MANUAL

LANTIME Firmware 6.20

Configuration and
Management Manual

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Meinberg Radio Clocks GmbH & Co. KG

Table of Contents

1 Imprint

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2 Safety instructions for building-in equipment

This building-in equipment has been designed and tested in accordance with the requirements of Standard IEC60950-1 "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.

LANTIME Railmount
NOTE: First attach the case to protective earth – before you connect the LANTIME OS6 Firmware with the power line.

GND

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 100-240VAC

- 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 100-240VDC

- The device can be disconnected outside the unit in accordance with the regulations as in EN 60950 (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: T3A
Connector Diameter: $1mm^2$ – $2,5mm^2$ / 17AWG – 13AWG

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

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

ATTENTION!

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

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

2.2 CE-Label

Low voltage directive:	**2006/95/EC EN 60950-1** Safety of Information Technology Equipment, including Electrical Business Equipment Electromagnetic compatibility.
EMV-directive:	**89/336EEC EN50081-1** Electromagnetic compatibility (EMC). Generic emission standard. Part 1: Residential, commercial and light industry
	EN50082-2 Electromagnetic compatibility (EMC). Generic immunity standard. Part 2: Industrial environment

C E

3 LANTIME: Quick Installation

When booting the system the following messages will be displayed while dots will be counted up in the lower line. After then Main Menu will be displayed with some important status informations after booting has finished.

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

```
NORMAL OPERATION          Refclk n.a.
NTP: Offs. 2ms            NTP:not sync.
Wed, dd.mm.yyyy           Wed, dd.mm.yyyy
UTC  12:00:00            UTC  12:00:00
```

GPS, MRS, GLN   PZF   MSF, WWVB,   TCR
                                    JJY ...

```
Sv Constellation        PZF State          Ref. State          TCR PARAMETERS
 SV in view: 10        CORR. : 97
 Good Svs  :  9        State : fine        State : sync        Set IRIG Code:
Sel:01 21 16 22        Field : 105         Field : 95          B006/B007 (DC)
```
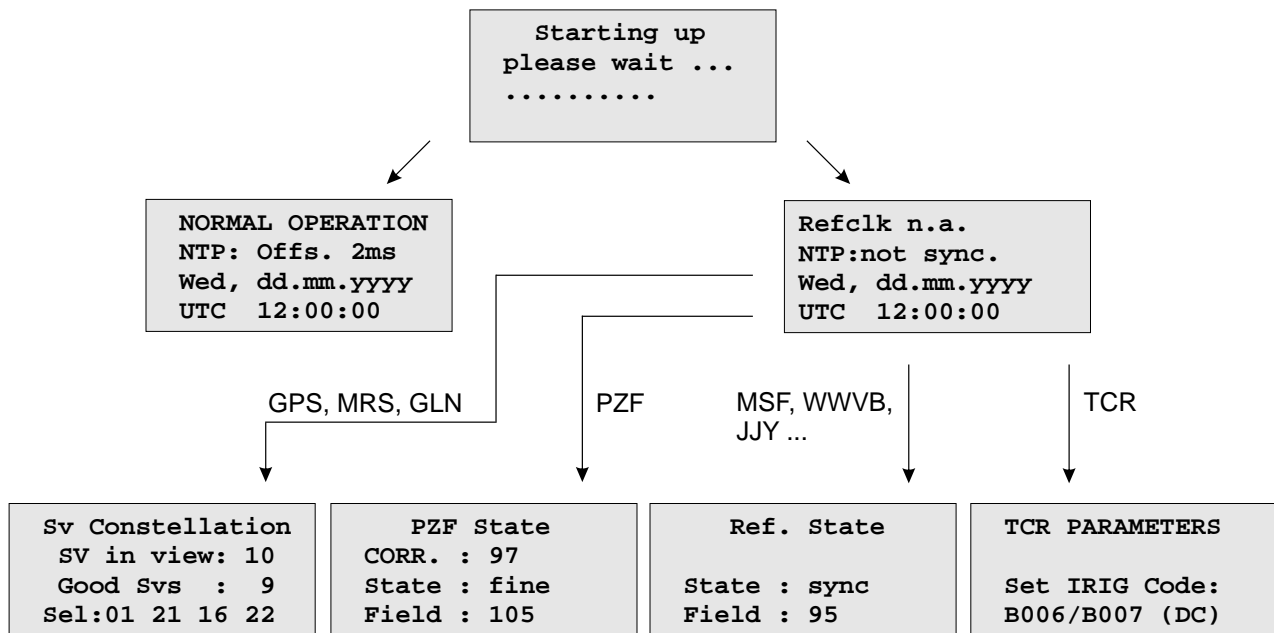
GPS/GLONASS: If the satellite receiver remains asynchronous (Ref. Time LED is still red after 12 minutes) the number of satellites in view and the good satellites are to check. The antenna has to be installed without any obstructions to the sky. If the receiver has not synchronized (Ref. Time LED is still red after 12 minutes), check the receiver status in the submenu *Reference Time*.

PZF: If the PZF receiver remains asynchronous (Ref. Time LED is still red after 3 minutes) the Field and the Correlation (at least 60, optimum 99) are to check. The antenna has to be installed with the longer side to direction of Frankfurt in Germany.

WWVB, MSF: If the long wave receiver remains asynchronous (Ref. Time LED is still red after 3 minutes) the field value has to be checked. The antenna has to be installed so that the longer side points to the location of the transmitter (WWVB in Fort Collins – Colorado, MSF in Anthorn – England).

TCR: If the time code receiver remains asynchronous (Ref. Time LED is still red after 1 minute) the selected IRIG code and the cable (Input Impedance) are to check within the *Reference Time* submenu.

RDT: The time server will wait for the external time source after booting the system. Possible time sources are external NTP server or serial RS232 time string on rear panel COM0 (Meinberg Standard Telegram 9600/7E2 or 9600/8N1 or Uni-Erlangen time string with 19200/8N1 or NMEA time string with 4800/8N1). With the NTP Parameter submenu you can adjust several external NTP server.

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 propper TCP/IP configuration:

```
->Interfaces<-          Use Up and Down
   Global Cfg.   OK      to select Port:   OK
   Services    ----->    lan0:0  #1      ----->
                         >172.100.000.001
```

```
>IPv4 Parameter<        > LAN Address  <         Set LAN Address
 IPv6 Parameter   OK       LAN Netmask     OK        IPv4 lan0:0
 Link Mode      ----->     Def. Gateway  ----->   DHCP:[]enabled
                                                   172.100.000.001
```
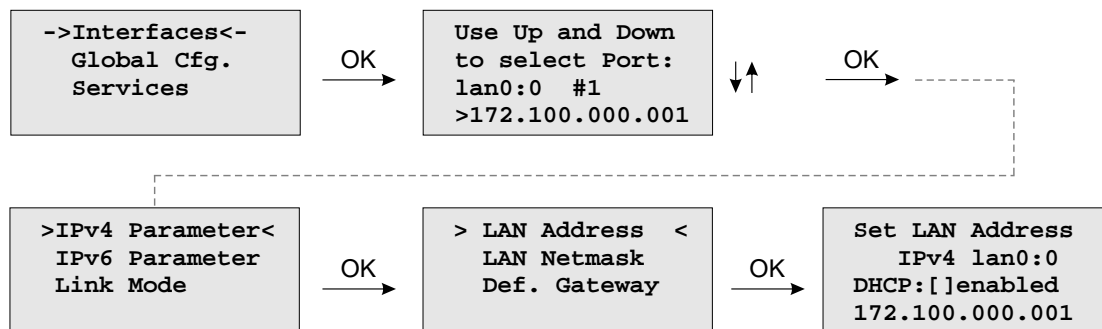
Select "Interfaces" and then press the OK button. Now you can select the appropriate network interface (eg. lan0:0 is the first physical interface of your time server). Press the OK button and you can modify the network parameters of the selected interface (IPv4, IPv6, Link Mode). Use the arrow keys to change the IP address, the netmask and, if necessary, the default gateway.

NOTE: These settings are related to the first Ethernet connection (LAN0). 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 LANTIME System Description

A LANTIME is a multi-purpose time and frequency synchronization solution with a flexible approach to support a large number of synchronization requirements in different applications and network environments. The system combines a powerful CPU with dedicated hardware like reference clocks or I/O modules, creating a powerful network appliance that supports almost all commonly used time and frequency synchronization protocols and signals.

The basic installation of a LANTIME Server is a very easy and straightforward process. After installing the hardware, the network address, the netmask and the default gateway have to be configured to be able to access the web GUI. If everything is set up correctl,y as soon as the device is reachable over the network, it can start serving time via NTP and/or PTP.

In addition to the time sync protocols NTP and PTP, the LANTIME system supports a number of additional network protocols primarily used for remote management of the system: HTTP(S), FTP, SSH and Telnet. Remote configuration, status checks and other maintenance procedures like fimrware updates or configuration backups can be controlled from any WEB browser. For security reasons, every protocol can be enabled or disabled for each configured IP address, allowing to reduce potential attack vectors and effectively control access to the device.

Status changes, alarms or other important events are logged in local log files and additionally can be forwarded to external SYSLOG servers. A number of notification protocols are supported to integrate the LANTIME system into already existing IT monitoring solutions. For example, SNMP traps or automatically generated e-mails are two potential options for notifying IT administrators about important events.

Installing multiple LANTIME devices in one network is a way to create redundancy for important network time synchronization services.

4.1 Network Configuration Concept

The LANTIME system supports a wide range of different network environments due to its flexible and powerful network configuration concept. A separation between physical and logical ("virtual") interface configurations covers almost all possible requirements for datacenters, telecommunication backhaul networks and industrial network environments.

Each LANTIME server has at least one physical ethernet interface which is provided by the CPU module (lan0). Additional network interfaces can be provided by network expansion cards (LNE or TSU cards) or on backplanes (depending on model). These additional physical interfaces can be used to provide synchronization services to multiple physical network segments, to separate management and synchronization networks or to combine multiple ethernet interfaces to form redundant connections ("bonding"). The 6th generation of LANTIME firmware (LTOS6) can manage up to 99 physical network interfaces as a theoretical maxmium.

Configuration of IPv4 and IPv6 addresses is done based on logical interface configurations. Each logical interface is assigned to one physical ethernet port and can be configured to use one IEEE 802.1q VLAN ID. The current firmware version supports up to 99 logical interfaces per server and all of those could be theoretically assigned to a single physical port.

The network ports of TSU modules (for PTP and Hardware-NTP) are not providing this logical interface functionality and are limited, at least in the current firmware version, to one IPv4/IPv6 address and one VLAN ID per physical interface. Redundancy and connectivity to multiple network segments and VLANs can be achieved by adding multiple TSU cards in a system.

For each logical interface the available netwokr services for synchronization (NTP, TIME, ..) and management (HTTP, HTTPS, SSH, SNMP, TELNET, ...) can be enabled/disabled individually. This allows to only provide synchronization on one IP address and remote access the unit for management tasks over a different IP address.

4.2 Additional Features

- external NTP timeserver
- free configuration of NTP: thereby MD5 authentication and access control via address & mask restriction
- extended menu guidance for configuration and monitoring via Telnet, SSH or serial terminal interface
- extended HTTP statistic support with long-term graphic and access statistic to NTP
- alarm messages can be displayed on external large display VP100/20/NET
- USB memory stick slot for extended functionality: software update, transfer of secure certificates, log files and configurations, keypad locking

4.3 User Interface

- Terminal connection via serial interface, status LED
- Web browser interface with graphical statistic of the one-day cycle offsets
- Telnet or Secure Shell Login for password protected operation of the Linux operating system
- FTP access for updating the operating system and downloading log files
- Simple Network Management Protocol for automatically SNMP-Traps in case of alarm
- SYSLOG messages can be passed to different computers
- Configurable e-mail notification
- Simulation of a synchronous radio clock in order to operate without antenna

4.4 Input and Output Options

- Additional Ethernet RJ45 connectors available (eight in 3U housing, four in 1U housing and eight additional connectors in HS – XL railmount housing)
- Frequency and pulse outputs via BNC connectors (e.g. 10 MHz, 2.048 MHz, PPS)
- Higher free running accuracy with optional oscillators (OCXO)
- IRIG–B outputs
- ANZ14NET or VP100/20/NET as display connected via network

4.5 Network Time Protocol (NTP)

NTP is a common method for the synchronization of hardware clocks in local and global networks. The basic concept, version 1 [Mills88], was published in 1988 as RFC (Request For Comments). Experiences acquired from its practical use on the Internet was followed by version 2 [Mills89]. The NTP software package is an implementation of the actual version 3 [Mills90], based on the specification RFC-1305 from 1990 (directory doc/NOTES). Permission to use, copy, modify and distribute this software for any purpose and without fee is hereby granted (read File COPYRIGHT).

NTP operates in a way that is basically different from that of most other timing protocols. NTP does not synchronize all connected clocks; instead it forms a hierarchy of timeservers and clients. Each level in this hierarchy is called a stratum, and Stratum 1 is the highest level. Timeservers at this level synchronize themselves by means of a reference time source such as a radio controlled clock, satellite receiver or modem time distribution. Stratum 1 Servers distribute their time to several clients in the network which are called Stratum 2.

Highly precise synchronization is feasible because of the several time references. Every computer synchronizes itself with up to three valued time sources. NTP enables the comparison of the hardware times and the adjustment of the internal clock. A time precision of 128 ms, and often better than 1 ms, is possible.

4.5.1 NTP Clients

The NTP software package was tested on different UNIX systems. Almost all UNIX-like systems come with a pre-installed NTP client software. In order to use the LANTIME as an NTP server, it is required to add its IP address to the client configuration. NTP client software are available for most other operating systems like Microsoft Windows or MAC OS.

The following WEB site is recommended to get the latest version of NTP:
http://www.ntp.org

You can find more information on our web page at: https://www.meinbergglobal.com/english/sw/ntp.htm

4.6 SNMP Support

The Simple Network Management Protocol (SNMP) has been created to achieve a standard for the management of different networks and the components of networks. SNMP is operating on the application layer and uses different transport protocols (like TCP/IP and UDP), so it is network hardware independent.

The SNMP design consists of two types of parties, the agent and the manager. SNMP is a client-server architecture, where the agent represents the server and the manager represents the client.

The LANTIME has an integrated SNMP agent, who is designed especially to handle SNMP requests for LANTIME specific status information (including status variables for the internal reference clock). The LANTIME SNMP agent is also capable of handling SET requests in order to manage the LANTIME configuration via SNMP, if your SNMP management software is also supporting this feature.

The elements (objects / variables) are organised in data structures called Management Information Base (MIB). The LANTIME includes the standard NET-SNMP MIB and is based on SNMPv1 (RFC 1155, 1157), SNMPv2 (RFC 1901-1908) and SNMPv3.

The following SNMP version is installed on the timeserver:

Net-SNMP Version:	5.0.8
Network transport support:	Callback Unix TCP UDP TCPIPv6 UDPIPv6
SNMPv3 Security Modules:	usm
Agent MIB code:	mibII, ucd_snmp, snmpv3mibs,
	notification, target, agent_mibs, agentx
	agent_mibs, utilities, meinberg, mibII/ipv6
Authentication support:	MD5 SHA1
Encryption support:	DES

By using the special Meinberg SNMP-agent all important status variables can be read with SNMP conformant client software. Where applicable, a variable is implemented as string and numeric value, for example allowing SNMP client software to use the information for drawing diagrams or monitor threshold levels.

When using the NET-SNMP suite, you can read all status information your LANTIME offers via SNMP by using the snmpwalk command:

snmpwalk –v2c –c public timeserver enterprises.5597

```
...mbgLtNtp.mbgLtNtpCurrentState.0 = 1 : no good refclock (->local)
...mbgLtNtp.mbgLtNtpCurrentStateVal.0 = 1
...mbgLtNtp.mbgLtNtpStratum.0 = 12
...mbgLtNtp.mbgLtNtpActiveRefclockId.0 = 1
...mbgLtNtp.mbgLtNtpActiveRefclockName.0 = LOCAL(0)
...mbgLtNtp.mbgLtNtpActiveRefclockOffset.0 = 0.000 ms
...mbgLtNtp.mbgLtNtpActiveRefclockOffsetVal.0 = 0
...mbgLtNtp.mbgLtNtpNumberOfRefclocks.0 = 3
...mbgLtNtp.mbgLtNtpAuthKeyId.0 = 0
...mbgLtNtp.mbgLtNtpVersion.0 = 4.2.0@1.1161-r Fri Mar 5 15:58:56 CET 2004 (3)

...mbgLtRefclock.mbgLtRefClockType.0 = Clock Type: GPS167 1HE
...mbgLtRefclock.mbgLtRefClockTypeVal.0 = 1
...mbgLtRefclock.mbgLtRefClockMode.0 = Clock Mode: Normal Operation

...mbgLtRefclock.mbgLtRefClockModeVal.0 = 1
...mbgLtRefclock.mbgLtRefGpsState.0 = GPS State: sync
...mbgLtRefclock.mbgLtRefGpsStateVal.0 = 1
...mbgLtRefclock.mbgLtRefGpsPosition.0 = GPS Position: 51.9834° 9.2259° 181m
...mbgLtRefclock.mbgLtRefGpsSatellites.0 = GPS Satellites: 06/06
...mbgLtRefclock.mbgLtRefGpsSatellitesGood.0 = 6
```

> ...mbgLtRefclock.mbgLtRefGpsSatellitesInView.0 = 6
> ...mbgLtRefclock.mbgLtRefPzfState.0 = PZF State: N/A
> ...mbgLtRefclock.mbgLtRefPzfStateVal.0 = 0
> ...mbgLtRefclock.mbgLtRefPzfKorrelation.0 = 0
> ...mbgLtRefclock.mbgLtRefPzfField.0 = 0

Please note that you only see the object names (like "mbgLtRefclock.mbgLtRefPzfField") if you installed the Meinberg MIB files on your client workstation first (please see the web interface or CLI setup tool chapters to find out how to do this).

By using the standard MIB, no NTP get requests are allowed. Only the standard system and network parameters can be accessed (e.g. using the NET-SNMP command "snmpget").

Only by using the Meinberg MIB the change of configuration parameters is possible (the command "snmpset" is used to alter a variable, for example).

4.6.1 Configuration over SNMP

The LANTIME timeserver can be configured via several user interfaces. Besides the possibility to setup its parameters with the web interface (HTTP and/or HTTPS) and the direct shell access via Telnet or SSH, a SNMP based configuration interface is available.

In order to use the SNMP configuration features of the timeserver, you need to fulfil the following requirements (the system has to be reachable over the network, of course):

    a)   SNMP has to be activated in the timeservers setup by setting up a RWCOMMUNITY
    b)   In the SNMP configuration the read-write-access needs to be activated
    c)   The timeserver-specific MIB files must be present on the clients,
               they have to be included in the SNMP setup of the client software

a) and b) can be achieved by using the web interface or the shell access, please see the appropriate chapters in this manual. The mentioned MIB files can be found directly on the timeserver located at /usr/local/share/snmp/mibs. All files with names starting with "MBG-SNMP-" have to be copied onto the SNMP clients by using the timeservers ftp access (for example). You may also use the web interface, on the page "Local – LANTIME Services" (V5) or "System – Services and Functions" (V6) you will find a button "Download MIB files". You will get a tar-archive if you are using the download button, which you have to unpack first.

Afterwards, copy all MIB files to the MIB directory on your client(s) and configure your SNMP client software to use them.

Examples for the usage of the SNMP configuration features

The following examples are using the software net-snmp, a SNMP open source project. You will find detailed information at www.net-snmp.org!

To browse the configuration branch of the timeserver-MIB, you could use the following command on a UNIX system with net-snmp SNMP tools installed:

root@testhost:/# snmpwalk -v 2c -c public timeserver.meinberg.de mbgLtCfg

MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfghostname.0 = STRING: LantimeSNMPTest
MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfgDomainname.0 = STRING: py.meinberg.de
MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfgNameserver1.0 = STRING: 172.16.3.1
MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfgNameserver2.0 = STRING:
MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfgSyslogserver1.0 = STRING:
MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfgSyslogserver2.0 = STRING:
[...]

To alter a parameter, with net-snmp you would use the snmpset command:

root@testhost:/# snmpset -v 2c -r 0 -t 10 -c rwsecret timeserver.meinberg.de
mbgLtCfghostname.0 string „helloworld"

MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfghostname.0 = STRING: helloworld
root@testhost:/#

Please note that your SNMP request has to be sent with a sufficient timeout (in the above snmpset example this was achieved by using the "-t 10" option, choosing a timeout of 10 seconds), because after each parameter change, the timeserver reloads its configuration, which takes a few seconds. The request is acknowledged by the SNMP agent afterwards.

To change a group of parameters without reloading the configuration after each parameter, you have to send all parameter changes in one single request. You can do this with the net-snmp snmpset command by specifying multiple parameters in one command line:

root@testhost:/# snmpset -v 2c -r 0 -t 10 -c rwsecret timeserver.meinberg.de
mbgLtCfghostname.0 string „helloworld" mbgLtCfgDomainname.0 string
„internal.meinberg.de"

MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfghostname.0 = STRING: helloworld
MBG-SNMP-LANTIME-CFG-MIB::mbgLtCfgDomainname.0 = STRING: internal.meinberg.de

root@testhost:/#

The available SNMP variables are described in detail in the "SNMP configuration reference" part of this manual. Additionally, it is recommended to also read the mentioned MIB files.

Further configuration possibilities

Because the timeserver uses a standard version of the net–snmp SNMP daemon (with extended features covering the timeserver-specific functions), all configuration parameters of the SNMPD can be used. The configuration file of the SNMP daemon is located at /usr/local/share/snmp after boot time, the filename is snmpd.conf.

During the boot sequence, this file is created dynamically by using a template file and appending the SNMP parameters stored in the timeserver setup.

If you need to customize the configuration of the timeservers SNMPD (for setting up detailed access control rights for example), you may edit **/mnt/flash/packages/snmp/etc/snmpd_conf.default** (which is the mentioned template file). Please note that some lines are appended to this file (as described above), before it is used as /usr/local/share/snmp/snmpd.conf by the snmpd process.

Send special timeserver commands with SNMP

The timeserver is capable of receiving special commands by SNMP in order to reboot the unit or reload its configuration after you manually changed it. A special SNMP variable is reserved for this (mbgLtCmdExecute) and has to be set to a special integer value for each command. The following commands are available:

Reboot(1)
Setting the mbgLtCmdExecute variable to value 1 will reboot the timeserver after a short waiting period of approximately 3–5 seconds.

FirmwareUpdate(2)
This command installs a previously uploaded (with FTP for example) firmware version.

ReloadConfig(3)
The parameters of the timeserver configuration (stored in /mnt/flash/global_configuration) are re-read and afterwards a number of subsystems (e.g. NTPD, HTTPD/HTTPSD, SMBD) will be restarted in order to use those eventually changed settings. Please note that the SNMPD will not be restarted by this command (you have to use reboot instead or restart it manually by killing the process and starting it again in the shell).

GenerateSSHKey(4)
A new SSH key will be generated.

GenerateHTTPSKey(5)
A new HTTPS key will be generated.

ResetFactoryDefaults(6)
The configuration of the timeserver is reset to factory defaults, afterwards an automatic ReloadConfig is executed in order to use these default settings.

GenerateNewNTPAutokeyCert(7)
A new key is generated, it can be used with the NTP AUTOKEY feature.

SendTestNotification(8)
A test message is sent by using all notification methods the timeserver has a configuration for (e.g. mail, win-popup, SYSLOG etc.).

A few examples:
(we are again using the snmpset command which comes with the net–snmp tools).

> **root@testhost:/# snmpset –v2c –r 0 –t 10 –c rwsecret timeserver.meinberg.de**
> **mbgLtCmdExecute.0 int 1**
>
> MBG–SNMP–LANTIME–CMD–MIB::mbgLtCmdExecute.0 = INTEGER: Reboot(1)
> **root@testhost:/#**

The command shown above is forcing the timeserver to reboot. Instead of using the integer value, you may also enter the command name, as it is defined in the MIB file MBG-SNMP-LANTIME-CMD.txt (and in the command list above).

If you want the timeserver to reload it's configuration file (which you previously uploaded via FTP probably), you would enter this command:

> **root@testhost:/# snmpset -v2c -r 0 -t 10 -c rwsecret timeserver.meinberg.de mbgLtCmdExecute.0 int ReloadConfig**
>
> MBG-SNMP-LANTIME-CMD-MIB::mbgLtCmdExecute.0 = INTEGER: ReloadConfig(3)
> **root@testhost:/#**

Please pay attention to the options "-r 0" (meaning "no retries") and "-t 10" (meaning "timeout of 10 secs") in the above examples. These options avoid multiple executions of the desired command, additionally they give your snmpset command enough time to wait for an acknowledgement from the timeservers snmp agent.

Configuration of the timeserver with SNMP: Reference

The MIB of the timeserver includes the following parts:

SNMP Object	Name	Description
enterprises.5597	mbgSNMP	Root node of the Meinberg–MIB
mbgSNMP.3	MbgLANTIME	Root node of the LANTIME MIB
mbgLANTIME.1	mbgLtNtp	LANTIME NTP status variables
mbgLANTIME.2	mbgLtRefclock	LANTIME reference time source status variables
mbgLANTIME.3	mbgLtTraps	LANTIME SNMP traps
mbgLANTIME.4	mbgLtCfg	LANTIME configuration variables
mbgLANTIME.5	mbgLtCmd	LANTIME control commands

Further detailed information can be found in the Meinberg MIB files.

Reference of LANTIME SNMP configuration variables:

SNMP branch	Variable	Data type	Description
mbgLtCfgNetwork	mbgLtCfghostname	string	The hostname of the timeserver
	mbgLtCfgDomainname	string	The Domainname of the timeserver
	mbgLtCfgNameserver1	string (IPv4 or IPv6–address)	IP–address of first nameserver
	mbgLtCfgNameserver2	string (IPv4 or IPv6–address)	IP–address of second nameserver
	mbgLtCfgSyslogserver1	string (IPv4 or IPv6–address or hostname)	IP–address or hostname of first syslog-server
	mbgLtCfgSyslogserver2	string (IPv4 or IPv6–address or hostname)	IP–address or hostname of second syslog-server
	mbgLtCfgTelnetAccess	integer (0 = dis-abled, 1 = en-abled)	Telnet access activated?
	mbgLtCfgFTPAccess	integer (0 = dis-abled, 1 = en-abled)	FTP–access activated?
	mbgLtCfgHTTPAccess	integer (0 = dis-abled, 1 = en-abled)	Webinterface activated?
	mbgLtCfgHTTPSAccess	integer (0 = dis-abled, 1 = en-abled)	Encrypted webinterface activated?
	mbgLtCfgSNMPAccess	integer (0 = dis-abled, 1 = en-abled)	SNMP–daemon activated?

SNMP branch	Variable	Data type	Description
	mbgLtCfgSambaAccess	integer (0 = disabled, 1 = enabled)	LANManager-access activated?
	mbgLtCfgIPv6Access	integer (0 = disabled, 1 = enabled)	IPv6-protocol enabled?
	mbgLtCfgSSHAccess	integer (0 = disabled, 1 = enabled)	SSH-access activated?
mbgLtCfgNTP	mbgLtCfgNtpServer1IP	string (IPv4 or IPv6-address or hostname)	First external NTP-server
	mbgLtCfgNtpServer1KEY	integer	Link to the key which should be used for the first NTP-server
	mbgLtCfgNtpServer2IP	string (IPv4 or IPv6-address or hostname)	Second external NTP-server
	mbgLtCfgNtpServer2KEY	integer	Link to the key which should be used for the second NTP-server
	mbgLtCfgNtpServer3IP	string (IPv4 or IPv6-address or hostname)	Third external NTP-server
	mbgLtCfgNtpServer3KEY	integer	Link to the key which should be used for the third NTP-server
	mbgLtCfgStratumLocal Clock	integer(0..15)	Stratum-value of the internal system clock of the timeserver
	mbgLtCfgNTPTrustedKey	integer	Link to the key which should be used for the internal reference time source
	mbgLtCfgNTPBroadcastIP	string (IPv4 or IPv6-address)	IP-address, which has to be used for NTP-broadcasts (or multicasts)
	mbgLtCfgNTPBroadcast Key	integer	Link to the key which should be used for outgoing NTP-broadcasts
	mbgLtCfgNTPBroadcast Autokey	integer (0 = disabled, 1 = enabled)	Use autokey for NTP broadcasts?
	mbgLtCfgAutokeyFeature	integer (0 = disabled, 1 = enabled)	Use autokey feature of the NTP server?

SNMP branch	Variable	Data type	Description
	mbgLtCfgAtomPPS	integer (0 = disabled, 1 = enabled)	Atom PPS (pulse per second) activated?
mbgLtCfgEMail	mbgLtCfgEMailTo	string (Liste von EMail-addressn)	One or more (semicolon separated) email address(es). which should receive warnings and alarm notifications from the timeserver
	mbgLtCfgEMailFrom	string (EMail-address)	The EMail-address which is used as the senders address for email notifcations
	mbgLtCfgEMailSmarthost	string (IPv4 or IPv6-address or hostname)	The SMTP-host, which is used for sending mails
mbgLtCfgSNMP	mbgLtCfgSNMPTrapReceiver1	string (IPv4 or IPv6-address or hostname)	First host, which receives notifications sent as SMTP-traps
	mbgLtCfgSNMPTrapReceiver1Community	string	The SNMP community used when sending SNMP-Traps to the first host
	mbgLtCfgSNMPTrapReceiver2	string (IPv4 or IPv6-address or hostname)	Second host, which receives notifications sent as SMTP-traps
	mbgLtCfgSNMPTrapReceiver2Community	string	The SNMP community used when sending SNMP-Traps to the second host
	mbgLtCfgSNMPRO Community	string	The SNMP community, which has read-only access and therefore can be used to only monitor status variables or configuration values (SNMP V2c)
	mbgLtCfgSNMPRW Community	string	The SNMP community, which has read-write access and there for can be used to monitor status variables and get/set configuration values (SNMP V2c)
	mbgLtCfgSNMPContact	string	Contact information (e.g. name of a contact person) of the timeserver
	mbgLtCfgSNMPLocation	string	Location (e.g. building/room number) of the timeserver
mbgLtCfgWinpopup	mbgLtCfgWMailAddress1	string	First receiver of notifications sent as windows popup messages
	mbgLtCfgWMailAddress2	string	Second receiver of notifications sent as windows popup messages

SNMP branch	Variable	Data type	Description
mbgLtCfgWalldisplay	mbgLtCfgVP100Display1IP	string (IPv4 or IPv6-address or hostname)	hostname or IP-address of the first wall-mount display used for showing notifications
	mbgLtCfgVP100Display 1SN	string (Hexstring)	The serial number of the first wall mount display used for showing notifications (can be found in the setup menu of the display)
	mbgLtCfgVP100Display 2IP	string (IPv4 or IPv6-address or hostname)	hostname or IP-address of the second wall mount display used for showing notifications
	mbgLtCfgVP100Display 2SN	string (Hexstring)	The serial number of the first wall mount display used for showing notifications (can be found in the setup menu of the display)
mbgLtCfgNotify	mbgLtCfgNotifyNTPNot Sync	string(combination)	Exactly one, none or a combination of the following notification types: email = sending an email wmail = sending a winpopup-message snmp = sending a SNMP-trap, disp = showing on wall mount display, syslog = sending a syslog-entry for the event „NTP not synchronized"
	mbgLtCfgNotifyNTP Stopped	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „NTP Daemon stopped"
	mbgLtCfgNotifyServer Boot	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „Timeserver reboot"
	mbgLtCfgNotifyRefclock NotResponding	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „Refclock not ready"
	mbgLtCfgNotifyRefclock NotSync	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „Refclock not synchron"
	mbgLtCfgNotifyAntenna Faulty	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „GPS antenna not connected or dammaged"
	mbgLtCfgNotifyAntenna Reconnect	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „GPS antenna reconnected"
	mbgLtCfgNotifyConfig Changed	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „Configuration changed"
	mbgLtCfgNotifyLeapSecond Announced	string (combination)	(see mbgLtCfgNotifyNTPNotSync) for the event „Leap second announced"

SNMP branch	Variable	Data type	Description
mbgLtCfgEthernet	mbgLtCfgEthernetIf0IPv4 IP	string (IPv4 IP-address)	IPv4-address of first network interface of the timeserver
	mbgLtCfgEthernetIf0IPv4 Netmask	string (IPv4 Netz-maske)	IPv4-netmask of first network interface of the timeserver
	mbgLtCfgEthernetIf0IPv4 Gateway	string (IPv4 IP-address)	IPv4-address of the default gateway of the timeservers first network interface
	mbgLtCfgEthernetIf0DHCP Client	integer (0 = dis-abled, 1 = en-abled)	Configure the first network interface of the timeserver with DHCP?
	mbgLtCfgEthernetIf0IPv6 IP1	string (IPv6 IP-address)	First IPv6-IP-address of the timeservers first network interface
	mbgLtCfgEthernetIf0IPv6 IP2	string (IPv6 IP-address)	Second IPv6-IP-address of the time-servers first network interface
	mbgLtCfgEthernetIf0IPv6 IP3	string (IPv6 IP-address)	Third IPv6-IP-address of the timeservers first network interface
	mbgLtCfgEthernetIf0IPv6 Autoconf	integer (0 = dis-abled, 1 = en-abled)	Activate autoconf for the IPv6 – configu-ration of the timeservers first network in-terface?
	mbgLtCfgEthernetIf0 NetlinkMode	integer (0..4)	Configuration of the network-speed and duplex settings of the timeservers first network interface
			0 = autosensing,
			1 = 10Mbit/s half duplex,
			2= 10Mbit/s full duplex,
			3=100Mbit/s half duplex,
			4=100Mbit/s full duplex

For all additional Ethernet interfaces of the timeserver, "If0" only has to be replaced with "Ifx", where "x" is substituted by the number of the desired Ethernet interface. Example: The IPv4-address of the timeservers third Ethernet interface can be set with mbgLtCfgEthernetIf2IPv4IP!

4.6.2 SNMP Traps

If configured, the LANTIME is sending SNMP traps, which can be received by up to 2 SNMP management systems. These traps can be received by using the NET-SNMP suite tool "snmptrapd", you can start it on a UNIX system with "snmptrapd –p" (-p is for output to stdout, -s would use the syslog for output). The corresponding MIB files can be found on the LANTIME at /usr/local/share/snmp/mibs/ , all Meinberg specific MIB files are named "MBG-SNMP...." . These MIB files can be downloaded by using the web interface (see "Local" page, "Download MIB files" button), after unpacking the archive file you can import the MIB files into your management system.

The following SNMP-traps are available:

"NTP not sync"	NTP not synchronised to refclock
"NTP stopped"	NTP stopped
"Server boot"	System has rebooted
"Receiver not responding"	no answer from GPS
"Receiver not sync"	GPS receiver not synchronised
"Antenna faulty"	GPS antenna not connected
"Antenna reconnect"	GPS antenna reconnected
"Config changed"	System parameter changed by user
„Leap second announced"	Leap second announced

See the "Notification" page at the web interface and Command Line Interface description to learn how to configure the SNMP trap receivers.

SNMP Trap Reference

All traps can be found under the mbgLtTraps section in the Meinberg MIB. A special trap exists for every notification event the timeserver knows. Please note that the traps are only sent if you configured the notification type "SNMP trap" for the event, otherwise no trap is generated. All traps have a string parameter included, which contains the plain text event message for the appropriate event (you are able to change the default text messages, see web interface and/or CLI setup section to find out how to do this).
Here is a list of all traps the timeserver knows:

- **mbgLtTrapNTPNotSync (mbgLtTraps.1):** Whenever the NTP daemon (ntpd) looses sync, it will generate this trap and send it to the configured SNMP trap receivers.
- **mbgLtTrapNTPStopped (mbgLtTraps.2):** This trap is sent when the NTP daemon stopped, manually or because of an error condition.
- **mbgLtTrapServerBoot (mbgLtTraps.3):** After finishing the boot process, this trap is generated.
- **mbgLtTrapReceiverNotResponding (mbgLtTraps.4):** Trap to be sent when the internal receiver of the timeserver is not responding.
- **mbgLtTrapReceiverNotSync (mbgLtTraps.5):** If the internal receiver looses sync, the SNMP trap receivers will receive this trap.
- **mbgLtTrapAntennaFaulty (mbgLtTraps.6):** This trap will be sent whenever the timeserver recognises a broken connection to the antenna of the receiver.
- **mbgLtTrapAntennaReconnect (mbgLtTraps.7):** After the connection to the antenna has been re-established, this trap is sent.
- **mbgLtTrapConfigChanged (mbgLtTraps 8):** After reloading its configuration, the timeserver generates this trap.
- **mbgLtTrapLeapSecondAnnounced (mbgLtTraps 9):** If a leap second has been announced by the internal GPS receiver, this trap will be sent.
- **mbgLtTrapTestNotification (mbgLtTraps 99):** This trap is sent whenever you are requesting a test notification; it is only used for testing the connection between the timeserver and your SNMP trap receivers.

4.7 Third party software

The LANTIME network timeserver is running a number of software products created and/or maintained by open source projects. A lot of people contributed to this and we explicitly want to thank everyone involved for her/his great work.

The used open source software comes with its own license which we want to mention below. If one of the licenses for a third party software product is violated, we will as soon as possible apply any changes needed in order to conform with the corresponding license after we acknowledged about that violation.

If a license for one of the software products states that we have to provide you with a copy of the source code or other material, we will gladly send it to you on data media via normal post or by e-mail upon request. Alternatively we can provide you with a link to a download location in the internet, allowing you to download the most actual version. Please note that we have to charge you for any incurred expenses if you choose to receive the source code on data media.

4.7.1 Operating System GNU/Linux

The distribution of the GNU/Linux operating system is covered by the GNU General Public License (GPL), which we included below.

More information about GNU/Linux can be found on the GNU website
www.gnu.org

and on the website of GNU/Linux
www.linux.org

4.7.2 Samba

The Samba software suite is a collection of programs, which implement the Server Message Block (SMB) protocol for UNIX systems. By using Samba your Lantime is capable of sending Windows popup messages and serves request for network time by clients using the NET TIME command.

The distribution of Samba is covered – like GNU/Linux – by the GNU General Public License, see below.

The website of the Samba project (or a mirror) can be reached at
www.samba.org

4.7.3 Network Time Protocol Version 4 (NTP)

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

```
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*                                                                       *
*************************************************************************
```

4.7.4 lighttpd

For our web based configuration tool (HTTP and HTTPS) we use Lightttpd. Lighttpd is a free web server, with all the essential
functions of a web server. Lighttpd has been developed by the german Software Developer Jan Kneschke.

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# 5 Option: Precision Time Protocol (PTP) / IEEE1588

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

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

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

5.1 General Information

The internal PTP card acts as a network interface card (10/100MBit) with an integrated hardware time stamp unit to obtain time stamps in PTP compatible networks. In conjunction with a single board computer running the PTP protocol stack and a reference time source (PTP master only) the module is capable of building a PTP Master or Slave system:
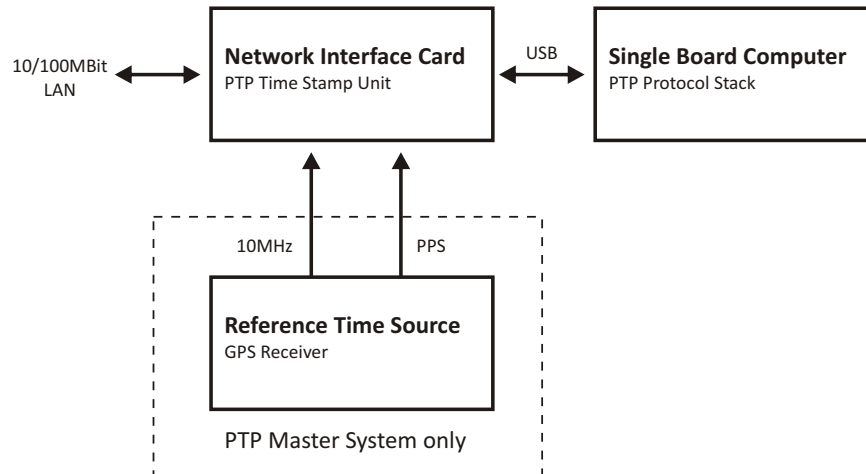
The Time Stamp Unit, integrated in an FPGA (Field Programmable Gate Array, a programmable logic device), checks the data traffic on the MII-interface between the PHY receiver (physical connection to the network) and the Ethernet controller (MAC) on the PTP module. If a valid PTP packet is detected, the time stamp unit takes a time stamp of that packet which is read by a single board computer (SBC) running the PTP software. The configuration and status traffic between the PTP board and main SBC is done over a USB connection.

5.2 Functionality in Master Systems

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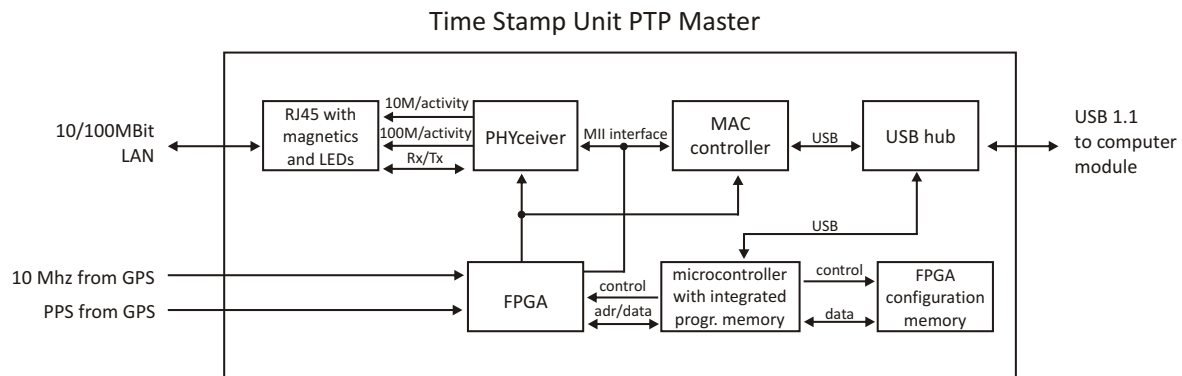
After power up, the module accepts the absolute time information (PTP seconds) of a reference time source (e.g. GPS reference clock) only once, and the PTP nanoseconds are set to zero. If the oscillator frequency of the reference time source has reached its nominal value, the nanoseconds are reset again.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

5.3 Functionality in Slave Systems

Time Stamp Unit PTP Slave
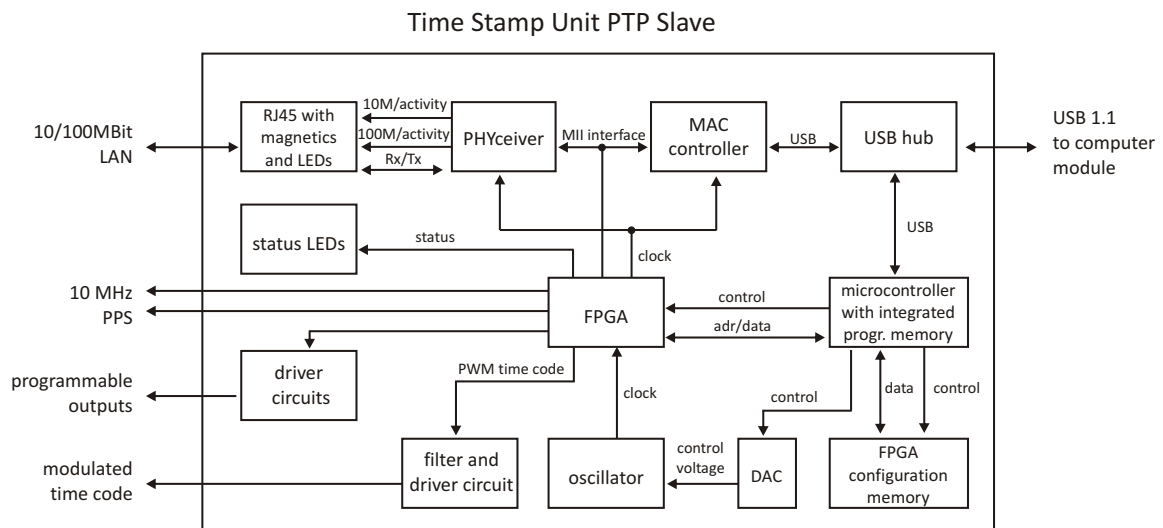
After decoding valid time information from a PTP Master, the system sets its own PTP seconds and nanoseconds accordingly. The PTP offset calculated by the PTP driver software of the single board computer is used to adjust the master oscillator of the TSU–USB. This allows the PTP Slave to generate very high accuracy output signals (10 MHz/1PPS/IRIG).

5.4 PTPv2 IEEE 1588-2008 Configuration Guide

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

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

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

5.4.1 General Options

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

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

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

5.4.2 Network Layer 2 or Layer 3

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

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

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

5.4.3 Multicast or Unicast

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

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

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

5.4.4 Two-Step or One-Step

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

5.4.5 End-To-End (E2E) or Peer-To-Peer (P2P) Delay Measurements

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

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

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

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

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

5.4.6 Mode Recommendations

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

5.4.7 Message Rate Settings

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

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

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

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

5.4.8 ANNOUNCE Messages

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

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

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

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

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

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

5.4.9 SYNC/FOLLOWUP Messages

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

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

5.4.10 (P)DELAY_REQUEST Messages

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

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

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

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

5.4.11 HQ Filter

If you use non PTP aware switches in a network where PTP should be used then the timing accuracy of the offset depends on the characteristic of the switches. Non PTP switches will cause time jitters (due to non deterministic delays in each path direction) in PTP measurement. In this section, the term "jitter" is used to describe the maximum deviation of the measured offsets around a certain mean value. This time jitter of standard non-PTP compliant switches can be in the range of 100 ns up to 10000 ns. When using routers this jitter can be even higher. To reduce this time jitter the HQ filter can be activated to achieve a better PTP slave synchronization quality. With Layer2 switches the accuracy can be achieved in the range of submicro seconds. Also Jitter caused by high network load and faulty measurements will be eliminated

Functionality

After activating the HQ-Filter some PTP measurements will be done first without controlling the timing of the PTP slave. This phase will be indicated by an extra hint "init" in the current status of the PTP slave. During this phase the maximum jitter of the PTP offset, the path delay and the current drift of the internal oscillator will be calculated by statistical methods. The only filter parameter which can be set by the user is the **estimated accuracy** which will set the maximum expected range of the incoming time jitter. All input values that are out of this range will be dropped. The maximum jitter of the input will be updated continuously during normal operation. By default **estimated accuracy** will be set to 1s to determine the maximum jitter automatically.

PDSC

PDSC means "Path Delay Step Compensation". The PDSC feature tries to eliminate jumps of the PTP path delay, so that there will be no effect on the timing accuracy. Such a jump of the PTP path delay (which should be usually constant) will be caused by changing the topology of the PTP network which could happen in SDH networks for example. The change of the PTP path delay is only detected, if the step is larger than the measured time jitter. This feature is an extension of the HQ-Filter and therefore the HQ-Filter has to be activated.

