
  - 720p/59.94Hz (SMPTE296M1)
  - 1080i/29.97Hz (SMPTE274M7)
  - V-, H-, Frame-Sync for HD and SD formats

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 mVpp @ 75Ω
  - 2x BNC female, unbalanced, 2.5 V TTL @ 75Ω

Ambient Temperature: 0 .. 55°C

Humidity: Max. 85%
12.8.25.1 VSG Configuration via Web Interface

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

![VSG - Video Signal Generator 1 [Chassis 0, Slot 105]](image)

**Overview Configuration VSG Video Sync Generator Outputs 1-4**

**Output 1**
- **Output Type:** Video Out
- **Epoch:** TAI, UTC, GPS
- **Format:** 720p 50Hz, 1080i 25Hz, 720p 59.94Hz, 1080i 59.94Hz
- **Phase Offset:** [Offset Value]

**Output 2**
- **Output Type:** Video Out
- **Epoch:** Like Output 1
- **Format:** NTSC, PAL
- **Phase Offset:** [Offset Value]
Output 3 / Output 4:

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

With the menu tab "Misc", the configuration of the VSG can be stored directly in the EEPROM of the card.
13 Declaration of Conformity

Konformitätserklärung
Doc ID: LANTIME M4000-2019-08-16

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

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

Produktbezeichnung
Product Designation
LANTIME M4000

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
ETSI EN 301 489-1 V1.9.2 (2011-09)
DIN EN 61000-6-2:2005
DIN EN 61000-6-3:2007 + A1:2011
DIN EN 55032:2012
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

Bad Pyrmont, den 2019-08-16

Stephan Meinberg
Production Manager