6 LANTIME CPU

6.1 LANTIME CPU

During startup, the LANTIME operating system is loaded from a flash disk into a RAM disk. Because of that it is guaranteed that the file system is in a defined condition after restart. The boot process takes approx. two minutes. During this time the following message appears on the display:

```
 Starting Up
 please wait ...

 .........
```
...
```
 LANTIME OS6
 [6.xx.xxx]
 Loading
 Configuration
```
...
```
 NORMAL OPERATION
 NTP: Offs. 50us
 Wed, dd.mm.yyyy
 UTC  12:00:00
```
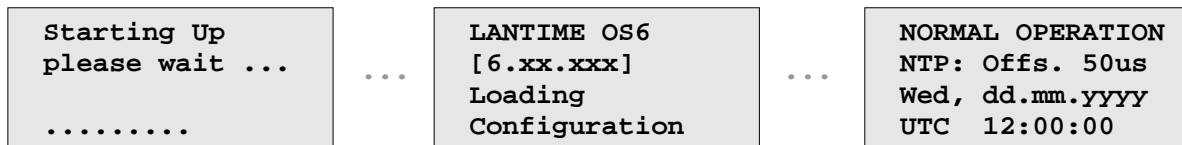
After starting up the operating system the network configuration is initiated and the central software process responsible for communicating with the reference clock and the NTP service (NTP daemon) is started and attempts to establish synchronization of the CPU with the connected clock module(s).

```
 CLK: Not Sync
 NTP: Sync to OSC
 Wed, dd.mm.yyyy
 UTC  12:00:00
```

For the synchronization of the NTP subsystem with the reference clock it is necessary that the clock module established synchronization with one of its reference sources (GPS, GLONASS, DCF77 or any other configured input signal ...).

The second line shows the user that the NTP service is synchronized with the reference time with an offset of -50us. Because of the internal time of the NTP which is adjusted by a software PLL (phase locked loop) it takes a certain time to reduce this offset. Typical values for the offset are +-5 us after the NTP system has established synchronization with the clock module, but the achievable accuracy is of course depending on the reference source.

6.2 Technical Specifications LAN CPU

CPU Module Type C051F1:

PROCESSOR: AMD Geode^{TM} LX 800 (500 MHz, 128 KB L2 cache, 3.6 W)

MAIN MEMORY: onboard 256 MByte

CACHE-MEMORY: 16 KB 2nd Level Cache

FLASHDISK: 1 GB

NETWORK
CONNECTOR: 10/100 MBIT with RJ45-Jack

POWER
REQUIREMENTS: 5 V +- 5 %, @ 1 A

FRONTPANEL: LTOS6 in 3U modular case
3U / 4 TE (128 mm high x 20,3 mm wide)

AMBIENT
TEMPERATURE: 0 ... 50 °C

HUMIDITY: 85 % max.

7 LANTIME Diagnostic File

A diagnostic file which includes all status data of a LANTIME system logged since the last reboot can be downloaded from all LANTIME Time servers. The file format of the diagnostic file is a tgz-archive. The archive contains all the important configuration and logfiles. In most support cases it is the first action to ask the customer to download the diagnostic file, because it is very helpful to identify the current state of the LANTIME and to find possible errors.

The following chapters describe how to download the file via HTTP web interface, command line interface (CLI) or via USB stick.

7.1 Download via Web GUI

Connect to the web interface of your LANTIME with the configured IP address of one of the connected network interfaces. Enter this IP into the address field of a web browser. Open the "System" section and the submenu "Diagnostics". Press the "Download Diagnostic File" button then.
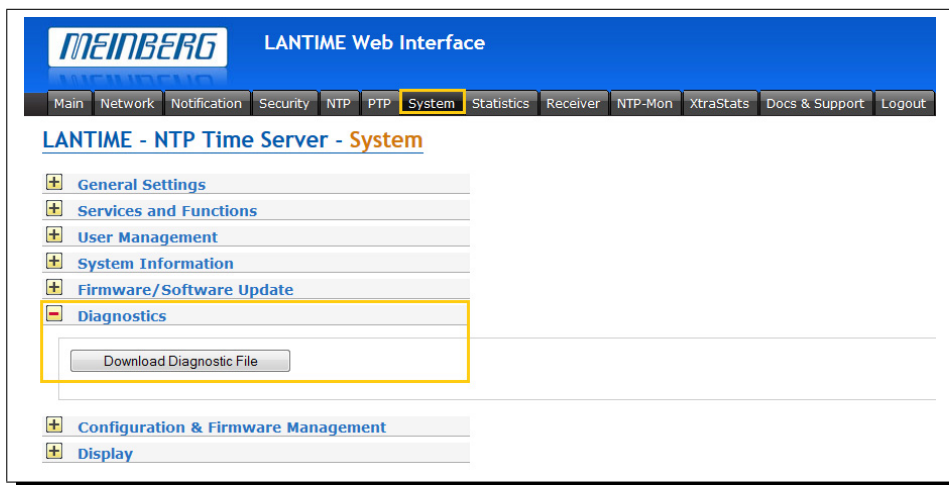

Figure: Download the diagnostic file via the Web GUI.

7.2 Download Diag-File via USB Interface

Connect a USB memory stick to the USB port of the LANTIME:

- The USB Memory Stick Menu opens automatically – press "OK" to confirm
- You can use the up and down arrows to navigate through the menu
- Select the "Write diagnostic file to USB stick" option to copy the current diagnostic file to the USB stick
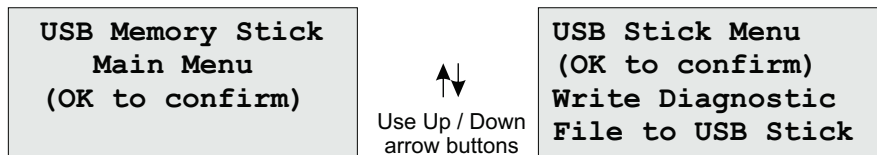
```
 USB Memory Stick
    Main Menu
 (OK to confirm)
```

↑↓

Use Up / Down
arrow buttons

```
 USB Stick Menu
 (OK to confirm)
 Write Diagnostic
 File to USB Stick
```

Figure: Steps how to download a diagnostic file via the USB interface of a LAN-CPU.

7.3 Download via Command Line Interface (CLI)

First Login with a terminal console. The access to a command line interface can be established via SSH, TELNET or serial connection.

To set up a TELNET connection the following commands should be entered:
telnet 198.168.10.10 LANTIME IP (this IP is an example address,
enter the assigned IP of your lantime here)

Default User: *root*
Default Password: *timeserver*

To set up a SSH connection the following commands should be entered:
ssh root@198.168.10.10 LANTIME IP
Default Password: *timeserver*

To set up a serial connection the Terminal (9pin D–SUB RS232 connector) in the front panel (LANTIME Family) or RJ45 connector of the IMS-CPU module (IMS Systems) has to be used. A NULL-MODEM cable to connect your PC or Laptop computer should be used. You can use a standard Hyper-terminal program shipped with your Windows operating system. Configure your terminal program with the following settings:

– 38400 Baud
– 8 Databits, no parity
– 1 Stopbit

The terminal emulation should be set to VT100. After connecting with the time server the login message will be displayed (press RETURN for the first connection):

default user: *root*
password: *timeserver*

Creating a diagnostic file
The diagnostic file can be created by using the command *"get_diag_file"*:

The archive that was created in this way can be found in the "/www/htdocs/upload/" directory. You can copy this file to another remote device with the help of an SCP/SSH client.

7.4 Content / most important Files in a Diagnostic Archive

/logs/messages (detailed log messages)

```
Apr 29 12:26:48 timeserver LANTIME[9306]: Leap-second file detected
Apr 29 12:26:49 timeserver cfgdb: saveconfig lantime
Apr 29 12:26:49 timeserver PPS: Enabling PPS support for 1:ttyS1
Apr 29 12:26:49 timeserver PPS: PPS support successfully enabled for
Apr 29 12:26:50 timeserver service_control: /var/run/firmware/packag
Apr 29 12:26:50 timeserver xinetd[16491]: Starting reconfiguration
Apr 29 12:26:50 timeserver xinetd[16491]: Swapping defaults
Apr 29 12:26:50 timeserver xinetd[16491]: readjusting service telnet
Apr 29 12:26:50 timeserver xinetd[16491]: Reconfigured: new=0 old=1
Apr 29 12:26:51 timeserver lt_set_systime: Lantimed is running -> se
```

An example of all logged messages of a LANTIME.

/logs/lantime_messages (most important log messages)

```
2015-04-29 12:54:54 UTC: LANTIME -> OSCILLATOR ADJUSTED [Refclock: 1 ]
2015-04-29 12:33:15 UTC: LANTIME -> DEVICE CONFIGURATION CHANGED
2015-04-29 12:27:54 UTC: LANTIME -> OSCILLATOR NOT ADJUSTED [Refclock: 1 ]
2015-04-29 12:27:13 UTC: LANTIME -> LEAP SECOND ANNOUNCED
2015-04-29 12:26:58 UTC: LANTIME -> NORMAL OPERATION
2015-04-29 12:26:56 UTC: LANTIME -> 1. REFCLOCK SYNC
2015-04-29 12:26:55 UTC: LANTIME -> NTP RESTART
2015-04-29 12:26:55 UTC: LANTIME -> NTP SYNC TO GPS
2015-04-29 12:26:55 UTC: LANTIME -> NTP SYNC
2015-04-29 12:26:55 UTC: LANTIME -> GPS NORMAL OPERATION
2015-04-29 12:26:55 UTC: LANTIME -> ANTENNA RECONNECT
2015-04-29 12:26:54 UTC: LANTIME -> NETWORK LINK UP [Affected LAN Interface: 1 ]
2015-04-29 12:26:54 UTC: LANTIME -> SYSTEM REBOOT
2015-04-29 12:26:48 UTC: LANTIME -> DEVICE CONFIGURATION CHANGED
2011-03-16 00:02:06 UTC: LANTIME -> 1. REFCLOCK NOT SYNC
2011-03-16 00:02:06 UTC: LANTIME -> NETWORK LINK DOWN [Affected LAN Interface: 1 ]
```

An example of logged messages dedicated to the LANTIME daemon.

/device (device information like serial number or running firmware version)

```
Device Version
=============================================
Tue May  5 10:59:53 UTC 2015
>>>                            firmware version
ID: LANTIME  ELX800  GPS180 M300  V6.16.009
S/N: 030111129550   <- serial number
GPS180 :2.03  S/N: 11090050
Customized version:
Oscillator type: TCXO
```

Main Device information from a diag file. One can find here a serial number of the LANTIME, which is important information for further troubleshooting of the system.

/network (list of network interfaces including IP Addresses)

```
=== Physical Interface lan0 :     00:13:95:15:d3:e9
    Speed: 100Mb/s
    Duplex: Full
    Link detected: yes

 Assigned Virtual Interfaces:  [:0]


  Active Virtual Interfaces: -------------------
    lan0:0     static      ipv4      138.227.102.180/255.255.254.0
```

IP Address and the network mask settings of the first network interface.

/ntp.conf (NTP configuration file)

```
#  ***  LANTIME  ***
# NTP.CONF for GPS with UNI ERLANGEN (do not modify)

tos orphan 12        #Stratum level when no ref source available

server  127.127.8.0 mode 151 prefer  minpoll 3 maxpoll 3 true  # UNI Erlangen with PPS
fudge    127.127.8.0 flag1 1
fudge    127.127.8.0 time2 345600      # trust time value
fudge    127.127.8.0 time1 0.004500      # calibration value
fudge    127.127.8.0 flag2 0  flag3 0
setvar LANTIME = LANTIME/GPS180/M300/V6.16.009/SN030111129550 default
enable stats
statsdir /var/log/
statistics loopstats sysstats
driftfile /etc/ntp.drift

leapfile /etc/leap_second


###########################################################
#ADD YOUR ADDITIONAL CONFIGURATION PARAMETERS BELOW THIS LINE:#
###########################################################
```

A default ntp.conf file on LANTIME servers.

gps_info (file only available on LANTIME GPS or GLN timeservers)
Status information about the staellite reference clock, for example how many satellites are in view and how many are considered as good.

```
GPS Information File
Updated: Tue May  5 10:59:51 2015

GPS Mode     : NORMAL OPERATION
GPS          : sync
GPS time     : 05.05.2015  12:59:51 CEST
Leapseconds  : 2015-06-30  (LS:16  LSF:17)

NTP          : Offs. GPS: 0us

Position:
  Lat: 51° 58' 57"N Lon: 09° 13' 33"E Alt: 168m

  Lat: 51.9827
  Lon: 9.2261
  Alt: 168m

  X: 3885658
  Y: 631155
  Z: 5001748

Satellite:
  in view : 7
  good SV : 7
  selected: 28 18 15 17
```

GPS status and satellite constellation in gps_info file.

/xmr_info (file only available on LANTIME MRS timeservers)
List of synchronization sources and their status.

```
MRS[0]:
Prio0: GPS            selected  * :   -1.0ns
Prio1: NTP            no signal : n/a
Prio2: PTP (IEEE1588) no signal : n/a
Prio3: STR in         no signal : n/a
```

List of synchronization sources (in this case only GPS is available and used for synchronization).

8 LANTIME Reference Clocks

The integrated clock modules are 100 mm x 160 mm microprocessor boards, and they are connected to the antenna unit by a coaxial cable (refer to manual "Mounting the Antenna"). An optional antenna splitter is available for our GPS, GLONASS and long wave receiver systems, to operate with up to four receivers from a single antenna.

8.1 GPS Satellite Controlled Clock

A Meinberg GPS satellite controlled radio clock is used as a reference time base. The satellite receiver clock provides extremely precise time. The clock has been developed for applications where conventional radio controlled clocks can not meet the growing demand for precision time. The advantage of the GPS clock is that it can provide highly precise time worldwide, 24 hours a day using the Global Positioning System.

The Global Positioning System (GPS) is a satellite-based radio-positioning, navigation, and time-transfer system. It was installed by the United States Department of Defense and provides two levels of accuracy: The Standard Positioning Service (SPS) and the Precise Positioning Service (PPS). SPS has been made available to the general public, but the PPS is encrypted and only available for authorized (military) users.

GPS accurately measures the propagation time of signals transmitted from satellites to the user's receiver. A nominal constellation of 24 satellites together with 3 active spares, in six orbital planes at 20,000 km altitude provides a minimum of four satellites in view 24 hours a day at every point on the globe. Four satellites need to be received simultaneously to determine both the receiver position (x, y, z) and the receiver clock offset from GPS system time. All the satellites are monitored by ground control stations which determine the exact orbit parameters and clock offsets of the satellites' onboard atomic clocks. These parameters are uploaded to the satellites and become part of a navigation message, which is retransmitted by the satellites and passed on to the user's receiver.

The high precision orbit parameters of the satellites are called ephemeris parameters, and a reduced precision subset of the ephemeris parameters is called a satellite's almanac. While ephemeris parameters must be evaluated to compute the receiver's position and clock offset, almanac parameters are used to check which satellites are in view from a given receiver position at a given time. Each satellite transmits its own set of ephemeris parameters and almanac parameters of all existing satellites.

8.1.1 GPS Clock Features

The GPS clock module is a 100 mm x 160 mm microprocessor board, and is connected to the antenna/converter unit by a 50 ohm coaxial cable (refer to "Mounting the Antenna"). DC power to fed to the antenna/downconverter via the antenna cable. An optional antenna splitter is available to operate up to four receivers from a single antenna.

The navigation message coming in from the satellites is decoded by the GPS clcok's microprocessor in order to track the GPS system time with an accuracy of better than 500 ns (or 250 nsec OCXO). Compensation of the RF signal's propagation delay is done by automatic determination of the receiver's position on the globe. A correction value computed from the satellites' navigation messages increases the accuracy of the board's TCXO or OCXO to 10 $^{-9}$ and automatically compensates for the oscillators aging. The last recent value is restored from the battery buffered memory at power-up.

8.1.2 Technical Specifications

Receiver:	GPS180: 12 – channel C/A code receiver GPS170: 6 – channel C/A code receiver
Antenna:	antenna/converter unit with remote power supply refer to chapter "Technical specifications of antenna"
Power Supply for Antenna:	15 V DC, continuous short circuit protection, automatic recovery isolation voltage 1000 VDC, provided via antenna cable
Antenna Input:	antenna circuit dc-insulated; dielectric strength: 1000V length of cable: refer to chapter "Mounting the Antenna
Time to Sychronization:	one minute with known receiver position and valid almanac 12 minutes if invalid battery buffered memory
Pulse Outputs:	change of second (P_SEC, TTL level) change of minute (P_MIN, TTL level)

Accuracy of Pulses:

after synchronization and 20 minutes of operation

TCXO, OCXO LQ:	better than +-100 nsec
OCXO SQ/MQ/HQ:	better than +-50 nsec
OCXO DHQ, Rubidium	better than +-50 nsec

better than $+-2\,\mu$sec during the first 20 minutes of operation

Frequency Outputs:

10 MHz, TTL level into 50 Ohm
1 MHz, TTL level
100 kHz, TTL level

Frequency Synthesizer:

1/8 Hz up to 10 MHz

Accuracy of Synthesizer:

base accuracy depends on system accuracy

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

Synthesizer Outputs:

F_SYNTH:	TTL level	
F_SYNTH_OD:	open drain	
	drain voltage:	< 100 V
	sink current to GND:	< 100 mA
	dissipation power at 25°C:	< 360 mW
F_SYNTH_SIN:	sine-wave	
	output voltage:	1.5 V eff.
	output impedance:	200 Ohm

Option Programmable Switch Outputs::

Four TTL outputs can configured independently for the following modes:
- free programmable cyclic or fixed impulses
- timecode
- timer mode; three 'ON'- and three 'OFF'-states can be setup per day

The switch states can be inverted for all three outputs, the impulse lengths are configurable in 10msec steps in a range from 10msec to 10sec. The impulse output can be configured for all channels together to 'always' or 'ifsync'.

Time_Syn Output:

TTL HIGH level if synchronized

Time Capture Inputs:	triggered on falling TTL slope Interval of events: 1.5msec min., Resolution: 100ns

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

Baud Rate:	300, 600, 1200, 2400, 4800, 9600, 19200 Baud
Framing:	7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8N1, 8N2, 8O1

default setting:

COM0:	19200, 8N1 Meinberg Standard time string, per second
COM1:	9600, 8N1 Capture string, automatically

Time Code Outputs: Unbalanced modulated sine wave signal:
$3V_{pp}$ (MARK), $1V_{pp}$ (SPACE) into 50 ohm

DCLS-signal: TTL into 50 ohm, active-high or -low

Power Requirements: +5 V +-5%, max. 1,2 A

Ambient Temp.: 0 ... 50°C

Humidity: 85% max.

8.1.3 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 45 cm plastic tube, two wall-mount brackets, and clamps for pole mounting are included with every . 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 receivers can be run with one antenna/downconverter unit by using an optional antenna split-ter. 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.

High voltage protectors must be installed directly after reaching the indoors. The optional delivered pro-tection kit is not for outdoor usage.
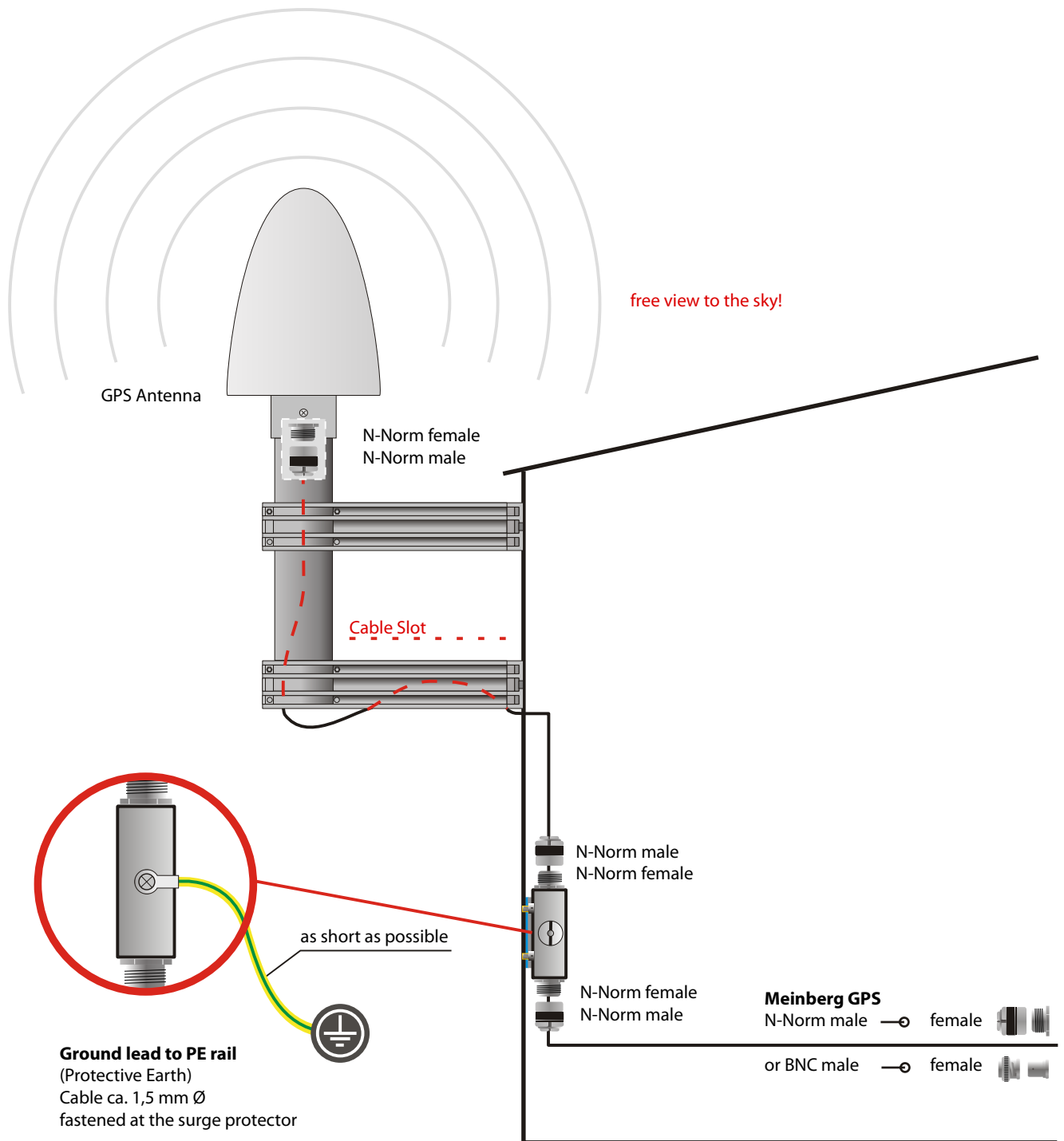
Example:

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

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

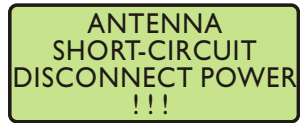**Antenna Assembly with Surge Voltage Protection**

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.

free view to the sky!

GPS Antenna

N-Norm female
N-Norm male

Cable Slot

N-Norm male
N-Norm female

as short as possible

N-Norm female
N-Norm male

Meinberg GPS
N-Norm male ———o female

or BNC male ———o female

Ground lead to PE rail
(Protective Earth)
Cable ca. 1,5 mm Ø
fastened at the surge protector

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 antenna supply voltage must be $15V_{DC}$.

Technical Specifications GPS Antenna

Antenna:	dielectrical patch antenna, receive frequency:	25 x 25 mm 1575.42 MHz
Bandwith:	9 MHz	
Converter:	local oscillator to converter frequency: first IF frequency:	10 MHz 35.4 MHz
Power Requirements:	12V ... 18V, @ 100mA (provided via antenna cable)	
Connector:	N-Type, female	
Ambient Temperature:	–40 ... +65°C	
Housing:	ABS plastic case for outdoor installation (IP66)	

Physical Dimension:
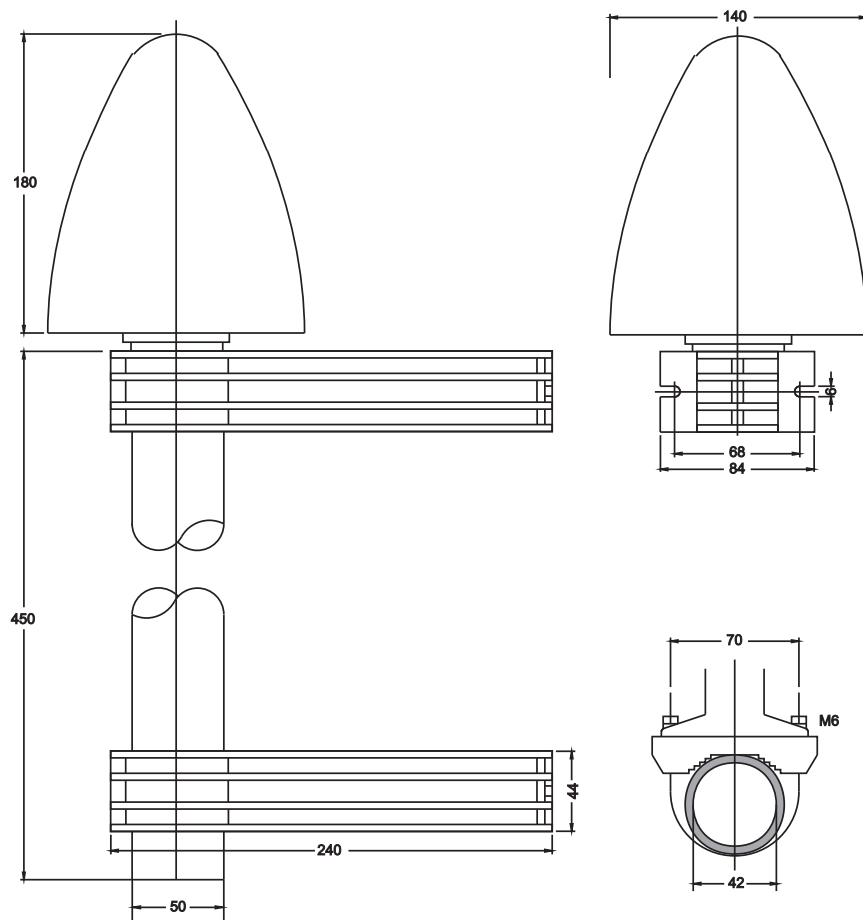
8.2 GPS/GLONASS satellite controlled clock

This clock has been developed for applications where conventional radio controlled clocks can't meet the growing requirements in precision. High precision available 24 hours a day around the whole world is the main feature of the new system which receives its information from the satellites of the russian GLONASS (GLObal NAvigation Satellite System) and the american GPS (Global Positioning System).

The GLONASS satellites are located on three orbital planes in 19100km over ground and turn around the earth once in about 12 hours.

GLONASS was developed to provide real-time position and velocity determination, initially for use by the Soviet military in navigating and ballistic missile targeting. Also GLONASS satellites transmit two types of signals: a Standard Precision (SP) signal and an obfuscated High Precision (HP) signal.

Satellite receiver for mobile applications:
The GLN timing board is designed for operating in mobile environments like cars, trains or airplanes. The on-board GPS / GLONASS receiver supports different dynamic platform models to adjust the navigation engine to the expected environment. These settings allow a better interpretation of the measurements and hence provides a more accurate position output.

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

8.2.1 GLN Features

The GLN board's hardware is a 100mm x 160mm microprocessor board. The 40.6mm wide front panel integrates two LED indicators and one covered push button. The receiver is connected to the combined GPS/GLONASS antenna by a 50 ohm coaxial cable with length of 15 meters (refer to "Mounting the Antenna").

The GLN board is equipped with a combined GPS/GLONASS receiver using the „Standard Positioning Service" (GPS) respectively „Standard Precision" (GLONASS). Compensation of the RF signal's propagation delay is done by automatic determination of the receiver's geographical position. A correction value computed from the satellites' navigation messages increases the accuracy of the board's oven controlled master oscillator (OCXO) and automatically compensates the OCXO's aging. The last state of this value is restored from the battery buffered memory at power-up.

The GLN receiver has several different optional outputs, including three programmable pulses, modulated / unmodulated time code and a maximum of four RS232 COM ports, depending on the hardware configuration. In addition, the board is available with different master oscillators (e.g. OCXO- LQ / MQ / HQ / DHQ or Rubidium) to cover all levels of requirements in accuracy.

8.2.2 Technical Specifications GLN Receiver

Receiver: Combined GPS/GLONASS receiver
                       Number of channels: 32
                       Frequency band: L1
                       Codes: C/A code (GPS)
                                             Standard accuracy (GLONASS)

Antenna: Combined GPS/GLONASS antenna
                       3dB Bandwidth: 1575.42 +-10 MHz / 1602-1615 MHz
                       Impedance: 50 Ω
                       Gain: 40 dB
                       Supply Voltage: 5 V

                       Length of antenna cable:20 meters

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

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

Pulse Outputs: Change of second (P_SEC, TTL level)
                       Change of minute (P_MIN, TTL level)

Accuracy
of Pulses: after synchronization and 20 minutes of operation
                       TCXO/OCXO LQ   :   better than +-100 nsec
                       OCXO MQ/OCXO HQ :   better than +-50 nsec
                       OCXO DHQ/Rubidium :   better than +-50 nsec

                       better than +-2 μsec during the first 20 minutes of operation

Frequency
Outputs: 10 MHz (TTL level)

Antenna: see chapter 8.3.3 Multi GNSS antenna
                       and chapter 8.3.4 L1 antenna for mobile applications

8.3 GNSS satellite controlled clock

This clock has been developed for applications where conventional radio controlled clocks can't meet the growing requirements in precision. High precision available 24 hours a day around the whole world is the main feature of the new system which receives its information from the satellites of the russian GLONASS (GLObal NAvigation Satellite System) and the american GPS (Global Positioning System).

The GLONASS satellites are located on three orbital planes in 19100km over ground and turn around the earth once in about 12 hours.

GLONASS was developed to provide real-time position and velocity determination, initially for use by the Soviet military in navigating and ballistic missile targeting. Also GLONASS satellites transmit two types of signals: a Standard Precision (SP) signal and an obfuscated High Precision (HP) signal.

The BeiDou Navigation Satellite System is the Chinese satellite navigation system. It became operational in China in December 2011. Similar to the other global navigation satellite systems (GNSSs), there will be two levels of positioning service: open (public) and restricted (military). The public service will be available globally to general users.

The BeiDou system will be a constellation of 35 satellites, which include 5 geostationary orbit satellites and 30 non-geostationary satellites (27 in medium Earth orbit / 22,000 km height and 3 in inclined geosynchronous orbit), that will offer complete coverage of the globe. The accuracy for public use is 10 m for the position and 0.2 m/s (≈ 0.7 km/h) for speed.

Satellite receiver for mobile applications:
The GLN timing board is designed for operating in mobile environments like cars, trains or airplanes. The on-board GPS / GLONASS receiver supports different dynamic platform models to adjust the navigation engine to the expected environment. These settings allow a better interpretation of the measurements and hence provides a more accurate position output.

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

8.3.1 GNSS Satellite Clock Features

The GNSS board is equipped with a combined GPS/GLONASS/Galileo/BeiDou receiver using the American „Standard Positioning Service" (GPS), the Russian „Standard Precision" (GLONASS), the European Galileo and the Chinese BeiDou navigation systems.

Compensation of the RF signal's propagation delay is done by automatic determination of the receiver's geographical position. A correction value computed from the satellites' navigation messages increases the accuracy of the board's oven controlled master oscillator (OCXO) and automatically compensates the OCXO's aging. The last state of this value is restored from the battery buffered memory at power-up.

The GNSS receiver has several different optional outputs, including three programmable pulses, modulated / unmodulated time code and a maximum of four RS232 COM ports, depending on the hardware configuration. In addition, the board is available with different master oscillators (e.g. OCXO- LQ / MQ / HQ / DHQ or Rubidium) to cover all levels of requirements in accuracy.

8.3.2 Technical Specifications GNSS Clock

Receiver:	Combined GPS/GLONASS/Galileo/BeiDou receiver	
	Number of channels:	32
	Frequency band:	L1
	Codes:	C/A code
		Standard accuracy (GNSS)

Antenna:	Multi GNSS antenna	
	3dB Bandwidth:	1575.42 +-10 MHz / 1602-1615 MHz
	Impedance:	50 Ω
	Gain:	40 dB
	Supply Voltage:	5 V
	Length of antenna cable:20 meters	

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

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

Pulse Outputs: Change of second (P_SEC, TTL level)
Change of minute (P_MIN, TTL level)

Accuracy of Pulses:

after synchronization and 20 minutes of operation

TCXO/OCXO LQ	:	better than +-100 nsec
OCXO MQ/OCXO HQ	:	better than +-50 nsec
OCXO DHQ/Rubidium	:	better than +-50 nsec

better than +-2 μsec during the first 20 minutes of operation

Frequency Outputs: 10 MHz (TTL level)

8.3.3 40dB Multi GNSS L1 Timing Antenna with Integrated Lightning Protection

The GPS, GLONASS, Galileo and BeiDou satellites are not stationary but circle round the globe in a period of about 12 hours. They can only be received if no building is in the line–of–sight from the antenna to the satellite, so the antenna unit must be installed in a location with a free view to the sky. The best reception is given when the antenna has a free view of 8° angular elevation above horizon. If this is not possible the antenna should be installed with a mostly free view to the equator because of the satellite courses which are located between latitudes of 55° North and 55° South. If even this is not possible problems occur especially when at least four satellites for positioning have to be found.

The active L1 timing reference antenna is specifically designed for long–lasting, trouble–free deployments for a variety of applications. The low noise, high gain amplifier is well suited to address attenuation issues. The proprietary 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`

8.3.4 RV-76G GPS/GLONASS Antenna for mobile Applications

Features
– Low noise figure
– Fully weather proof
– Excelent temperature stability
– High sensitivity

The RV-76G GPS / GLONASS antenna is the integration of a high performance GPS patch antenna and a state-of-the-art low noise amplifier into a very low-profile, extremely compact and fully waterproof enclosure which, when connected to a GPS receiver with 5 V DC antenna power, provide adequate signal amplification and out-band rejection.

The flat design and the robustness of the case make the RV-76G to one of the most popular antennas on the vehicle navigation and marine market.

Figure: RV-76G with Mounting Kit

Technical Drawing
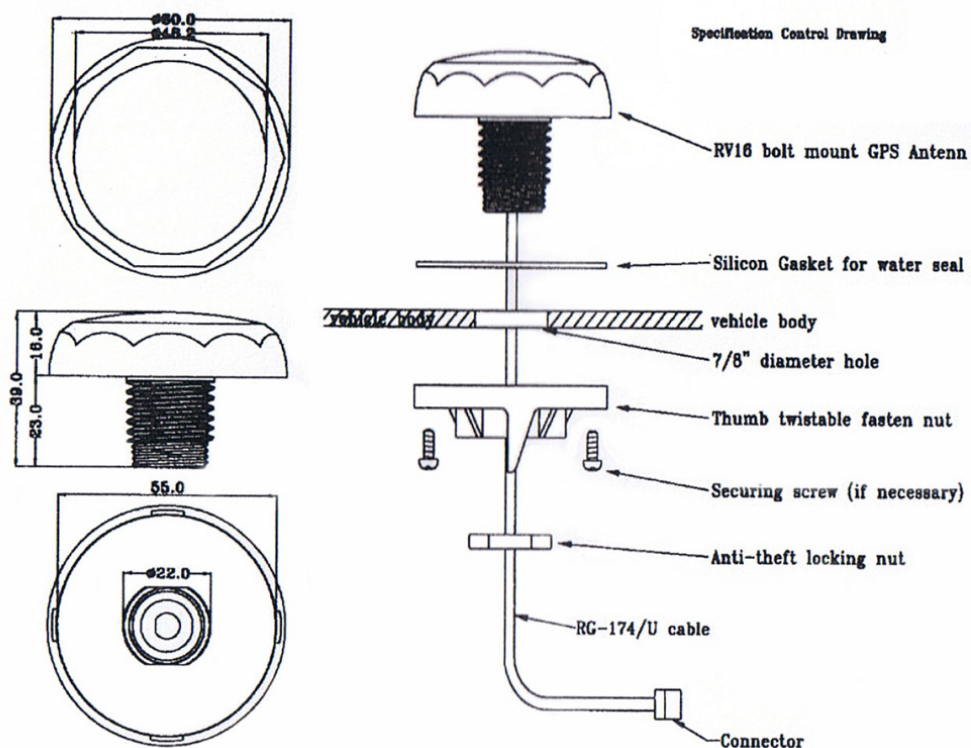
Physical Characterisics

Construction   Polycarbonate radome detachable cable/connector for easy mount,
                                rubber-O-rign between top radome and screw base for waterproof.

Dimensions   60 mm in Diameter x 38 mm in height
Weight   125 g (Excluding cabel and connector)
Color   Standard in ivory white
Mounting   Bulkhead mount with 0.8 inch threaded wing nut

Antenna Element

Center frequency   1575.42 MHz +- 10 MHz & 1602 MHz +- 8 MHz
Polarization   R.H.C.P. (Right Hand Circular Polarization)

Gain at Zenith   +1.5 dBic typ.
Axial Ratio   3 dB max.
                                mounted on the 70mm x 70mm square ground plane

Low Noise Amplifier

Center frequency   1575.42 MHz +- 10 MHz & 1602 MHz +- 8 MHz
Gain   27 dB @ 3V typ.
Band Width   43 MHz min. @ =< -10 dB
Noise Figure   1.5 typ.
Outband attenuation   20 dB min. at Fo +/- 50 Hz
Supply Voltage   +2.5   +5.5 V DC
Current consumption   3 V DC : 10.6 mA typ. / 5.0 V DC : 21 mA typ.
Impedance   50 Ohm

Cable & Connector

RF cable   5 m RG174/U (standard)
Pulling strength   6 Kg @ 5 sec. With molded plastics on connector for strain relief

Overall performance (antenna element, LNA & cable)

Center frequency   1575.42 MHz +- 10 MHz & 1602 MHz +- 8 MHz
Gain   At 90° 27 + 3dB (cable loss)
                                Note: Mounted on the 70mm x 70mm square ground plane

Noise figure   2.0 max.
Band width   2 MHz
Axial ratio   3 dB max.
VSWR   2.0 max.
Impedance   50 Ohm

Environmental Conditions

Operating temperature   -40°C   +85°C
Storage temperature   -40°C   +90°C
Relative humidity   95% non-condensing
Waterproof   100% waterproof

8.4 GNSS satellite controlled clock with MRS option

Lantime/MRS is a Multi Reference Source time server. The reference time base, integrated into the LANTIME, consists of a high precision oscillator OCXO HQ. This oscillator can be optionally controlled by the integrated GNSS receiver, an external Puls Per Second (PPS input), Standard Frequency Input (10MHz), an IRIG time code receiver, by max. 7 external NTP servers or by a PTP IEEE 1588 Time Stamp Unit.

In any case a OCXO oscillator is used as a reference for internal NTP, even if GNSS reception or external reference clock are not available. All outputs like serial output, PPS output or 10MHz will be driven by the internal oscillator. The priority which reference clock will discipline the internal OCXO can be set up in a user defined list via the display or the HTTP interface.

8.4.1 MRS functionality

After power up the system the internal clock module will be free running on an internal oscillator. If the GNSS receiver or one of the external reference sources are available and synchronized then the internal clock will be set once and the internal OCXO will be adjusted. For the first time adjust with an external NTP server the system will wait until the internal NTP has been synchronized and the time offset is below 1 ms (this will take appr. 5 Min). After that the offset to the external NTP server will be calculated and set the internal clock module. The following reference clocks are possible (depending on the expansions):

- GPS / GLONASS / Galileo / BeiDou receiver
- IRIG time code receiver with DCLS or modulated
- Pulse Per Second Input (PPS in)
- up to 7 external NTP server
- PTP IEEE-1588 (M400, M600 and M900 only)
- Pulse Per Second plus serial time string (STR)
- Freq. In.

If more than one reference clock is available and synchronized then the clock with the highest priority will be taken to adjust the internal OCXO. This reference clock will be called master clock. If this master clock is unavailable a different clock with the highest priority will be chosen. If a reference clock with a higher priority than the current master will be available the master clock will be switched to the higher priority.

Each external reference source can be set with a bias (a fix offset), if you know the constant offset (bias) of an external reference source. By default this value is 0 ns. The bias of the internal GNSS receiver can not be set up – indirectly this can be done via the antenna cable length.

Each reference clock can be assigned a specific precision which will reflect the accuracy of the reference clock. This precision value will determine the hold over time when switching to the next reference clock if the current master is not available anymore. If the precision is set to 0 then the next reference clock will be switched at once. If the precision value is greater then 0 the time for switching to the next reference (hold over time) will be calculated by the following formula:

*(precision of next reference) / (precision of current master) * constant [s]*
The parameter "constant" depends on the quality of the internal oscillator.

Example: the external PPS with an precision of 100ns is the current master. If this master is no longer available it will switch to the next reference source of the priority order – in this case the IRIG input with an precision of 10us. With the formula ((10000ns/100ns)*11.4) we get hold over time of 19min. The online display of the MRS status will show the remaining time and the calculated time. The hold over time will be recalculated if the status of the reference clocks will change.

The internal NTP is not requesting the external reference clocks directly. It will see only the internal clock of the GPS/MRS module with its high precision oscillator OCXO. The controlling of the internal OCXO will be done by the GPS/MRS module. All offsets from the internal reference time to the external reference clocks will be send to the GPS/MRS clock. The external NTP server will be configured as "server" at the internal NTP

with the option "noselect" only to get the offsets to the external NTP servers.

The status information of the activated reference clocks will be shown in the display. The state of the master will be marked with "*" or written as text. Also the offset from the reference clock to the internal clock will be displayed.

```
    1.GPS *   20ns       2.PPS    30ns
    2.NTP    30.000us
```
M300: LC-Display 40 x 2 Characters

```
1.GPS * 20ns
2.PPS    30ns
3.NTP    30.000us
```
M400 / M900: LC-display, 4 x 16 Characters

```
        MRS Input Priorities        ⌐┐
1.GPS           is master   : -10ns
2.PPS in        is available : -20ns
3.IRIG          no signal   : n/a
4.NTP           is available : -30.000us
2.PTP(IEEE1588)is available : -300ns
```
M600: Vacuum fluorescent graphic display (VFD), 256 x 64 dots

If an external PTP IEEE1588 grandmaster is available the reference source will be taken prior to the external NTP server. The PTP time stamping unit will be scanned every 10 seconds (independently of the broadcast interval of the PTP master). The external NTP server will be scanned every 64 seconds.

After setting the time offset of the internal clock module the NTP will be restarted. Now only small offset values will be sent to the internal clock module; the fine synchronization mode will start. In the "fine synchronization mode" all offsets greater than 10 ms will be ignored 5 times in a row – after the 5 times the offset will be set.

IMPORTANT: After power up the Lantime/MRS the maximum time difference between internal clock and external NTP server or PTP grandmaster must be lower than 1000s. Otherwise the internal clock must be set manually via LC-Display or synchronized by GPS once.

8.5 General information PZF

The German long wave transmitter DCF77 started continuous operation in 1970. The introduction of time codes in 1973 build the basic for developing modern radio remote clocks.

The carrier frequency of 77.5 kHz is amplitude modulated with time marks each second. The BCD-coding of the time telegram is done by shifting the amplitude to 25% for a period of 0.1s for a logical '0' and for 0.2s for a logical '1'. The receiver reconstructs the time frame by demodulating this DCF-signal. Because the AM-signal is normally superimposed by interfering signals, filtering of the received signal is required. The resulting bandwidth–limiting causes a skew of the demodulated time marks which is in the range of 10 ms. Variations of the trigger level of the demodulator make the accuracy of the time marks worse by additional +/–3 ms. Because this precision is not sufficient for lots of applications, the PTB (Physical and Technical Institute of Germany) began to spread time information by using the correlation technique.

The DCF–transmitter is modulated with a pseudo-random phase noise in addition to the AM. The pseudo-random sequence (PZF) contains 512 bits which are transmitted by phase modulation between the AM-time marks. The bit sequence is build of the same number of logical '0' and logical '1' to get a symmetrical PZF to keep the average phase of the carrier constant. The length of one bit is 120 DCF–clocks, corresponding to 1,55 ms. The carrier of 77.5 kHz is modulated with a phase deviation of +/-10° per bit. The bit sequence is transmitted each second, it starts 200ms after the beginning of an AM second mark and ends shortly before the next one.

Compared to an AM DCF77–receiver, the input filter of a correlation receiver can be dimensioned wide-bandwidth. The incoming signal is correlated with a reconstructed receiver–PZF. This correlation analysis allows the generation of time marks which have a skew of only some microseconds. In addition, the interference immunity is increased by this method because interference signals are suppressed by averaging the incoming signal. By sending the original or the complemented bit sequence, the BCD-coded time information is transmitted.

The absolute accuracy of the generated time frame depends on the quality of the receiver and the distance to the transmitter, but also on the conditions of transmission. Therefore the absolute precision of the time frame is better in summer and at day than in winter and at night. The reason for this phenomenon is a difference in the portion of the sky wave which superimposes the ground wave. To check the accuracy of the time frame, the comparison of two systems with compensated propagation delay is meaningful.

8.5.1 Features of PZF

The PZF is a high precision receiveer module for the DCF77-signal build in euro card size (100 mm x 160 mm).

The micro controller of the system correlates its receiver-PZF with the incoming pseudorandom sequence and decodes the time information of the DCF-telegram simultaneously. The controller handles input and output functions of the and synchronizes the internal real-time clock.

By evaluating the pseudorandom phase noise, the PZF is able to generate time frames with thousand times the accuracy of standard AM-time code receivers. The precise regulation of the main oscillator (TCXO, OCXO optional for higher accuracy) of the radio clock is possible therefore. So, the PZF can be used as a standard frequency generator besides the application as a time code receiver. Three fixed and one settable TTL-level standard frequencies are available at the rear VG-connector. The synthesizer frequency exists as an open drain output and a sine wave signal also.

The PZF delivers TTL-low and TTL-high active pulses per minute and per second further. To distribute information concerning date, time and status, four independent serial interfaces (RS232) are used which are configurable in a setup menu.

Like mentioned before, the PZF includes a battery-backed real-time clock which runs crystal-precise if the main power supply fails.

8.5.2 Technical specifications PZF600

Receiver:	Two seperate receiver channels for signal conversion and best aquisition and tracking of the DCF77 signal. Reception via external ferrite antenna AW02.
Control of Reception:	The DCF-signal is checked for minimum field strength by microprocessor. The result is indicated by LED. In addition, the value of the digitized field strength is displayed in menu 'FIELD'.
Battery-Backup:	In case of power failure an internal realtime clock runs crystal-precise. Important parameters are stored in the system-RAM. Life time of lithium battery: 10 years minimum Option: capacitance-backup for about 150 hours
Interfaces:	Four independant asynchronous serial ports (internal RS232)
Pulse Outputs:	Active-high and active-low pulses per minute and per second, TTL-level, pulse duration 200 ms
Accuracy of Pulses:	Time delay of two systems with a maximum distance of 50 km: typ. $20\mu s$, max. $50\mu s$ Time shifting of successive pulses: max. $1.5\mu s$
Propagation Time Compensation:	The signal delay is compensated if the distance of the receiver to the transmitter is given.
Standard Frequencies:	10 MHz are synchronized to DCF by a digital PLL. Accuracy in synchronized state: $+/- 5 \cdot 10^{-9}$ (short term stability) Accuracy in unsynchronized state: $1 \cdot 10^{-8}$ for one hour
	77.5 kHz, 155 kHz und 310 kHz derived from receiver-PLL Accuracy in synchronous state: $+/- 5 \cdot 10^{-7}$ (short term stability)
Terminal Connection:	Blade-connector strip VG64, DIN 41612 Sub-miniatur coaxial HF-connector (SMB internal)
Board Dimensions:	Eurocard size 100 mm x 160 mm, Epoxy 1,5 mm Front panel 12TE (61 mm)
Antenna:	Ferrite antenna in plastic housing
Humidity:	Relativ humidity 85 % max.
Temperature Range:	0° - 60 ° Celsius
Power Supply:	+ 5 V, approx. 230 mA

8.5.3 DCF77 Antenna

The PZF Radio Clock operates with a ferrite antenna which is damped to match the bandwidth needed for the correlation reception. The IP-Code is: IP56

Assembly of the Antenna

The antenna has to be mounted as exactly as possible. Turning it out of the main receive direction will result in less accurate time frames. The antenna must be placed in longitudinal direction to the DCF-transmitter (Frankfurt). The antenna should be installed with a minimum distance of 30cm to all metal objects and, if possible, to any microcomputers and the PZF itself as well. A distance of several meters to TV- or computermonitors must be kept.

With help of the menu 'FIELD' the adjustment of the antenna can be done easily. The displayed value is proportional to the received field strength. The best method of mounting the antenna is to look for the minimum field strength and turn the antenna by 90° into maximum, then. A high field strength on its own is no guarantee for good conditions of reception, because interfering signals within the bandwidth of the receiver also have an effect on the displayed value.

The maximum interference immunity can be found by looking at the autocorrelation coefficient (in percent) in the menu 'PZF-STAT'. The displayed value should be close to 100% for best receiption.

8.6 IRIG/AFNOR Time Code Receiver

The TCR receiver has been designed for the decoding of unmodulated and modulated IRIG- and AFNOR-Timecodes. Modulated codes transport the time information by modulating a sinusoidal carrier signals amplitude whereas unmodulated signals employ a pulse width modulated DC signal.

The receivers automatic gain control allows the reception of signals within a range from abt. 600mVpp up to 8Vpp. The potential free input can be jumper selectable terminated in either 50 Ohm, 600 Ohm or 5 kOhm.

Principle of Function
After the received IRIG time code has passed a consistency check, the board clock and the battery backed-up realtime clock of the time code receiver are synchronized to the external time reference. If an error in the IRIG-telegram is detected, the reference clock switches into holdover mode.

IRIG-Codes do not carry a complete date but the number of the day within the current year (1...366).

The day within the current year calculated from the RTC's date is compared with the day number from the IRIG-Code every minute. When a mismatch between these two day numbers is detected the board signalizes freewheeling mode, however the board's time base will continue to synchronize with the IRIG-signal.

Most IRIG time codes do not include or support announcements for the change of time zone (daylight saving on/off) or for the insertion of a leap second. Start or end of daylight saving time is executed with a delay of one second. If a leap second is inserted, the system clock will be set to second '0' for two consecutive seconds. A LANTIME system can be prepared for an upcoming leap second by installing a leap second file. This will ensure proper operation during and after the leap second event and allows the system to properly send announcements to network clients and other connected devices (if the protocol or signal supports this).

8.6.1 Technical Specifications TCR

Receiver Input:	AM Input:
	Insulated by transformer
	Impedance: 50 Ω, 600 Ω, 5 kΩ selectable by jumper
	Input signal: abt.600 mVpp to 8 V (Mark)
	other ranges on request

DC–Level Shift Input:
Insulated by opto–coupler device
Internal series resistor: 330 Ω
Max. input current: 25 mA
Diode forward voltage: 1.0 V...1.3 V

Decoding: Decoding of the following codes possible :
IRIG–A133/A132/A003/A002
IRIG–B123/B122/B003/B002
AFNOR NFS 87–500 and IEEE1344

**Accuracy of
Time Base:** +/- 10 μs compared to IRIG reference marker

**Required Accuracy
of Time Code
Source:** +/- 100 ppm

Holdover Mode: Automatic switching to crystal time base,
accuracy: see accuracy of oscillator

Backup Battery: Onboard realtime clock keeps time and date in case of power supply failure.
System parameters are stored in battery buffered RAM.
Life time of lithium battery: at least 10 years

**Reliability of
Operation:** Microprocessor supervisory circuit generates reset signal in case of brown–out,
software watchdog generates reset in case of improper program execution

Initialisation: Initial time and date can be set by standard Meinberg telegram via serial port COM0

Pulse Outputs: Pulse per second (PPS), TTL level pulse, active
high, 200 ms pulse width
Pulse per minute (PPM), TTL level pulse, active
high, 200 ms pulse width

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

**Relative Accuracy of
Frequencies compared
to IRIG Source:** +/- 1E–8 with TCXO–HQ option
+/- 5E–9 with OCXO–LQ option

Status Output: TIME_SYN, TTL level, active high when clock is synchronuos

Serial Ports: Two independent RS–232 ports

Baud Rates: 9600Bd, 19200Bd

Framings:	7E2, 8N1
Output Cycle:	Per second or per minute
Serial Telegram:	Meinberg Standard Time String
Rear Edge Connector:	According to DIN41612, type C64, rows a+c (male)
Power Consumption:	VCC +5 V, abt. 300 mA VDD +5 V, abt. 50 mA with TCXO-HQ option Max. 500 mA OCXO-LQ/MQ
Physical Dimensions:	Eurocard 100 mm x 160 mm, 1.5 mm epoxy
Ambient Temperature:	0...50 °C
Humidity:	Max. 85 %

8.6.2 Description of IRIG-Codes

The specification of individual IRIG time code formats is defined in IRIG Standard 200-98. They are described by an alphabetical character followed by a three-digit number sequence. The following identification is taken from the IRIG Standard 200-98 (only the codes relevant to TCR receiver are listed):

character	bit rate designation	A	1000 pps	
		B	100 pps	
1st digit	form designation	0	DC Level Shift width coded	
		1	sine wave amplitude modulated	
2nd digit	carrier resolution	0	no carrier (DC Level Shift)	
		1	100 Hz, resolution 10 msec	
		2	1 kHz, resolution 1 msec	
		3	10 kHz, resolution 100 msec	
3rd digit	coded expressions	0	BCD, CF, SBS	
		1	BCD, CF	
		2	BCD	
		3	BCD, SBS	
	BCD:		time of year, BCD-coded	
	CF:		control-functions (user defined)	
	SBS:		seconds of day since midnight (binary)	

8.6.3 Time Code

Abstract of Time Code

The transmission of coded timing signals began to take on widespread importance in the early 1950's. Especially the US missile and space programs were the forces behind the development of these time codes, which were used for the correlation of data. The definition of time code formats was completely arbitrary and left to the individual ideas of each design engineer. Hundreds of different time codes were formed, some of which were standardized by the "Inter Range Instrumentation Group" (IRIG) in the early 60's.

Except these "IRIG Time Codes", other formats like NASA36, XR3 or 2137 are still in use. The LANTIME OS6 Firmware however generates the IRIG-B, AFNOR NFS 87-500 code as well as IEEE1344 code which is an IRIG coded extended by information for time zone, leap second and date.

Block Diagram Time Code

IRIG Standard Format

TYPICAL MODULATED CARRIER   IRIG-A : 10000 Hz
                                   IRIB-B : 1000   Hz
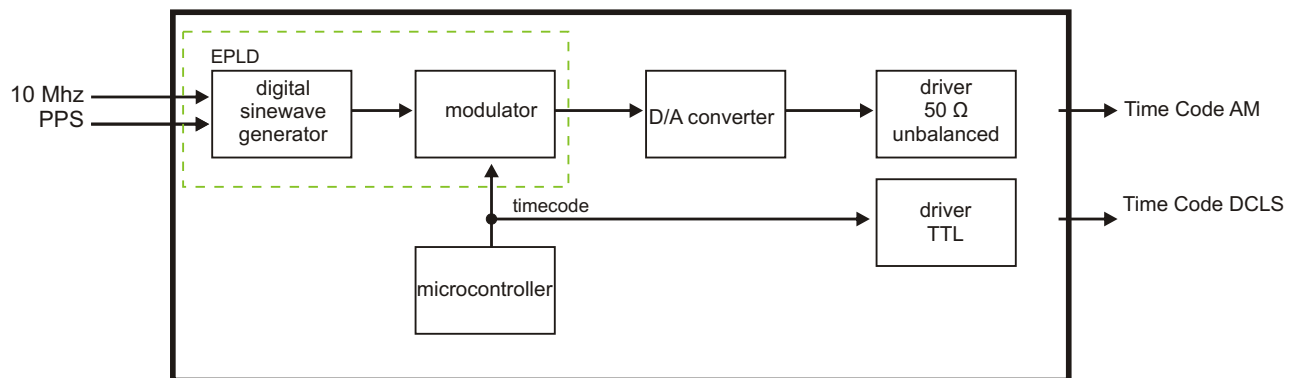
AFNOR Standard Format

Assignment of CF Segment in IEEE1344 Code

Bit No.	Designation	Description
49	Position Identifier P5	
50	Year BCD encoded 1	
51	Year BCD encoded 2	low nibble of BCD encoded year
52	Year BCD encoded 4	
53	Year BCD encoded 8	
54	empty, always zero	
55	Year BCD encoded 10	
56	Year BCD encoded 20	high nibble of BCD encoded year
57	Year BCD encoded 40	
58	Year BCD encoded 80	
59	Position Identifier P6	
60	LSP – Leap Second Pending	set up to 59s before LS insertion
61	LS – Leap Second	0 = add leap second, 1 = delete leap second [1]
62	DSP – Daylight Saving Pending	set up to 59s before daylight saving changeover
63	DST – Daylight Saving Time	set during daylight saving time
64	Timezone Offset Sign	sign of TZ offset 0 = '+', 1 = '–'
65	TZ Offset binary encoded 1	
66	TZ Offset binary encoded 2	Offset from IRIG time to UTC time.
67	TZ Offset binary encoded 4	Encoded IRIG time plus TZ Offset equals UTC at all times!
68	TZ Offset binary encoded 8	
69	Position Identifier P7	
70	TZ Offset 0.5 hour	set if additional half hour offset
71	TFOM Time figure of merit	
72	TFOM Time figure of merit	time figure of merit represents approximated clock error. [2]
73	TFOM Time figure of merit	0x00 = clock locked, 0x0F = clock failed
74	TFOM Time figure of merit	
75	PARITY	parity on all preceding bits incl. IRIG-B time

1.) current firmware does not support leap deletion of leap seconds
2.) TFOM is cleared, when clock is synchronized first after power up. see chapter Selection of generated timecode

Generated Time Codes

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

a) B002:   100 pps, DCLS signal, no carrier
                        BCD time-of-year

b) B122:   100 pps, AM sine wave signal, 1 kHz carrier frequency
                        BCD time-of-year

c) B003:   100 pps, DCLS signal, no carrier
                        BCD time-of-year, SBS time-of-day

d) B123:   100 pps, AM sine wave signal, 1 kHz carrier frequency
                        BCD time-of-year, SBS time-of-day

e) B006:   100 pps, DCLS Signal, no carrier
                        BCD time-of-year, Year

f) B126:   100 pps, AM sine wave signal, 1 kHz carrier frequency
                        BCD time-of-year, Year

g) B007:   100 pps, DCLS Signal, no carrier
                        BCD time-of-year, Year, SBS time-of-day

h) B127:   100 pps, AM sine wave signal, 1 kHz carrier frequency
                        BCD time-of-year, Year, SBS time-of-day

i) AFNOR: Code according to NFS-87500, 100 pps, wave signal,
                        1kHz carrier frequency, BCD time-of-year, complete date,
                        SBS time-of-day, Signal level according to NFS-87500

j) IEEE1344:   Code according to IEEE1344-1995, 100 pps, AM sine wave signal,
                        1kHz carrier frequency, BCD time-of-year, SBS time-of-day,
                        IEEE1344 extensions for date, timezone, daylight saving and
                        leap second in control functions (CF) segment.
                        (also see table 'Assignment of CF segment in IEEE1344 mode')

k) C37.118   Like IEEE1344 – with turned sign bit for UTC–Offset

Selection of Generated Time Code

The time code to be generated can be selected by Menu Setup IRIG–settings or the Monitorprogram GPSMON32 (except Lantime models). DC–Level Shift Codes (PWM–signal) B00x and modulated sine wave carrier B12x are always generated simultaneously. Both signals are provided at the VG64–Connector, i.e. if code B132 is se-lected also code B002 is available. This applies for the codes AFNOR NFS 87–500 and IEEE1344 as well.

The TFOM field in IEEE1344 code is set dependent on the 'already sync'ed' character ('#') which is sent in the serial time telegram. This character is set, whenever the preconnected clock was not able to synchronize after power up reset. The 'time figure of merit' (TFOM) field is set as follows.

Clock synchronized once after power up: TFOM = 0000
Clock not synchronized after power up: TFOM = 1111

 For testing purposes the output of TFOM in IEEE1344 mode can be disabled. The segment is set to all zeros then.

Outputs

The module LANTIME OS6 Firmware provides modulated (AM) and unmodulated (DCLS) outputs. The format of the timecodes is illustrated in the diagramms "IRIG-" and "AFNOR standard-format".

AM - Sine Wave Output

The carrier frequency depends on the code and has a value of 1 kHz (IRIG-B). The signal amplitude is 3 Vpp (MARK) and 1 Vpp (SPACE) into 50 Ohm. The encoding is made by the number of MARK-amplitudes during ten carrier waves. The following agreements are valid:

a)   binary "0":   2 MARK-amplitudes, 8 SPACE-amplitudes
b)   binary "1":   5 MARK-amplitudes, 5 SPACE-amplitudes
c)   position-identifier: 8 MARK-amplitudes, 2 SPACE-amplitudes

PWM DC Output

The pulse width DCLS signals shown in the diagramms "IRIG" and "AFNOR standard format" are coexistent to the modulated output and is available at the VG connector pin 13a with TTL level.

Technical Data

Outputs: Unbalanced AM-sine wave-signal:
                3 V_{pp} (MARK) / 1 V_{pp} (SPACE) into 50 Ohm

                DCLS signal: TTL

8.7 MSF Receiver

General information about Anthorn MSF

The MSF transmission from Anthorn is used to spread the UK national standards of time and frequency which are maintained by the National Physical Laboratory. The signal provides adequate field strength throughout the UK and it can be received widely in northern and western Europe. A simple on–off modulation of the carrier frequency (60kHz) is used to transmit BCD–coded informations about time and date. Every UTC second is marked by an off stage of carrier of at least 100ms. This second marker has an accuracy better than +/– 1ms.

The time code format is a one minute time frame, which is used to transmit data applied to the following minute. To broadcast the informations, bits 'A' and 'B' of each second are used (see code format below). If the carrier is on a logical '0' is transmitted, otherwise a logical '1'.The first second of a minute nominally contains a period of 500ms with carrier off to serve as a minute marker. However, there may be on/off carrier modulation between 25ms and 330ms during second 00 to distribute information of hour, minute, day and month with a fast 100 bits/s code. Seconds 01B to 16B are used to transmit the difference between UTC and UT1 (which is closely equivalent to GMT), called DUT1. Seconds 17A to 51A are used to transmit the local time and date. Seconds 52A to 59A include informations about change of BST/UTC, BST status and some parity bits.

8.7.1 Code Format
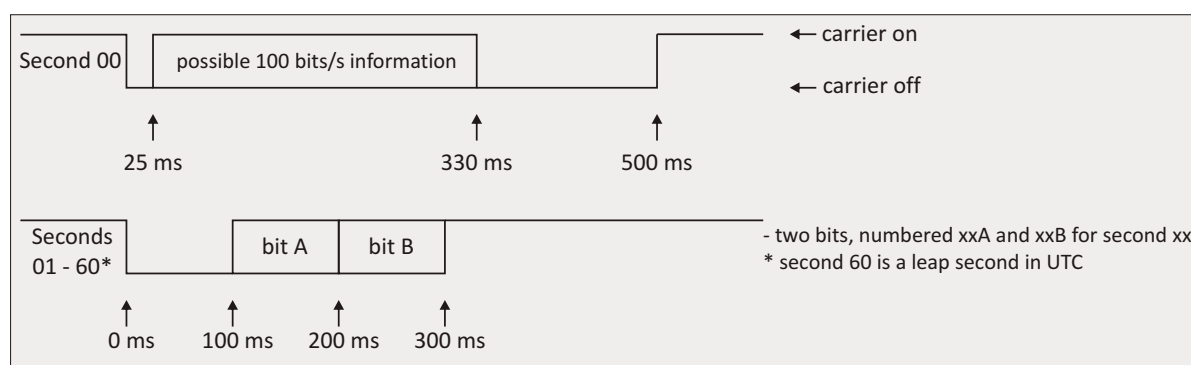
8.7.2 DUT Code

The DUT1 is signaled to the nearest 100ms in the range of +/-800ms. A positive figure means that GMT is at a higher count than UTC. Bits 01B to 16B are used to signal the DUT code in the following way.

DUT1	positive	DUT1	negative
0ms	no bits set to '1'	0ms	no bits set to '1'
+100ms	bit 01B '1'	-100ms	bit 09B set to '1'
+200ms	bits 01B and 02B '1'	-200ms	bits 09B and 10B '1'
+300ms	bits 01B to 03B '1'	-300ms	bits 09B to 11B '1'
+400ms	bits 01B to 04B '1'	-400ms	bits 09B to 12B '1'
+500ms	bits 01B to 05B '1'	-500ms	bits 09B to 13B '1'
+600ms	bits 01B to 06B '1'	-600ms	bits 09B to 14 B '1'
+700ms	bits 01B to 07B '1'	-700ms	bits 09B to 15B '1'
+800ms	bits 01B to 08B '1'	-800ms	bits 09B to 16B '1'

8.7.3 Time and Date Codes

Time and date informations are transmitted and coded in the following way.

Binary-Coded-Decimal Year (00-99)												
order	80	40	20	10	8	4	2	1				
bit	17A	18A	19A	20A	21A	22A	23A	24A				
BCD month (01-12)					BCD day-of-month (01-31)						BCD day-of-week (0-6)	
order	10	8	4	2	1	20	10	8	4	2	1	4	2	1
bit	25A	26A	27A	28A	29A	30A	31A	32A	33A	34A	35A	36A	37A	38A
BCD hour (00-23)					BCD minute (00-59)							
order	20	10	8	4	2	1	40	20	10	8	4	2	1
Bit	39A	40A	41A	42A	43A	44A	45A	46A	47A	48A	49A	50A	51A

8.7.4 Other Codes

Minute Identifier

Bits 53A to 58A are all set permanently at '1' and are always preceded by bit 52A at '0' and followed by bit 59A at '0'. This sequence '01111110' never appears elsewhere in bit xxA, so it uniquely identifies the following second 00 minute marker. In minutes lengthened or shortened by a positive or negative leap second all these numbers are correspondingly increased or decreased by one (i.e. during these 61- or 59-second minutes the position of the time and date code is shifted by one second relative to the start of minute).

Parity Bits

The parity bits are providing and odd number of 1's.

      Bit 54B taken with bits 17A to 24A
      Bit 55B taken with bits 25A to 35A
      Bit 56B taken with bits 36A to 38A
      Bit 57B taken with bits 39A to 51A

Summer Time

When UK civil time is subject to an one-hour positive offset during part of the year, this period is indicated by setting bit 58B to '1'. Bit 53B is set to '1' during the 61 consecutive minutes immediately before a change, the last being minute 59, when bit 58B changes.

Unused Bits

The unused bits are currently set to '0', but may be used in the future.

8.7.5 Features of MSF Radio Clock

The built-in MSF Radio clock's hardware is a 100mm x 160mm microprocessor board. The external ferrite antenna is connected to the receiver by a 50 ohm coaxial antenna cable. Cable runs up to 100 m are possible without amplification.

The internal Meinberg MSF Radio Clock is equipped with a Flash-EPROM with bootstrap loader that allows the user to load a new software system without removing the clock via the serial interface.

8.7.6 Technical specifications AM5xx

Receiver:
Direct conversion quadrature receiver with automatic gain control
Bandwidth: approx. 20Hz, external ferrite antenna

**Control of
Reception:**
The incoming signal is checked for minimum field strength by microprocessor.
The result is indicated by LED. In addition, the value of the digitized
field strength is displayed in menu 'FIELD'.

Backup:
In case of supply voltage failure the on-board RTC keeps the time based
on XTAL for more than 150 hours (buffer capacitor)
optional lithium backup battery (life time: 10 years)

Display:
Option – Eight-digit alphanumeric display shows important time and status
information. Digit-height 5mm.

Interfaces:
Three independent RS232 ports
Baudrate: 600, 1200, 2400, 4800, 9600 or 19200 Baud
Framing: 7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 7O2 or 8O1
Time string: Meinberg Standard

**Pulse
Outputs:**
Active-high and active-low pulses per minute and per second, TTL-level,
pulse duration 200ms

Time_Syn Output:
TTL-level, logical-high if receiver is synchronous

**Terminal
Connection:**
Blade-connector strip VG64, DIN 41612
Sub-miniature coaxial HF-connector (SMB)

**Board
Dimensions:**
Eurocard size 100mm x 160mm, Epoxy 1,5mm
Front panel 12TE (61mm)

Antenna:
Ferrite antenna in plastic housing (AW02)

Humidity:
Relative humidity 85% max.

Temperature Range:
0 ... 50°C

Power Supply:
+ 5V, 230mA

8.8 General information about WWVB

NIST radio station WWVB is located near Fort Collins, Colorado, on the same site as station WWV. The WWVB broadcast is used by millions of people throughout North America to synchronize consumer electronic timing products such as wall clocks, clock radios, and wristwatches. In addition, WWVB is used for high level applications including network time synchronization and frequency calibration. The WWVB transmission is maintained by the National Institute of Standards and Technology (NIST).

WWVB continuously broadcasts a time and frequency signal at 60 kHz. The carrier frequency provides a stable frequency reference traceable to the national standard. There are no voice announcements on the station, but a time code is synchronized with the 60 kHz carrier and broadcast continuously at the rate of 1 bit per second using pulse width modulation. The carrier power level is modulated to encode the time data. The carrier power is reduced by 17 dB at the start of each second, so that the leading edge of every negative going pulse is on time. Full power is restored 0.2 s later for a binary #0#, 0.5 s later for a binary #1#, or 0.8 s later to convey a position marker. The binary coded decimal (BCD) format is used, which combines binary digits to represent decimal numbers. The time code contains the year, day of year, hour, minute, second, and flags that indicate the status of Daylight Savings Time, leap year, and leap seconds. WWVB identifes itself by advancing its carrier phase 45 degrees at 10 minutes after the hour and returning to normal phase at 15 minutes after the hour. If you plot WWVB phase, this results in a phase step of approximately 2.08 microseconds.

8.8.1 Code Format
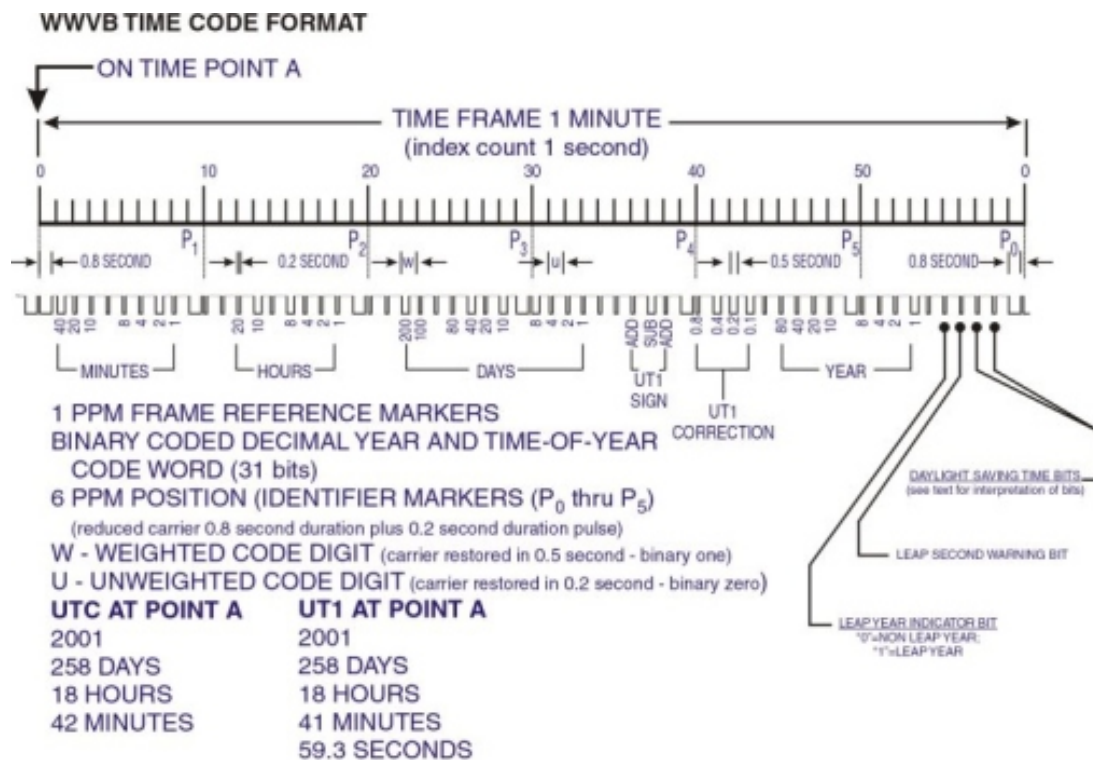
8.9 RDT -External Reference Clock

Only LANTIME M300 models are available as RDT-variant

In RDT systems an external time source can be used for the NTP time service (e.g. Meinberg satellite receiver) or the RDT System will be synchronized by other external NTP time server.

At least one reference clock has to be connected to the first serial line (Refclock 0 / RS232 Level) or an external NTP time server configured. The parameter for the serial clock can be selected by one of the following time strings:

> Meinberg Standard 9600Baud 7E2 per second
> Meinberg Standard 9600Baud 8N1 per second
> Uni Erlangen 19200Baud 8N1 per second
> NMEA 4800Baud 8N1 per second

Only the standard Meinberg serial time telegram could be used with MEZ/MESZ or UTC time zone configured. The UNI ERLANGEN telegram include the offset to UTC. The telegram type will be detected automatically when booting the system.

The RDT system is a perfect solution to expand an existing network structure in which stratum 1 ntp server already exists. The RDT system will be synchronized by NTP and distributes the correct time to its clients via the network interfaces.

Configuration of external NTP server as time reference
Press the down button once from the main menu to set up the NTP specific parameters:

```
RDT
    Reference Time          > external NTP  <          > extern NTP 1 <          IPv4 address of
> Time Service  <    OK      Local Stratum      OK       extern NTP 2       OK    external NTP
  Network                    Restart NTP  F1             extern NTP 3             server 1 F1
  System                                                 extern NTP 4             000.000.000.000
```
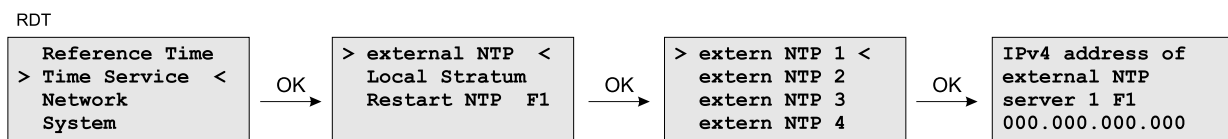
Press OK button two times to set up the IP address of the first external NTP server as reference clock. Network parameters of the M300/RDT like IP-address and net mask have to set properly to reach the external timeserver. It is possible to set up 7 external NTP timeserver via front panel or HTTP interface. The second serial connector (Refclock 1) can be used for an additional serial time source.

Moreover, a RDT system can also operate as a stratum 1 NTP server similar to time servers from our LANTIME M-series. In this case the RDT requires a serial time telegram and a PPS pulse from an external clock (e.g. Meinberg GPS satellite receiver).

Note: The RDT system does not have an internal hardware clock (Meinberg receiver) and can not provide and distribute the common standard signals (PPS, 10MHz ...), like a LANTIME system with an integrated GPS receiver.

To activate and configure the second serial time source you have to configure file "/mnt/flash/ntpconf.add" manually. Open the HTTP Interface and activate the "NTP" button. Press the button "Edit additional NTP parameter" and add the following line:

server 127.127.8.1 mode 2 # Meinberg Standard Format 9600Baud 7E2
The "mode" parameter will configure the serial parameter:

mode 2:   9600Baud 7E2 Meinberg Standard
mode 19:   9600Baud 8N1 Meinberg Standard
mode 7:   19200Baud 8N1 Uni Erlangen
server 127.127.20.1 # NMEA time string on second port

8.10 Time Zone and Daylight Saving

GPS system time differs from the universal time scale (UTC) by the number of leap seconds which have been inserted into the UTC time scale since GPS was initiated in 1980. The current number of leap seconds is part of the navigation message supplied by the satellites, so the internal real time of the is based on UTC time scale. Conversion to local time and annual daylight saving time can be done by the receiver's microprocessor if the corresponding parameters are set up by the user.

8.11 Booting the Meinberg Receivers

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

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

PZF receiver:
If both, the antenna and the power supply, have been connected the system is ready to operate. About 10 seconds after power–up the receiver's TCXO has warmed up and operates with the required accuracy.

Press navigation keys "↓. OK, OK, ↓, OK" from main menu to check the field and correlation values. The correlation "State" starts in "row" mode. If a good correlation has been found the receiver check 20 times this new correlation: this State is called "check" and the correlation value counts from 1 to 20. If the correlation is stell good the State changes to "fine" mode.

MSF receiver:
After connecting the power supply and the antenna the system is ready to operate. In order to achieve the best reception, the antenna should be aligned carefully. If the antenna is not installed properly and the signal from MSF can not be received without strong distortions, the FIELD strength has to be checked. Check if there is some electrical noise around which prevents the microprocessor from decoding the time message. So a better location for the antenna must be found. In case of correct reception it takes up to three minutes after power–up until the clock is synchronized. Without RF signal the clock runs on internal oscillator.

WWVB receiver:
After starting up the system, the network function is initiated and the program for communication with the WWVB receiver and the NTPD (NTP daemon) is started. After that NTPD starts synchronization with the reference clocks (usual the hardware clock of the single board computer and the WWVB receiver).

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

8.12 Oscillator specifications

Verfügbare Oszillatoren für Meinberg GPS Empfänger und NTP Zeitserver:
OCXO, TCXO, Rubidium

	TCXO	OCXO LQ	OCXO SQ	OCXO MQ	OCXO HQ	OCXO DHQ	Rubidium (only available for 3U models)
Kurzzeitstabilität (τ = 1 sec)	$2 \cdot 10^{-9}$	$1 \cdot 10^{-9}$	$5 \cdot 10^{-10}$	$2 \cdot 10^{-10}$	$5 \cdot 10^{-12}$	$2 \cdot 10^{-12}$	$2 \cdot 10^{-11}$
Genauigkeit des PPS (Sekundenimpuls)	< ±100 ns	< ±100 ns	< ±50 ns	< ±50 ns	< ±50 ns	< ±50 ns	< ±50 ns
Phasenrauschen	1Hz -60dBc/Hz 10Hz -90dBc/Hz 100Hz -120dBc/Hz 1kHz -130dBc/Hz	1Hz -60dBc/Hz 10Hz -90dBc/Hz 100Hz -120dBc/Hz 1kHz -130dBc/Hz	1Hz -70dBc/Hz 10Hz -105dBc/Hz 100Hz -125dBc/Hz 1kHz -140dBc/Hz	1Hz -75dBc/Hz 10Hz -110dBc/Hz 100Hz -130dBc/Hz 1kHz -140dBc/Hz	1Hz -85dBc/Hz 10Hz -115dBc/Hz 100Hz -130dBc/Hz 1kHz -140dBc/Hz	1Hz -80dBc/Hz 10Hz -110dBc/Hz 100Hz -125dBc/Hz 1kHz -135dBc/Hz	1Hz -75dBc/Hz 10Hz -89dBc/Hz 100Hz -128dBc/Hz 1kHz -140dBc/Hz
Genauigkeit freilaufend, ein Tag	$\pm 1 \cdot 10^{-7}$ ±1Hz [1]	$\pm 2 \cdot 10^{-8}$ ±0.2Hz [1]	$\pm 5 \cdot 10^{-9}$ ±50mHz [1]	$\pm 1.5 \cdot 10^{-9}$ ±15mHz [1]	$\pm 5 \cdot 10^{-10}$ ±5mHz [1]	$\pm 1 \cdot 10^{-10}$ ±1mHz [1]	$\pm 2 \cdot 10^{-11}$ ±0.2mHz [1]
Genauigkeit freilaufend, 1 Jahr	$\pm 1 \cdot 10^{-6}$ ±10Hz [1]	$\pm 4 \cdot 10^{-7}$ ±4Hz [1]	$\pm 2 \cdot 10^{-7}$ ±2Hz [1]	$\pm 1 \cdot 10^{-7}$ ±1Hz [1]	$\pm 5 \cdot 10^{-8}$ ±0.5Hz [1]	$\pm 1 \cdot 10^{-8}$ ±0.1Hz [1]	$\pm 5 \cdot 10^{-10}$ ±5mHz [1]
Genauigkeit GPS-synchron, 24h gemittelt	$\pm 1 \cdot 10^{-11}$	$\pm 1 \cdot 10^{-11}$	$\pm 1 \cdot 10^{-11}$	$\pm 5 \cdot 10^{-12}$	$\pm 1 \cdot 10^{-12}$	$\pm 1 \cdot 10^{-12}$	$\pm 1 \cdot 10^{-12}$
Genauigkeit der Zeit freilaufend, 1 Tag	± 4.3 ms	± 865 µs	± 220 µs	± 65 µs	± 22 µs	± 4.5 µs	± 1.1 µs
Genauigkeit der Zeit freilaufend, 1 Jahr	± 16 s	± 6.3 s	± 4.7 s	± 1.6 s	± 788 ms	± 158 ms	± 8 ms
Temperaturdrift freilaufend	$\pm 1 \cdot 10^{-6}$ (-20...70°C)	$\pm 2 \cdot 10^{-7}$ (0...60°C)	$\pm 1 \cdot 10^{-7}$ (-10...70°C)	$\pm 5 \cdot 10^{-8}$ (-20...70°C)	$\pm 1 \cdot 10^{-8}$ (5...70°C)	$\pm 2 \cdot 10^{-10}$ (5...70°C)	$\pm 6 \cdot 10^{-10}$ (-25...70°C)

Hinweis 1:
Die Genauigkeit in Hertz basiert auf der Normalfrequenz von 10MHz.
Zum Beispiel: Genauigkeit des TCXO (freilaufend, ein Tag) ist $\pm 1 \cdot 10^{-7} \cdot 10MHz = \pm 1$ HZ

Die angegebenen Werte für die Zeit und Frequenzgenauigkeit (nicht Kurzzeitstabilität) sind nur für eine konstante Umgebungstemperatur gültig!
Es sind mindestens 24 Stunden GPS-Synchronizität vor Freilauf erforderlich.

9 Configuration User Interface

9.1 Introduction: Configuration LANTIME

There are several ways to configure the LANTIME parameters:

TELNET
SSH
HTTP Interface
Secure HTTP Interface (HTTPS)
Terminal in front panel (38400/8N1/VT100)
Front panel LCD/VFD Interface
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). 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:

Note: If the system doesn't has a display feature (e.g. LANTIME M100), goto chapter LANTIME Setup Wizard in this manual.

To set up a TELNET connection the following commands are entered:
telnet 198.168.10.10 // LANTIME IP
Default User: root
Default Password: timeserver

To set up a SSH connection the following commands are entered:
ssh root@198.168.10.10 // LANTIME IP
Default Password: timeserver

To set up a HTTP connection the following address is to enter in a web browser:
http://198.168.10.10 // LANTIME IP
Default User: root
Default 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
Default User: root
Default Password: timeserver

9.2 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.

```
       DSR_IN -            -DCD_IN
      RTS_OUT-             -RXD_IN
       CTS_IN-             -TXD_OUT
        RI_IN-             -DTR_OUT
                           -GND

            TERM
```

```
                    TXD_OUT  3
                    GND      4 + 5
                    RXD_IN   6
                    DCD_IN   7

            CONSOLE
            38400 / 8N1
```
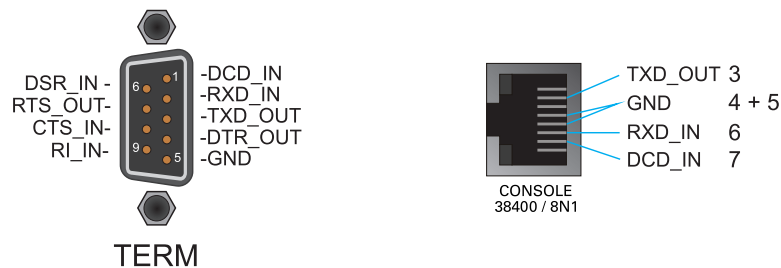
You can use e.g. the standard Hyperterminal program shipped with your Windows operating system. Configure your terminal program with 38400 Baud, 8 Databits, no parity and 1 Stopbit. The terminal emulation have to set to VT100. After connecting to the timeserver there will be displayed the login message (press RETURN for first connection; default user: root password: timeserver).

9.3 LANTIME Display Types

For our LANTIME NTP server, there are four different display types - this is due to the design, housing and by the functionality of the systems. In principle the functionality and menu navigation in all four display types the same. The difference arises from the used receiver system and the available device options.

The high-resolution VF-Display, which is used in our LANTIME M600 systems, also offers a graphical representation of the measured input signals (NTP, PTP, IRIG, PPS ...). The graphic VF-Display is described in the following chapter.

The illustrations of the configuration menus is reacted with a four-line graphics, the menus of the respective systems may differ in the display of it (see Figure 1.0).

```
GPS: NORMAL OPERATION     Mon ,  dd.mm.yyyy
NTP: Offset    PPS:    -4µs    UTC   12 : 00 : 00
```

M200/M300

```
GPS: NORMAL OPERATION
NTP:  Offs.  PPS: 0µs
Mon.  26.04.2010
UTC:  11:06:32
```

M400/M900

```
07:23:25  UTC
          Thu,      30.12.2010
NTP:  Offs. PPS: 5us        Stratum:  1
GPS:  NORMAL OPERATION      Satellites: 8/8
PTP2: ok INITIALIZING       GM: 00...........
Press F1 for help or F2 for setup overview
```

M600
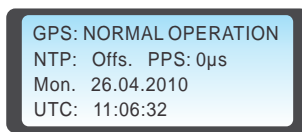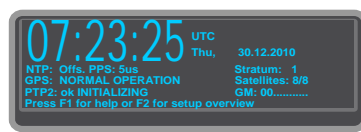
```
NORMAL OPERATION
NTP:        Offs. -5us
THU,       26.06.2010
UTC           12:12:00
```
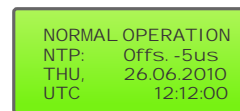
SyncFire 1000

Figure 1.0 - LANTIME Displays

SyncFire 1000 / 1100	LC-Display, 4 x 20 characters
M200/M300	LC-Display, 2 x 40 characters
M400/M900/IMS	LC-Display, 4 x 16 characters
M600	Vacuum Fluorescent Graphic Display (VFD), 256 x 64 Dots

9.3.1 Description of the graphical menu: VF-Display

The graphical menu is used to graphically display offset values [1] between a given input signal [2] and the oscillator of a GPS card. The program can be started with the ↑ button in the corresponding status menu. Furthermore, a list of various offsets for the input signals respectively is available in the MRS status function. To access it please press the ↓ button if you are in the main menu (where the current time is displayed).

The main menu of the Lantime (where time and date in the selected time zone are displayed).

```
                            F1

            12:00:00
         UTC Thu, 01.01.2011
```
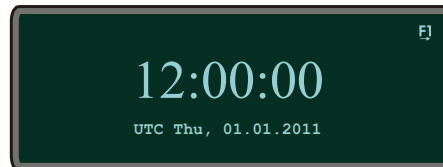
Choose Reference Time ↓, MRS Management, MRS Status and Setup, and eventually MRS Status. Now you can choose whether the numerical offsets of all available input signals should be displayed or if a graphical display program should start. If the graphical option is selected you have to choose one of the input signals as a reference.

By pressing buttons ↑ and ↓ one can change among several reference signals and select one by pressing the OK button. In the graphic mode one can choose among four different display options how the offset of a given reference signal shall be displayed (online mode, full graph, statistics and scrolling mode).

The cursor position and consequently the option selection can be modified with the ↑ and ↓ buttons. In the upper right corner one can find the selected reference source signal, which offset is graphically displayed. With the OK or → button the selected graphical mode can be started.

Main menu of the graphical display with various options:

```
    show online mode          GPS
 -> show full graph      <-     ↑
    show statistics
    show scrolling mode         ↓
                              [ESC]
```
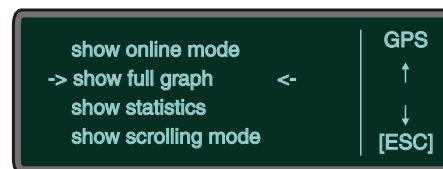
Each of these modes contains an information menu accessed by F1. One can find here some current status information as well as selection buttons and options of the current mode. With the ESC button one can always return to the menu on the upper level.

---

[1]Offset: an offset is a time difference between two systems. In our example, the offset is time difference between a given input signal and an oscillator, which disciplines its local clock.

[2]Input signals: GPS, PTP, PPS, NTP, TCR, FRQ- which of these input signals are available can be identified from the numerical status (Numerical Status)

Each graphic mode is displayed within a range of values: [3]

Display of the selected mode (here: SCROLLING MODE)

After one of the graphical menu options is selected, the current mode appears for one second on the display. Under the current mode the origin file from which the graphic is generated appears in small fonts.

The first mode is the "ONLINE MODE"
This mode displays the last 255 offset values and it checks regularly for new offsets. When a new value appears the graphic display shifts six pixels to the left to make space for the new values. Additionally, the time range is displayed below and the offset range on the left.

Graph of the Online Mode (not zoomed)
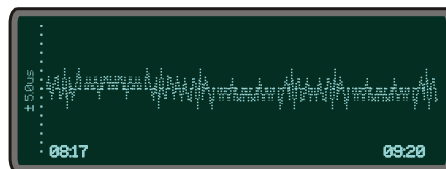
With the ↑ (zoom in) and ↓ (zoom out) buttons the range of the y-axis can be changed any time in order to display graph larger or smaller.
Graph of Online Mode (zoomed out)
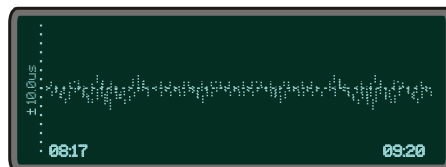
The next mode is the "FULL GRAPHIC MODE"
After the status mode is displayed, offset values start being plotted. All values from the statistic file are displayed as long as no more than 255 values are available. If more values than a display length (255 points) are available, only each xth offset value [4] is displayed.

Thus a mean value graph is generated which looks similar to this one: An example of a generated graph with the corresponding range of values (here: FULL GRAPHIC)

---
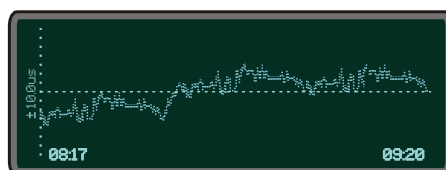
[3] The display has an x and y axis: the y-axis displays the offset value, which is the higher between absolute minimum and maximum value and is computed automatically at the first start of the menu. It is step-wisely ordered as follows: +- 1, 2, 5, 10, 20, ... (in 30 day [units – one picosecond [ps]). The x-axis is a time axis. It shows from and until when particular offset values occur.
[4] The xth value is the number of available values divided with the display length.

The range of values is automatically adjusted. The x-axis starts with the first
chronological value available in the given file. The last value is not necessarily also the last value from the
given file. If more than 255 values are available then only each xth value is displayed.

A legend can be displayed by pressing the F2 button. It contains the value range, as well as the mini-
mum and maximum of the graphic. By pressing a F2 button for the second time the legend disappears.
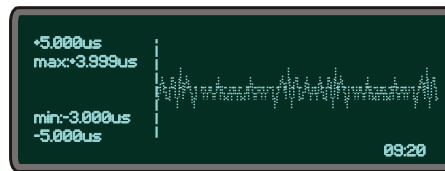
The help menu appears by pressing the F1- information button in the "FULL GRAPHIC MODE". It shows all
available options in this mode. Other options are only partially available from here. To end this function one
has to press ESC-, OK- or again the F2- button.

In the "FULL GRAPHIC MODE" the graph can be maximized or minimized with ↑ (zoom in) and ↓ (zoom
out) buttons. If the legend is currently displayed, selecting the zoom-buttons causes that the range of y-axis
gets automatically adjusted and the legend renewed. With the ESC-button one can get back to the main menu
of the graphical program where the legend is not displayed. Alternatively, a display returns back to a "FULL
GRAPHIC MODE" with a default value range.

The „Statistic" - option comes next in the graphic menu. When you select it, you can decide if the mini-
mum or the maximum value of the current statistics file shall be displayed or not.

The minimum or the maximum values are plotted in the middle of a display, as long as at least 128 values
(a half of the display length) are available. A legend is shown on the display at the same time and apart of the
minimum or maximum value also the corresponding UTC time is displayed [5].

Display of the minimum including the legend:
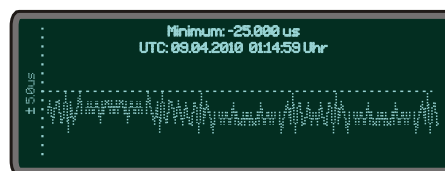
Display of the maximum including the legend:

The "SCROLLING MODE" comes as last in the graphical mode
After the status mode is displayed the whole available offsets are shown in a scrolling way. The ↑ or ↓ buttons
refer in the „SCROLLING MODE" to its scaled up or scaled down range of values of the y-axis. Each time
when selecting these two buttons the „SCROLLING MODE" starts again from the beginning. Pressing the OK
or ← button causes that the graphic holds on; and pressing the OK or → again the graph continues to scroll
on. When the mode is stopped (the value range will be displayed) one can change the y-axis value range with
the ↑ (scaled up) and ↓ (scaled down) buttons. The offset values will only be scrolled to the end of a display

---

[5]UTC: Universal Time Coordinated is the standardized world time which does not include daylight saving time change

and again with the OK or → button the scrolling will continue.
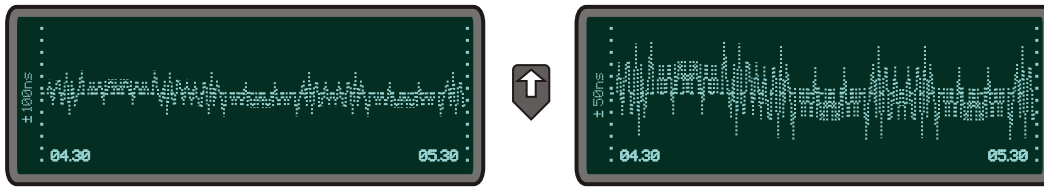
When the ← button is selected the displayed graph moves half of a display to the left if the „SCROLLING MODE" has not been stopped beforehand. Even here the value range of the y-axis can be changed or the graph can be shifted a few more steps to the left. In order to continue the scrolling mode one has to press the OK or → button. If you select the ESC button then you come back to the main menu of the graphical program.

9.4 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 holding „ESC" for a few seconds. 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. The text "NORMAL MODE" might be replaced by "NOT SYNC". If a excisting antenna connection is interrupted or not working properly, the text "ANTENNA FAULTY" is displayed instead.

With an integrated time code receiver it might be possible, that the message "NO DATA" appears on the display – in this case the correct value can be set in the time-code parameter submenu.

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 "SIMULATION MODE" 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 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.

If the symbol „F1" will be shown in the upper right corner a help page can be displayed when pressing the „F1" button. When pressing „F1" from main menu a short description for menu navigation will be displayed:

```
Use → and ← to
select different
main menus. Use
↑and ↓ to enter.
```

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

```
ELX800    VX.XXx
SN: 000000000000
NTP: X.X.Xx@X.X
Krn.: X.X.XX.X
```

The following main menus will be displayed when pressing the arrow buttons:

```
┌─────────────────────┐
│ NORMAL MODE         │
│ NTP: Offs. 1ms      │
│ Wed, dd.mm.yyyy     │
│ UTC  12:00:00       │
└─────────────────────┘
           │
           ▼
```

```
┌─────────────────────┐   ┌─────────────────────┐   ┌─────────────────────┐   ┌─────────────────────┐
│ ->Ref. Time   <-    │   │    Ref. Time        │   │    Ref. Time        │   │    Ref. Time        │
│   Time Service      │   │ ->Time Service<-    │   │    Time Service     │   │    Time Service     │
│   Network           │   │   Network           │   │ ->Network      <-   │   │ ->Network      <-   │
│   System            │   │   System            │   │   System            │   │   System            │
└─────────────────────┘   └─────────────────────┘   └─────────────────────┘   └─────────────────────┘
        OK                       │    OK                    │    OK                    │    OK
       ──────▶                   ▼   ──────▶                ▼   ──────▶                ▼   ──────▶
```

```
┌─────────────────────┐   ┌─────────────────────┐   ┌─────────────────────┐   ┌─────────────────────┐
│ ->Setup MRS   <-    │   │ ->external NTP<-    │   │ ->Interfaces <-     │   │ ->Time Zone    <-   │
│   Info REFCLK       │   │   Local Strat.      │   │   Global Cfg.       │   │   Restart Menu      │
│   Setup REFCLK      │   │   Restart NTP       │   │   Services          │   │   Factory Reset     │
│   Set Outputs       │   │   PTP IEEE1588      │   │                     │   │                     │
└─────────────────────┘   └─────────────────────┘   └─────────────────────┘   └─────────────────────┘
```

9.5 Menu: Reference Time

```
->Ref. Time    <-
   Time Service
   Network
   System
```

REFCLK = GPS, GLN, PZF, MSF, WWVB, JJY ...

```
->Info REFCLK <-
   Setup REFCLK
   Set Outputs
```

Redundant System — NO — MRS System — NO

YES

```
   Ref. Time 1
->Switch Unit <-
   Ref. Time 2
```

YES

```
->Setup MRS    <-
   Info REFCLK
   Setup REFCLK
   Set Outputs
```

Select Clock

```
        MRS

>Set MRS & Info<
   IRIG Receiver
```

Setup MRS

The Reference Clock menu and all its sub menus will manage all status information and parameters of the reference clock. To enter the following sub menus press the "OK" button.

9.5.1 Optional Menu Switch Unit

```
   Ref. Time 1
->Switch Unit <-
   Ref. Time 2
```

OK →

```
->SCU State <-
   SCU Cnt1
   SCU INFO
```

↓

```
   SCU State
->SCU Cntl  <-
   SCU INFO
```

↓

```
   SCU State
   SCU Cnt1
->SCU INFO  <-
```

OK →

```
Mode:manual
CLK1:1  CLK2:1
PSU1:1  PSU2:1
MUX: enabled  1
```

OK →

```
 REMOTE: disable
>OUTPUTS: enabled<
 Selected Clk:1
```

OK →

```
S/N:11010000
Ver:100
CLK1:0
CLK2:0
```
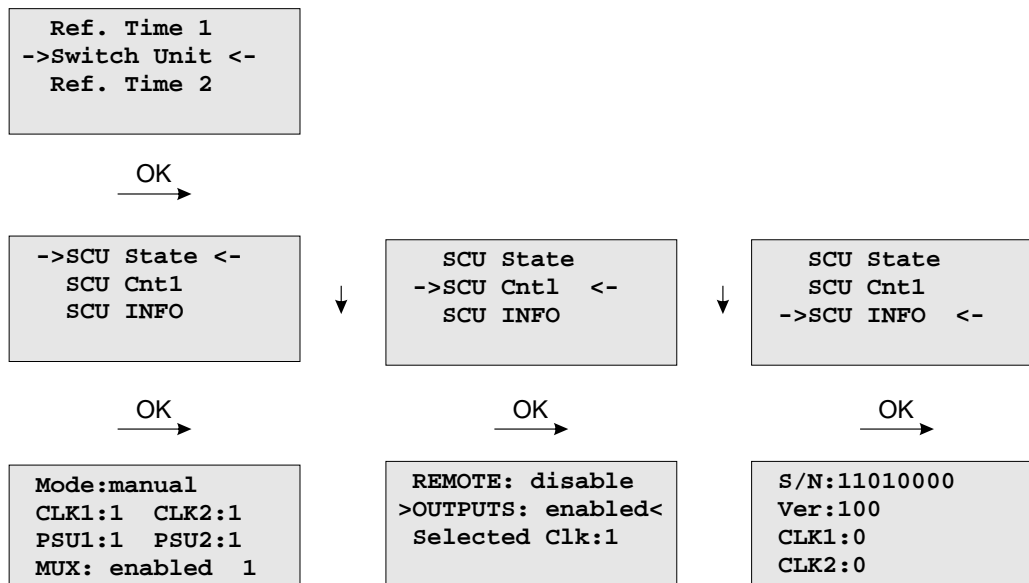
With this menue you can check all important status information about the switch card unit. The example above shows a perfect mode of operation. Both power supplies (PSU1, PSU2) are connected – the two receivers are working in "normal operation mode" (CLK1, CLK2). If the second clock is not connected or in free running mode, the display shows "CLK2:0". If there is no power connected on PSU1, you can see the status "PSU1:0" on the display of the LANTIME.

With the submenue **SCU Cntl** you can configure the following parameters:

REMOTE: disabled/enabled
                  disable or enable remote control of the SCU

OUTPUTS: enabled/disabled
                  disable or enable outputs of the SCU

Selected Clk: Clk:1, Clk:2
                  The reference clock can be selected with the function keys or from a connected workstation – for this the mechanical switch in front of the SCU card must be locked in position "Auto". Otherwise (position "Manual") the selected clock can only be changed by using the switch of the SCU.

9.5.2 Menu Option Setup MRS

The internal reference clock of the integrated GPS clock module with the high precision oscillator (OCXO HQ) can be disciplined by different time sources. Possible time sources are GPS receiver, external Pulse Per Second (PPS), IRIG 10MHz Frequency, IRIG Time Code, external NTP server or IEEE1588 Grandmaster (M400, M600, M900). The priorities for the internal controlling can be set up in configuration. The priority will define which reference source will be used next if the highest priority reference source will be no longer available. For each reference source a bias (fixed offset) and a precision value can be defined.

```
        MRS

 >Set MRS & Info<
   IRIG Receiver
```

OK →

```
> MRS Status    <        MRS Status            MRS Status            MRS Status
   Priorities          > Priorities   <         Priorities            Priorities
   Fix Offsets            Fix Offsets         > Fix Offsets  <         Fix Offsets
   Precisions            Precisions            Precisions          > Precisions    <
```

OK →   OK →   OK →   OK →

```
 0.GPS*  +32.0ns        0. GPS              Set FixOff[ns]        Set Precis[ns]
 1.NTP  +6.000us        1. PPS in           PPS:                  GPS:10
 2.PPS   n/a            2. NTP              NTP:                  PPS:100
 3.PTP   n/a            3. PTP IEEE1588     PTP:                  NTP:
```
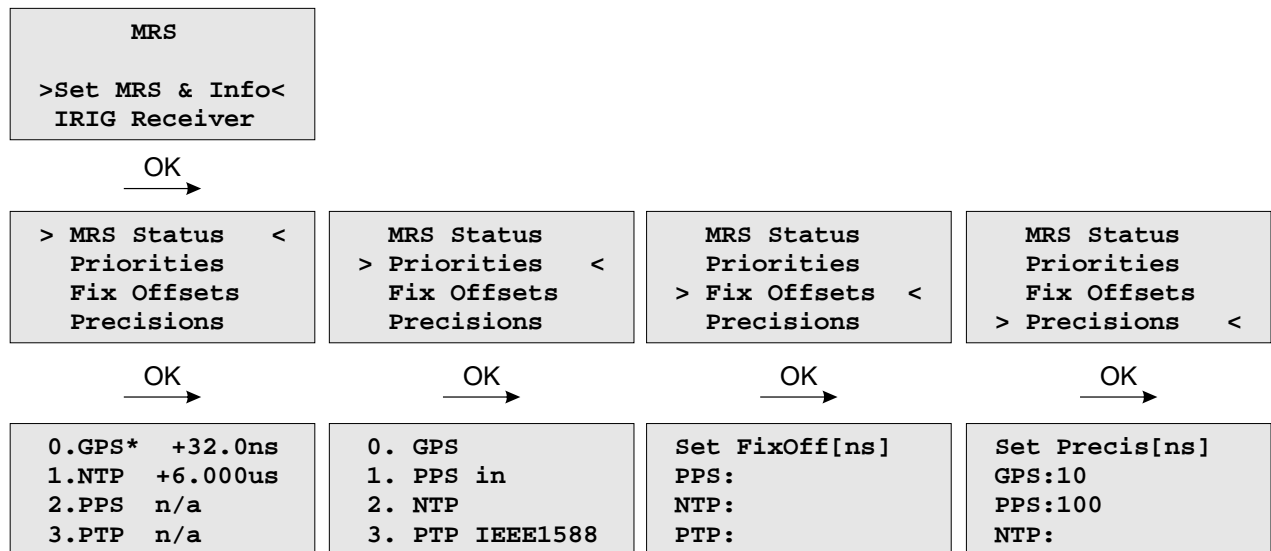
With the OK and arrow buttons you can choose the current status of the MRS. All possible reference clocks will be shown with the number of priority, the name of the reference clock and the current offset to the internal reference clock (OCXO). The current master will be signed with an "*" behind the name of the reference clock.

In the next menu the user can define in which order the references will be used to control the internal oscillator. The reference clock with the highest priority will be used always if this is available.

The "Fixed Offsets" can be set up in the next sub menu, if you know the constant offset (bias) of an external reference source. By default this value is 0 ns. The bias of the internal GPS receiver can not be set up – indirectly this can be done via the antenna cable length.

This precision value will determine the hold over time when switching to the next reference clock if the current master is not available anymore. If the precision is 0 the next reference clock will be switched at once. If the precision value is greater then 0 the time for switching to the next reference (hold over time) will be calculated by the following formula:

(precision of next reference) / (precision of current master) * constant [s]
The parameter „constant" depends on the quality of the internal oscillator.

Example:
The GPS receiver with an precision of 10ns is the current master. If this master is no longer available it will switch to the next reference source of the priority order – in this case the PPS input with a precision of 100us. With the formula ((100ns/10ns)*11.4) we get hold over time of 114 seconds/1.9 min. The online display of the MRS status will show the remaining time and the calculated time. The hold over time will be recalculated if the status of the reference clocks will change.

```
> MRS Status   <                  0.GPS (30s/1m54)
  Priorities         OK           1.NTP +6.000us
  Fix Offsets     ------->        2.PPS n/a
  Precisions                      3.PTP n/a
```
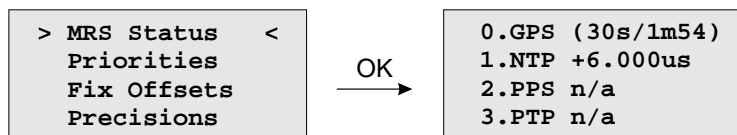
Menu Option MRS - Setup Time Code Receiver

With this menu, the parameters for the time code input signals can be displayed and adjusted.

```
     MRS                       IRIG                   Time Code Rec.
                   OK        Receiver        OK       B122/B123
 Set MRS & Info  ------->  >Show IRIG Info< ------->  Offs.UTC: +00:00
 >IRIG Receiver <           Setup IRIG               State:  --------
```

```
                           IRIG                   Set IRIG Params
                         Receiver        OK       B122/B123
                        Show IRIG Info ------->    Offset from UTC:
                        >  Setup IRIG  <           (+HH:MM) +00:00
```

9.5.3 Menu: Info Receiver

```
                            ┌──────────────────────┐
                            │ ->Ref. Time      <-  │
                            │    Time Service      │
                            │    Network           │
                            │    System            │
                            └──────────────────────┘
```

```
     GPS / GLONASS                                                    IRIG
                           PZF          MSF, WWVB, JJY ...
┌──────────────────┐ ┌──────────────────┐ ┌──────────────────┐ ┌──────────────────┐
│   Setup MRS      │ │ ->Info  PZF   <- │ │ ->Status     <-  │ │ -> Info TCR   <- │
│ ->Info REFCLK <- │ │   Setup PZF      │ │    Version       │ │    Setup TCR     │
│   Setup REFCLK   │ │   Serial Outputs │ │    Tran. Distance│ │                  │
│   Set Outputs    │ │                  │ │                  │ │                  │
└──────────────────┘ └──────────────────┘ └──────────────────┘ └──────────────────┘
        OK                   OK                   OK                   OK
┌──────────────────┐ ┌──────────────────┐ ┌──────────────────┐ ┌──────────────────┐
│ >CLK Status    < │ │ >Status & Version<│ │ ->Status     <-  │ │ ->Version Info <-│
│  CLK Version     │ │  Corr. & Field   │ │    Version       │ │   Recv. State    │
│  CLK Position    │ │                  │ │    Trans.Distance│ │                  │
│  CLK Satellites  │ │                  │ │                  │ │                  │
└──────────────────┘ └──────────────────┘ └──────────────────┘ └──────────────────┘
```

In this menu all relevant information about the reference clock, the internal oscillator and in case of a GPS or GLONASS receiver, the visible and good satellites will be shown in the display.

9.5.4 Receiver Status and Version

GPS / GLONASS (CLK)

```
>CLK Status    <        CLK Status           CLK Status           CLK Status
  CLK Version          >CLK Version   <       CLK Version          CLK Version
  CLK Position          CLK Position         >CLK Position  <      CLK Position
  CLK Satellites        CLK Satellites        CLK Satellites      >CLK Satellites<
```

            OK   OK   OK   OK
            →   →   →   →

```
CLKxxx    SYNC        SN: 029*********      Receiver Pos.       SV CONSTELLATION
OSC warmed up: *      REFCLK vX.XX         LAT: 51.9828          SVs in view: 10
DAC  cal:505          OSC: TCXO            LON:  9.2258          Good SVs:    10
DAC  val:-24          EPLD: 002E10CB       ALT: 176 m           Sel: 04 10 24 13
```

```
                                          Receiver Pos.
                                    ↑↓   LAT: 51°58'57"N
                                         LON: 09°13'32"E
                                         ALT: 176 m
```

```
                                          Receiver Pos.
                                    ↑↓   X: 3885662 m
                                         y: 631131  m
                                         z: 5001761 m
```

PZF

```
>Status & Version<        Status & Version
  Corr. & Field          >Corr. & Field    <
```

            OK   OK
            →   →

```
PZFxxx   SYNC             PZF STATE
PZFxxx vX.XX            CORR.:
SN: xxxxxxxxxxxx        18  State:row
TCXO HQ                 FIELD:0
```

```
                          PZF STATE
                    ↑↓   CORR.:
                        1   State:check
                        FIELD:94
```

```
                          PZF STATE
                    ↑↓   CORR.:
                        97  State:fine
                        FIELD:94
```

WWVB, MSF, JJY ... (REF)

```
->Status       <-          Status               Status
  Version                ->Version       <-     Version
  Tran. Distance           Tran. Distance     ->Tran. Distance<-
```

            OK   OK   OK
            →   →   →

```
    REF STATE:           REF CLOCK                Setup:
State: SYNC              REF vX.XX          Receiver Position
FIELD: 100              State: SYNC         Trans. Distance
                        S/N:001510000000          1200km
```

This first menu will monitor the current state („sync" or „not sync"). The next line will reflect the firmware version, the serial number of the internal GPS and the type of the integrated oscillator.

Menu: IRIG Receiver State

The first line of the display shows the system state with 8 options – described in the next paragraph. The second line will display the drift in [us] of the internal oscillator and the TFOM value (Time Figure Of Merit: the quality of the IRIG-signal, only used with IEEE 1344) and the current system configuration is shown on the third line. On the fourth line the AGC (Automatic Gain Control of the input signal) value in hexadecimal will be shown.

IRIG (TCR)

```
->Version Info<-
  Recv. State
```

```
   Version Info
->Recv. State <-
```

OK ─────▶   OK ─────▶

```
TCR   sync.
SN:   TCR: X.XX
OSC: TCXO
```

```
State: --*-*-**
DRIFT: +00000us
TFOM:  0x00
AGC:0xFF SC:0x02
```
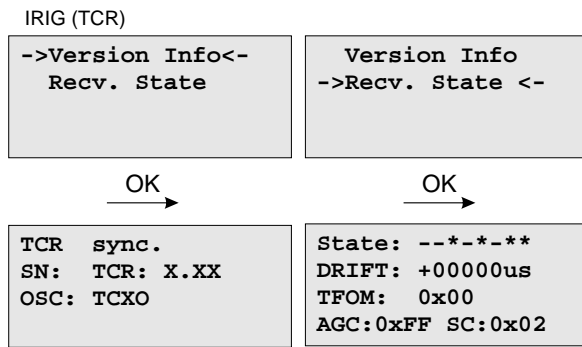
IRIG Receiver State: Bit 7 ... 0
Bit 7:   Invalid UTC parameter
Bit 6:   TCAP exceeded, jitter out of range
Bit 5:   Lock on
Bit 4:   Telegramm error
Bit 3:   Data available
Bit 2:   Invalid sysconf
Bit 1:   Pulses enabled
Bit 0:   Warmed up

Invalid UTC parameter: This bit is set to one if the checksum of the 'Offset from UTC' parameter, which must be used if no IEEE1344 extensions are available, is invalid. User must enter new 'Offset from UTC' data to clear this bit. Please note that the IRIG-receiver never leaves freewheeling mode if IEEE1344 is disabled and the UTC-Parameter are invalid!

TCAP exceeded, jitter out of range: If the jitter between two consecutive IRIG-telegrams exceeds +/- 100us the receiver switches into freewheeling mode and the 'TCAP exceeded' Bit is set. 'TCAP exceeded' is cleared if the measured jitter is below +/- 100us.

Lock on: 'Lock On' is set whenever the receiver is in synchronous mode and the internal oscillator correction value has settled.

Telegram error: This bit is set if the consistency check of two consecutive IRIG-telegrams fails. The IRIG-receiver switches into free wheling mode if 'telegram error' is set.

Data available: 'data available' is set if the receiver can read the timecode.

Invalid sysconf: If 'invalid sysconf' is set the checksum of the system configuration data is invalid. In this case the default mode 'IEEE1344 disabled' is selected. User must cycle the system or enter a new system configuration in the IRIG-parameter menu.

Pulses enabled: The pulse per second (PPS) signal which increases the NTP's accuracy is turned when 'lock on' is set the first time. The 'pulses enabled' bit is set if the PPS signal is enabled.

IRIG system configuration Bit 2 ... 0
Bit 7 ... 4:   reserved
Bit 3:   ignore Day Of Year enabled
Bit 2:   ignore TFOM
Bit 1:   ignore SYNC
Bit 0:   IEEE 1344 enabled

9.5.5 Menu: Setup Meinberg Receiver

GPS / GLONASS (CLK)

```
   Setup MRS
   Info REFCLK
->Setup REFCLK<-
   Set Outputs
```
OK →
```
>Antenna Length<
  Simulation Mode
  Init CLK
```

PZF

```
   Info  PZF
->Setup PZF     <-
   Serial Outputs
```
OK →
```
> Trans.Distance <
  Init Time
  Ignore Lock
```

WWVB, MSF, JJY ...

```
   Status
   Version
->Tran. Distance<-
```
OK →
```
        Setup:
Receiver Position
Tran. Distance
        1200km
```

IRIG

```
    Info TCR
 -> Setup TCR <-
```
OK →
```
->UTC Offset  <-
   IRIG Code
   Initial Time
   Ignore Lock
```
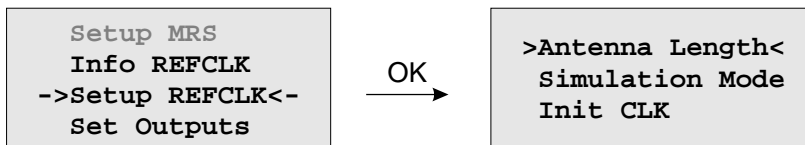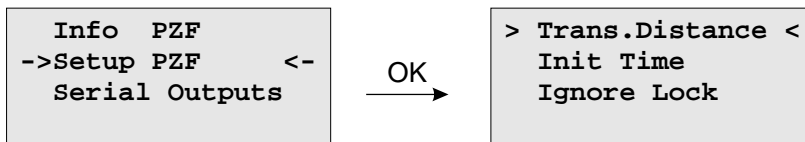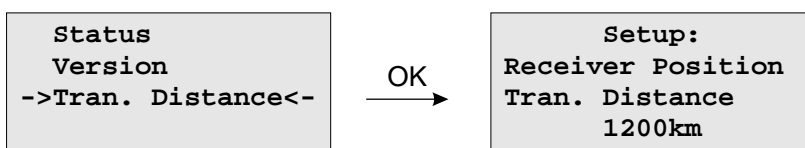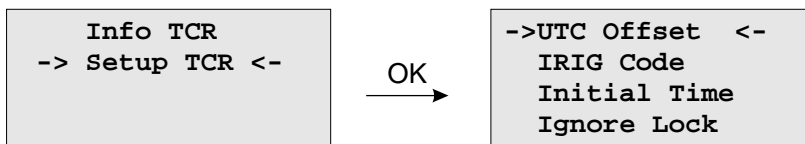
In the Reference Time -> Setup Clock menu the receiver clock parameters can be configure. The antenna cable length of satellite based receivers must be entered here. The GPS and GLONASS reference clocks can be run in simulation mode.

Meinbergs PZF correlation receivers can be operate in simulation mode as well. In addition to that, the distance to the transmitter must be set in the setup menu.

For our long wave receivers (WWVB, MSF, JJY ...) there is only the setting for "Transmitter Distance" available – in the Submenu *Reference Time -> Info Refclock*. The setup for our IRIG time code receivers includes the settings for the UTC offset and the corresponding time code. The time code receiver can also operate in simulation mode with **IGNORE LOCK**. With **Initial Time** and **Init Clock** (GPS, GLONASS), the time and date for the simulation mode is set.

9.5.6 Menu: Output Options

```
 >Output Options<                >enable Outputs<                ENABLE OUTPUTS
  Serial Outputs        OK         Time Zone          OK         Serial: always
  IRIG Output         ------->                      ------->     Pulses: if sync
  Pulse Outputs
```

```
                                  enable Outputs                 Set Timezone
                                 >Time Zone     <      OK       ->DL Sav ON   <-
                                                     ------->     DL Sav OFF
```
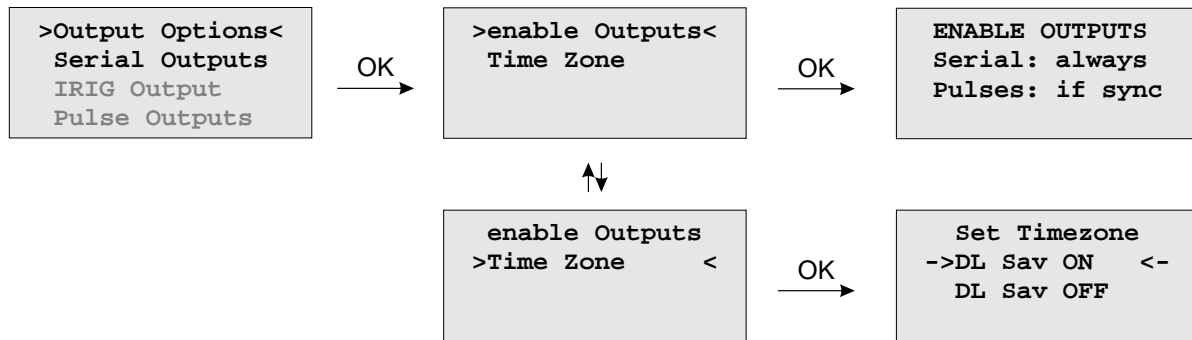
Enable Outputs:

The submenu *Output Options -> Enable Outputs* lets the user configure at which time after power up the serial ports and pulse/frequency outputs are to be enabled. Outputs which are shown to be enabled 'always' will be enabled immediately after power–up. Outputs which are shown to be enabled 'if Sync' will be enabled after the receiver has decoded the incoming signals and has checked or corrected its on–board clock. The default setting for all outputs is 'if Sync'.

Time Zone:

See Chapter "Set Time Zone of Serial Outputs".

9.5.7 Menu: Serial Outputs

This menu lets the user configure the baud rate and the framing of the serial RS232 port to one of the following values:

Baudrate:	300 to 19200
Dataformat:	7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8N1, 8N2, 8O1

```
  Output Options                Serial Outputs              COM0:  19200 8N1
 >Serial Outputs<     OK       ->Setup COM 0<-    OK        Mode/Str. Type:
  IRIG Output        ───►         Setup COM 1    ───►       per second
  Pulse Outputs                                             Meinberg Standard
```
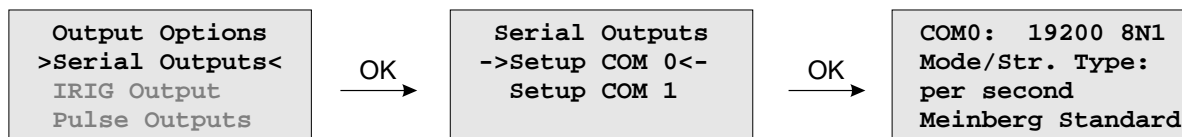
COM0 provides a time string once per second, once per minute or on request. If the „on request" is activated you have to send the character "?" to get the timestring.

Defaultsettings COM0:	Speed	Framing	Mode	Signal Type
	19200 baud	8N1	per second	Meinberg Standard

This topic is used to select one of several different types of serial time strings or the capture string for each serial port.

The following time strings can be selected. All time strings are described in the appendix at the end of this documentation.

- Standard Meinberg-Telegram
- ION
- NMEA-Telegram (ZDA)
- NMEA-Telegram (RMC GGA)
- NMEA-Telegram (GGA)
- Meinberg GPS
- RACAL-Telegram
- SPA-Telegram
- Meinberg Capture
- Sysplex1-Telegram
- Computime-Telegram
- UNI-Erlangen-Telegram
- NMEA-Telegram (RMC)
- SAT-Telegram

9.5.8 Setup Output Time Zone

The time zone of the internal receiver can be set up. These parameters will affect the serial output lines and the timecode (IRIG) outputs. The internal time zone of the timeserver and the time of NTP will always be UTC. The time monitored in the main menu will be the time of the NTP.

The menu *Set Timezone* lets the user enter the names of the local time zone with daylight saving disabled and enabled, together with the zones time offsets from UTC. These parameters are used to convert UTC to local time, e.g. CET = UTC + 1h and CEST = UTC + 2h for central Europe. The values of daylight saving are configurable using the Time Zone setup menu.
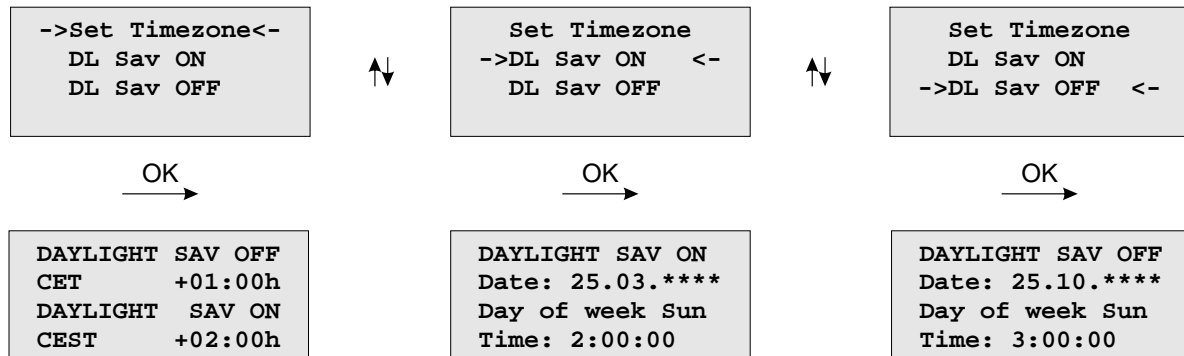
```
->Set Timezone<-            Set Timezone               Set Timezone
   DL Sav ON             ->DL Sav ON   <-             DL Sav ON
   DL Sav OFF              DL Sav OFF              ->DL Sav OFF  <-
```

```
            OK                         OK                         OK
   ————————>                  ————————>                  ————————>
```

```
DAYLIGHT SAV OFF          DAYLIGHT SAV ON           DAYLIGHT SAV OFF
CET       +01:00h         Date: 25.03.****          Date: 25.10.****
DAYLIGHT  SAV ON          Day of week Sun           Day of week Sun
CEST      +02:00h         Time: 2:00:00             Time: 3:00:00
```

Beginning and ending of daylight saving may either be defined by exact dates for a single year or using an algorithm which allows the receiver to re-compute the effective dates year by year.The figure show how to enter parameters for the automatic mode. If the number of the year is displayed as wildcards '****', a day-of-week must be specified. Then, starting from the configured date, daylight saving changes the first day which matches the configured day-of-week. In the figure October 25th is a Saturday, so the next Sunday is October 26th.

All changeover rules for the daylight saving like "the first/the second/the second to last/the last Sunday/-Monday etc. in the x-th month," can be described by the used format "first specified day-of-week after a defined date".
If the number of the year is not displayed as wildcards the complete date exactly determines the day daylight saving has to change, so the day-of-week does not need to be specified.

If no changeover in daylight saving is wanted, identical dates and times must be entered in both of the submenus (DAYLIGHT SAV ON/OFF). After this a restart should be done.

9.5.9 Menu: Setup Time Code

The IRIG Time Code is an optional output.

```
   Output Options                  IRIG Output
   Serial Outputs                Code:
  >IRIG Output   <     OK        IEEE1344
   Pulse Outputs    ———————>     Time: UTC
```
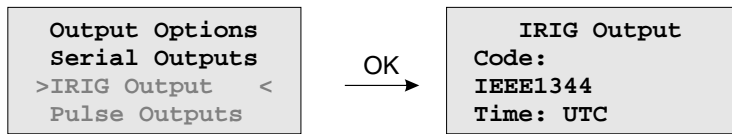
This menu lets the user select the Timecodes to be generated by internal reference clock. Most IRIG-Codes do not carry any time zone information, hence UTC is selected for output by default. If desired, the clocks local time can be output by selecting "TIME: Local".

The following codes can be selected:

- IRIG B002+B122
- IRIG B006+B126
- IRIG B007+B127
- AFNOR NF S87-500
- C37.M8
- IEEE1344

Refer to chapter **Timecode** for details.

9.5.10 Option: Setup Progr. Pulses

Timer Mode
This mode simulates a programmable day assigned timer. Three turn–off and turn–on times are programmable for each output. If you want to program a switchtime, change the turn–on time "On" and the corresponding turn–off time "Off". A turn–on time later than the turn–off time would cause a switch program running over midnight. For example a program "On"10.45.00, "Off" 9.30.00 would cause an active ouput from 10.45 to 9.30 (the next day!). If one or more of the three switching times are unused just enter the same time into the values "On" and "Off". In this case the switch time does not affect the output.

```
->Setup Pulses <-
   Setup Synth.
```
OK →

```
  Pulse Outputs
Out1:Pulse Per S
Out2:Pulse Per S    ↑↓
Out3:Pulse Per S
```
OK →

```
  Select Output

  Output  2
```
OK →
```
  Setup Output2

  -> Mode     <-
     Holdover
```
OK →
```
  Setup Output2

     Mode
  -> Holdover <-
```
OK →
```
  Setup Output2
     Mode
  Pulse Per Second
```
↑↓
```
  Setup Output2
     Holdover
     disabled
```

```
  Cyclic Pulse                enabled
  Single Shot
  Timer
  Idle
  All Sync
  Time Sync
  Position OK
  DCF77 Marks
  Pulse Per Hour
  Pulse Per Min
```

As already mentioned, the outputs home position is selected by "active: high or low".

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

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

DCF77 Marks
In "DCF77 Marks" mode the selected output simulates the telegram as transmitted by german time code trans–mitter DCF77. The generated time code is related to the local time zone. If you want DCF simulation to be disabled when the clock is in free running mode, you can enter the delay (given in minutes) for deactivat–

ing the DCF–Simulation with the "Timeout" value. DCF Simulation is never suspended, if the delay value is zero.

Single Shot Modus

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

Pulses Per Second, Per Min, Per Hour Modes

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

Position OK, Time Sync and All Sync

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

Idle Mode

Selecting "Idle" deactivates the output.

Holdover

If "enabled" is selected the operation of the output remains. Otherwise ("disabled") the operation of the output will be switched off when synchronization is lost.

9.5.11 Option: Synthesizer Frequency Output

```
   Setup Pulses              OK        Synthesizer
 ->Setup Synth. <-    ────────────>    Frequency:
                                         0000 Hz
                                       Phase: 000.0°
```
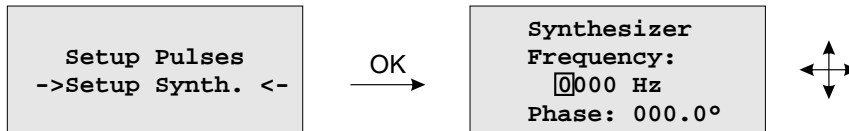
This setup menu lets the user edit the frequency and phase to be generated by the on-board synthesizer. Frequencies from 1/8 Hz up to 10 MHz can be entered using four digits and a range. The range can be selected if the „UP" or „DOWN" key is pressed while the cursor is positioned on the frequency's units string. If the least significant range has been selected valid fractions of the frequency are .0, .1 (displayed as 1/8), .3 (displayed as 1/3), .5 and .6 (displayed as 2/3). Selection of 1/3 or 2/3 means real 1/3 or 2/3 Hz, not 0.33 or 0.66. If frequency is set to 0 the synthesizer is disabled.

The last line of the display lets the user enter the phase of the generated frequency from -360° to +360° with a resolution of 0.1°. Increasing the phase lets the signal come out later. Phase affects frequencies less than 10.00 kHz only, if a higher frequency is selected a message "(phase ignored)" informs the user that the phase value is ignored.

9.6 Menu: Time Service

The NTP configuration page is used to set up the additional NTP parameters needed for a more specific configuration of the NTP subsystem. The optional available PTP adjustments can be done with this menu.

```
   Ref. Time
->Time Service<-
   Network
   System
```

OK →

Redundant System

NO →

```
->NTP Settings<-
  PTP IEEE1588
```

```
->NTP Info    <-
  NTP Setup
  NTP Restart
```

YES

```
->NTP Settings<-
   2nd Receiver
   PTP IEEE1588
```

OK →

```
   NTP Settings
->2nd Receiver<-
   PTP IEEE1588
```

OK →

```
->Fallback Mode<-
   Timelimits
```

OK →

```
   Fallback Mode:

  Redundant
   SHS
```

```
   Fallback Mode
->Timelimits    <-
```

OK →

```
>Warning Lvl. <
 Critical Lvl.
```

9.6.1 Menu NTP

```
->NTP Info      <-                MRS: St: 00 Wh:00
   NTP Setup            OK         Reach: 377 D:0.00
   NTP Restart                     Off: 0.002 J:0.00
                                   o internal Ref.


   NTP Info                      ->external NTP<-              ->extern NTP 1<-
->NTP Setup  <-          OK         Local Strat.       OK        extern NTP 2
   NTP Restart                                                   extern NTP 3
                                                                 extern NTP 4


                                    external NTP                 Setup Stratum of
                                 ->Local Strat.<-     OK            local clock
                                                                        1 2


   NTP Info                        Reset time and
   NTP Setup                       restart NTP?
->NTP Restart<-          OK        Press F2
                                   to confirm.
```

Menu: external NTP

Additional external NTP servers can be set up to provide a high grade of redundancy for the internal reference clock.

The internal reference clock always has priority over the external NTP servers. If the internal reference clock is not synchronized or has failed, the NTP will automatically switch to an external NTP server. With this menu item some external NTP server can be configured.

```
->external NTP<-                  ->extern NTP 1<-
   Local Strat.          OK          extern NTP 2
                                     extern NTP 3
                                     extern NTP 4
```
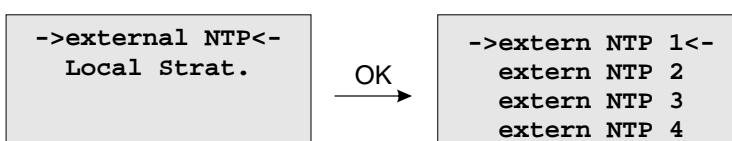
Menu: Stratum of local clock

The local clock is only chosen as the NTP time reference after the reference clock lost its synchronisation. The stratum level of the local clock is set to 12, this ensures that clients recognise the switchover to the local clock and are able to eventually take further actions. The local clock can be disabled if the timeserver should not answer anymore when the reference clock is out of order. The field "Stratum of local clock" is used to change the stratum level of the local clock, default value is 12.

```
   external NTP                    Setup Stratum of
->Local Strat.<-         OK           local Clock

                                           12
```
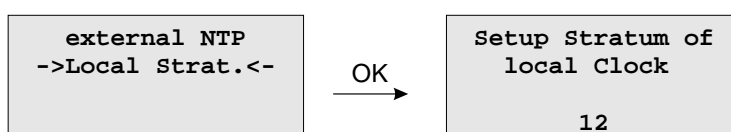
Menu: Restart NTP

The system time is setup, together with the reference time and the NTP service is rebooting.

```
   NTP Info
   NTP Setup
->NTP Restart<-
```

OK ⟶

```
Reset time and
restart NTP?
Press F2
to confirm.
```
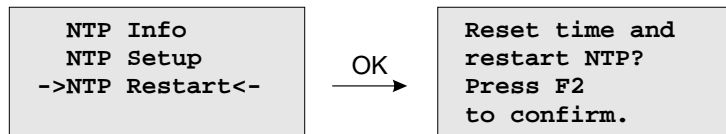
9.6.2 Option: Menu PTPv2 - IEEE 1588-2008

```
    NTP Settings
    2nd Receiver
  ->PTP IEEE1588<-
```

OK →

```
  Select PTP TSU
  #1 IMS-Slot MRI1
  ID:EC46700051F5
  State:UNINITIAL
```

OK →

```
 >PTP Settings  <
  Netw.Settings
  PTP Presets
```

OK →

```
 >PTP Mode      <
  PTP Parameters
  PTP Debug
```

⇅

```
  PTP Settings
 >Netw.Settings <
  PTP Presets
```

OK →

```
 ->IP Config  <-
   VLAN Config
   SSHD
```

⇅

```
  PTP Settings
  Netw.Settings
 >PTP Presets  <
```

OK →

```
  PTP Presets

  E2E Dflt. Profile
```
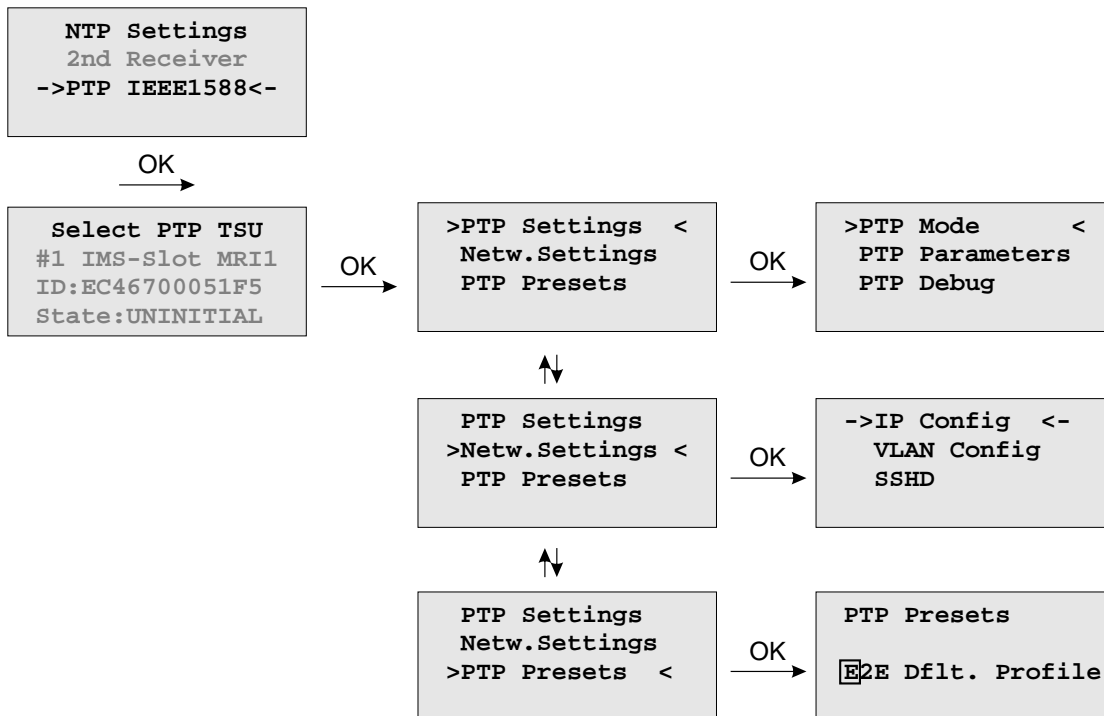
The menu for PTP IEEE 1588 configuration is located in the "Time Service" main menu. A device with more than one PTPv2 cards (also called TSU – Time Stamp Units) lists all cards in the sub menu which follows. With ↓ and ↑ buttons one can select among different PTP cards available in the system. A slot number, MAC address and the current state of the selected TSU will be displayed.

Menu TSU Info

```
Select TSU Index          State:UNINITALI          GM:000000000000
#1 of 10 Interf.          Offset:0ns               DelayMech:E2E
ID:EC46700051F5            Delay:0ns                NetwProto:UDP/IP
State:UNINITALI           Link:0  Domain:1         TScale:   ARB
```
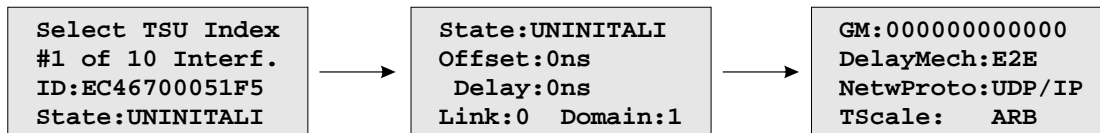
The page "TSU Info" gives an overview of the state of the most important PTP parameters from the time stamp unit which is connected to the PTP0 interface. The appearance of this page is depending on the mode of the PTP engine. There are different states of a TSU possible. For example, if the unit is configured as a PTP Grandmaster clock, then this page shows the "Master" state. On the other hand in MRS (Multi Reference Source) devices, the PTP mode "Slave" is displayed here.

The full list of **TSU States** is as follows:

uninitialized: The port is booting up, the software daemon has not yet started, the IP address is not yet assigned.

initializing: In this state the port initializes its data sets, hardware, and communication facilities.

faulty: Not defined in LANTIME systems.

disabled: PTP service has been disabled on this port, either by user configuration or because the module is in a standby mode.

listening: The port is waiting for the announceReceiptTimeout to expire or to receive an Announce message from a master.

preMaster: A short transitional state while the port is becoming a master.

master: The port is a current master.

passive: The port is in passive mode, meaning there is another master clock active in the PTP domain. The port can enter master state when it wins the BMCA (Best Master Clock Algorithm) due to a failure/service degradation of the current master.

uncalibrated: One or more master ports have been detected in the same domain. The TSU is waiting to calculate the path delay to a Grandmaster.

slave: The port has successfully subscribed to a master and receives all expected messages. It also successfully measured the path delay using delay request messages.

Values **Offset** and **Delay**

"Master" state: 0 ns since they refer to its internal clock.

"Slave" state: they show the offset to the Grandmaster and the mean network delay between the master and a slave.

Link: status 0: The queried port is down, check the link LED. If faulty, replace the network card.
status 1: The port of interest is in normal operation.

Domain: A PTP domain is a logical group of PTP devices within a physical network that belong to the same domain number. Slave devices that shall sync to a certain master within a network must have been configured with a unique domain number which is the as same on the master.

GM: A MAC address of the current Grandmaster.

DelayMech: two options possible:
E2E (End-to-end) where delay measurement messages are sent from the slave to the master (the two end nodes).

P2P (Peer-to-peer): where each device (a peer) in the network exchanges peer-delay measurement messages. This way each device can keep track of the delays between itself and its immediately connected neighbors. P2P mechanism can be used in 1588 PTP-capable networks only.

NetwProto: two options possible:
ETH-IEEE 802.3 / Ethernet (Layer 2): Ethernet frame including MAC addresses of a destination and a source.

UDP-UDP/IPv4 (Layer 3): User Data Protocol one of the main protocols used for the Internet.

Menu TSU Setup

With this menu, all PTP parameters can be configured for the selected interface:

```
>PTP  Settings <
 Netw.Settings
 PTP Presets
```

OK →

```
>PTP Mode      <
 PTP Parameters
 PTP Debug
```
⇅
```
 PTP Mode
>PTP Parameters <
 PTP Debug
```
⇅
```
 PTP Mode
 PTP Parameters
>PTP Debug      <
```

OK →   OK →   OK →

```
Setup PTP Mode:
Multicast Master
...
```
```
Setup PTPv2
Parameters in
Master Mode
PRESS OK
```
```
>Set Dbg Level <
 Set temp Offs
 Enable Stats
```

```
Multicast Slave
Unicast Master
Unicast Slave
Multicast Auto
```
```
Setup PTPv2
Parameters in
Slave Mode
PRESS OK
```

The **Set Dbg Level** menu is for maintenance and debugging purposes only, therefore leave it unchanged unless advised by a technician. The Level of debugging can be increased from 0 (default) to 3 with additional data being logged at each increased debugging level.

Set temp Offs is an offset value set temporarily, mainly for a debugging purpose. With the next warm boot the value is set back to 0.

Enable Stats option is also mainly for debugging. Per default it is disabled.

Menu PTP Mode

```
 >PTP Mode        <          Setup PTP Mode:
  PTP Presets          OK    Multicast Master
  PTP Parameters    ──────▶
                             ...              ↕
```

```
                             Multicast Slave
                             Multicast Auto
                             Unicast Master
                             Unicast Slave
```
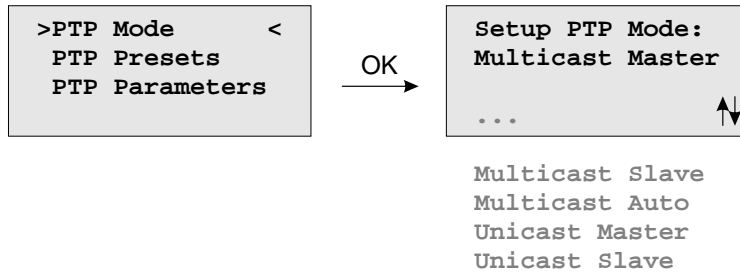
The number of different PTP operation modes depends on the feature set of the purchased unit.

Supported modes on a GPS-only or GPS/GLONASS-only system:
– PTPv2 Multicast Master
– PTPv2 Unicast Master

Supported Modes on a MRS system:
– PTPv2 Multicast Slave
– PTPv2 Multicast Master
– PTPv2 Multicast Auto
– PTPv2 Unicast Slave
– PTPv2 Unicast Master

Load PTP Presets

Each PTP preset represents a set of PTP configuration parameters that will switch the PTP engine to a dedicated PTP profile. After a preset has been selected, the user still has the opportunity to change all PTP parameters and "fine-tune" them.

```
 PTP Settings
 Netw.Settings          OK        E2E Dflt Profile
>PTP Presets   <       ----->            ...

                                 Custom
                                 Telecom Profile
                                 Power Profile
                                 P2P Dflt Profile
```
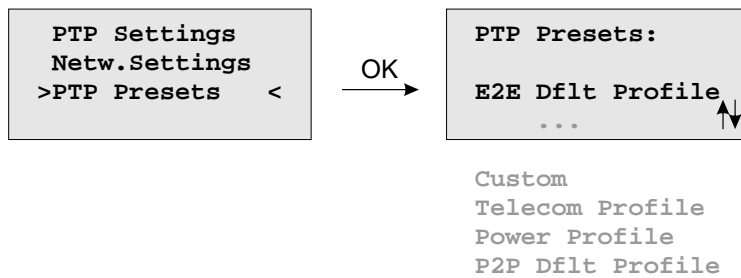
Note: Whenever a PTP preset is selected, all previously saved PTP parameters will be overwritten!

Six different presets are supported:

In Multicast Master / Slave Mode:

Delay Request Response Default Profile
– Sync Msg Rate: 1/sec
– Ann Msg Rate: 2 sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "E2E"

Peer-to-Peer Default Profile
– Sync Msg Rate: 1/sec
– Ann. Msg Rate: 2 sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "P2P"

Power Systems Profile
– Sync Msg Rate: 1/sec
– Ann Msg Rate: 1/sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "P2P"
– VLAN (802.1Q) enabled (VLAN ID:0, Prio:4)
– Power Profile TLVs enabled

Telecom ITU–T G.8275.1
– Ann Msg. Rate: 8/sec
– Sync Msg. Rate:16/sec
– Del Req Rate: 16/sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "E2E"
– Network Prot. "Layer 2 (IEEE 802.3)"

―――――――――――――――――――――――
In Unicast Master / Slave Mode:
―――――――――――――――――――――――

Telecom ITU-T G.8265.1
- Ann Msg. Rate: 1/sec
- Sync Msg. Rate:16/sec
- Del Req Rate: 16/sec
- Priority 1:   128
- Priority 2:   128
- Delay Mech: "E2E"
- Network Prot.   "Layer 3 (UDP/IPv4)"

―――――――――――――――――――――――
In Unicast or Multicast Master / Slave Mode:
―――――――――――――――――――――――

SMPTE ST 2059-2
–Ann Msg. Rate: 4/sec
–Sync Msg. Rate: 8/sec
–Del Req Rate: 8/sec
–Priority 1:   128
–Priority 2:   128
–Delay Mech: "E2E" or "P2P"

Custom Profile
By selecting "Custom" settings all parameters are ready for editing.

PTP Parameters

Depending on the selected mode, different sub menus will appear for configuring the PTP parameters.

MULTICAST MASTER

```
 >Priorities    <        Priorities           Priorities           Priorities
  Special               >Special        <      Special              Domain
  DlyMech & Prot         DlyMech & Prot        >DlyMech & Prot<      DlyMech & Prot
  Msg. Intervals         Msg. Intervals         Msg. Intervals      >Msg. Intervals<
```

   OK   OK   OK   OK

```
   Priority 1:128        >PTPv2 Domain <       >DelayMech:E2E<      >Anno Intv:   2s<
   Priority 2:128         Timescale             Net.Pr:ETH/L2        Sync.Intv: 1/s
                          One/Two-Step                               Requ.Intv:  8s
                          Management Msg                             Ann.Recei: 3
```

UNICAST MASTER

```
 >Priorities    <        Priorities           Priorities           Priorities
  Special               >Special        <      Special              Domain
  DlyMech & Prot         DlyMech & Prot        >DlyMech & Prot<      DlyMech & Prot
  Msg. Intervals         Msg. Intervals         Msg. Intervals      >Msg. Intervals<
```

   OK   OK   OK   OK

```
   Priority 1:128        >PTPv2 Domain <       >NetPr:UDP/IPv4<     >Anno Intv:   2s<
   Priority 2:128         Timescale                                  Sync.Intv: 1/s
                          One/Two-Step                               Requ.Intv:  8s
                          Management Msg                             Ann.Recei: 3
```

MULTICAST SLAVE

```
 -> Global    <-          Global               Global
  Msg. Intervals        >Msg. Intervals<       Msg. Intervals
   HQ Filter              HQ Filter            -> HQ Filter <-
```

   OK   OK   OK

```
  Asym:+0               >Anno.Int:   2s <      Filter active
  Domain Number:0        Requ.Int:   8s        ■disabled
  DelayMechan:E2E        Ann.Recei: 3
  NetPr:UDP/IPv4
```

UNICAST SLAVE

```
 -> Global    <-          Global               Global
    Unicast             -> Unicast   <-          Unicast
   HQ Filter              HQ Filter            -> HQ Filter <-
```

   OK   OK   OK

```
 >Asym:+0        <-      Unicast Slave         Filter active
  Domain Number:0       >Msg Intervals <       ■disabled
  NetPr:UDP/IPv4         Master IPv4
```

Multicast Master

```
>Priorities    <      Priorities          Priorities          Priorities
  Special            >Special       <     Special             Domain
  DlyMech & Prot       DlyMech & Prot    >DlyMech & Prot<      DlyMech & Prot
  Msg. Intervals       Msg. Intervals     Msg. Intervals     >Msg. Intervals<
```

OK →   OK →   OK →   OK →

```
>Priority 1:128<-     >PTPv2 Domain  <    >DelayMech:E2E <     >Anno.Int:  2s<-
  Priority 2:128        Timescale          NetPr:UDP/IPv4      Sync.Int: 1/s
                        One/Two-Step                           Requ.Int:  8s
                        Management Msg                         Ann.Recei:3
```

OK →

```
 PTPv2 Domain
 Number:    0
```

In Multicast mode all PTP messages will be sent as Multicast packets where receiving nodes (slave clocks) do not require to know the identity of the time sources in the network. The selection of the active time source (the Grandmaster) follows the so-called "Best Master Clock Algorithm" a mechanism that all participating PTP masters must follow. The multicast communication model requires a minimized configuration of all participating nodes and this advantage is beneficial in smaller networks. In larger newtorks it is considered inefficient as the content of message is forwarded to all nodes, requiring them to spend network bandwidth and CPU resources.

The following settings can be done in Multicast Master Mode.

Priority1:   The attribute is used in the execution of the best master clock algorithm (BMCA). Lower values take precedence.

Configurable range: 0..255.

The operation of the BMCA selects clocks from a set with a lower value of priority1 over clocks from a set with a greater value of priority1.

Priority2:   The attribute is used in the execution of the BMCA. Lower values take precedence.

Configurable range: 0..255.

In the event that the operation of the BMCA fails to order the clocks based on the values of priority1, clockClass, clockAccuracy, and scaledOffsetLogVariance, the priority2 attribute allows the creation of up to 256 priorities to be evaluated before the tiebreaker. The tiebreaker is based on the clockIdentity. The values clockClass, clockAccuracy, and scaledOffsetLogVariance depend on the internal state of the grandmaster and cannot be configured.

PTPv2 Domain: A PTP domain is a logical group of PTP devices within a physical network that belong to the same domain number. Slave devices that shall sync to a certain master within a network must have configured a unique domain number which is the same on the master.

Timescale: two options possible:
PTP: In normal operation, the epoch is the PTP epoch and the timescale is continuous. The unit of measure of time is the SI second. The PTP epoch is 1 January 1970 00:00:00 TAI time source.

ARB as arbitrary: In normal operation, the epoch is set by an administrative procedure.

One / Two Step: Per default Two Step approach is enabled
Two Step approach: The PTP protocol requires the master to periodically send SYNC messages
to the slave devices. The hardware time stamping approach of PTP requires that the master
records the exact time when such a SYNC packet is going on the network wire and needs to
communicate this time stamp to the slaves. This can be achieved by sending this time stamp
in a separate packet (a so-called FOLLOW-UP message).

One Step approach: the SYNC message itself is time stamped on- the- fly just before it leaves
the network port. Therefore, not FOLLOW-UP message is needed.

Management Msg: A protocol within PTP used to query and update the PTP data sets maintained by master
clocks. These messages are also used to customize a PTP system and for initialization and
fault management. Management messages are used between management nodes and clocks.
Per default are enabled.

DelayMech: two options possible:
E2E (End-to-end) where delay measurement messages are sent from the slave to the master
(the two end nodes).

P2P (Peer-to-peer): where each device (a peer) in the network exchanges peer-delay
measurement messages. This way each device can keep track of the delays between itself
and its immediately connected neighbors. P2P mechanism can be used in 1588 PTP-capable
networks only.

NetPr: two options for the network protocol are possible:
ETH-IEEE 802.3 / Ethernet (Layer 2): Ethernet frame including MAC addresses of a destination
and a source.

UDP-UDP/IPv4/IPv6 (Layer 3): User Data Protocol one of the main protocols used for the Internet.

Msg. Intervals: specify the settings for the PTP timing messages.
Anno. Intv specifies the time for sending announce messages between masters to select the
Grand Master. Available settings are: 16/s, 8/s, 4/s ... 2s, 4s, 8s, 16s with a default value 2
seconds.

Sync. Intv specifies the time for sending sync messages from a master to a slave. Available
settings are: 128/s, 64/s ... 64s, 128s, with a default value 1 second.

Requ. Intv specifies an interval how often delay request messages are sent from a slave to
the master. Delay request messages intervals 128/s, 64/s,... 64s, 128s, with a default
value 2 seconds.

Ann. Recei value specifies the time for announce receipt timeout messages which is 2-10
times the Announce interval, with a default of 3. This is the time for a BMCA to determine
a Grand master.

Unicast Master

Unicast mode is applicable generally in larger networks to reduce the overall traffic or when the network is not set up to support multicast. Sometimes there is only one slave and one master of interest and they just want to be alone with each other to have a private conversation without other PTP capable devices being involved. Whatever the reason IEEE 1588 2008 includes support for unicast operation.

When one or more masters have been identified the slave can use Unicast Negotiation to get Announce and Sync messages sent from the master, and to get Delay Requests answered with Delay Responses.

The PTP message sequences between the master and a slave are repeated until the duration of a negotiated interval expires. For example a slave might ask for 4 Sync messages per second, for a period of 60 seconds. In this case after 60 seconds the master would stop sending Sync messages until another Sync message contract was negotiated.

If unicast mode is selected then an additional sub menu will appear to configure or display unicast specific parameters.

```
  >Priorities    <        Priorities              Priorities              Priorities
   Special              >Special        <        Special                 Domain
   DlyMech & Prot        DlyMech & Prot        >DlyMech & Prot<          DlyMech & Prot
   Msg. Intervals        Msg. Intervals         Msg. Intervals          >Msg. Intervals<
```
```
        OK                     OK                     OK                     OK
        ───►                   ───►                   ───►                   ───►
```
```
   Priority 1:128        >PTPv2 Domain <        >NetPr:UDP/IPv4<         >Anno.Intv:  2s<-
   Priority 2:128         Timescale                                      Sync.Intv: 1/s
                          One/Two-Step                                   Requ.Intv:  8s
                          Management Msg                                 Ann.Recei: 3
```
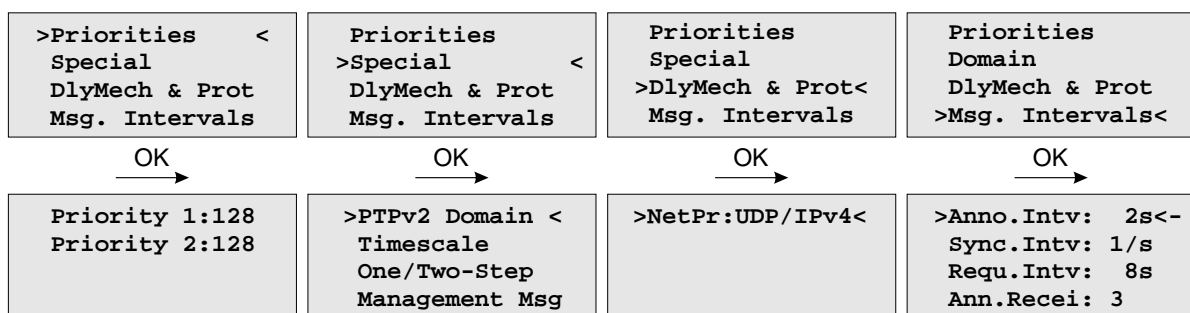
The following settings can be done in Unicast Master Mode:

Priority1:   The attribute is used in the execution of the best master clock algorithm (BMCA). Lower values take precedence.

Configurable range: 0..255.

The operation of the BMCA selects clocks from a set with a lower value of priority1 over clocks from a set with a greater value of priority1.

Priority2:   The attribute is used in the execution of the BMCA. Lower values take precedence.

Configurable range: 0..255.

In the event that the operation of the BMCA fails to order the clocks based on the values of priority1, clockClass, clockAccuracy, and scaledOffsetLogVariance, the priority2 attribute allows the creation of up to 256 priorities to be evaluated before the tiebreaker. The tiebreaker is based on the clockIdentity. The values clockClass, clockAccuracy, and scaledOffsetLogVariance depend on the internal state of the grandmaster and cannot be configured.

PTPv2 Domain: A PTP domain is a logical group of PTP devices within a physical network that belong to the same domain number. Slave devices that shall sync to a certain master within a network must have configured a unique domain number which is the same on the master.

Timescale: two options possible:
PTP: In normal operation, the epoch is the PTP epoch and the timescale is continuous. The unit of measure of time is the SI second. The PTP epoch is 1 January 1970 00:00:00 TAI time source.

ARB as arbitrary: In normal operation, the epoch is set by an administrative procedure.

One / Two Step: Two Step approach: The PTP protocol requires the master to periodically send SYNC messages to the slave devices. The hardware time stamping approach of PTP requires that the master records the exact time when such a SYNC packet is going on the network wire and needs to communicate this time stamp to the slaves. This can be achieved by sending this time stamp in a separate packet (a so-called FOLLOW-UP message).

One Step approach: the SYNC message itself is time stamped on- the- fly just before it leaves the network port. Therefore, not FOLLOW-UP message is needed.

Per default Two Step approach is enabled.

Management Msg: A protocol within PTP used to query and update the PTP data sets maintained by master clocks. These messages are also used to customize a PTP system and for initialization and fault management. Management messages are used between management nodes and clocks.

Per default are enabled.

DelayMech: in unicast mode only one option possible:
E2E (End-to-end) where delay measurement messages are sent from the slave to the master (the two end nodes).

NetPr: in unicast mode only one option for the network protocol possible:
UDP-UDP / IPv4 / IPv6 (Layer 3): User Data Protocol is one of the main protocols used for the Internet.

Msg. Intervals: specify the settings for the PTP timing messages.
Anno. Intv specifies the time for sending announce messages between masters to select the Grand Master. Available settings are: 16/s, 8/s, 4/s … 2s, 4s, 8s, 16s with a default value 2 seconds.

Sync. Intv specifies the time for sending sync messages from a master to a slave. Available settings are: 128/s, 64/s … 64s, 128s, with a default value 1 second.

Requ. Intv specifies an interval how often delay request messages are sent from a slave to the master. Delay request messages intervals 128/s, 64/s,… 64s, 128s, with a default value 2 seconds.

Ann. Recei value specifies the time for announce receipt timeout messages which is 2-10 times the Announce interval, with a default of 3. This is the time for a BMCA to determine a Grand master.

Multicast Slave (MRS only)

```
 ->   Global    <-
   Msg. Intervals
      HQ Filter
```
```
       Global
    >Msg. Intervals<
      HQ Filter
```
```
       Global
    >Msg. Intervals<
      HQ Filter
```

OK →   OK →   OK →

```
 >Asym:+0        <-
   DomainNumber:0
   DelayMechan:E2E
   NetPr:UDP/IPv4
```
```
 >Anno.Int:  2s<-
   Requ.Int:  8s
   Ann.Recei:3
```
```
   Filter active
   ■disabled
```
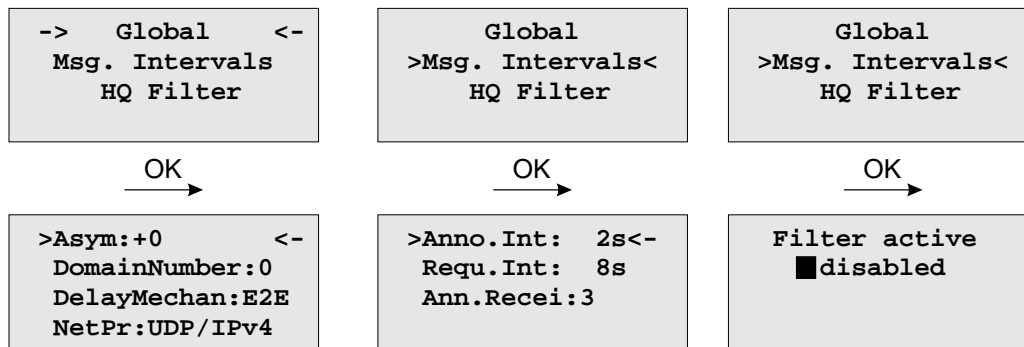
The following settings can be done in Multicast Slave Mode:

Asym: or Default Asymmetry is an initial calibration value (in ns) and can be entered here
              if a certain asymmetry offset in the network path is known before the PTP unit starts.
              This occurs in SDH networks for example.

Max.Path Delay: If a measured path delay exceeds the value of this parameter (in ns), then the PTP unit
              is able to detect a change in the asymmetry offset and can take this into account for
              its delay measurements.

Note: Keep defaults settings here (0 ns for both parameters) unless some problems with the
              client synchronization accuracy are observed and only if the asymmetry offset can be
              measured beforehand.

PTPv2 Domain: A PTP domain is a logical group of PTP devices within a physical network that belong to
              the same domain number. Slave devices that shall sync to a certain master within a network
              must have configured a unique domain number which is the same on the master.

DelayMech: two options possible:
              E2E (End-to-end) where delay measurement messages are sent from the slave to the master
              (the two end nodes).

              P2P (Peer-to-peer): where each device (a peer) in the network exchanges peer-delay
              measurement messages. This way each device can keep track of the delays between itself
              and its immediately connected neighbors (for example a switch or a router). P2P mechanism
              can be used in 1588 PTP capable networks only.

NetPr: two options for the network protocol possible:
              ETH-IEEE 802.3 / Ethernet (Layer 2): Ethernet frame including MAC addresses of a destination
              and a source.

              UDP-UDP/IPv4/IPv6 (Layer 3): User Data Protocol one of the main protocols used for the Internet.

Msg. Intervals: specify the settings for the PTP timing messages.
Anno. Intv specifies the time for sending announce messages between masters to select the Grand Master. Available settings are: 16/s, 8/s, 4/s ... 2s, 4s, 8s, 16s with a default value 2 seconds.

Sync. Intv specifies the time for sending sync messages from a master to a slave. Available settings are: 128/s, 64/s ... 64s, 128s, with a default value 1 second.

Requ. Intv specifies an interval how often delay request messages are sent from a slave to the master. Delay request messages intervals 128/s, 64/s,... 64s, 128s, with a default value 2 seconds.

Ann. Recei value specifies the time for announce receipt timeout messages which is 2-10 times the Announce interval, with a default of 3. This is the time for a BMCA to determine a Grand master.

HQ Filter: In heavy loaded networks when using non-PTP compliant switches, the "HQ Filter" can be activated to reduce the jitter. Detailed information about the usage and the configuration of the HQ filter can be found in the "PTPv2 Configuration Guide "in chapter ?? The Default setting is with HQ Filter disabled.

Unicast Slave (MRS only)

```
 -> Global   <-            Global                          Global
    Unicast            -> Unicast  <-                     Unicast
    HQ Filter             HQ Filter                    -> HQ Filter <-
```

OK ⟶   OK ⟶   OK ⟶

```
>Asym:0        <       Unicast Slave      Unicast Slave      Filter: active
 Domain Number:0      > Msg Intervals <     Msg Intervals     ■disabled
 NetPr:UDP/IPv4          Master IPv4       > Master IPv4   <
```

OK ⟶   OK ⟶

```
Anno.Int:  2s        IPv4 Address
Sync.Int: 1/s        of UnicastMaster
Requ.Int:  8s        ⬛72.030.100.200
Duration: 60
```
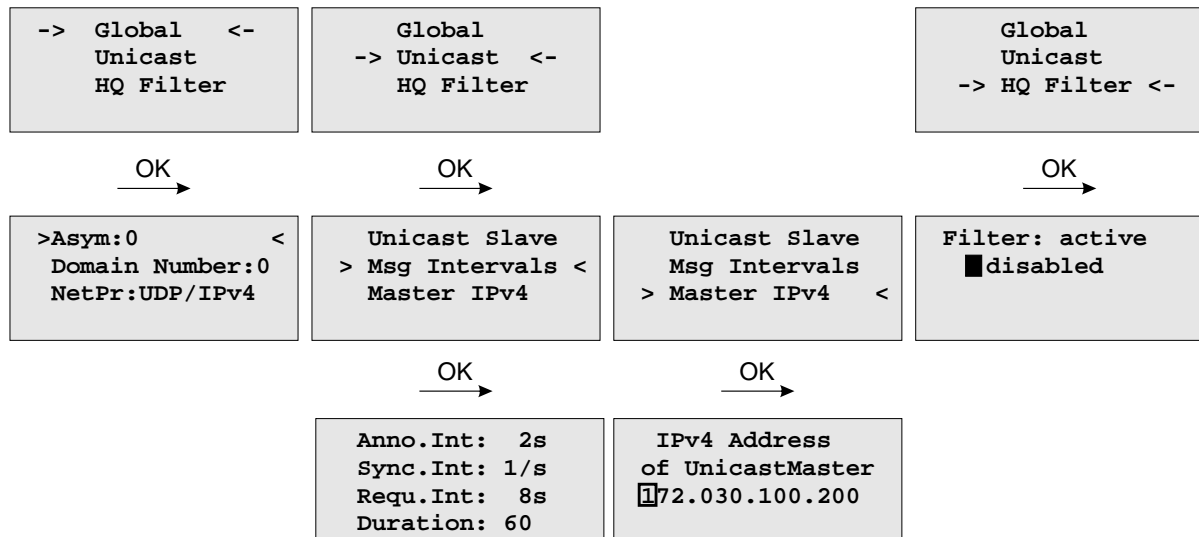
The following settings can be done in Unicast Slave Mode:

Asym: or Default Asymmetry is an initial calibration value (in ns) and can be entered here
                 if a certain asymmetry offset in the network path is known before the PTP unit starts.
                 This occurs in SDH networks for example.

Max. Path Delay: If a measured path delay exceeds the value of this parameter (in ns), then the PTP unit
                 is able to detect a change in the asymmetry offset and can take this into account for
                 its delay measurements.

Note: Keep defaults settings here (0 ns for both parameters) unless some problems with the
                 client synchronization accuracy are observed and only if the asymmetry offset can be
                 measured beforehand.

PTPv2 Domain: A PTP domain is a logical group of PTP devices within a physical network that belong to
                 the same domain number. Slave devices that shall sync to a certain master within a network
                 must have configured a unique domain number which is the same on the master.

NetPr: one setting possible:
                 UDP-UDP/IPv4 (Layer 3): User Data Protocol one of the main protocols used for the Internet.

Msg Intervals: specify the settings for the PTP timing messages.
                 Anno. Intv specifies the time interval of announce messages between master servers
                 to select the Grand Master. Note: This value should be the same as for the master. Available
                 settings are: 1, 2, 4, 8 or 16 seconds, with a default value of 2 seconds.

                 Sync. Intv specifies the time interval of sync messages that a slave requests from
                 a master. Available settings are 0.5, 1, or 2 seconds, with a default value of 1 second.

                 Requ. Intv specifies an interval how often delay request messages are sent from a
                 slave to the master. Delay request messages intervals of 1, 2, 4, 8, 16 or 32 seconds,
                 with a default value of 8 seconds.

                 The **Duration** parameter is used to set a timeout for the grandmaster that sends out
                 the sync packages until the timeout expires. A slave sends a new signaling message to
                 refresh the request before the end of the Duration timeout. Thus it is receiving the requested
                 sync packages continuously. The duration parameter will handle all message types and should
                 be in the range between 10–300 s.

Master IPv4:   The correct IP address of the Master's PTP port must be entered in this field.

HQ Filter: In heavy loaded networks when using non-PTP compliant switches, the "HQ Filter" can be activated to reduce the jitter. Detailed information about the usage and the configuration of the HQ filter can be found in the "PTPv2 Configuration Guide "in chapter ?? The Default setting is with HQ Filter disabled.

Menu PTP Network Settings

Configuration for the PTP network port

```
->IP Config  <-        ->IPv4 Config<-         ->IPv4 Address<-
   VLAN Config            IPv6 Config             Netmask
   SSHD                                           Gateway
                                                  DHCP Client
```
OK (between box 1 and box 2)
OK (between box 2 and box 3)

```
          PTP IP CONFIG

          TCP/IP Address:
          192.000.000.000
```
OK

```
   IP Config             IPv4 Config              IPv4 Address
->VLAN Config <-      ->IPv6 Config<-          ->Netmask       <-
   SSHD                                           Gateway
                                                  DHCP Client
```

```
          VLAN Settings:
          >VLAN: disabled<
             VLAN ID: 0
             Priority:0
```
OK

```
   IPv6 Address
Mode:static addr
...
```
OK

```
Mode:IPv6 DHCP
Mode:IPv6 RA
```

```
          PTP IP CONFIG

             Netmask:
          255.255.255.000
```
OK

```
   IPv4 Address
   Netmask
->Gateway       <-
   DHCP Client
```

```
          PTP IP CONFIG

             Gateway:
          192.000.000.000
```
OK

```
   IP Config
   VLAN Config
->SSHD          <-
```

```
          SSH Settings
          on PTP Port0
          SSHD: ■enabled
```
OK

```
   IPv4 Address
   Netmask
   Gateway
->DHCP Client <-
```

```
          PTP IP CONFIG

          DHCP Client:
             disabled
```
OK

IP configuration for the PTPx interface. It can be selected if either a static IP address shall be used or if a dynamic IP address via DHCP should be assigned.

VLAN Config:
Configuration of Virtual LAN (IEEE 802.1Q) settings for the PTPx interface:

- VLAN ID: A 12-bit value (0..4096) specifying the VLAN to which the network port belongs.
- VLAN Priority: The priority indicates the frame priority level from 0 (lowest) to 7 (highest), which can be used to prioritize different classes of traffic (voice, video, data,...)

9.6.3 Optional Menu: 2nd Receivere

With the submenu *2ndreceiver* you can select the Fallback mode (Redundant or SHS) and you also can adjust the time limits for the "Warning level" and the "Critical Level" here.

```
   NTP Settings
->2nd Receiver<-
  PTP IEEE1588
```

OK →

```
->Fallback Mode<-
   Timelimits
```

OK →

```
Fallback Mode:

 Redundant
  SHS
```

↓

```
   Fallback Mode
->Timelimits    <-
```

OK →

```
>Warning Lvl. <
 Critical Lvl.
```

OK →

```
Warning Level:
   *0   ms
```

↓

```
>Warning Lvl. <
 Critical Lvl.
```

OK →

```
Critical Level:
   25   ms
```

9.7 Menu: Network

```
   Ref. Time
   Time Service
->Network     <-
   System
```

OK →

```
->Interfaces <-
   Global Cfg.
   Services
```

⇅

```
   Interfaces
->Global Cfg.<-
   Services
```

⇅

```
   Interfaces
   Global Cfg.
->Services    <-
```

OK →

```
Use Up and Down
to select Port:
lan0:0  #1 of 1
>172.160.100.200
```

OK →

```
->Device Names<-
   Network LED
```

OK →

```
Use Up and Down
to select Port:
lan0:0  #1 of 1
>172.160.100.200
```

In this submenu the network configuration parameters related to the network interfaces can be changed. The submenus can be selected with the arrow keys and the "OK" button:

As soon as an IP address is configured, additional network configuration can be done via network connection with TELNET, SSH or the WEB interface. Ask your network administrator for network specific parameters. Every change of the network parameters will restart the NTP. All network specific parameters will be saved on the flash disk (/mnt/flash/config/global_configuration) and will be reloaded after reboot. It is highly recommended not to edit this file manually but to configure the parameters via the several configuration interfaces (HTTP, CLI or SNMP). If this file is not present, an empty file will be created. See Appendix for the default settings of this file.

9.7.1 Menu: Setup Network Interfaces

In the network configuration parameters related to the network interfaces can be changed. The following submenus can be selected with the arrow keys and the "OK" button:

```
Use Up and Down
to select Port:
lan0:0  #1 of 1
>172.160.100.200
```

⇅ OK →

```
>IPv4 Parameter<
   IPv6 Parameter
   Link Mode
```

OK →

```
>LAN  Address  <
   LAN  Netmask
   LAN  Gateway
```
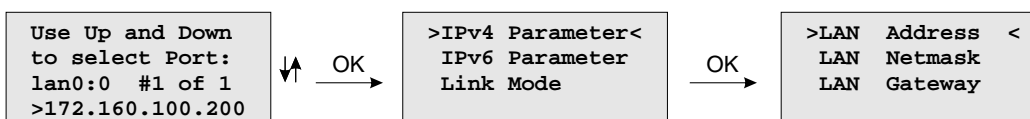
When configured an IP address once additionally network configuration can be done via network connection with TELNET, SSH or the WEB interface. Ask your network administrator for network specific parameters. Every change of the network parameters will restart the NTP. All network specific parameters will be saved on the flash disk (/mnt/flash/config/global_configuration) and will be reloaded after reboot.

9.7.2 Menu: Setup IPv4 LAN Parameter

```
>IPv4 Parameter<          >LAN  Address  <         Set LAN Address
 IPv6 Parameter    OK      LAN  Netmask     OK      IPv4 lan0:0     :
 Link Mode        ──►      Def. Gateway    ──►      DHCP: enabled
                           Gateway                  172.16.100.120
```

```
                           LAN  Address              Set LAN Netmask
                          >LAN  Netmask  <    OK      IPv4 lan0:0     :
                           Def. Gateway     ──►
                           Gateway                   255.255.000.000
```

```
                           LAN  Address                  Set IPv4
                           LAN  Netmask          OK    Default Gateway
                          >Def. Gateway  <      ──►     IPv4 lan0:0  :
                           Gateway                      172.029.006.001
```

```
                           LAN  Address                  Set IPv4
                           LAN  Netmask          OK     Gateway of Itf.
                           Def. Gateway         ──►      IPv4 lan0:0    :
                          >Gateway        <              *00.000.000.000
```

There is a separate configuration submenu for every physical network interface. If there is no DHCP client mode activated a static IP address for each interface can be entered. IPv4 addresses are built of 32 bits which are grouped in four octets, each containing 8 bits. You can specify an IP address in this mask by entering four decimal numbers, separated by a point ".".

Example: 172.160.100.200

Additionally you can specify the IPv4 netmask and your default gateway address.

Please contact your network administrator, who can provide you with the settings suitable for your specific network.

If there is a DHCP (Dynamic Host Configuration Protocol) server available in your network, the LANTIME system can obtain its IPv4 settings automatically from this server. If you want to use this feature (again, you should ask your network administrator whether this is applicable in your network), you can change the DHCP Client parameter to "enabled". Using DHCP is the default factory setting.

If the DHCP client has been activated, the automatically obtained parameters are shown in the appropriate fields (IPv4 Address, Netmask, Default Gateway).

9.7.3 Menu: Setup IPv6 Parameter

```
  IPv4 Parameter
 >IPv6 Parameter<
  Link Mode
```

OK
→

```
>IPv6 LinkLocal<        IPv6 LinkLocal         IPv6 LinkLocal         IPv6 LinkLocal
 IPv6 Autoconf.        >IPv6 Autoconf.<        IPv6 Autoconf.         IPv6 Autoconf.
 Global Addr 1          Global Addr 1         >Global Addr 1 <        Global Addr 1
 Global Addr 2          Global Addr 2          Global Addr 2        >Global Addr 2 <
```

OK   OK   OK   OK
→   →   →   →

```
 Show current          Set IPv6 Auto-          Set IPv6 Link          Set IPv6 Link
 Link Local Addr       configuration         Global Address 1       Global Address 2
 IPv6 lan0:0    :      Flag:  lan0:0    :      IPv6 lan0:0   :        IPv6 lan0:0   :
 not assigned           []disabled            []                     []
```

The IPV6 parameter can be configured via the front panel display for the first ethernet port (ETH0) only. Additionally IPV6 configuration can be done via network connection with TELNET, SSH or the WEB interface.

You can specify up to three IPv6 addresses for your LANTIME timeserver. Additionally you can switch off the IPv6 autoconf feature. IPv6 addresses are 128 bits in length and written as a chain of 16 bit numbers in hexadecimal notation, separated with colons. A sequence of zeros can be substituted with "::" once.

If you enabled the IPv6 protocol, the LANTIME always gets a link local address in the format "fe80:: ....", which is based upon the MAC address of the interface. If a IPv6 router advertiser is available in your network and if you enabled the IPv6 autoconf feature, your LANTIME will be set up with up to three link global addresses automatically.

9.7.4 Menu: Link Mode

```
  IPv4 Parameter
  IPv6 Parameter
 >Link Mode     <
```

OK
→

```
 Link   Speed/Mode
 AUTO

 ...
```

↓↑

```
 10HD
 10FD
 100HD
 100FD
 1000HD
 1000FD
```
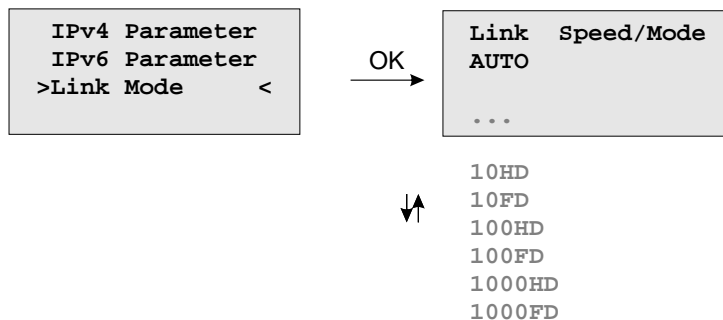
With the Link Mode submenu the parameters for link speed and duplex mode of the first ethernet interface (ETH0) can be configured. There are 5 modes available: Autosensing, 10 Mbit/Half Duplex, 100 Mbit/Half–Duplex, 1000 Mbit/Half–Duplex (Gigabit Support), 10MBit/Full–Duplex, 100 Mbit/Full–Duplex and 1000 Mbit/Full–Duplex (Gigabit Support).

The interfaces are configured with „Autosensing" by default.

9.7.5 Menu: Global Configuration

```
> Device Names <
  Network LED
```

OK →

```
>Hostname      <
 Domainname
 Nameserver
 Syslogserver
```

```
 Hostname
>Domainname    <
 Nameserver
 Syslogserver
```

```
 Hostname
 Domainname
>Nameserver    <
 Syslogserver
```

```
 Hostname
 Domainname
 Nameserver
>Syslogserver <
```

OK →   OK →   OK →   OK →

```
Set Hostname:
[]M400gps_ptp
```

```
Set Domainname:
[]py.meinberg.de
```

```
Set Nameserver:
000.000.000.000
```

```
Syslog Server:
000.000.000.000
```
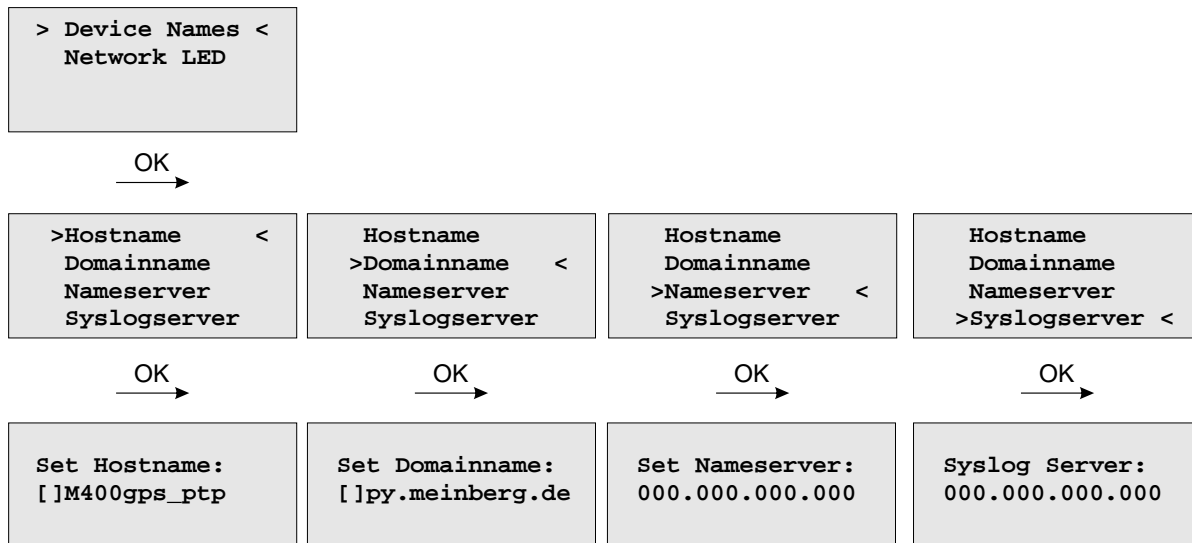
In this sub menu you can change the global network settings like host and domain name, nameserver and syslog server. Further name- or syslog servers can be set up via HTTP interface or CLI Setup. In the nameserver and syslog server fields you have to enter an Ipv4 address.

All information written to the LANTIME SYSLOG (/var/log/messages) can be forwarded to one or two remote SYSLOG servers. The SYSLOG daemon of this remote SYSLOG needs to be configured to allow remote systems to create entries. A Linux SYSLOG daemon can be told to do so by using the command "syslogd –r" when starting the daemon.

If you enter nothing in the SYSLOG server fields or specify 0 .0.0.0 as the SYSLOG servers addresses, the remote SYSLOG service is not used on your LANTIME.

Please be aware of the fact that all SYSLOG entries of the timeserver are stored in „/var/log/messages" and will be deleted when you power off or reboot the timeserver. A daily CRON job is checking for the size of the LANTIME SYSLOG and deletes it automatically if the log size is exceeding a certain limit.

By specifying one or two remote SYSLOG servers, you can preserve the SYSLOG information even when you need to reboot or switch off the LANTIME.

```
   Interfaces
->Global Cfg.<-
   Services
```

OK →

```
  Device Names
->Network LED <-
```

OK →

```
Check LAN Port:
LAN0:*   LAN1:-
LAN2:-   LAN3:-
LAN4:-
```
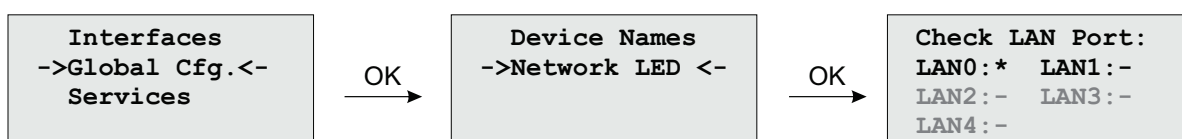
The submenu „Netw. LED" will monitor the network ports, which will be checked continuously if the network port is „LINKED UP". If one of these ports has no link up, the network LED on the front panel will change to red. An „L" for „LED" indicates if the port is checked. Please navigate through the list of ports with the LEFT/RIGHT buttons and change the setting with the UP/DOWN buttons.

9.7.6 Menu: Network Services

```
   Interfaces                Use Up and Down           Network Services
   Global Cfg.      OK        to select Port:    OK       on lan0:0 :
 ->Services   <-   ─────→     lan0:0  #1 of 1   ─────→    SSH:* HTTPS:*
                             >172.160.100.200            TELN:*  HTTP:*
```
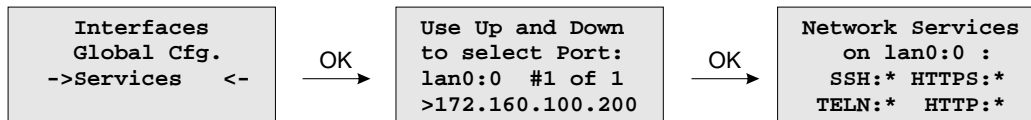
The possible network protocols and access methods can be configured. After pressing the OK button you can enable/disable SSH, TELNET, SNMP, FTP, IPV6, HTTP, HTTPS and NETBIOS by using the UP/DOWN Keys and navigate through the list with the LEFT/RIGHT keys. After you saved your settings with the "OK" button, all these subsystems are stopped and eventually restarted (only if they are enabled, of course).

9.8 Menu: System

```
   Ref. Time
   Time Service
   Network
->System      <-
```
      OK →

```
>Time Zone      <
 Options
 System Info
 Fan Control
```
↓↑
```
 Time Zone
>Options         <
 System Info
 Fan Control
```
↓↑
```
 Time Zone
 Options
>System Info  <
 Fan Control
```
↓↑
```
 Time Zone
 Options
 System Info
>Fan Control  <
```

  OK →   OK →   OK →   OK →

```
>Set Time Zone<
 DL Sav ON
 DL Sav OFF
```
```
>Restart NTP   <
 Restart System

 Reset Factory
```
```
>CPU Temperatur<
 IMS Info
```
```
>Show Fan State<
 Fan Control
 Show CPU Temp.
```

       OK →

```
Reset time and
restart NTP?
Press F2
to confirm!
```

In this submenu system specific parameters can be configured.

9.8.1 Menu: Set Time Zone of Display

The time zone of the time that is shown on the front panel display can be set up here. The internal time zone of the timeserver and the time of NTP will always be UTC. These parameters will not affect the serial output lines and the timecode (IRIG) outputs. These parameters have to be configured in another menu – **(Reference Time->Setup Outputs)**.

```
  ->Set Timezone<-              Set Timezone                Set Timezone
    DL Sav ON          ↕↑    ->DL Sav ON    <-     ↑↕      DL Sav ON
    DL Sav OFF                  DL Sav OFF                ->DL Sav OFF  <-
```

```
        OK                          OK                          OK
      ─────►                      ─────►                      ─────►
```

```
     TIME ZONE               DAYLIGHT SAV ON            DAYLIGHT SAV OFF
  Off<-DAYL SAV->On          Date: 25.03.****           Date: 25.10.****
   UTC   -    UTC            Day of week Sun            Day of week Sun
  +00:00h    +00:00h         Time: 2:00:00              Time: 3:00:00
```
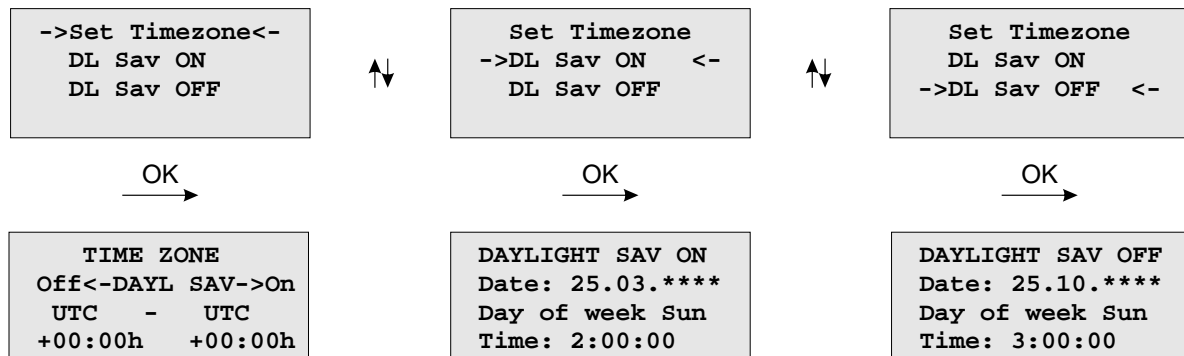
This menu lets the user enter the names of the local time zone with daylight saving disabled and enabled, together with the zones' time offsets from UTC. These parameters are used to convert UTC to local time, e.g. MEZ = UTC + 1h and MESZ = UTC + 2h for central Europe. The range of date daylight saving comes in effect can be entered using the next two pages of the setup menu.

Beginning and ending of daylight saving may either be defined by exact dates for a single year or using an algorithm which allows the receiver to re-compute the effective dates year by year. The figures below show how to enter parameters in both cases. If the number of the year is displayed as wildcards ('*'), a day-of-week must be specified. Then, starting from the configured date, daylight saving changes the first day which matches the configured day-of-week. In the figure below October 25th, 2008 is a Saturday, so the next Sunday is October 26th, 2008.

All changeover rules for the daylight saving like "the first/the second/the second to last/the last Sunday/Monday etc. in the x-th month," can be described by the used format "first specified day-of-week after a defined date".

If the number of the year is not displayed as wildcards the complete date exactly determines the day daylight saving has to change (October 26th, 2008 in the figures below), so the day-of-week does not need to be specified and therefore is displayed as wildcards.

If no changeover in daylight saving is wanted, identical dates and times must be entered in both of the submenus (DAYLIGHT SAV ON/OFF).

9.8.2 Menu Options

```
   Time Zone
 >Options        <        OK
   System Info     ───────▶
   Fan Control
```

```
 >Restart NTP   <        OK       Reset time and
   Restart System  ──────▶         restart NTP?
                                   Press F2
   Reset Factory                   to confirm!
```

```
   Restart NTP            OK          REBOOT
 >Restart System<  ──────▶        Time Server!
                                  Are you sure?
   Reset Factory                    Press F2!
```

```
   Restart NTP            OK          RESET TO
   Restart System  ──────▶      FACTORY DEFAULTS
                                  Are you sure?
 >Reset Factory<                   Press F2!
```
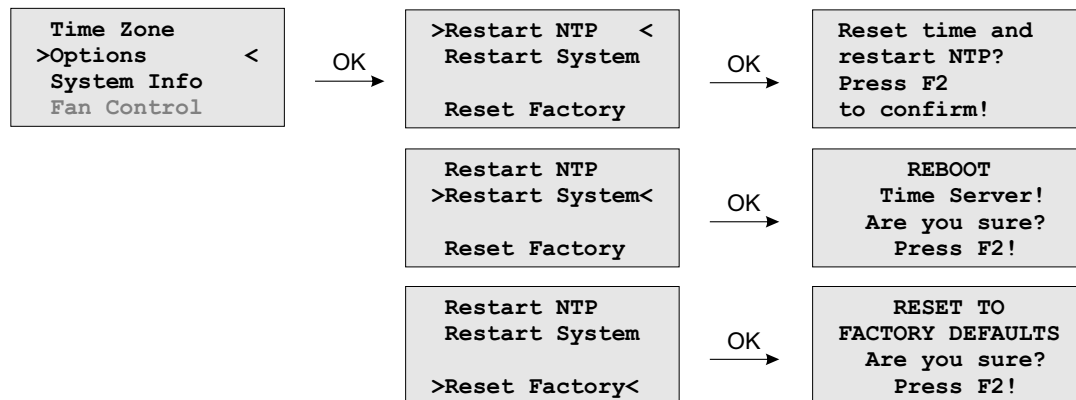
In menu option you can make the following settings or request setting information:

Time Zone: The converted time (offset to UTC) for the configured time zone, which is shown in the display. This has no effect on the time strings that are outputted via the serial interfaces.

You can make this setting via the menu *"Ref. Time -> Set Outputs -> Time Zone"*.

Options: In this sub menu you can reset the system to the state of delivery by using *"Reset Factory"*. The network settings remain unchanged.

With *"Restart NTP"* you can restart the NTP service and with "Restart System" the LINUX operating system of the CPU.

System Info: With "System Info" you can request the current operating temperature of the CPU. If the LANTIME is used in an IMS System, information about the system configuration, like the allocation of single slots, can be displayed in this menu section.

Fan Control: If an active cooling is installed, the cooling status can be displayed via this menu item and via *"Fan Control"* you can set the mode of the active cooling:

Auto: (temperature independent – the threshold value can be adjusted via the webinterface – menu "System -> Fan Control".

FAN ON: The cooling is permanently active.

FAN OFF: The cooling is permanently off.

Menu: Restart System

```
 >Restart NTP   <          Restart NTP              Restart NTP
  Restart System          >Restart System <         Restart System
  Reset Factory            Reset Factory           >Reset Factory <
```

```
OK                         OK                        OK
```

```
 Reset time and            REBOOT                  RESET TO
 restart NTP?            Time Server!           FACTORY DEFAULTS
 Press F2               Are you sure?            Are you sure?
 to confirm!              Press F2!                Press F2!
```
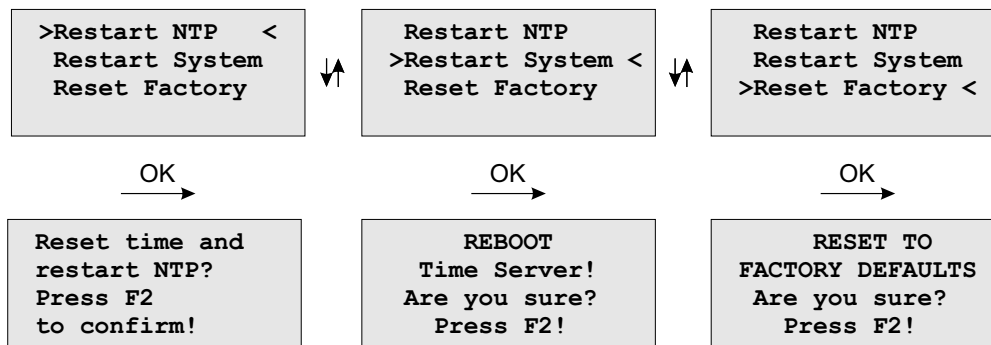
If the time of the reference clock has changed (e.g. while testing with different times) the system time has to bet set with the time of the reference clock and the NTP has to be restarted.

The command **Reboot System** reboots the Linux operating system – the built-in reference clock will not be restarted.

Menu Factory Reset

```
  Restart NTP                          RESET TO
  Restart System          OK       FACTORY DEFAULTS
 >Reset Factory <                    Are you sure?
                                      Press F2!
```
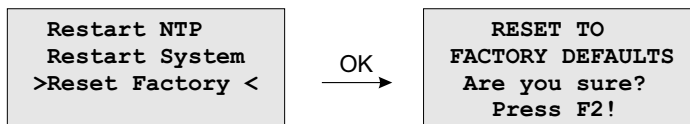
When **Reset to factory defaults** is called, all system parameters will be reset to initial values. However the parameters of each network interface do not change.

9.8.3 Menu System Info

```
   Time Zone                >CPU Temperatur<              CPU
   Options          OK        IMS Info         OK      Temperature
 >System Info  <    ──→                        ──→        64 C
   Fan Control                                            147 F


                            CPU Temperatur             IMS Slot Info
                          >IMS Info        <           PWR:*--- REF:*--
                                           OK          IMS:*-*-**----
                                           ──→         More Details: ->
```
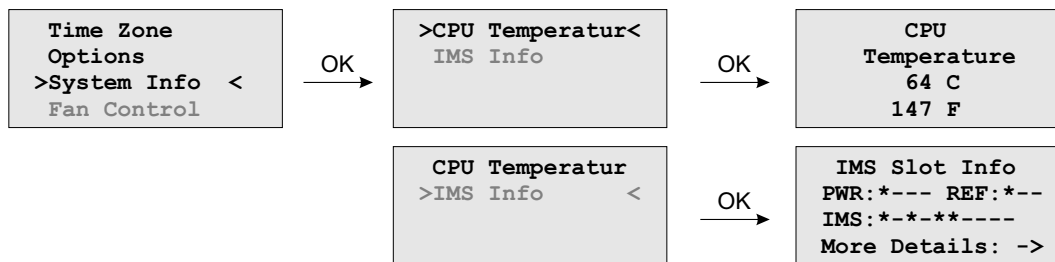
In the "System Info" submenu, the CPU temperature can be queried. In IMS systems a detailed overview of the system configuration can be shown.

Option: Menu IMS Slot Info

```
   CPU Temperatur                IMS Slot Info
 >IMS Info        <              PWR:*--- REF:*--
                     OK          IMS:*-*-**----
                     ──→         More Details: ->
```
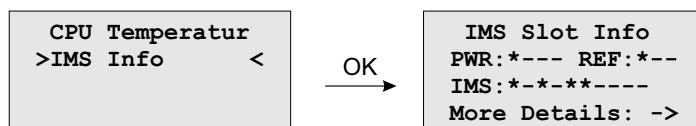
Note: This display menu is visible only in case of an IMS system. Here a detailed overview of the modules, used in the selected slots, are given.

The example above shows the configuration of a LANTIME M3000:

PWR:*—   This string means PWR 1 is occupied and active.
REF:*–   CLK 1 is occupied, CLK 2 and RSC (SCU slot) are empty.
IMS:*-*-**—-   Indicates that the IMS slots MRI 1, ESI 1 and IO 1 and IO2 are occupied and active.
More Details: ->With the OK button you can open the submenu "Select Slot"

Option: IMS Menu Select Slots

```
  IMS Slot Info
 PWR:*--- REF:*--
 IMS:*-*-**----
 More Details: ->
```

              OK
            ───────▶

```
Select Slot ^ v        Select Slot ^ v        Select Slot ^ v        Select Slot ^ v
Slot Name: PWR1    ^   Slot Name: CLK1    ^   Slot Name: CPU     ^   Slot Name: MRI1
IMS Type: PWR      ^   IMS Type: REF      ^   IMS Type: CPU          IMS Type: TSU
connected          ^   GPS180 51.0C       ^   ELX800 64.0C           PTPv2 TSU 63.0C
```
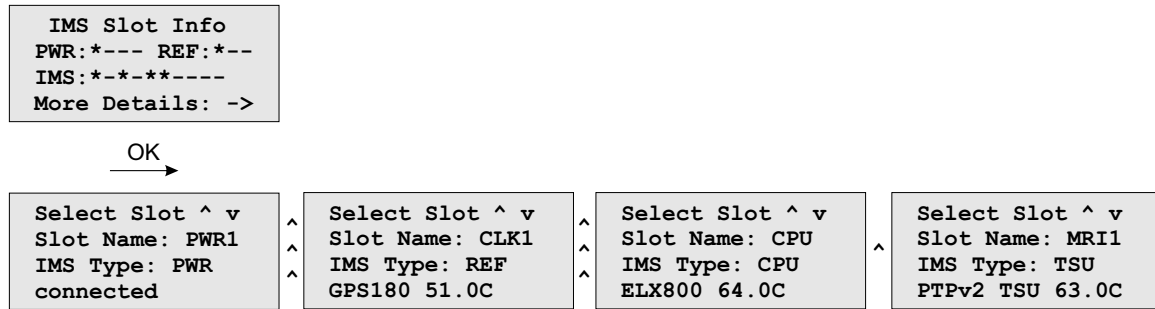
This menu shows which module is inserted into the selected slot.

Displayed values are:
Slot Name: In this example, PWR 1, CLK1, CPU, MRI1, IO1 and IO2
IMS Type: PWR (power supply), REF (receiver), CPU (processor unit), LIU (Telecom outputs) ...

On the bottom line, the current operating temperature (degrees/celsius) is displayed.

9.8.4 Option: Fan Control
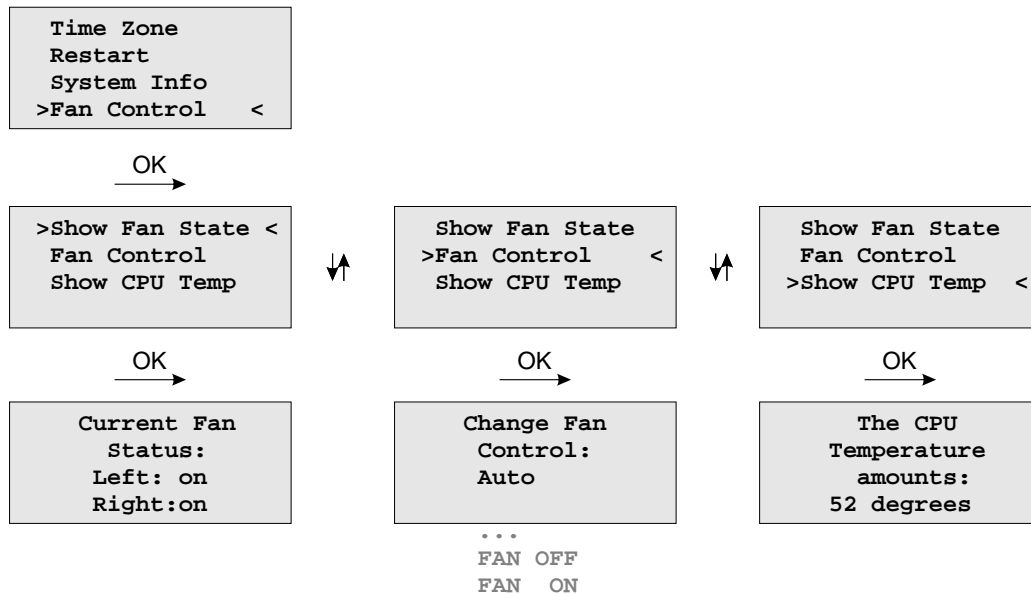
```
 ┌────────────────────────┐
 │  Time Zone             │
 │  Restart               │
 │  System Info           │
 │ >Fan Control     <     │
 └────────────────────────┘
```

          OK
    ──────────▶

```
┌────────────────────┐        ┌────────────────────┐        ┌────────────────────┐
│ >Show Fan State <  │        │   Show Fan State   │        │   Show Fan State   │
│  Fan Control       │   ↓↑   │  >Fan Control    < │   ↓↑   │  Fan Control       │
│  Show CPU Temp     │        │   Show CPU Temp    │        │ >Show CPU Temp  <  │
└────────────────────┘        └────────────────────┘        └────────────────────┘
```

        OK   OK   OK
   ──────────▶   ──────────▶   ──────────▶

```
┌────────────────────┐        ┌────────────────────┐        ┌────────────────────┐
│   Current Fan      │        │   Change Fan       │        │    The CPU         │
│     Status:        │        │    Control:        │        │  Temperature       │
│   Left: on         │        │    Auto            │        │    amounts:        │
│   Right:on         │        │                    │        │   52 degrees       │
└────────────────────┘        └────────────────────┘        └────────────────────┘
                                    ...
                                   FAN OFF
                                   FAN  ON
```

With the optional fan control menu the current status of the operational temperature and the fans can be displayed on the systems interface. The mode of the fans can be selected here:

FAN ON   the ventilators are always running
FAN OFF   the ventilators are off
Auto   the ventilation runs from the temperature, which is specified by the
             "Temperature Threshold" parameter (see "The Web Interface").
             The default value is +55 degrees celsius. If the temperature of the
             device is less than 7 degrees (Celsius) as the specified value, the
             fan control turns off automatically.

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 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.

11 The WEB Interface

Connect to the web interface by entering the IP address of the corresponding time server into the address field of your web browser:

11.1 Configuration: Main Menu

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.

- Information about LANTIME model and software
- Network information
- Receiver status
- NTP status
- PTP status (option)
- Last messages
- Statistics (NTP/MRS Performance, NTP Access ...)
- Extended Statistics (MRS – external reference input signals)
- Documentation (Manuals), support information

The field in the lower section shows the last messages of the system with a timestamp added. The newest messages are on top of the list. This is the content of the file /var/log/messages, which is created after every start of the system (and is lost after a power off or reboot).

By using the navigation on top of the page you can reach a number of configuration menus, which are de-scribed in the following chapters.

11.2 Configuration: Network
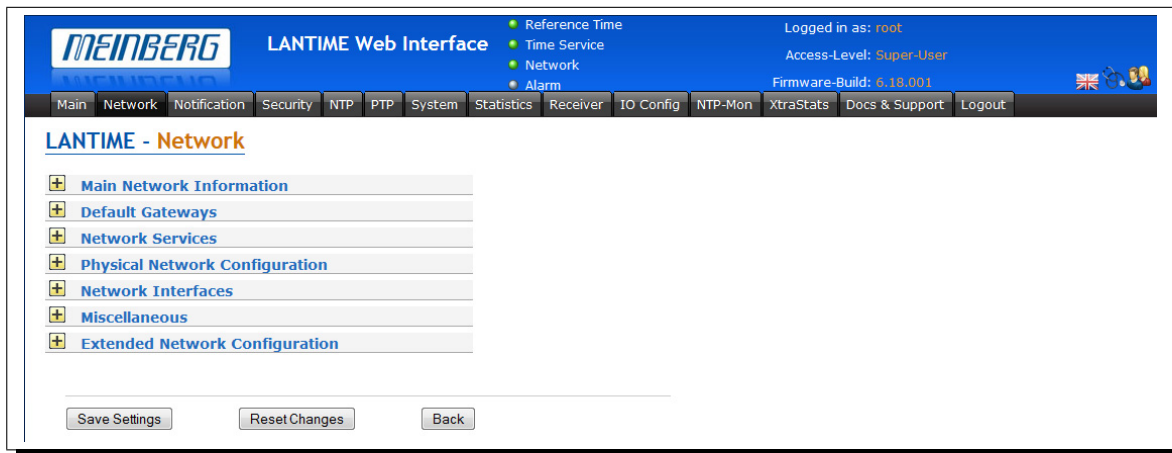
In the network configuration all parameters related to the network interfaces can be changed. In the first section you can edit the hostname and domain name. You can also specify two nameserver – in the nameserver field you may enter an IPv4 or IPv6 address.

11.2.1 Network interface specific configuration

Standard Gateways:

In this Subsection you can enter a Default Gateway for IPv4 and IPv6

Network Services
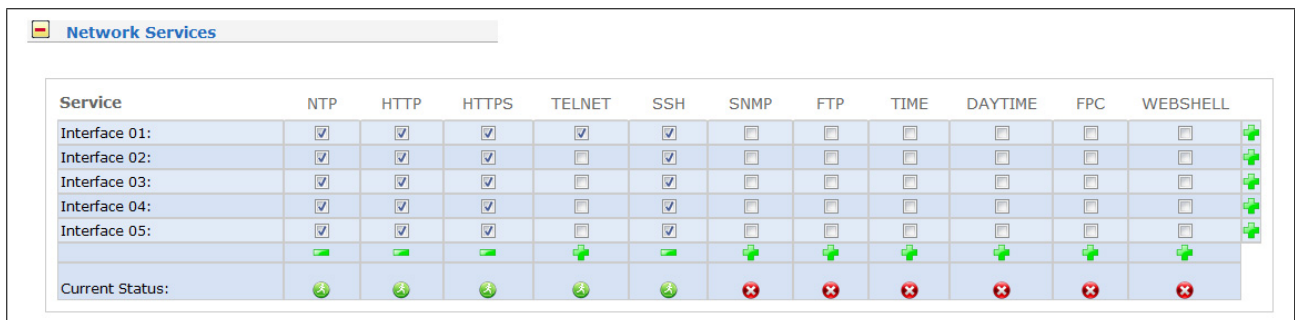
In the second section the possible network protocols and access methods can be configured. You can enable/disable NTP, HTTP, HTTPS, TELNET, SSH, SNMP, FTP, TIME, DAYTIME, FPC and WEBSHELL by checking/unchecking the appropriate check boxes. After you saved your settings with the "Save Settings" button, all these subsystems are stopped and eventually restarted (if they are enabled).

Physical Network Configuration

The "Net Link Mode" controls the port speed and duplex mode of the selected Ethernet port. Under normal circumstances, you should leave the default setting (AUTO) untouched, until your network administrator tells you to change it.

Possible values are:

AUTO   Autonegotiation or Autosensing – the link mode is set up automatically..

10 MBIT HALF DUPLEX   Transmission of information in both direction of the channel –
100 MBIT HALF DUPLEX   but not at the same time, only alternate.
1000 MBIT HALF DUPLEX

10 MBIT FULL DUPLEX   The simultaneous transmission of data in both directions is possible
100 MBIT FULL DUPLEX   in Full Duplex mode.
1000 MBIT FULL DUPLEX

Further configurations:
With the checkbox you can activate the Network LED at the front panel of your LANTIME for the corresponding physical network interface and you can activate/deactivate IPv6 mode in the drop down list.

Network Interfaces:

Here you can edit/select parameters for IPv4 and IPv6. In this version the IPv4 protocol is mandatory and cannot be disabled, but as a workaround a standalone IPv6 mode can be achieved by entering an IPv4 address "0.0.0.0" and disabling the DHCP client option for every network interface of your LANTIME. By doing so, you ensure that the timeserver cannot be reached with IPv4. Please note that TELNET and FTP cannot be used over IPv6 in this version. It is no problem to use IPv4 and IPv6 in a mixed mode environment on your LANTIME.

For each physical network interface you find a seperate submenu after first start of the device. The parameters of the interfaces are editable with the context menu (see chapter "IPv4 addresses and DHCP").

NTP Cluster

To enable NTP redundancy for network clients, which can only communicate with one time server, multiple time servers can be assigned to a cluster.

For this purpose, the selected interfaces of the involved time servers are assigned to a common cluster-IP. The NTP-clients can send their NTP-requests to this cluster-IP. The current master sends its NTP packets via this IP to the clients.

In our example, we will choose the virtual port 01 (assigned to the physical interface LAN 0 of this time server) as cluster port. The cluster tag of this interface is selected and the corresponding fields are filled with the cluster-IP and subnet-mask, as shown in the dialog screen above.

The same cluster IP configuration is entered on all involved NTP servers in the cluster. If you want to set the priority of a particular server as master, then the priority value in the list must be set to a smaller value than the value of the other servers in the cluster.

The MASTER server is chosen according to parameters in the following order:
1. NTP status (sync, not sync);
2. Priority (user configurable, the lower value the higher priority, default value is 0
3. Ref Clock Type – GNSS receiver has the highest rating
4. Ref Clock Status (sync, not sync)

Extended Network Configuration

With the submenu "Extended Network Configuration" you can configure additional network parameter like special network routes or alias definitions. For this you will edit a script file which will be activated every time after the network configuration will run.

Edit Additional Network Configuration:

```
#!/bin/bash

#Example how to setup an additional route
#route add -net 172.16.6.0 netmask 255.255.255.0 eth0
```

11.2.2 IPv4 addresses and DHCP

IPv4 addresses are built of 32 bits, which are grouped in four octets, each containing 8 bits. You can specify an IP address in this mask by entering four decimal numbers, separated by a point ".".

Example: 192.168.10.2

Additionally you can specify the IPv4 netmask and your default gateway address. Please contact your network administrator, who can provide you with the settings suitable for your specific network.

If there is a DHCP (Dynamic Host Configuration Protocol) server available in your network, the LANTIME system can obtain its IPv4 settings automatically from this server. If you want to use this feature (again, you should ask your network administrator whether this is applicable in your network), you can change the DHCP Client parameter to "ENABLED". In order to activate the DHCP client functionality, you can also enter the IP address "000.000.000.000" in the LCD menu by using the front panel buttons of the LANTIME. Using DHCP is the default factory setting.

The MAC address of your timeserver can be read in the LCD menu by pressing the NEXT button on the front panel twice. This value is often needed by the network administrator when setting up the DHCP parameters for your LANTIME at the DHCP server.

If the DHCP client has been activated, the automatically obtained parameters are shown in the appropriate fields (IPv4 address, netmask, gateway).

11.2.3 IPv6 addresses and autoconf

You can specify up to three IPv6 addresses for your LANTIME timeserver. Additionally you can switch off the IPv6 autoconf feature. IPv6 addresses are 128 bits in length and written as a chain of 16bit numbers in hexadecimal notation, separated with colons. A sequence of zeros can be substituted with "::" once.

Examples:

"::"   is the address, which simply consists of zeros
"::1"   is the address, which only consists of zeros and a 1
        as the last bit. This is the so-called host local address
        of IPv6 and is the equivalent to 127.0.0.1 in the IPv4 world

"fe80::0211:22FF:FE33:4455" is a typical so-called link local address, because it uses the "fe80" prefix.

In URLs the colon interferes with the port section, therefore IPv6-IP-addresses are written in brackets in an URL. ("http://[1080::8:800:200C:417A]:80/" ; the last ":80" simply sets the port to 80, the default http port)

Interface 01:	IPv4	IPv6	Misc	VLAN	Cluster

IPv6:

TCP/IP address	
Enable DHCP-Client	☐
IP by Router Advertisement	3ffe:302:11:2:213:95ff:fe02:c2fa/64
Link Local	fe80::213:95ff:fe02:c2fa/64

Interface 02:	IPv4	IPv6	Misc	VLAN	Cluster

If you enabled the IPv6 protocol, the LANTIME always gets a link local address in the format "fe80:: ....", which is based upon the MAC address of the interface. If a IPv6 router advertiser is available in your network and if you enabled the IPv6 autoconf feature, your LANTIME will be set up with up to three link global addresses automatically.

11.2.4 High Availability Bonding

The standard moniker for this technology is IEEE 802.3ad, although it is known by the common names of trunking, port trunking, teaming and link aggregation. The conventional use of bonding under Linux is an implementation of this link aggregation.

Only one link is used at any given time. At least two physical Ethernet ports must be linked to one bonding group to activate this feature. The first Ethernet Port in one bonding group provides the IP-Address and the net mask of this new virtual device. The implementation of the LANTIME Bonding feature will not replace the MAC address of the active ethernet port. Depending on the LINK state of the ETH-port the IP address of the first port in the bonding group will be set to the next ethernet port. All services will be restarted automatically.

11.3 Configuration: Notification
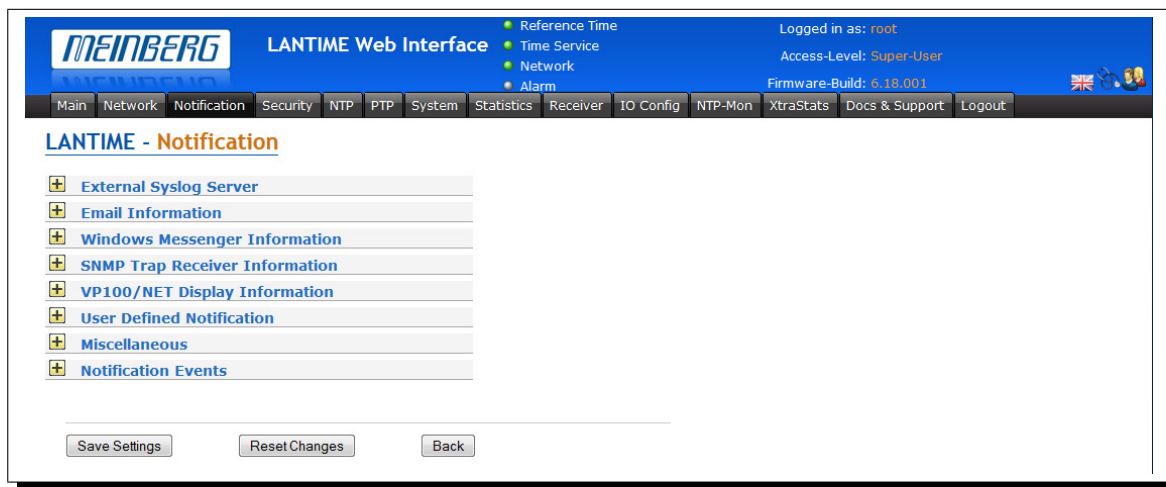
11.3.1 SYSLOG Server

All information written to the LANTIME SYSLOG (/var/log/messages) can be forwarded to one or two remote SYSLOG servers. The SYSLOG daemon of this remote SYSLOG needs to be configured to allow remote systems to create entries. A Linux SYSLOD can be told to do so by using the command "syslogd –r" when starting the daemon.

If you enter nothing in the SYSLOG server fields or specify 0.0.0.0 as the SYSLOG servers addresses, the remote SYSLOG service is not used on your LANTIME.

Please be aware of the fact that all SYSLOG entries of the timeserver are stored in /var/log/messages and will be deleted when you power off or reboot the timeserver. A daily CRON job is checking for the size of the LANTIME SYSLOG and deletes it automatically, if the log size is exceeding a certain limit.

By specifying one or two remote SYSLOG servers, you can preserve the SYSLOG information even when you need to reboot or switch off the LANTIME.

11.3.2 E-mail messages

You can specify the e-mail address which is used as the senders address of the notification e-mail (From: address), the e-mail address of the receiver (To: address) and a SMTP smarthost, that is a mail server forwarding your mail to the receiver's mail server. If your LANTIME system is connected to the internet, it can deliver those e-mails itself by directly connecting to the receivers mail server. Additional e-mail addresses can be specified via the CC-recipients button.

These settings cannot be altered with the LC display buttons of the front panel. Please note the following:

- The host name and domain name should be known to the SMTP smarthost
- A valid nameserver entry is needed
- The domain part of the "From:" address has to be valid

11.3.3 Windows Messenger Information

11.3.4 SNMP-TRAP messages

Up to four independent SNMP trap receiver hosts can be configured in this subsection, you may use IPv4 or IPv6 addresses or specify a hostname. Additionally you have to enter a valid SNMP community string for your trap receiving community. These can be unrelated to the SNMP community strings used for status monitoring and configuration access (see SNMP configuration on the "Security" page).

11.3.5 VP100/NET wall mount display

The VP100/NET wall display is an optional accessory for the LANTIME timeserver, it has an own integrated Ethernet port (10/100 Mbit) and a SNTP client. The time for the display can be received from any NTP server using the SNTP protocol (like your LANTIME), additionally the display is capable of showing text messages, which are sent by using a special utility. The LANTIME can send an alarm message to one or two VP100/NET displays over the network, whenever an event occurs for which you selected the display notification type. If this happens, a scrolling alarm message is shown three times on the display.

Just enter the display's IP address and its serial number (this is used for authorisation), which can be found by pressing the SET button on the back of the display four times. The serial number consists of 8 characters, representing four bytes in hexadecimal notation.

If you want to use the display for other purposes, you can send text messages to it by using our command line tool send2display, which can be found on the LANTIME. This allows you to use the display by CRON jobs or your own shell scripts etc. If you run the tool without parameters, a short usage screen is shown, explaining all parameters it may understand. See appendix for a printout of this usage screen.

11.3.6 User defined Alarm scripts

You can define your own alarm script for every event by using the "Edit user defined notification script". This script will be called automatically if one of the selected events occurs.

```
Edit user defined notification:

#!/bin/bash
# Example:
# $1 : notification message number
# $2 : standard notification message text
#
#output the message to file
#echo $1 $2 > /notification.txt
#
#passing message to binary
#/mnt/flash/my_bin $1 $2
#
#sending an email
#echo -e "Subject: $2\n\n $2" | sendmail -f Lantime  info@meinberg.de
#
#add message to syslog
#logger $2
```

This user alarm script will be stored on the Flash-Disk at "/mnt/flash/user_defined_notification". This script will be called with index and the alarm message as text. The index value of the test message is 0.

11.3.7 Miscellaneous

A heartbeat is a periodic signal generated by hardware or software to indicate normal operation or to synchronize other parts of a system. Usually a heartbeat is sent between machines at a regular interval on the order of seconds. If a heartbeat isn't received for a time – usually a few heartbeat intervals – the machine that should have sent the heartbeat is assumed to have failed.

11.3.8 Alarm events

On this page you can set up different notification types for a number of events. This is an important feature because of the nature of a timeserver: running unobserved in the background. If an error or problem occurs, the timeserver is able to notify an administrator by using a number of different notification types.

The LANTIME timeserver offers different ways of informing the administrator or a responsible person about nine different events: EMAIL sends an e-mail message to a specified e-mail account, SNMP-TRAP sends a SNMP trap to one or two SNMP trap receivers, WINDOWS POPUP MESSAGE sends a winpopup message to one or two different computers. DISPLAY shows the alarm message on a wall mount display model VP100/NET, which is an optional accessory you can obtain for your LANTIME. You also can use user defined scripts (read section "User defined Alarm scripts") and the error relay out.

Attention: mbgLtTrapNormalOperation clears everything! It is a master trap to show that the LANTIME is running in full state!

Trapname	Cleared By
NTPStopped	NTPNotSync or NTP Sync
NTPNotSync	NTPSync
ReceiverNotResponding	ReceiverNotSync or ReceiverSync
ReceiverNotSync	ReceiverSync
AntennaFaulty	AntennaReconnect
SecondaryRecNotSync	SecondaryRecSync
PowerSupplyFailure	PowerSupplyUp
NetworkDown	NetworkUp
SecondaryRecNotResp	RecNotSync or RecSync

The following traps are notifications that do not have a "clearing" trap:

– mbgLtTrapConfigChanged
– mbgLtTrapLeapSecondAnnounced
– mbgLtTrapServerBoot

Every event can use a combination of those four notification types, of course you can disable notification for an event (by just disabling all notification types for this event). The configuration of the four notification types can be changed in the upper section of the page, you can control which notification is used for which event in the lower part of the page.

11.4 Configuration: Security
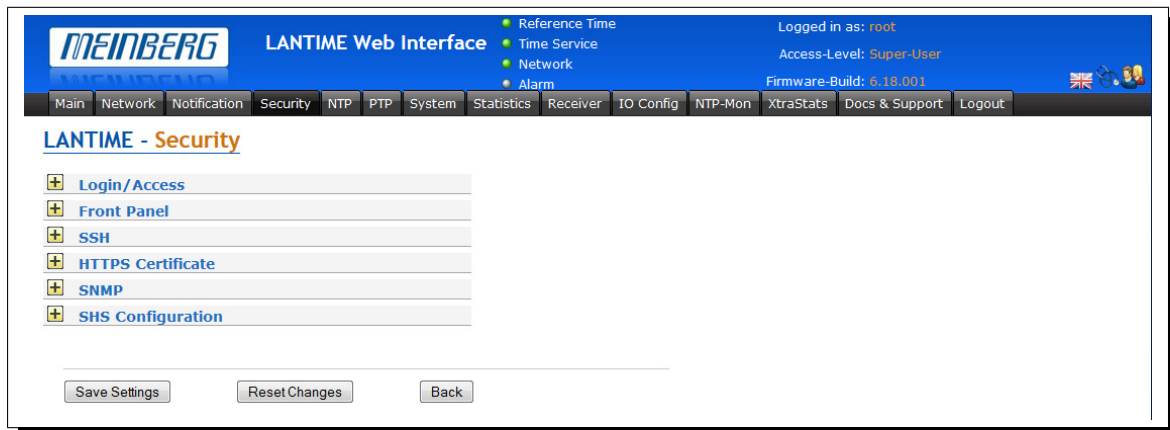
11.4.1 HTTP Access Control
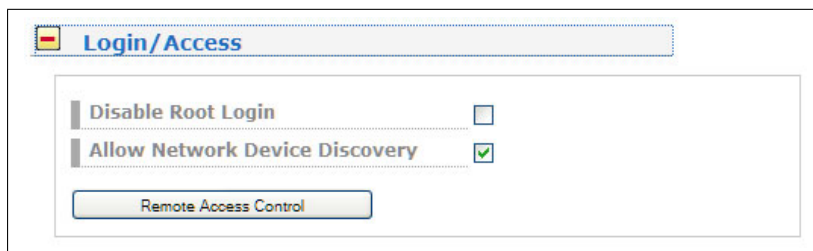
With this function you can restrict the access to the web interface and allow only a few hosts to login. Only the hosts you entered in the list are able to login to the HTTP/HTTPS server of your LANTIME.

11.4.2 Front Panel

With the checkboxes the frontpanel and USB port of the LANTIME can be locked.
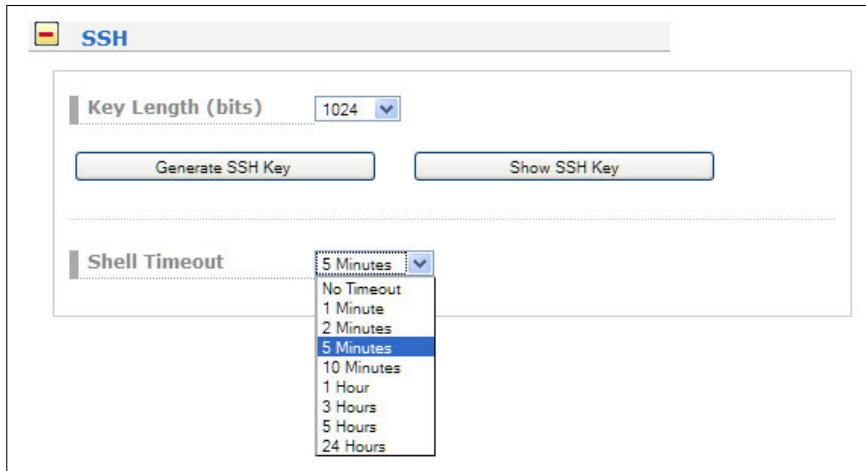
11.4.3 SSH Secure Shell Login

The SSH provides you with a secure shell access to your timeserver. The connection is encrypted, so no readable passwords are transmitted over your network. The actual LANTIME version supports SSH1 and SSH2 over IPv4 and IPv6. In order to use this feature, you have to enable the SSHD subsystem and a security key has to be generated on the timeserver by using the "Generate SSH key" button. Afterwards, a SSH client can connect to the timeserver and opens a secure shell: **ssh root @ 192.168.16.111**

The first time you connect to a SSH server with an unknown certificate, you have to accept the certificate, afterwards you are prompted for your password (which is configured in the first section of this page).

Default Password: **timeserver**

If you generate a new SSH key, you can copy and paste it into your SSH client configuration afterwards in order to allow you to login without being prompted for a password. We strongly recommend to use SSH for shell access, TELNET is a very insecure protocol (transmitting passwords in plain text over your network).
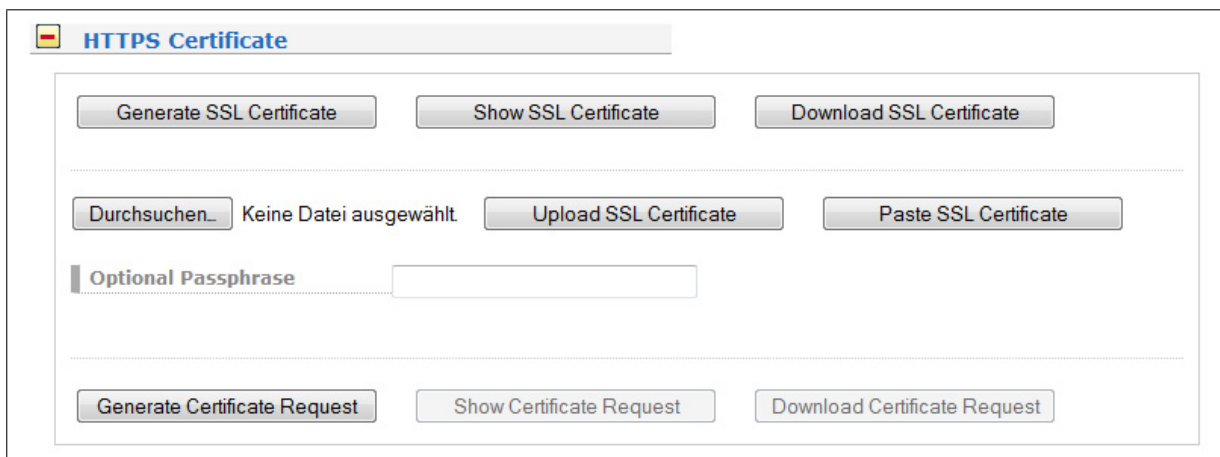
If you enabled SSH, your LANTIME automatically is able to use secure file transfer with SCP or SFTP protocol. The usage of FTP as a file transfer protocol is as insecure as using TELNET for shell access.

11.4.4 Generate SSL Certificate for HTTPS

HTTPS is the standard for encrypted transmission of data between web browser and web server. It relies on X.509 certificates and asymmetric crypto procedures. The timeserver uses these certificates to authenticate itself to the client (web browser). The first time a web browser connects to the HTTPS web server of your LANTIME, you are asked to accept the certificate of the web server. To make sure that you are talking to your known timeserver, check the certificate and accept it, if it matches the one stored on the LANTIME. All further connections are comparing the certificate with this one, which is saved in your web browser configuration. Afterwards you are prompted to verify the certificate only when it changed.

By using the button "Generate SSL certificate for HTTP" you can create a new certificate. Please enter your organisation, name, mail address and the location in the upcoming form and press "Generate SSL certificate" to finally generate it.

After the successful generation of the certificate and with the button "SSL..." the certificate is shown to you in the tetxtarea:

It is also possible to upload your own HTTPS certification. If you upload a non valid certification HTTPS will not work.

Uploading certified SSL Certificates

A certificate which is certified by a certification authority (CA) can be installed using the "Upload SSL Cer-tificate" button. This certificate must be in PEM file format, it must contain a private key and the certificate itself.

The content of the private key starts with
"——BEGIN RSA PRIVATE KEY——"
and ends with
"——END RSA PRIVATE KEY——"

the certificate itself starts with
"——BEGIN CERTIFICATE——"
and ends with
"——END CERTIFICATE——".

This example is an excerpt from a PEM file:

```
---BEGIN RSA PRIVATE KEY---
MIICXQIBAAKBgQC6FkGxyJ6+Bqxzfp3bNtEYyiRIAbQAIsHblYPG7aQk+8XbIXWB
...
aiLbmu7N3TEdWVDgro8kMuQC/Ugkttx7TdJJbqJoVsF5
---END RSA PRIVATE KEY---
---BEGIN CERTIFICATE---
MIIEJTCCA46gAwIBAgIJANF4dlCI2saDMA0GCSqGSIb3DQEBBQUAMIG+MQswCQYD
...
ekZ970dAaPca
---END CERTIFICATE---
```

IMPORTANT: The certificate should not be protected with a password, otherwise the web server cannot start automatically.

Uploading certified Multi-Level / chained Certificates

Steps below require an SSH access to your timeserver.

In addition to SSL certificates, also multi-level / chained certificates are supported. In this case, a private key and a certificate chain are divided into two files, which are both in a PEM format. The actual PEM file contains the private key which is enclosed between BEGIN RSA PRIVATE KEY and END RSA PRIVATE KEY line as shown above. The CA-file on the other hand contains the certificate chain, where each single certificate is enclosed between BEGIN and END CERTIFICATE line as shown above.

The PEM file that contains the private key should be copied manually to *"/etc/https.pem"* and the CA to *"/etc/https_cert.pem"*.

Subsequently, the line 'ssl.ca-file = "/etc/https_cert.pem"' should be added in a server configuration file *"/etc/httpsd.conf"*.

Running the command "saveconfig" saves the settings persistently, the command "restart https" applies the settings.

Please Note: the certificates should not be protected with a password for the reasons stated above.

11.4.5 SNMP Parameter

In the last Section all parameters for SNMP can be configured. More information you can find in the chapter "SNMP Configuration" in this manual.

SNMP Engine ID

The snmpEngineID is a unique string used to identify the device for administration purposes. When using SNMP V3, a snmpEngineID must be entered. The snmpEngineID textual convention [RFC3411] defines that an snmpEngineID value MUST be between 5 and 32 octets long.
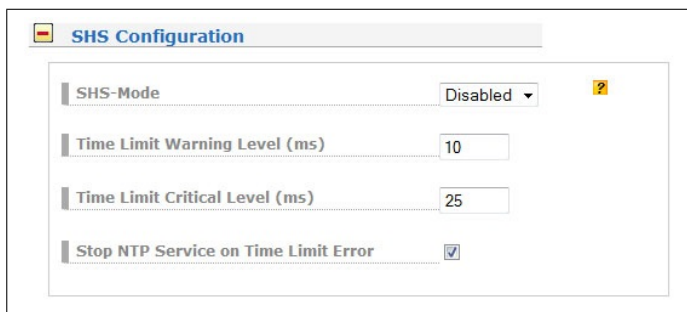
Example: You can use the MAC Adress of your physical LAN 0 interface (delete the colons).

11.4.6 SHS Configuration

SHS Parameter

SHS is the abbrevation of Secure Hybrid Systems and is available on systems with two reference clocks. It provide a plausibility mode where the incoming times of both time signals are continuously compared against each other. Only if the time difference between those reference times does not exceed a certain limit (configurable) it will give over the time to the NTP service. Otherwise the time output is stopped immediately.

SHS-Mode

This parameter is used to activate the SHS feature and with it the comparison of time. If the SHS mode is disabled the times of both receivers are passed directly to the NTP service. The NTP service decide autonomous which reference time will be used. In case of the master reference time got unavailable the NTP service just switch over to the other time source.

Time Limit Warning Level(ms)

This value indicate at which calculated time difference between the two reference times an alarm is generated over the built-in notifcation system. The warning level indicate that the reference times are no longer equal and that a time error may be imminent. The NTP service is still receiving the time from the SHS system.

Time Limit Error Level(ms)

This value indicate at which difference the time output to NTP is stopped and an appropriate alarm is generated over the built-in notification system. If the SHS error was triggered an administrator action is needed to bring the NTP service back to normal operation. The administrator must check the times of both receiver and confirm that everything is ok. An appropriate dialog is shown on the web interface. After affirmation the handover of time to the NTP service is resumed and NTP will resynchronize.

Stop NTP Service on Time Limit Error

This parameter is used to decide whether the NTP service is stopped directly in case of a time limit error. In this case no NTP client got an answer anymore from the time server.

11.5 Configuration: NTP
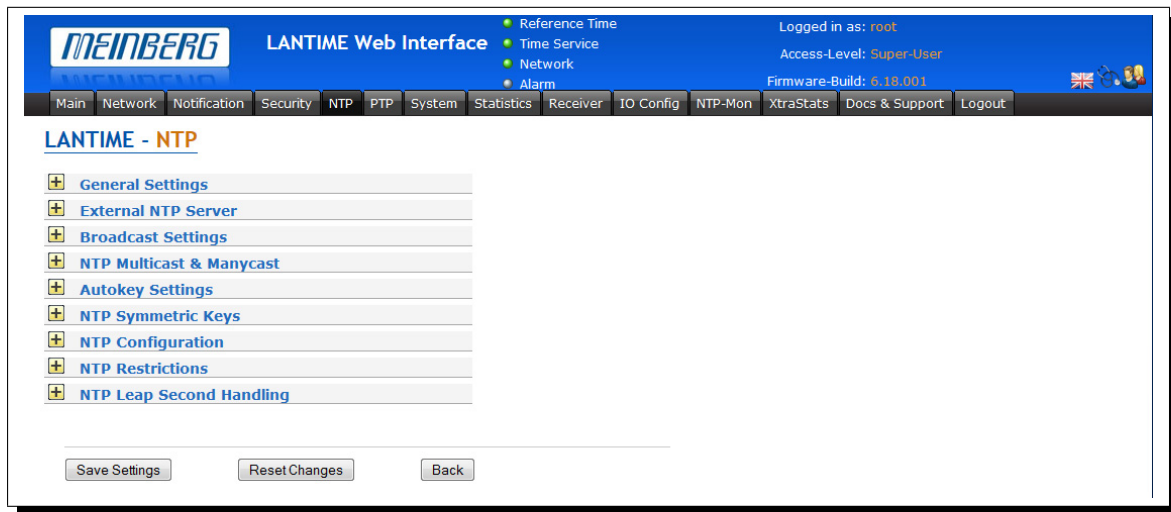
The NTP configuration page is used to set up the additional NTP parameters needed for a more specific configuration of the NTP subsystem.

11.5.1 General Settings
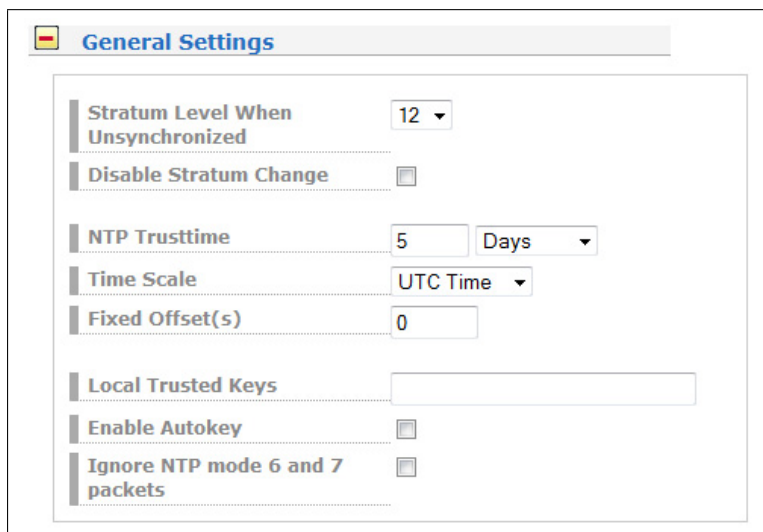
The "Local trusted key" field holds a list of all trusted symmetric keys (comma or space separated), which have to be accepted by the NTPD of your LANTIME.

11.5.2 External NTP Server

Via this configuration screen you can set additional NTP parameters. In the upper part you can specify up to 7 external NTP Servers to provide redundancy for the internal reference clock. Optionally you can enter a symmetric key and activate AUTOKEY.

For an MRS time server the external NTP servers cannot be registered as fallback in the NTP configuration. The external NTP servers can be queried by using the command "ntpdate"; the mediated time offset to the internal reference is filtered and sent to the MRS unit.

Please note: The external NTP server configuration possibility of an MRS time server turns out differently. To get to the manual configuration screen follow the steps below:

Web Interface → System → Services and Functions → Manual Configuration → Standard Configuration → Other Configuration

The following options can be set via the manual configuration in the Web Interface. Please Note: Only qualified users should perform changes.

MRS NTP POLL INTERVAL: Default Value = 5
The value is a 2 potency, which means a value of 5 is equal to
$2^5 = 32$s Polling Interval. Values between 1 and 10 can be set.

MRS NUM NTP PACKETS PER POLL: Default Value = 4
This value indicates how many NTP-requests shall be
sent per interval. Values between 1 and 8 can be set.

11.5.3 NTP Local Clock

The default configuration of the timeserver consists of a local clock, which represents the hardware clock of your LANTIME system and the reference clock. The local clock is only chosen as the NTP time reference after the receiver's clock lost its synchronisation. The stratum level of this local clock is set to 12, this ensures that clients recognise the switchover to the local clock and are able to eventually take further actions. The local clock can be disabled if the timeserver should not answer any more when the reference clock is out of order.

Because the reference clock is internally connected to the LANTIME system by using a serial connection, the accuracy using this way of synchronisation is around 1 ms. The high accuracy of the LANTIME timeserver (around 10 microseconds) is available by using the PPS (PulsePerSecond) of the reference clock (GPS), which is evaluated by the operating system. The default configuration looks like this:

```
# *** lantime ***
# NTP.CONF for GPS167 with UNI ERLANGEN

server 127.127.1.0                 # local clock
fudge 127.127.1.0 stratum 12       # local stratum

server 127.127.8.0 mode 135 prefer# GPS167 UNI Erlangen PPS
fudge 127.127.8.0 time1 0.0042     # relative to PPS
server 127.127.22.0                # ATOM (PPS)
fudge 127.127.22.0 flag3 1         # enable PPS API
enable stats
statsdir /var/log/
statistics loopstats
driftfile /etc/ntp.drift

# Edit /mnt/flash/ntpconf.add to add additional NTP parameters
```

11.5.4 NTP Broadcast

If you want to use your LANTIME timeserver to send NTP broadcast packets to your network, you have to enter a valid broadcast address in "NTP broadcast address". If you want to use IPv6 multicast mode, you have to enter a valid IPv6 multicast address in this field. Please note that NTP Version 4, which is used by the LANTIME timeserver, only permits authenticated broadcast mode. Therefore you have to set up the AUTOKEY feature or a symmetric key if you use a NTPv4 client and want to broadcast / multicast your time. A sample configuration of the NTP client for broadcast with symmetric keys looks like:

```
broadcastclient yes
broadcastdelay 0.05    # depends on your network
keys /etc/ntp/keys
trustedkey 6 15
requestkey 15
controlkey 15
```

 In the next section you can enable the AUTOKEY feature for your LANTIME timeserver and the PPS mode (which is enabled in default settings), see above for a description.

The NTP Trusttime will specify the time how long the NTP will trust the reference time if this is not synchronized (free running). This time will be set in seconds or minutes or hours. The value 0 will be select the default value for the specific reference clock. The default values are:

```
LANTIME/GPS:       96 h
LANTIME/PZF:       0,5 h
LANTIME/RDT:       0,5 h
LANTIME/MRS:       96 h
```

After each restart and after any change of configuration a new /etc/ntp.conf file is generated by the LANTIME software. Any changes you made to this file are lost. In order to use your custom ntp.conf (your LANTIME is using a standard version of the NTP software suite, therefore all configuration parameters of the NTP software are fully supported), you have to edit the file /mnt/flash/ntpconf.add, which is automatically appended to the /etc/ntp.conf file generated at boot time or when reloading configuration after a change. You can edit this file by using the button "Edit additional NTP parameter".

11.5.5 Show NTP Configuration

By choosing "Show NTP configuration", you can review the actual state of the /etc/ntp.conf file. The file cannot be changed on this page, see above for a description why editing this file is not reasonable.

11.5.6 NTP Restrictions

With "Edit NTP Restrictions" you can allow access to specified NTP clients. Enter the IP address and the netmask as shown in the section below. All other IP address are invalid if an entry in the restriction list is made. Only the users from the list have NTP access on this time server.

The following lines are written automatically in the NTP configuration file:
#NTP RESTRICTION SECTION – LAST MODIFIED: Wed Jan 5 07:47:58 2011
restrict 0.0.0.0 mask 0.0.0.0 ignore   # block IPv4 completely
restrict 127.0.0.1 mask 255.255.255.255# allow localhost
restrict ::0 ignore   # block IPv6 completely

#USER DEFINED RESTRICTIONS
restrict 172.16.3.13   mask 255.255.255.255
restrict 172.16.5.0   mask 255.255.255.0

The address 172.16.3.13 and all IPs from the subnet 172.16.5.xx
have access to all NTP services.

Add NTP Restrictions

IP Address

Netmask

Add Restriction

Current NTP Restrictions

Currently no NTP Restrictions saved.

11.5.7 NTP Authentication

NTP version 2 and version 3 support an authentication method using symmetric keys. If a packet is sent by the NTPD while using this authentication mode, every packet is provided with a 32 bit key ID and a cryptographic 64/128 bit checksum of the packet. This checksum is built with MD5 or DES, both algorithms offer a sufficient protection against manipulation of data.

Please note that the distribution of DES in the United States of America and Canada is subject to restrictions, while MD5 is not affected by that. With any of these algorithms the receiving NTP clients validate the check-sum. Both parties (server and client) need to have the same crypto key with the same key ID.
In the authentication mode a party is marked "untrusted" and not suitable for synchronisation, whenever unauthorised packets or authorised packets with a wrong key are used. Please note that a server may recognise a lot of keys but uses only a few of them. This allows a timeserver to serve a client, who is demanding an authenticated time information, without "trusting" the client.

Some additional parameters are used to specify the key IDs used for validating the authentic of each partner. The configuration file /etc/ntp.conf of a server using this authentication mode may look like this:

```
# peer configuration for 128.100.100.7
# (expected to operate at stratum 2)
# fully authenticated this time

peer 128.100.49.105 key 22 # suzuki.ccie.utoronto.ca
peer 128.8.10.1 key 4      # umd1.umd.edu
peer 192.35.82.50 key 6    # lilben.tn.cornell.edu

keys /mnt/flash/ntp.keys   # path for key file
trustedkey 1 2 14 15       # define trusted keys
requestkey 15              # key (mode 6) for accessing server variables
controlkey 15              # key (mode 7) for accessing server variables
```

The "keys" parameter indicates the location of the file, in which all symmetric keys are stored. The "trustedkey" line identifies all key IDs, which have to be considered "trusted" or "uncompromised". All other keys defined in the keyfile are considered "compromised". This allows to re-use already owned keys by just adding their respective key ID to the "trustedkey" parameter. If a key needs to be "switched off", it can be removed from this line without actually removing it from the system. This ensures an easy way to re-activate it later without actually transferring the key again.

The line "requestkey 15" declares the key ID for mode-6 control messages (as described in RFC-1305), which are used by the ntpq utility for example. The "controlkey" parameter is specifying the key used for mode-7 private control messages, for example used by the ntpdc utility. These keys protect the ntpd variables against unauthorised modification.

The ntp.keys file mentioned above holds a list of all keys and their respective ID known by the server. This file should not be world-readable (only root should be able to look into this) and it may look like this:
ntp keys file (ntp.keys)

```
1      N 29233E0461ECD6AE   # des key in NTP format
2      M RIrop8KPPvQvYotM   # md5 key as an ASCII random string
14     M sundial            # md5 key as an ASCII string
15     A sundial            # des key as an ASCII string
                            # the following 3 keys are identical
10     A SeCReT
10     N d3e54352e5548080
10     S a7cb86a4cba80101
```

The first column holds the key ID (used in the ntp.conf file), the second column defines the format of the key, which is following in column three. There are four different key formats:

- **"A"** means DES key with up to eight 7-bit ASCII characters, where each character is standing for a key octet (this is used by Unix passwords, too).

- **"S"** is a DES key written in hexadecimal notation, where the lowest bit (LSB) of each octet is used as the odd parity bit.

- If the key format is specified as **"N"**, it also consists of a hexadecimal string, but in NTP standard format by using the highest bit (HSB) of each octet used as the odd parity bit.

- A key defined as **"M"** is a MD5 key with up to 31 ASCII characters.

- The LANTIME supports MD5 authentication only.

- Please be aware of the following restrictions: No **"#", "t" (tab), "n" (newline) and "0"** (null) are allowed in a DES or MD5 ASCII key. The key ID 0 is reserved for special purposes and should not appear in the keys file.

11.5.8 NTP Autokey Settings

NTP Version 4 supports symmetric keys and additionally provides the so-called AUTOKEY feature. The authentic of received time at the NTP clients is sufficiently ensured by the symmetric key technique. In order to achieve a higher security, e.g. against so-called replay attacks, it is important to change the used crypto keys from time to time.

In networks with a lot of clients, this can lead to a logistic problem, because the server key has to be changed on every single client. To help the administrator to reduce this work (or even eliminate it completely), the NTP developers invented the AUTOKEY feature, which works with a combination of group keys and public keys. All NTP clients are able to verify the authentic of the time they received from the NTP servers of their own AUTOKEY group by using this AUTOKEY technique.

The AUTOKEY features works by creating so-called secure groups, in which NTP servers and clients are combined. There are three different kinds of members in such a group:

a) Trusted Host
One or more trusted NTP servers. In order to become a "trusted" server, a NTP server must own a self-signed certificate marked as "trusted". It is good practice to operate the trusted hosts of a secure group at the lowest stratum level (of this group).

b) Host
One or more NTP servers, which do not own a "trusted" certificate, but only a self-signed certificate without this "trusted" mark.

c) Client
One or more NTP client systems, which in contrast to the above mentioned servers do not provide accurate time to other systems in the secure group. They only receive time.

All members of this group (trusted hosts, hosts and clients) have to have the same group key. This group key is generated by a so-called trusted authority (TA) and has to be deployed manually to all members of the group by secure means (e.g. with the UNIX SCP command). The role of a TA can be fulfilled by one of the trusted hosts of the group, but an external TA can be used, too.

The used public keys can be periodically re-created (there are menu functions for this available in the web interface and also in the CLI setup program, see "Generate NTP Autokey Certificate" in section "NTP Autokey Settings" of the "Security Management" page) and then distributed automatically to all members of the secure group. The group key remains unchanged, therefore the manual update process for crypto keys for the secure group is eliminated.
A LANTIME can be a trusted authority / trusted host combination and also a "non-trusted" host in such a secure group.

To configure the LANTIME as a TA / trusted host, enable the AUTOKEY feature and initialise the group key via the HTTPS web interface ("Generate groupkey") or CLI setup program. In order to create such a group key, a crypto password has to be used in order to encrypt / decrypt the certificate. This crypto password is

shared between all group members and can be entered in the web interface and CLI setup program, too. After generating the group key, you have to distribute it to all members of your secure group (and setup these systems to use AUTOKEY, too). In the ntp.conf file of all group members you have to add the following lines (or change them, if they are already included):

```
crypto pw cryptosecret
keysdir /etc/ntp/
```

In the above example "cryptosecret" is the crypto password, that has been used to create the group key and the public key. Please note that the crypto password is included as a plain text password in the ntp.conf, therefore this file should not be world-readable (only root should have read access to it).

On the clients, the server entries must be altered to enable the AUTOKEY feature for the connections to the NTP servers of the group. This looks like:

```
server time.meinberg.de autokey version 4
server time2.meinberg.de
```

You find the server time.meinberg.de which is using the AUTOKEY feature, while time2.meinberg.de is used without any authentic checks.

If you want to setup the LANTIME server as a trusted host, but need to use a different trusted authority, please create your own group key with this TA and include it with the web interface of your LANTIME (on page "Security Management" see section "NTP autokey" , function "Upload groupkey").

If you want to setup the LANTIME as a "non-trusted" NTP server, you have to upload the group key of your secure group ("Security Management" / "NTP autokey" / "Upload groupkey") and create your own, self-signed certificate (without marking it as "trusted"). Because every certificate which is creating by using the web interface and/or CLI setup is marked "trusted", you have to execute the tool "ntp-keygen" manually on your LANTIME by using shell access (via SSH).

```
LantimeGpsV4:/etc/ntp # ntp-keygen -q cryptosecret
```

Here, too, "cryptosecret" is the crypto password used in the ntp.conf entry. Then you have to copy the new ntpkeys to the flash disk with:

```
cp /etc/ntp/ntpkey_*   /mnt/flash/config/ntp/uploaded_groupkeys
```

A detailed description about ntp-keygen can be found on the NTP website (http://www.ntp.org).

Example:
This autokey group is formed by one Stratum–1–server (B), two Stratum–2–servers (D and E) and a number of clients (in the diagram there are 4 clients shown, c1 – c4). B is the trusted host, he holds the group key and a self–signed certificate marked as "trusted".
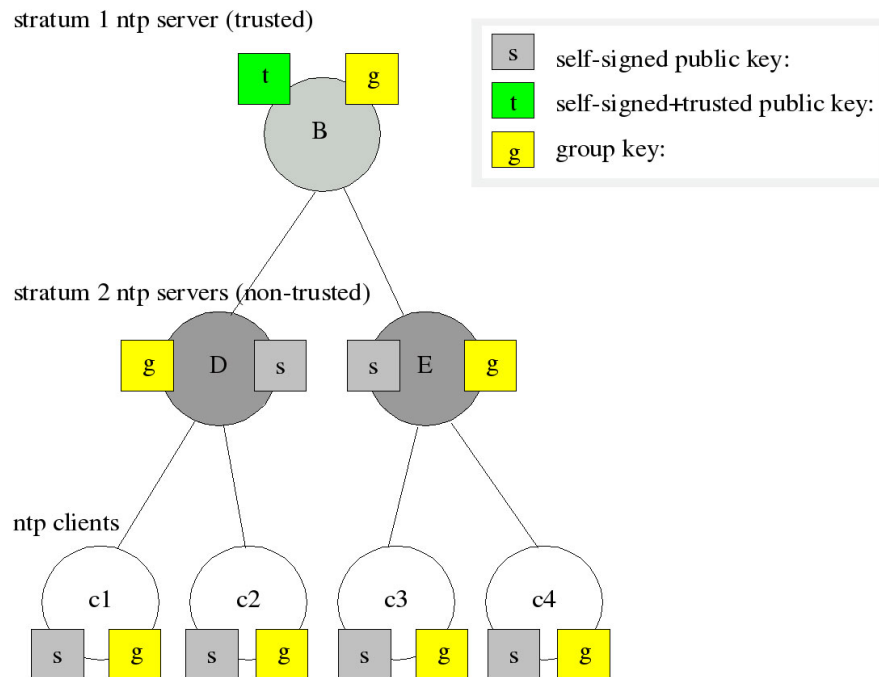
D and E are NTP servers, which are "non–trusted" hosts of the group, they hold the group key and a self–signed certificate which lacks the "trusted" mark. The clients also hold the group key and a self–signed certificate. In order to distribute new public keys to the whole group, the administrator only has to generate a new "t" key, which will be distributed automatically to the two hosts D and E. Because these two servers can now present a unbroken chain of certificates to a trusted host, they can be considered "trusted" by the clients as well.

More about the technical background and detailed processes of the AUTOKEY technique can be found at the official NTP website (http://www.ntp.org).

11.5.9 NTP Leap Second Handling

GPS system time differs from the universal time scale (UTC) by the number of leap seconds which have been inserted into the UTC time scale since GPS was initiated in 1980. The current number of leap seconds is part of the navigation message supplied by the satellites or radio transmitters, so the internal real time of the clock is based on UTC.

In this menu you can select an available "Leap Second File" from the Meinberg or NTP web server. Of course you can enter your an other download link or you can upload your own file for leap second handling.

Available Download Sources
Meinberg: https://www.meinberg.de/download/ntp/leap_second
NTP.ORG: ftp://time.nist.gov/pub/ (leap–seconds.xxxxxxxxxx)

11.6 Configuration: PTP V2

TSU–GbE card – optional functionalities: SyncE* / Hardware NTP Interface*
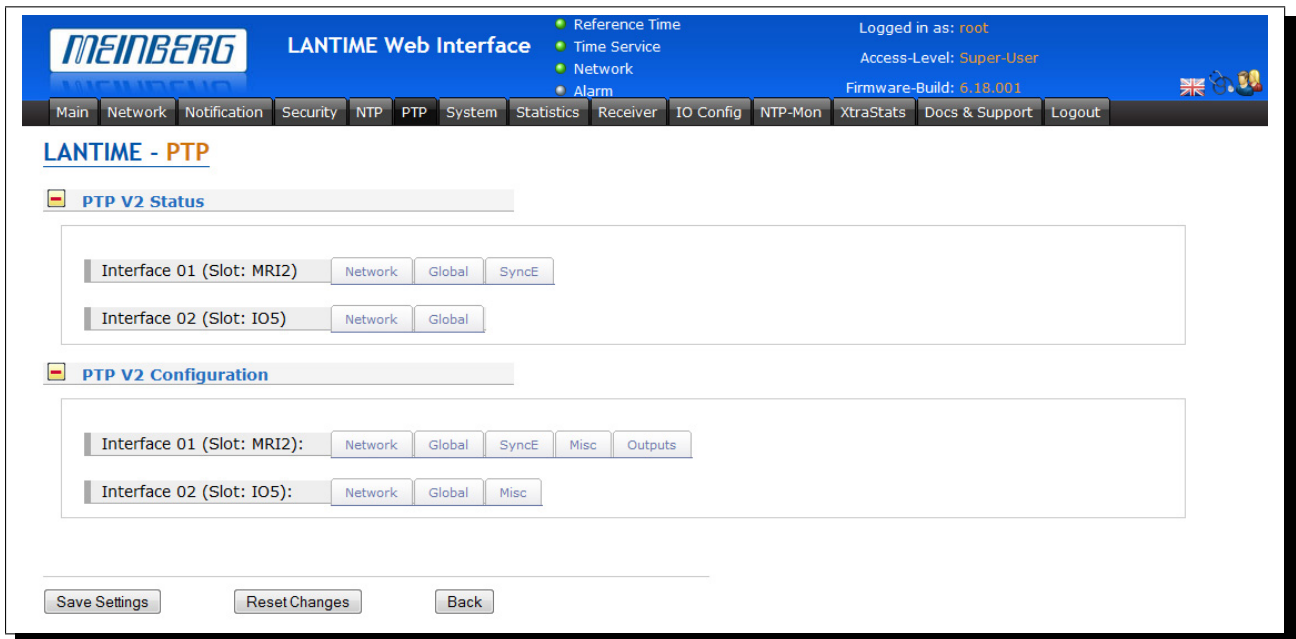
All parameters for proper PTP functionality can be configured in a clear and user friendly Web GUI. The set of parameters which can be configured in the Web GUI corresponds to the PTP card version currently installed in the system. Some features are available with TSU–GbE cards and above only and these are marked as optional (*) in this manual.

When you log in to the Web GUI, please follow to the PTP dialog. In the main menu the following sub-menus are listed:

- PTPv2 Status
- PTPv2 Configuration

If more than one PTP unit (PTP ports) is built into the system, then the status and configuration for each port can be edited separately and will be listed on this page.

11.6.1 PTP Status Information

The PTPv2 status dialogue shows all current status information of the selected PTP card according to its settings configured in the configuration submenu.

PTP Network Status

In the Network tab you can check if network settings of the PTP card are valid.

Local MAC Address of the PTP unit

If the PTP card operates currently as a Grandmaster (GM) its local MAC Address is shown in the status of PTP slaves which are currently synchronized to this GM.

UUID

The UUID is the unique identifier of the PTP port which is based on the MAC address of the PTP port.

PTP Global Status

In the Global submenu the current operation mode of the selected PTP port (interface) is shown. The appear-
ance of this page depends on the mode of the PTP card operation. Different states of a PTP port are possible.
For example, if the unit is configured as a PTP master clock, then this page shows "Master" state. In MRS
(Multi Reference Source) devices, the PTP mode "Slave" may be displayed here.

PTP Port States

uninitialized:	The PTP module is booting up, the software daemon has not yet started, the IP address is not yet assigned.
initializing:	In this state the port initializes its data sets, hardware, and communication facilities.
faulty:	Not defined in LANTIME systems.
stopped:	The PTP service has been stopped or it has not started due to a missing link on the PTP port or a not-synchronized master clock after a startup.
disabled:	Not defined in LANTIME systems.
listening:	The port is waiting for the announceReceiptTimeout to expire or to receive an Announce message from a master.
preMaster:	A short transitional state while the port is becoming a master.
master:	The port is a current master.
passive:	The port is in passive mode, meaning there is another master clock active in the PTP domain. The port can enter master state when it wins the BMCA (Best Master Clock Algorithm) due to a failure/service degradation of the current master.
uncalibrated:	The port wants to become a slave in the PTP domain and has already detected a suitable grandmaster. The TSU is waiting to calculate the path delay to a Grandmaster.

slave: The port has successfully subscribed to a master and receives all expected messages. It also successfully measured the path delay using delay request messages.

Grandmaster MAC The MAC Address of the current Grandmaster.

Clock Accuracy The clock accuracy of the active grandmaster. This value is used in the Best Master Clock Algorithm to select the best master.

PTP Seconds Current value of the raw PTP seconds value (seconds since 1970).

UTC Offset This value represent the current Offset to the PTP time based on TAI to calculate UTC.

Domain Number A PTP domain is a logical group of PTP devices within a physical network which is defined by the same domain number. Slave devices that should sync to a certain master in the network must be configured with a unique domain number which is the same as for the master.

Port Link up Status 0: the port is down, check the link LED and the connection to the link partner. If faulty, the network card should be replaced.
Status 1: the port is in normal operation.

Delay Asymmetry If a static asymmetry offset in the network is known, this value may be entered (in ns) to compensate it before the PTP start.

Clock Class PTP Clock class of the currently selected PTP grandmaster. This value is used in the Best Master Clock Algorithm.

Time Source The type of a time source as used by the Grandmaster (informative only).

Leap Second Leap second announcement flag, set up to 24 hours prior the leap second event, depending on the GM implementation.

TSU Time Displayed time of day in the selected PTP timescale.

SyncE Status

You can check if SyncE functionality is activated on the card or not (if supported by the PTP module).

11.6.2 PTP Configuration Menu

All parameters for proper operation of each PTP port (interface) which are built into the system should be configured separately according to its function in the PTP network. Whenever a change should be applied, it needs to be saved by confirming the "Save Settings" button at the bottom of the page.
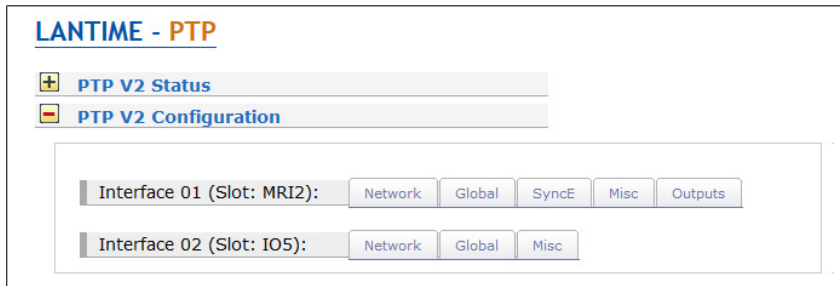
The configuration parameters are grouped in the submenus as follows. Submenus marked with * are available in TSU–GbE (and higher version) cards only.

- Network
- Global
- SyncE*
- Misc*
- Outputs*

PTP Network Configuration

Network Configuration

Hostname   Hostname for the selected PTP port can be entered.

Domainname   Domainname for the selected PTP can be assigned.

Nameserver1   Nameserver1 can be entered if it is used in a network.

Nameserver2   Nameserver2 can be entered if it is used in a network.

Enable DHCP-Client   Activation / deactivation of DHCP service. If a DHCP Client is activated the field for static IP configuration is deactivated. The opposite is the case when DHCP Client is deactivated.

IP-Address
from DHCP   If DHCP service is found in the network, a valid IP for a PTP port will be assigned automatically and displayed here.

Netmask from DHCP   If DHCP service is found in the network, a valid Netmask for a PTP port will be assigned automatically.

Gateway from DHCP   If DHCP service is found in the network, a valid Gateway for a PTP port will be assigned

automatically.

TCP / IP Address	If the DHCP Client is deactivated, this field can be edited to assign a valid static IP address for the selected PTP interface.
Netmask	If the DHCP Client is deactivated, this field can be edited to assign a netmask for the selected PTP interface.
Default Gateway	If the DHCP Client is deactivated, this field can be edited to assign a default gateway for the selected PTP interface.
IPv6 Mode	IPv6 adressing via DHCPv6 / Static assignement / Router Advertisement are available.
IPv6 Address	Ipv6 Address assigned to the selected PTP port. If Static option is activated for Ipv6 Mode, then a valid static IP address can be configured in this field.
IPv6 Multicast Scope	The prefix of IPv6 multicast addresses specifies their scope. A specific scope in case of multicast mode can be selected here.
Enable VLAN Option	Activation / deactivation of Virtual LAN (IEEE 802.1Q) service on the PTP interface.
VLAN-Tag (1-4094)	A 12-bit value specifying a VLAN ID to which a PTP port belongs.
Priority	Values 0 (default, lowest priority) to 7 (highest priority) which can be used to prioritize network traffic for different types of data.
Disable SSH Service	If checked then SSH Access for this PTP port is deactivated.
DCSP PTP Classification	Differentiated Services Code Point. This is a QoS parameter within the IP header of the PTP packet to prioritize the traffic.
Multicast TTL	Time-To-Live. By default, the PTP multicast traffic is not routed and this value is defined as "1" by the PTP standard. However a user defined configuration of the TTL value can be entered here to change the default value.

PTP - Global Configuration

Operating Mode: If supported, there is an option to run a NTP service in Server mode with hardware timestamp support. Select between PTP and NTP mode at this step. It is not possible to run both modes at the same time on one TSU card.

Select Profile: User can choose among preselected sets of PTP parameters defined in profiles usually used in different industries. If the default setting "Custom" is selected, the user can select any parameter combination available in the global configuration section as long as the PTP standard allows it. Depending on the selected profile, there might be profile specific parameters available which can be found in the "Profile Specific Parameters" section below the standard PTP parameters sections.

There are six different presets currently supported on PTP cards:

Default E2E IEEE 1588–2008
Default Profile with End-To-End Delay Mechanism as defined by the IEEE 1588–2008 standard,
available in Multicast and Unicast mode.
– Ann Msg Rate: 2 sec
– Sync Msg Rate: 1/sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "E2E"

Default P2P IEEE 1588–2008
Default Profile with P2P delay mechanism as defined by the IEEE 1588–2008 standard, available in Multicast mode.
– Ann. Msg Rate: 2 sec
– Sync Msg Rate: 1/sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "P2P"
– Network Prot.   "Layer 3 (UDP/IPv4)"

Power IEEE C37.238
– Ann Msg Rate: 1/sec
– Sync Msg Rate: 1/sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "P2P"
– Network Prot.   "Layer 2 (IEEE 802.3)"
– VLAN (802.1Q) enabled (VLAN ID:0, Prio:4)
– Power Profile TLVs enabled

Telecom ITU–T G.8275.1
– Ann Msg. Rate: 8/sec
– Sync Msg. Rate: 16/sec
– Del Req Rate: 16/sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "E2E"
– Network Prot. "Layer 2 (IEEE 802.3)"

_____

In Unicast Master / Slave Mode:
_____

Telecom ITU–T G.8265.1
– Ann Msg. Rate: 1/sec
– Sync Msg. Rate: 16/sec
– Del Req Rate: 16/sec
– Priority 1:   128
– Priority 2:   128
– Delay Mech: "E2E"
– Network Prot.   "Layer 3 (UDP/IPv4)"

_____

In Unicast or Multicast Master / Slave Mode:
_____

SMPTE ST 2059–2
–Ann Msg. Rate: 4/sec
–Sync Msg. Rate: 8/sec
–Del Req Rate: 8/sec
–Priority 1:   128
–Priority 2:   128
–Delay Mech: "E2E" or "P2P"

PTP Mode: A PTP port can operate in one mode only: master or slave. When the mode is selected the user can choose between multicast or unicast-only protocol. In the newest firmware a combined unicast multicast master mode of operation is also supported.

Hybrid Mode: In this mode PTP messages Sync, FollowUp and Announce are sent in Multicast whereas the DelayRequest and DelayResponse Messages are sent in Unicast.

Delay Mechanism: Two options possible:
E2E (End-to-end) where delay measurement messages are sent directly from a slave to the master (two end nodes).

P2P (Peer-to-peer): each device (a peer) in the network exchanges peer-delay measurement messages. This way each node can keep a track of the delays between itself and its immediately connected neighbour. P2P mechanism can be used in 1588 PTP-capable networks only.

Network Protocol: Two options for network protocol are possible:
ETH-IEEE 802.3 / Ethernet (Layer 2): Ethernet frames including MAC addresses of a slave and master.

UDP-UDP/IPv4/IPv6 (Layer 3): User Data Protocol one of the main protocols used for the Internet.

Priority 1:   The attribute is used in the execution of the best master clock algorithm (BMCA). Lower values take precedence.

Configurable range: 0..255. The operation of the BMCA selects clocks from a set with a lower value of priority1 over clocks from a set with a greater value of priority1.

Priority 2:   The attribute is used in the execution of the BMCA. Lower values take precedence.

Configurable range: 0..255.

In the event that the operation of the BMCA fails to order the clocks based on the values of priority1, clockClass, clockAccuracy, and scaledOffsetLogVariance, the priority2 attribute allows the creation of up to 256 priorities to be evaluated before the tiebreaker. The tiebreaker is based on the clockIdentity. The values clockClass, clockAccuracy, and scaledOffsetLogVariance depend on the internal state of the grandmaster and cannot be configured.

Msg. Intervals: Specify the settings for PTP message rates.

Announce Interval: Specifies the rate for sending announce messages between masters in order to select the current Grand Master.

Available settings are: 16/s, 8/s, 4/s ... 2s, 4s, 8s, 16s
with a default value 2 seconds.

Sync Interval: Specifies the rate for sending sync messages from a master to slave.

Available settings are: 128/s, 64/s ... 64s, 128s, with a default value 1 second.

Delay Request Interval   Specifies the rate how often delay request messages are sent from a slave to the master. Delay request messages intervals 128/s, 64/s,... 64s, 128s, with a default value 2 seconds.

Announce Receipt Timeout: Specifies the rate for announce receipt timeout messages which is generally 2-10 times the Announce Interval rate, with a default value of 3. In this time the BMCA procedure should select the current Grand Master.

Interval Duration [s]: Requested duration until timeout / renewal.

Domain Number: A PTP domain is a logical group of PTP devices within a physical network which is defined by the same domain number. Slave devices that should sync to a certain master in the network must be configured with a unique domain number which is the same as for the master.

Timescale: Two options are possible:
PTP: As per default TAI timescale is used in PTP timing. TAI is a linear timescale without discontinuities such as inserted leap seconds in the UTC timescale. A time unit is based on SI second. The TAI timescale started with 1 January 1970 00:00:00.

ARB as arbitrary: In normal operation, the epoch is set by an administrative procedure.

Fixed / Asymmetry Offset [ns]: User defined network asymmetry / known offset compared to the Reference Time. Possible value [0 – 1000000 ns].

HQ Filter: In heavy loaded networks when using non-PTP compliant switches, the "HQ Filter" can be activated to reduce the jitter.

Option SyncE Configuration

This submenu allows all relevant settings for the Synchronous Ethernet functionality. SyncE is an ITU-T standard for computer networking that facilitates the transference of clock signals over the Ethernet physical layer.

Note: The SyncE signal can only be used as a reference input signal, when a TSU-GbE card operates in an MRI Slot (see menu – "Configuration Receiver -> MRS Settings").

Enable SyncE: Activation / Deactivation of SyncE signal on a PTP port. SyncE runs on the PHY network layer therefore it does not disturb PTP on Layer 2 or Layer 3. They both can run in parallel on the same port.

Quality Level Selection   If enabled, the Quality Level is transported once per second within the ESMC (Ethernet Synchronization Message channel) and are determined automatically depending on the clock status in master mode or used as they are received as an input in slave mode.

    If this mode is disabled, then the settings chosen below in Fixed Input SSM and Fixed Output SSM are used permanently as static values.

SDH Network Option   The selectable values for the Quality levels depend on the SDH network options which reflect to Option 1 (for SDH, E1 based systems) or Option 2 (for SONET, T1 based systems).

Fixed Input SSM   Fixed Quality level of the SyncE input signal.

Fixed Output SSM   Fixed Quality level of the SyncE output signal.

Gbit Link Copper Mode   If the copper port is used for SyncE in GBit mode then the Clock Master or Clock Slave needs to be defined. This is not necessary if optical connections via SFP are used as this is determined automatically there.

Mode   User can select if the copper port should be forced to act as the clock master or clock slave depending on the role (Master/Slave) that this SyncE port should have. Misconfiguration can lead to link loss, so the user needs to take care about the proper configuration of the link partners.

Port   The port can operate in a SyncE clock master or clock slave mode. A configuration is only necessary for the copper port but not for Fibre Optic connections.

Option Misc. Configuration

Activate PTP One Step: Per default Two Step approach is active.

Two Step approach: The PTP protocol requires the master to periodically send SYNC messages to slave devices. The hardware time stamping approach of PTP requires that the master records the exact time when such a SYNC packet is going on the network wire and needs to communicate this time stamp to the slaves. This can be achieved by sending this time stamp in a separate packet (a so-called FOLLOW-UP message).

One Step operation enabled: the SYNC message itself is time stamped on- the- fly just before it leaves the network port. Therefore, not FOLLOW-UP message is needed.

Disable PTP Management Messages: A protocol within PTP used to query and update the PTP data sets maintained by master clocks. These messages are also used to customize a PTP system and for initialization and fault management. Management messages are used between management nodes and clocks. This feature is enabled per default.

Option: Output Configuration
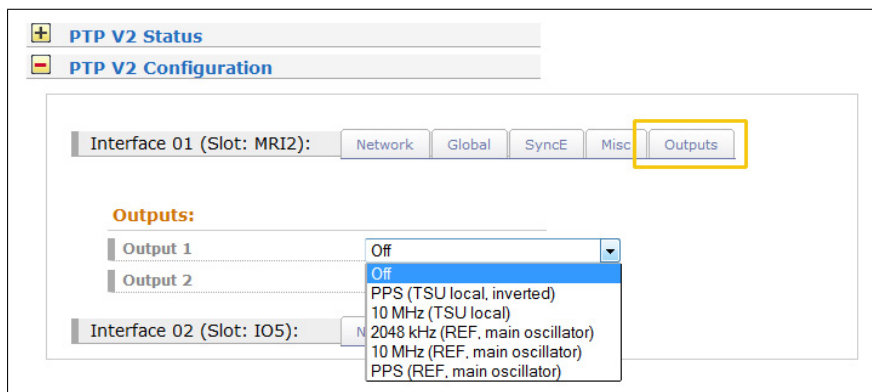
TSU–GbE card comprises one Gigabit Ethernet SFP/RJ45 Combo Port for network synchronization and two female BNC output interfaces with a list of available signals as follows:

- PPS (generated locally on the TSU, inverted)
- 10 MHz (generated locally on the TSU)
- 2.048 MHz (taken from the active internal clock module)
- 10 MHz (taken from the active internal clock module)
- PPS (taken from the active internal clock module)

Per default no output signal is active on both outputs.

11.7 FDM - Frequency Deviation Monitoring

Powerline Frequency Monitoring – Überwachung der Frequenz in Stromleitungen

The FDM module uses a GNSS synchronized 10 MHz signal as a reference and calculates a running average over either 100ms or 1s. Other powerline frequency related measurements are also available including:

Frequency Deviation	the difference between the actual frequency and the nominal frequency 50 Hz or 60 Hz.
PLT – Powerline Time	a separate timebase that is initialized using GNSS time and then advanced based upon the 50/60 Hz frequency.
TDEV Time Deviation	the difference between the powerline time and the reference time (REF). The resolution of the frequency measurements is 0.001 Hz.

11.7.1 FDM Status

This menu shows the following values:

Current Frequency: the current frequency of the monitored power network
Reference Time:　　REF – the time of the reference clock (i.e. GPS)
Power Line Time:　　PLT – the time of the monitored power line

Line Frequency:　　mains frequency (Auto, 50Hz or 60Hz)
Flags:　　　　　　transmitted Flags by FDM (Error Bits)

Receiver State

The "Receiver" tab displays all connected and configured receivers.

11.7.2 FDM Configuration

Automatic Monitoring of Powerline Frequency
It is possible to define an upper and lower limit for the powerline frequency and receive alarm messages (email, syslog, SNMP traps) when a LANTIME device detects that the frequency measurement value is outside the acceptable range.

Interface 01	General	Serial Port	Set TDEV	New Receiver

General:

Line Frequency	60 Hz	
Min Frequency Deviation	60000	mHz
Max Frequency Deviation	60000	mHz
Min Time Deviation	-0	ms
Max Time Deviation	0	ms
Timezone	(UTC) - UTC	

With the FDM configuration menu the following parameters can be set:

Line Frequency — measured nominal frequency
Min Frequency Deviation — lower frequency limit, at which an FDM Error is generated
Max Frequency Deviation — upper frequency limit, at which an FDM Error is generated

Min Time Deviation — limit of the negative difference between Powerline Time and Reference Time, under which an FDM Error is generated

Max Time Deviation — limit of the positive difference between Powerline Time and Reference Time, over which an FDM Error is generated

Timezone — used time zone for Reference Time and Powerline Time

Configuration of serial ports

Baud Rate	baud rate (bps) for the transmission of serial time telegrams
Framing	framing for the transmission of serial time telegrams
String Type	type of generated serial time telegram

The standard telegram format contains the following values:
mains frequency (FF.xxx Hz)
frequency deviation (+-FF.xxx Hz)
reference time (HH:MM:SS)
power line time (HH:MM:SS.mmm)
time deviation (+-MM:SS.mmm)

Configuration of time deviation

After power-up, the Powerline Time is reset to the Reference Time and therefore the time deviation is set to +00.000s.

However, if a different start value is required because of any reason, a time deviation preset value in the range between –99.999s and +99.999s can be entered for TDEV. The Powerline Time is then calculated according to the new value of the time deviation.

In order to synchronize the time deviation values on multiple LANTIME units, the end user can easily set the time deviation value to an arbitrary number.

Example
00.000 => curent Powerline Time = Reference Time
–10.000 => curent Powerline Time = Reference Time – 10s
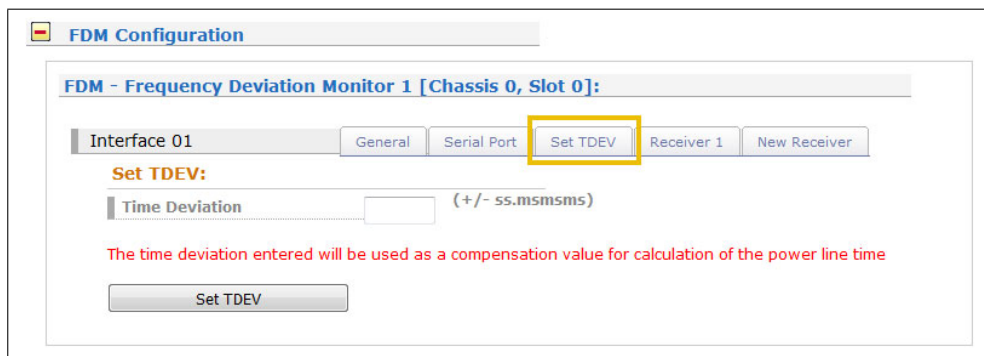
Time Deviation		Known difference between reference time and powerline time.
		Value range +99.999ms – –99.999ms

New Receiver

In this section, the user can add a new receiver for FDM telegrams. Any number of receivers (network displays and/or PCs for analysis and display of status messages or frequencies), which are connected to the same net–work, can be configured here.

Receiver Type   Type of telegram for the network transmission
Standard: Standard FDM time telegram
Sent once per second
i.e. "F:50.016 FD:+00.016 REF:15:17:57 PLT:15:17:57.056 TD:+00.056"

Extended: Extended FDM time telegram with intermediate measurements and sequence ID
Sent once per second
i.e. "F:50.006 F:50.004 F:50.013 F:50.012 F:50.010 F:50.010 F:50.006 F:50.012 F:50.020"
or "F:50.013 FD:+00.013 REF:15:19:10 PLT:15:19:10.071 TD:+00.071 SEQ:0000000004"

Intermediate: Truncated FDM time telegram with intermediate measurements
Sent once per 100ms
M1:49.997 SEQ:0000000053
M2:49.996 SEQ:0000000054
M3:50.000 SEQ:0000000055
M4:49.999 SEQ:0000000056
M5:49.996 SEQ:0000000057
M6:49.996 SEQ:0000000058
M7:49.997 SEQ:0000000059
M8:49.995 SEQ:0000000060
M9:49.996 SEQ:0000000061
M9:49.996 SEQ:0000000062

Custom: Customized FDM time telegram, which consists of prefix, string and suffix
Sent once per second

Address: Address or host name of the message recipient (display or computer)

Port: Used TCP/UDP port for telegram transmission

Transport Protocol: Used protocol for telegram transmission (TCP/UDP)

Only if receiver type "Custom" is selected

Prefix: Prefix of customized strings, control characters can be specified
by their hex value (ASCII), for example:
"\x01" for SOH (Start of Header) or "\x02" for SOT (Start of Text)

String: Customized time telegram, which can be composed of arbitrary text
and the following variables (identified by the prefix '%'):

PLFRQ	Power Line Frequency (i.e. 50.023)
FRQDEV	Frequency Deviation (i.e. +00.023)
REFTIME	Referenc Time (i.e. 15:17:23)
POWERLNTIME	Power Line Time (i.e.. 15:17:22.550)
PLTDEV	Power Line Time Deviation (i.e. –00.450)
IDX	Intermediate Measurement Index (i.e. 1)
IMMFRQ1	Intermediate Measurement Frequency with Index 1 (i.e. 50.034)
IMMFRQ2	Intermediate Measurement Frequency with Index 2 (i.e. 50.034)
...	
SEQID	Sequence ID (i.e. 0000000061)
SYSTIME	System Time (i.e. 15:17:23)
SYNCSTATE	Synchronization Status (' ' = synchronized, '*' = unsynchronized)
SYNCTEXT	Synchronization Text („OK" = synchronized, „NO" = unsynchronized)
TIMESTAMP	Current Timestamp (i.e. 2016-03-15 16:03:10.042)
TIMESTRING	Time string to set the display time (i.e. S16:04:37;15.03.16S)

An auto-toggle feature allows to define a sequence of formats by setting up comma-
separated format strings. Additionally, the duration of a format string can be defined
using the FORMATSTR@DURATION format.

The following example will show the Powerline Frequency for 20 seconds, then the
Reference Time for 30 seconds, then the Frequency Deviation for 10 seconds. Afterwards,
it will start over with the PLF display:
PLF %PLFRQ Hz@20,REF %REFTIME@30,FDV %FRQDEV@10

Suffix: Suffix of customized strings, control characters can be specified
by their hex value (ASCII), for example:
"\x0A" for LF (Line Feed) or "\x0D" for CR (Carriage Return)

Append Timestamps: Indicates, whether a timestamp shall be appended to the message

11.7.3 FDM Information

11.7.4 FDM Telegrams

Standard FDM String

The STANDARD string is a sequence of 62 ASCII characters containing the frequency F, the frequency deviation FD, the REF time, the power line time PLT and the timedeviation TD, each item seperated by a space character. The string is send out at the beginning of every new REF time second and ends with the characters Carriage-Return (ASCII code 0Dh) and Line-Feed (ASCII code 0Ah). The letters displayed in italics are replaced by the calculated values whereas the other characters are part of the string:

*F:49.984*_FD:*-00.016*_REF:*15:03:30*_PLT:*15:03:30.378*_TD:+*00.378*<CR><LF>

The meaning of the several values is described below:

F:*49.984* The measured power line frequency with a resolution of 1mHz

FD:*-00.016* The frequency deviation between calculated and nominal frequency, with sign character (+/-), resolution: 1mHz, maximum: +-09.999Hz

REF:*15:03:30* The reference time from the preconnected clock (hours:minutes:seconds)

PLT:15:03:30.378 The power line time, based on the mains frequency, (hours:minutes:seconds:milliseconds) Time jumps, like changeover in daylight saving or leap seconds will not be executed by the PL time!

TD:+*00.378* The time deviation between REF time and PL time, with sign character (+/-), resolution: 1ms, maximum: +-99.999s

Short FDM String

The SHORT string is a sequence of 23 ASCII characters containing simply information about frequency deviation FD and time deviation TD, seperated by a space character. The string is send out at the beginning of every new REF time second and ends with the characters Carriage-Return (ASCII code 0Dh) and Line-Feed (ASCII code 0Ah). The letters displayed in italics are replaced by the calculated values whereas the other characters are part of the string:

FD:*-00.016*_TD:+*00.378*<CR><LF>

The meaning of the several values is described below:

FD:*-00.016* The frequency deviation between calculated and nominal frequency, with sign character (+/-), resolution: 1mHz, maximum: +-09.999Hz

TD:+*00.378* The time deviation between REF time and PL time„ with sign character (+/-), resolution: 1ms, Maximum +-99.999s

Computime Extended FDM String

The extended Computime string is a sequence of 42 ASCII characters containing the REF time (with date and day–of–the–week), the time deviation TD and the frequency F. The string is send out at the beginning of every new REF time second and ends with the characters Carriage–Return (ASCII code 0Dh) and Line–Feed (ASCII code 0Ah). The letters displayed in italics are replaced by the calculated values whereas the other characters are part of the string:

T:*10:03:09:02:15:03:30*D:*+000.378F:49.984*<CR><LF>

The meaning of the several values is described below:

10:03:09:02	The date of the reference time from the preconnected clock, (year:month:day:day–of–the–week / Monday = 01, Sunday = 07)
15:03:30	The reference time from the preconnected clock, (hours:minutes:seconds)
+000.378	The time deviation between REF time and PL time, with sign character (+/–), resolution: 1ms, maximum: +–99.999s (the first digit is always 0!)
49.984	The measured power line frequency with a resolution of 1mHz

11.8 Configuration: System
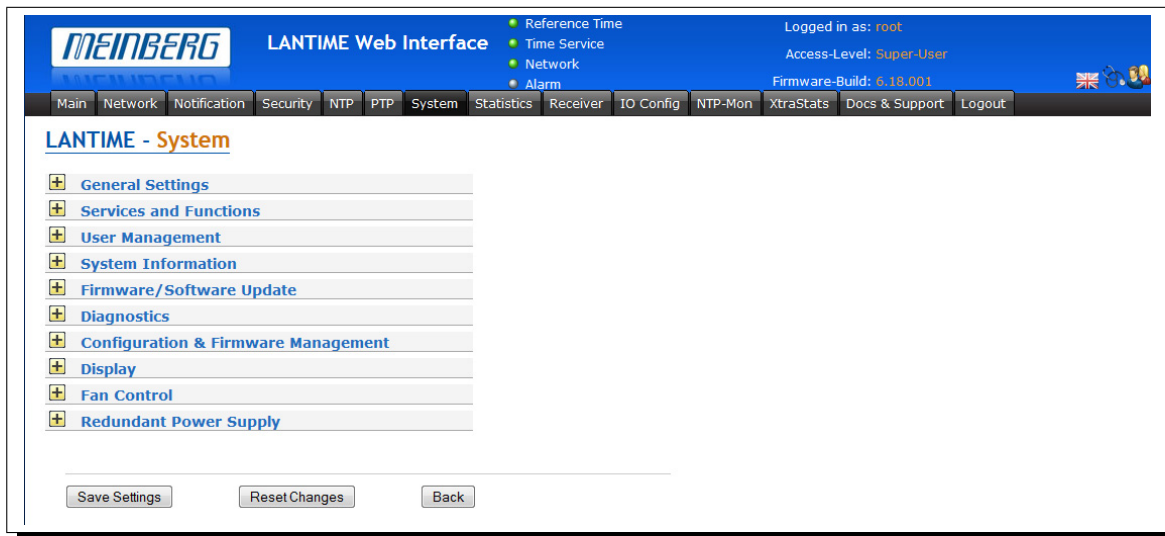
11.8.1 Common Configuration
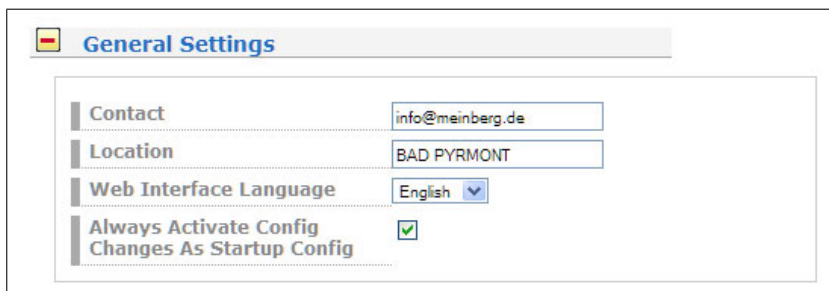
You can enter a contact address, the location of the LANTIME and the language of the web interface. If the checkbox is activated then all changes during the last session will be stored as new startup configuration.

11.8.2 Web interface language

With the selector box "Web interface language" you can change the displayed language of the WEB interface.

11.8.3 Services and Functions

In the first section there are several functions which may be used by the administrator. The button "Reboot Device" is restarting the system, the built-in reference clock is not affected by this, only the included computer system is rebooted, which may take up to 30 seconds.
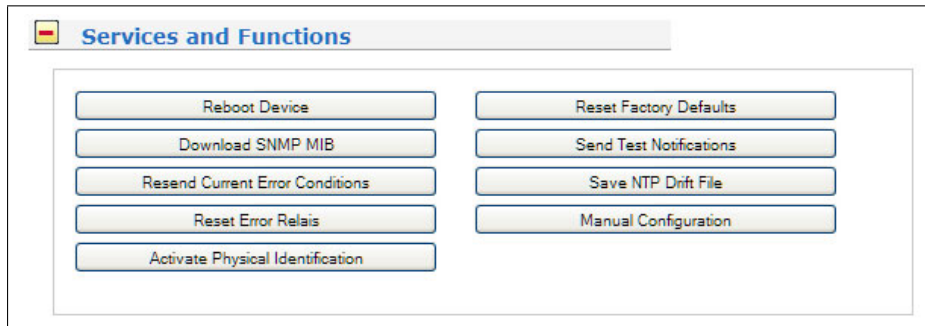
With "Manual configuration" you are able to change the main configuration by editing the configuration file by hand. After editing, press the "Save file" button to preserve your changes, afterwards you are asked if your changes should be activated by reloading the configuration (this results in reloading several subsystems like NTPD, HTTPD etc.).
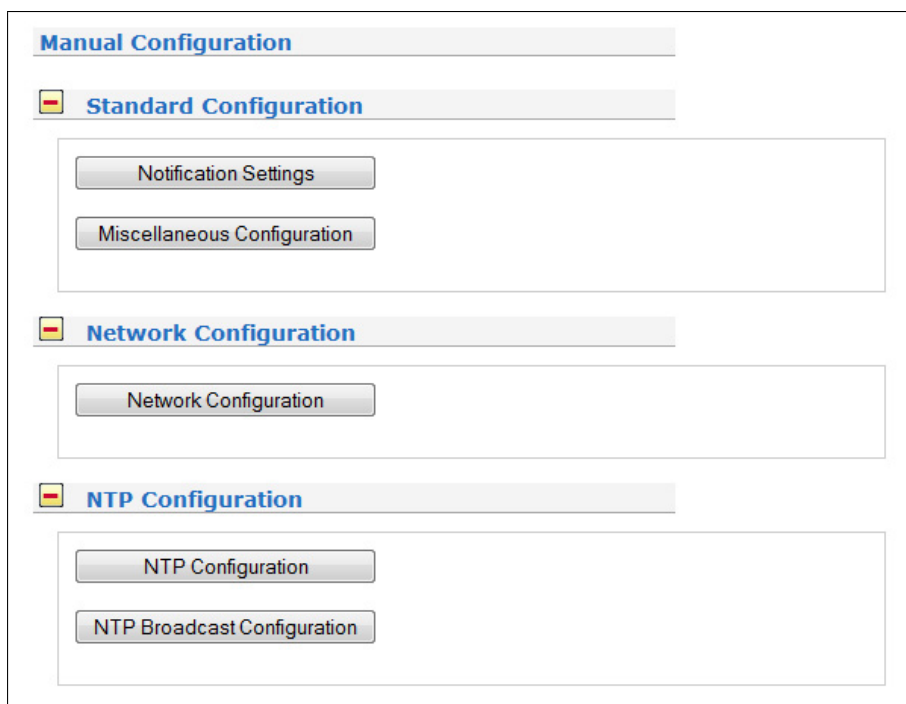
The function "Send test notification" is generating a test alarm message and sends it using all configured notify possibilities (e-mail, WMail, SNMP-Traps, wall mount display).

You can use the function "Save NTP drift file" to copy the file /etc/ntp.drift to the internal flash disc of your LANTIME. NTP is using this file to have the parameters for compensation of the incorrectness of the system clock available directly after a restart. This results in a faster synchronisation process of the NTPD subsystem after a system restart. You should use this function only, if the NTPD has been synchronized to the internal reference clock for more than one day. This is done here at Meinberg directly before shipping the LANTIME unit to our customers, so you do not need to use this function during normal operation. It may be applicable after a software update.

The function "Reset to factory defaults" is setting all configuration parameters back to default values. The regular file /mnt/flash/global_configuration will be replaced with the file /mnt/flash/factory.conf, but first a copy of the configuration is saved under /mnt/flash/global_configuration.old for backup reasons. The default password "timeserver" is replacing the actual password, too. After using this function, all certificates should be recreated because of the change of the unit's hostname.

Please be aware of the fact that the default configuration is not activated instantly. If you want to avoid setting up the IP address of your unit by locally configuring it on site with the buttons of the front panel (meaning physical presence of someone directly at the location of the LANTIME), you have to configure the network parameters of your LANTIME immediately after using the "reset to factory defaults" button. So, please proceed directly to the Ethernet page and check/change the IP address and the possible access subsystems (HTTP for example) of the LANTIME. The first usage of "Save settings" will load the configuration from flash into memory and activate it.

The point "Download SNMP MIB files" can be used to download all Meinberg specific SNMP MIB files to your workstation. They can be distributed to all SNMP management clients afterwards.

11.8.4 User Management

It is possible to create multiple user accounts on a LANTIME system, each account can be assigned one of three access levels: the Super-User level has full read-write access to the configuration of the LANTIME system, it can modify all parameters and has full shell access to the system when logging in via Telnet, SSH or serial console port.

Administrator level accounts can only modify parameters via the WEB interface but does not have shell access. The access level "Info" can only review status and configuration options but is not allowed to modify any parameters or configuration files.
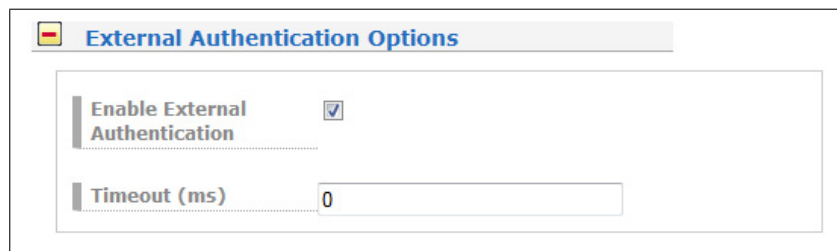

The "User Management" menu allows you to set up different users with password and the access level. To change the properties of an user you have to delete the old user and set up a new one. The user "root" cannot be deleted and has always the membership of Super-User. The password of the user "root" can be set on the security page.
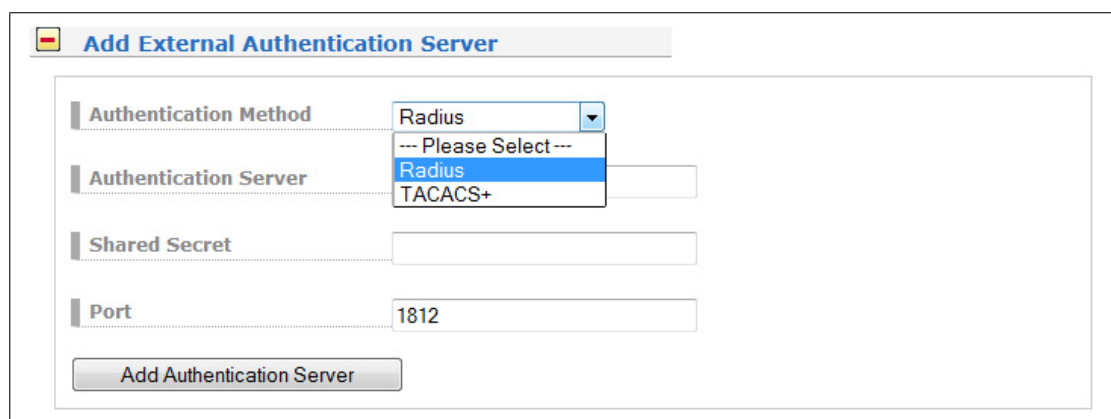
Authentification Options

You can choose between several Authentification Methods:

TACACS: Terminal Access Controller Access-Control System (TACACS) is a remote authentication protocol that is used to communicate with an authentication server commonly used in UNIX networks.

The LANTIME TACACS authentication feature requires that each account that should be able to login to the LANTIME needs a special attribute called „priv-lvl". This attribute has to be configured on the TACACS Server. In addition to that, you need to assign a value of 100 (=Super User), 200 (=Admin User) or 300 (=Info User) for this attribute to each TACACS user account that should be able to login to a LANTIME.

Please note that you have to define the attribute for the service "lantime_mgmt", for example:

service = lantime_mgmt {
      priv-lvl = 100
}

RADIUS: Remote Authentication Dial In User Service (RADIUS) is a networking protocol that provides centralized Authentication for MEINBERG Time Servers to connect and use the network services. RADIUS is a client/server protocol that runs in the application layer, using UDP as transport.

The LANTIME RADIUS authentication feature requires that each account that should be able to login to the LANTIME needs a Vendor Specific Attribute (VSA) called MBG-Management-Privilege-Level. This VSA has to be added to the configuration of your RADIUS Server. Here some additional information on the attribute:

Name = MBG–Management–Privilege–Level
Datatype = Integer
Vendor–Code = 5597
Vendor assigned attribute number = 1
Value range = 100, 200, 300

In addition you need to assign a value of 100 (=Super User), 200 (=Admin User) or 300 (=Info User) for this attribute to each RADIUS user account that should be able to login to a LANTIME.

Passwort-Options

In this section you can activate special options to enhance security features of the user passwords.

Minimum Password Length

This parameter set the minimum number of characters of a password before it is accepted by the system as a valid password. This value is used when creating a new user as well as when you change a current user password.

Allow Secure Passwords Only

The password must contain at least one lower character [a–z], one upper character [A–Z], one number [0–9] and one special character.

List of valid special characters:

```
- _ . ! " [ ] } @ \ § $ % & ,
( ) = ? * + ' # ~ { / : ; ^ °
```
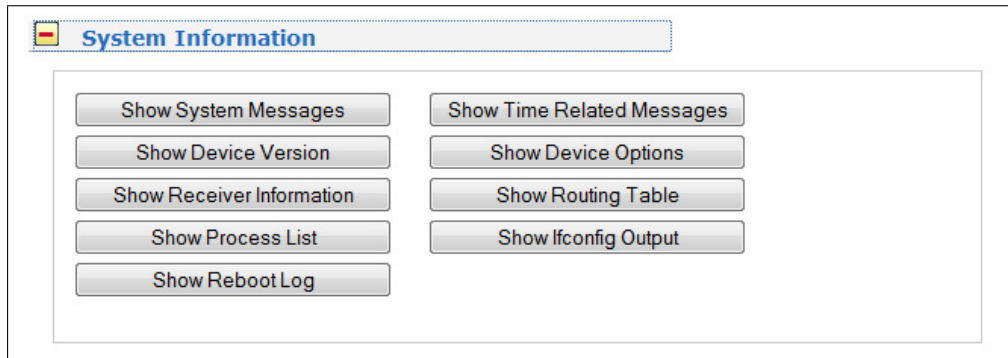
User must change password periodically
Users will be forced to change there passwords at regular intervals. If a password is expired the user can't log in to the unit before changing his current password.

Available intervals:
Monthly   = Every 30 Days
Half-Yearly   = Every 180 Days
Yearly   = Every 360 Days

11.8.5 System Information

The button "System Information" displays the SYSLOG of the LANTIME completely. In this log all subsystems create their entries, even the OS (upper case) kernel. The SYSLOG file /var/log/messages is only stored in the system's ram disk, therefore it is lost after a power off or restart. If you configured an external SYSLOG server, all LANTIME syslog entries will be duplicated on this remote system and can be saved permanently this way.

11.8.6 Show System Messages
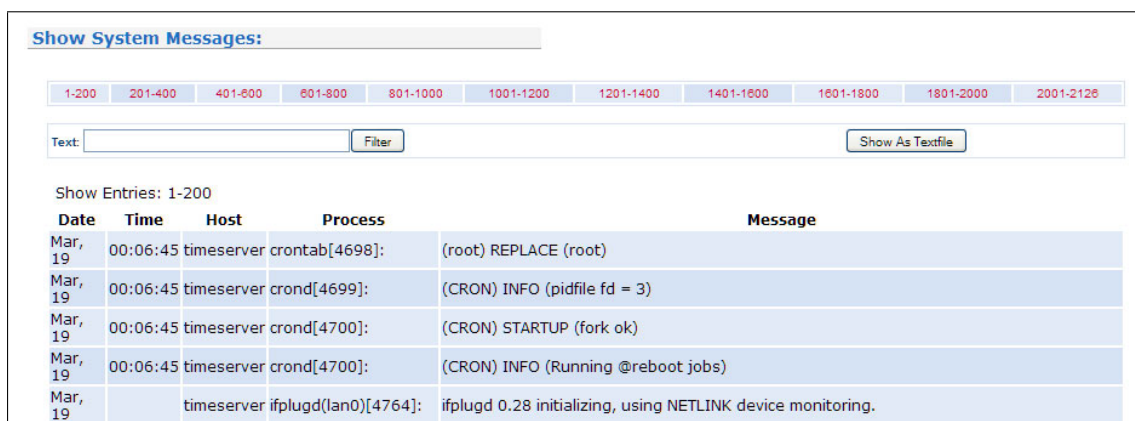
Show Time Related Messages:

A list of time related messages appears which are registered by certain events like reboot of the system, change of configuration settings and so on. After a restart this list is overwritten!

Show Device Version

With "Show Device Version" a number of version numbers (including LANTIME software, operating system and NTPD) are shown in a textbox.

Show Device Options

The function "Show Device Options" shows the hardware options installed in your LANTIME.


```
Show Device Options:

#GLOBAL OPTIONS

NUMBER ETHERNET INTERFACES: 1
SYSTEM LAYOUT: 0
SYSTEM ADV LAYOUT: 0
SYSTEM LANGUAGE: 0
SYSTEM PARAMETER: server
SYSTEM DESIGN: 0
PTP PARAMETER:
REDUNDANT POWER SUPPLY:
NOTIFICATIONS:
ADV HTTP OPTION:
```

Show Receiver Information

Using the button "Show Receiver Information" gives you the possibility to check detailed receiver status information. The first parameter indicates the time and date of the last update of the shown parameters. Next you find the receiver status and the NTP status.
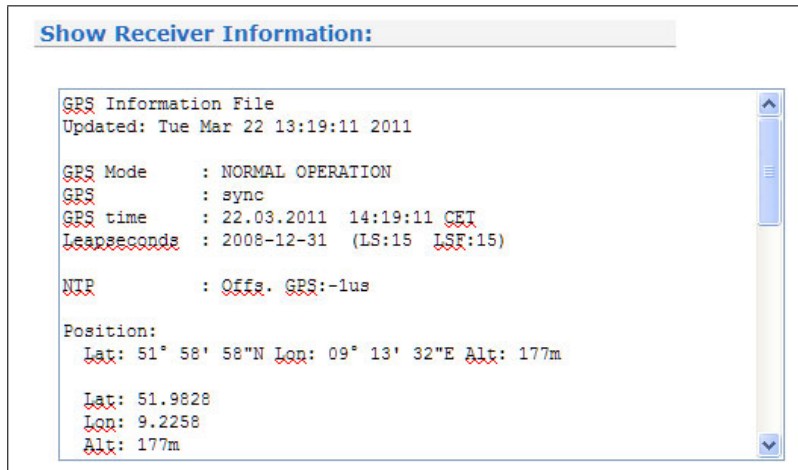
In case of a GPS receiver you can find GPS position data in this file. The position uses the Latitude / Longitude / Altitude format. Latitude and Longitude are shown in degrees, minutes and seconds, Altitude is shown in meters above WGS84 ellipsoid. The satellite section shows the numbers of satellites in view and the number of usable satellites ("good SV"). Additionally, the selected set of the four used satellites can be read.

The accuracy of the calculated receiver position and time deviation is dependent on the constellation of the four selected satellites. Using the position of the receiver and the satellites, a number of values can be calculated, which allow a rating of the selected constellation. These values are called "Dilutions of Precision (DOP)". PDOP is the abbreviation for "Position Dilution of Precision", TDOP means "Time Dilution of Precision" and GDOP stands for "General Dilution of Precision". Lower values are indicating better accuracy.

The next section "Satellite Info" shows information about all the satellites, which are in view momentarily. The satellite ID, elevation, Azimuth and distance to the receiver reveal the position of the satellite in the sky. The Doppler shows whether the satellite is ascending (positive values) or descending (negative value).

MRS Systems: The configured external NTP servers can be found under:
_____

List of external NTP server:
server 172.160.100.000, stratum 1, offset –0.000020, delay 0.02599
server 172.160.100.001, stratum 1, offset 0.000026, delay 0.02603
server 172.160.100.002, stratum 0, offset 0.000000, delay 0.00000
28 Aug 10:58:56 ntpdate[12367]: adjust time server 172.160.100.000 offset –0.000020 sec
_____

The list shows also the currently used external NTP server (adjust).

Show Routing Table:

Destination	Gateway	Genmask	Flags	Metric	Ref	Use	Iface
169.254.100.0	*	255.255.255.0	U	0	0	0	tsu100
172.16.0.0	*	255.255.0.0	U	0	0	0	lan0
default	meinberg.py.mei	0.0.0.0	UG	0	0	0	lan0

The table shows all available and configured network routes.

Show Process List

Show Process List:

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
7502	root	20	0	3916	1796	1460	R	23.1	1.8	0:00.12	ssh
5306	root	20	0	88672	2860	1020	S	3.8	2.8	41:31.17	lantimed
7499	root	20	0	2256	940	736	R	1.9	0.9	0:00.02	top
1	root	20	0	1740	576	504	S	0.0	0.6	0:01.58	init
2	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kthreadd

A list of all active processes (CPU performance, used memory, runtime...) of the LAN-CPU is indicated with this table.

Show Ifconfig Output

Show Ifconfig Output:

```
bond0     Link encap:Ethernet  HWaddr 00:00:00:00:00:00
          BROADCAST MASTER MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

bond1     Link encap:Ethernet  HWaddr 00:00:00:00:00:00
          BROADCAST MASTER MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

bond2     Link encap:Ethernet  HWaddr 00:00:00:00:00:00
          BROADCAST MASTER MULTICAST  MTU:1500  Metric:1
```

Show Reboot Log

Show Reboot Log :
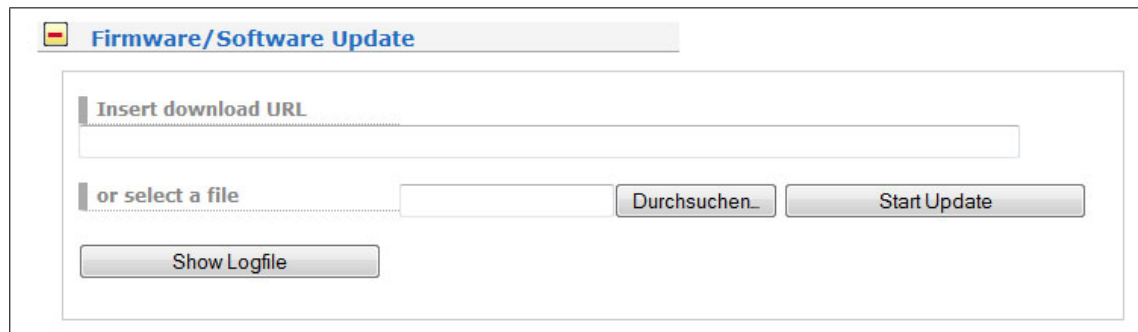
```
Fri Apr 19 07:17:45 UTC 2013 reboot initiated: TTY=PID 21319 USER=root PID=21319 REASON=Autoreboot by install-
release REMOTEHOST= REMOTEUSER=
Mon Apr 22 09:54:39 UTC 2013 reboot initiated: TTY=PID 8517 USER=root PID=8517 REASON=- REMOTEHOST= REMOTEUSER=
Tue Apr 23 08:39:44 UTC 2013 reboot initiated: TTY=PID 17245 USER=root PID=17245 REASON=Manual Reboot
REMOTEHOST=172.16.100.34 REMOTEUSER=
Tue Apr 23 08:49:01 UTC 2013 reboot initiated: TTY=PID 23577 USER=root PID=23577 REASON=Manual Reboot
REMOTEHOST=172.16.100.34 REMOTEUSER=
```

11.8.7 Firmware/Software Update

If you need to update the software of your LANTIME, you need a special file from Meinberg, which can be uploaded to the LANTIME by first choosing the file on your local computer with the "Browse" button and then press "Start Update".

The chosen file will be uploaded to the LANTIME, afterwards you are prompted to confirm the start of the update process. The scope of the update only depends on the chosen file.

11.8.8 Download Diagnostic File

A diagnostic file which includes all status data of a LANTIME system logged since the last reboot can be downloaded from all LANTIME Time servers. The file format of the diagnostic file is a tgz-archive. The archive contains all the important configuration and logfiles. In most support cases it is the first action to ask the customer to download the diagnostic file, because it is very helpful to identify the current state of the LANTIME and to find possible errors.

Download via Web Interface
1. Open the "System" page and the submenu "Diagnostics".
2. Press the "Download Diagnostic File" button.
3. Send the tgz-archive with a short description of your problem
   to our technical support: techsupport@meinberg.de

11.8.9 Configuration and Firmware Management

With this menu you can save the current configuration on the flash memory of the LANTIME. On this way it is possible to save different configuration files on the system. Later you can activate a stored configuration as startup file.

Additionally more than one Firmware version can be archived on the LANTIME. If a updated version is not correspond correctly in the environment, then it is possible to reload an established version on the LANTIME.

11.8.10 Display

Time Table:
Here you can edit the Time Table directly. You can add a new timezone with daylight savings and the app.
parameters. So you can show the local time on the LC Display of the LANTIME.

Example:

(UTC+1) – CET/CEST,CEST,0,25.03.****,+,02:00,02:00:00,CET,0,25.10.****,+,01:00,03:00:00

The string above is the local time zone of middle europe. The offset from UTC is +1 hour. Daylight saving ON with an offset of +2 hours on 25th of march at 2:00 am and OFF at 3:00 am at 25th of october.

The first part of the character string (the Komma is delimiter), you can see as option in the dropdown selection list.

11.8.11 Option: Fan Control

With the optional fan control menu the current status of the operational temperature and the fans can be displayed on the systems interface. The mode of the fans can be selected here:

On	the ventilators are always running
Off	the ventilators are off
Automatically	the ventilation runs from the temperature, which is specified by the "Temperature Threshold" parameter. This value is only editable, if the operation mode "Automatically" is selected. If the temperature of the device is less than 7 degrees (Celsius) as the specified value, the fan control turns off automatically.

11.9 Configuration: Statistics
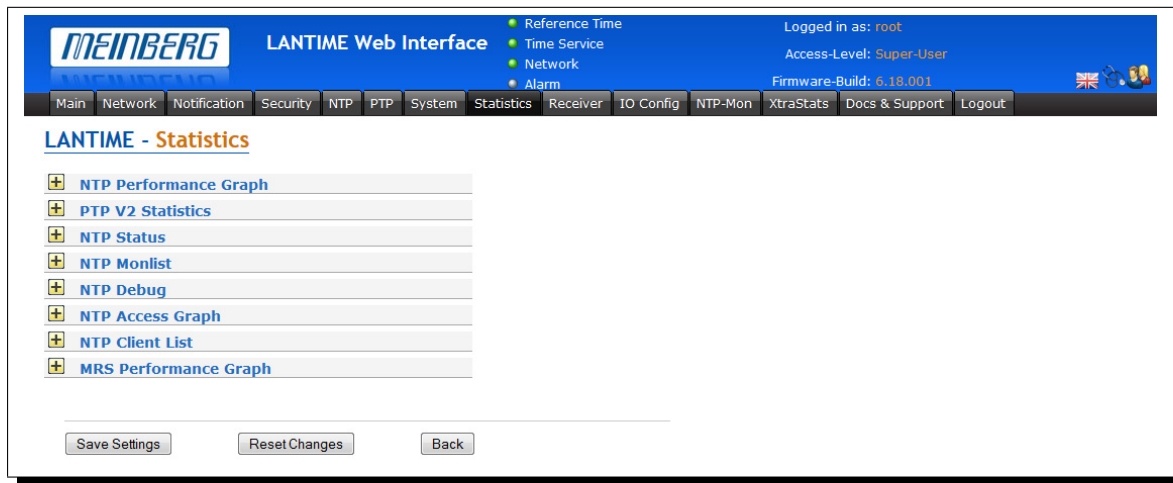
NTP Performance Graph

In the first section a graphical diagram shows the running synchronisation process. NTP is storing this statistical information in so-called "loopstats" files, which are used here to draw the curves. The red line is describing the offset between the internal reference clock (GPS) and the system clock. The blue line shows the frequency errors of the system time (in PPM, parts per million). In the upper right corner of the diagram you will find the measurement range of the red and blue curve. The last 24 hours are shown initially, but you are able to select the last 10 days (or fewer days, depending on the system uptime) or switch to a "merge loopstats" diagram, which shows all available days in one diagram (with a maximum of 10 days). All time data is using UTC.

NTP Status

After that a list of all actually refclocks of the internal NTP server will be shown. The last section will show some NTP specific informations about the refclock.

NTP Status

Remote	RefID	Stratum	Type	When	Poll	Reach	Delay	Offset	Jitter
LOCAL(0)	.LOCL.	12	l	7h	8	0	0.000	0.000	0.000
oGENERIC(0)	.GPS.	0	l	6	8	377	0.000	0.000	0.002

with the following meaning:
_____

- remote: list of all valid time servers (ntp.conf)
- refid: reference number
- st: actual stratum value (hierarchy level)
- when: last request (seconds)
- poll: period of requesting the time server (seconds)
- reach: octal notation of the successful requests, shifted left
- delay: delay of the network transmission (milliseconds)
- offset: difference between system time and reference time (milliseconds)
- jitter: variance of the offsets (milliseconds)

NTP Monitor

In the next section all NTP clients accessing the NTP server are listed. This list is maintained internally by NTPD, clients who did not access the NTPD for a longer period are automatically removed. This section can grow very long in large networks.

NTP Monlist

Remote Address	Port	Local Address	Count	M	Version	Code	Avg Length	First/Last
172.16.100.124	123	172.16.100.167	367	3	4	0	69	53

NTP Debug

NTP Debug

Index	assID	Status	Conf	Reach	Auth	Condition	Last Event	Count
1	37751	8033	yes	no	none	reject	unreachable	3
2	37752	973a	yes	yes	none	pps.peer	sys_peer	3

| assID: 0 | Sysvars |

| assID: 37751 | Clockvars | Readvars |

| assID: 37752 | Clockvars | Readvars |

NTP Access Graph
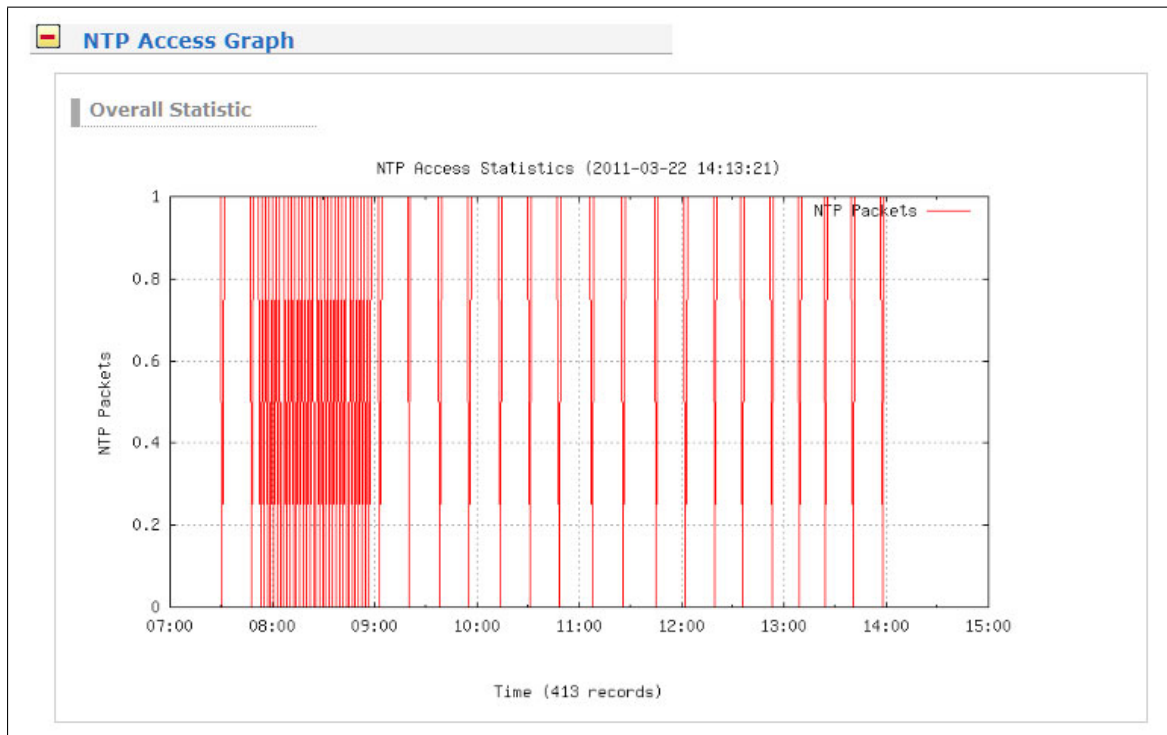
11.9.1 Statistical Information

In the first section a graphical diagram shows the running synchronisation process. NTP is storing this statistical information in so-called "loopstats" files, which are used here to draw the curves. The red line is describing the offset between the internal reference clock (GPS) and the system clock. The blue line shows the frequency errors of the system time (in PPM, parts per million). In the upper right corner of the diagram you will find the measurement range of the red and blue curve. The last 24 hours are shown initially, but you are able to select the last 10 days (or fewer days, depending on the system uptime) or switch to a "merge loopstats" diagram, which shows all available days in one diagram (with a maximum of 10 days). All time data is using UTC.

The next sections shows version information for a number of subsystems, including the OS kernel version, NTPD version and the GPS firmware revision of the internal reference clock. Additionally, the MAC address of the first Ethernet interface can be found here. The "Mem free" value is indicating the free memory available to the system, the Disk free value is related to the ram disk of the LANTIME. Both system memory and ram disk have a total capacity of 32 MB (each). The Uptime parameter displays the time since the last boot process of the unit.

In the next section all NTP clients accessing the NTP server are listed. This list is maintained internally by NTPD, clients who did not access the NTPD for a longer period are automatically removed. This section can grow very long in large networks. There are no further information found about the parameters "code, avglen and first. The name resolution of the IP address in the first colume will take too much time; so its disabled. After that a list of all actually refclocks of the internal NTP server will be shown.

remote	refid	st	t	when	poll	reach	delay	offset	jitter
LOCAL(0)	LOCAL(0)	3	l	36	64	3	0.00	0.000	7885
lantime	.GPS.	0	l	36	64	1	0.00	60.1	15875

with the following meaning:

- remote: list of all valid time servers (ntp.conf)
- refid: reference number
- st: actual stratum value (hierarchy level)
- when: last request (seconds
- poll: period of requesting the time server (seconds)
- reach: octal notation of the successful requests, shifted left
- delay: delay of the network transmission (milliseconds)
- offset: difference between system time and reference time (milliseconds)
- jitter: variance of the offsets (milliseconds)

The last section will show some NTP specific informations about the refclock.

11.10 Configuration: Receiver
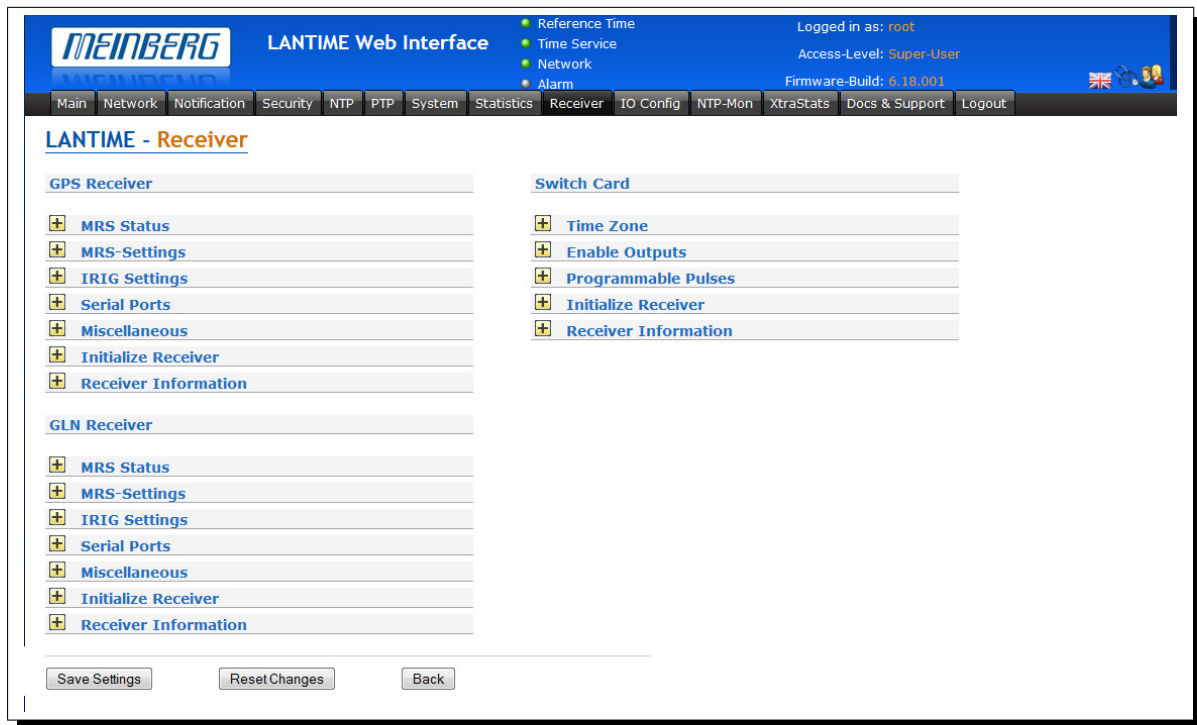
On this page you can edit the important receiver settings like "Serial Ports" or "Time Zone" and you can get an overview about the information of ypur LANTIME's internal receiver.

11.10.1 MRS Status

In this submenu, the status messages of the available references can be monitored.

11.10.2 MRS Settings

With this submenu you can setup some important parameters of the selected systems reference time:

```
┌─ MRS-Settings ──────────────────────────────────────────────┐
│                                                              │
│  ┌─ Source Priority ──────────────┐                         │
│  │                                                          │
│  │  █ 1. Source    GPS          ▼                           │
│  │  █ 2. Source    NTP          ▼                           │
│  │  █ 3. Source    PTP (IEEE1588) ▼                         │
│  │  █ 4. Source    PPS plus string ▼                        │
│  │  █ 5. Source    ext. Osc.    ▼                           │
│  │                                                          │
│  ┌─ Fixed Offset, Precision & Limit ──────┐                 │
│                                                              │
│                 Offset      Precision    Limit    Features   │
│  █ GPS            0 ns        0 ns         0 ns  ☐ Auto Bias Master  │
│  █ NTP            0 ns        0 ns         0 ns                │
│  █ PTP (IEEE1588) 0 ns        0 ns         0 ns  ☐ Auto Bias Slave  ☐ Asymmetry Step Detection │
│  █ PPS plus string 0 ns       0 ns         0 ns  ☐ Auto Bias Master │
│  █ ext. Osc.      0 ns        0 ns         0 ns                │
│                                                              │
└──────────────────────────────────────────────────────────────┘
```

In the next menu the user can define in which order the references will be used to control the internal oscillator. The reference clock with the highest priority will be used always if this is available. You can set an fixed offset for the available references in the next sub menu. By default this value is 0 ns. The bias of the internal GPS receiver can not be set up – indirectly this can be done via the antenna cable length.

Possible values for reference input signals:

GPS	GPS signal of internal receiver
PPS in	PulsePerSecond input reference
IRIG	IRIG Time Code (DCLS/AM)
NTP	external NTP time server
PTP (IEEE1588)	IEEE 1588 (Slave mode)
SyncE	TSUv3 Time Stamp Unit in MRI Slot (Slave Mode)
Fixed Freq. in	Frequency input

Each reference clock can be assigned a specific precision which will reflect the accuracy of the reference clock. This precision value will determine the hold over time when switching to the next reference clock if the current master is not available anymore. If the precision is 0 the next reference clock will be switched at once. If the precision value is greater then 0 the time for switching to the next reference (hold over time) will be calculated by the following formula: (precision of next reference) / (precision of current master) * constant [s]

The parameter „constant" depends on the quality of the internal oscillator!

Example: the external PPS with an precision of 100ns is the current master. If this master is no longer available it will switch to the next reference source of the priority order – in this case the IRIG input with an precision of 10us. With the formula ((10000ns/100ns)*11.4) we get hold over time of 19min. The online display of the MRS status will show the remaining time and the calculated time. The hold over time will be recalculated if the status of the reference clocks will change.

Auto Bias Master

"Auto Bias" provides a technology for a situation where a constant offset which is present with a given input

signal can be measured and compensated against a trusted reference automatically. The reasons for this constant offset could be a cable delay which introduces a fix offset (5ns per each m of coax cable and 3ns for fiber), a delay caused by an IRIG generator if IRIG is used as an input, or a constant offset via PTP due to a network or traffic asymmetry.

So, if you choose for example GPS as a reference signal at priority 1 while having "Auto Bias Master" activated for GPS, then GPS will be used as a measurement reference for all other sources as long as GPS is available.

If PTP is configured as a secondary priority with "Auto Bias Slave" activated, the constant offset of the PTP input signal is measured against the current "Auto Bias Master" reference (e.g. GPS) and will be compensated automatically.

Furthermore, even if PTP becomes a reference signal in case that a Master is not available, the PTP offsets will include a compensation for the initial offset measured against the previous Master automatically.

In this operating mode a smooth transition from GPS to PTP will be possible without a time step in case GPS becomes unavailable.

If PTP is then a primary sync source and an asymmetry step suddenly occurs in the network (due to path rearrangements e.g.), the occurring asymmetry step will be therefore automatically compensated as well in case "Asymmetry Step Detection" is activated.

11.10.3 IRIG Settings

With IRIG Settings you can adjust the IRIG/AFNOR outputs of the device:

B002+B122	IRIG-B 100PPS: DC Level Shift (DCLS), No carrier(DCLS), coding of time (HH,MM,SS,DDD) + modulated, 1 kHz / 1 millisecond resolution, coding of time (HH,MM,SS,DDD), Control Functions
B003+B123	like B002+B122, with second of day (0....86400)
AFNOR NF S87-500	AFNOR NFS 87-500 is a standarized french time code similar to IRIG-B but contains additional day, day-of-month and year information.
IEEE1344	Additional extensions to the IRIG-B time code: year, time quality, daylight savings time, local time offset and leap second information

11.10.4 Serial Ports

This menu lets the user configure the baud rate, the framing and the string type of the serial RS232 port to one of the following values:

Baud Rate: 300 to 19200
Framing: 7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8N1, 8N2, 8O1

Selectable Telegrams

- Meinberg Standard
- SAT
- NMEA RMC
- Uni Erlangen
- Computime
- Sysplex 1
- Meinberg Capture
- SPA
- RACAL
- Meinberg GPS
- NMEA GGA
- NMEA RMC GGA
- NMEA ZDA
- ION

COM provides a time string once per second, once per minute or on request. If the "on request" is activated you have to send the character "?" to get the time string.

Default settings: COM:19200 baud, 8N1, per second, Meinberg Standard Time String

11.10.5 Synthesiser

Here you can edit the frequency and phase to be generated by the on-board synthesizer. Frequencies from 1/8 Hz up to 10 MHz can be entered using four digits and a range. If frequency is set to 0 the synthesizer is disabled.

With "Phase" you can enter the phase of the generated frequency from –360° to +360° with a resolution of 0.1°. Increasing the phase lets the signal come out later. Phase affects frequencies less than 10.00 kHz only!

11.10.6 Time Zone

With the dropdown list you can select the local time zone. You can add more values to the list with the menu you find in "System -> Display -> Edit Time Zone Table".

11.10.7 Enable Outputs

This menu lets the user configure at which time after power up the serial ports are enabled. Outputs which are enabled "always" will be enabled immediately after power up. Outputs which are enabled "if sync" will be enabled after the integrated receiver is running in normal operation mode.

11.10.8 Miscellaneous

GPS Receiver:

1. Antenna Cable Length:
Enter the length of the antenna cable here. The received time frame is delayed by approx. 5 ns per meter antenna cable. The receiver is able to compensate this delay if the exact cable length is given. The default value is 20 m. The maximum value you can enter in this field is 500m. In case of longer cable runs you have to use an amplifier or a fiber optic connection.

2. GPS Simulation Mode (GPS Receiver)
Enabling this menu lets the user run the LANTIME without antenna. Normally the NTPD loses synchronisation with the GPS when the antenna is disconnected or the GPS did not receive enough satellites (red FAIL LED is turned on). So it is possible to set the NTPD with any other time. If this option is enabled an "*" will be shown behind the time string in the root menu of the display.

3. GPS Time Scale (GPS Receiver)
You can select between the following values:
UTC – Coordinated Universal Time (including leap seconds)
GPS – since 1th of January 1980 – equivalent to TAI Time Scale with the difference from a constant value of 19 seconds (this time scale includes the leap seconds from 1980 until today).
TAI – since 1968, 1th of January 1900 as reference start time – International Atomic Time (without Leap Seconds)

4. Logged Satellite Visibility (GPS Receiver)
If this checkbox is activated, the system generates a graphic from the constellation of the visible satellites.
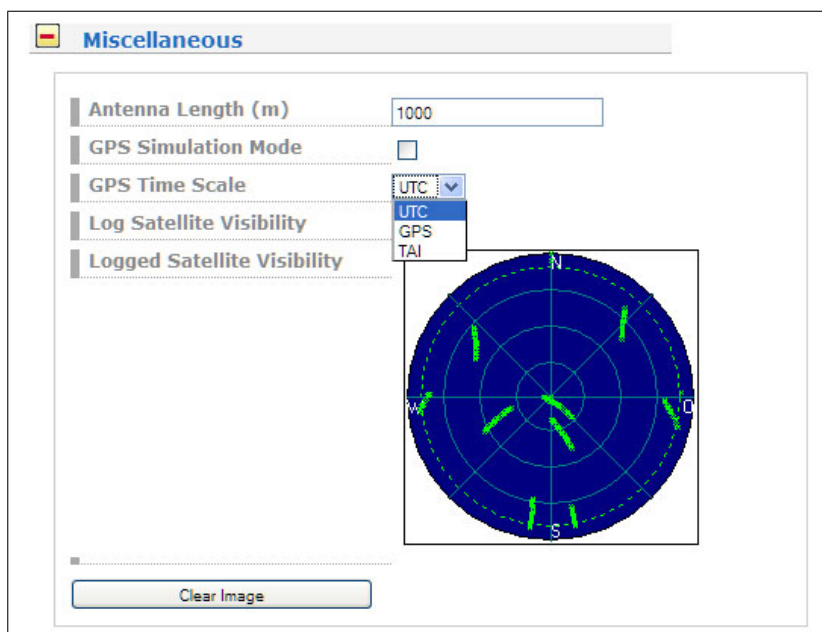
Init Receiver (GPS Receiver)

Warm Boot Mode (GPS Receiver)
You can force the receiver into the Boot Mode. This may be necessary when the satellite data in the memory are too old or the receiver position has changed by some hundred kilometres since last operation. Synchronisation time may be reduced significantly. If there is valid satellite data in the memory the system starts in the WARM BOOT mode, otherwise the system changes into COLD BOOT to read new data.

Cold Boot Mode (GPS Receiver)
With this button you can initialize all GPS data, i.e. all saved satellite data will be cleared. You have to confirm this operation before the initialisation starts. The system starts operating in the COLD BOOT mode and seeks for a satellite to read its actual parameters. Please note, that the GPS receiver needs approximately 15 minutes for the initiated COLD BOOT!

Long Wave Receiver (DCF77, MSF, WWVB):

Distance to Transmitter
In this submenu the distance to the transmitter is entered for compensating the propagation delay of the received pseudo-random code. This setting should be done as exact as possible because the absolute precision of the time frame is influenced by this value.

Simulation Mode
With "Simulation Mode" the user enable or disable the SYNC simulation mode. If you want to use the receiver without connecting an antenna this mode will simulate a valid output for the NTP daemon. This is only for test purposes. "Simulation Mode" should be disabled under normal operating conditions.

11.10.9 Receiver Information

Here you can indicate all important and relevant information about the used receiver and its internal oscillator

Receiver Information

Common Receiver Information

Name	Value
Model:	GPS170
Serial Number:	029010012290
Software Revision:	ext. PPS sync
Oscillator Type:	TCXO
Supported Features:	Pulse Per Second, Pulse Per Minute, DCF77 Time Marks, Ignore Lock
Number of Programmable Pulse Outputs:	0
Number of Serial Ports:	4

Special Receiver Information

Name	Value
GPS Status:	NORMAL OPERATION
GPS Position LLA:	Lat: 51.9828 Lon: 9.2258 Alt: 166m
GPS Position XYZ:	X:3885651m Y: 631133m Z:5001753m
Number Satellite In View:	9
Number Good Satellites:	9
Selected Satellite Set:	13 20 31 04

11.11 I/O Configuration

This menu occurs in the case of a MRS system
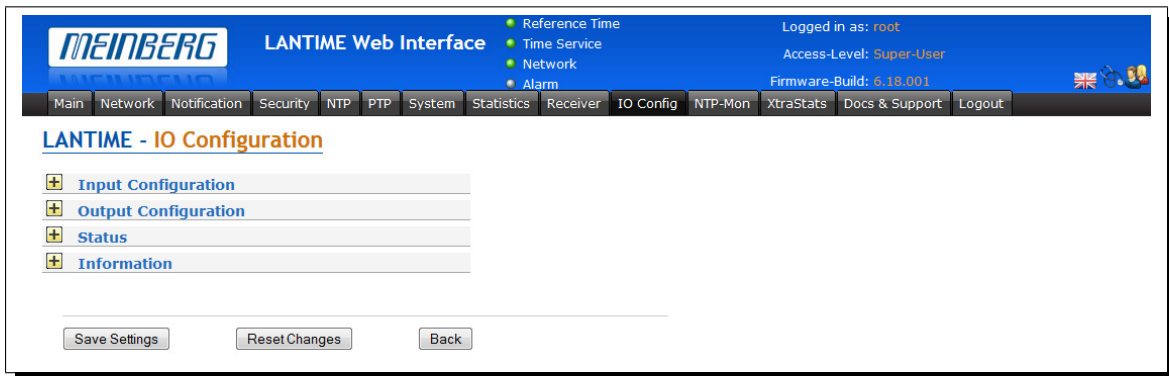
11.11.1 Configuration: Input

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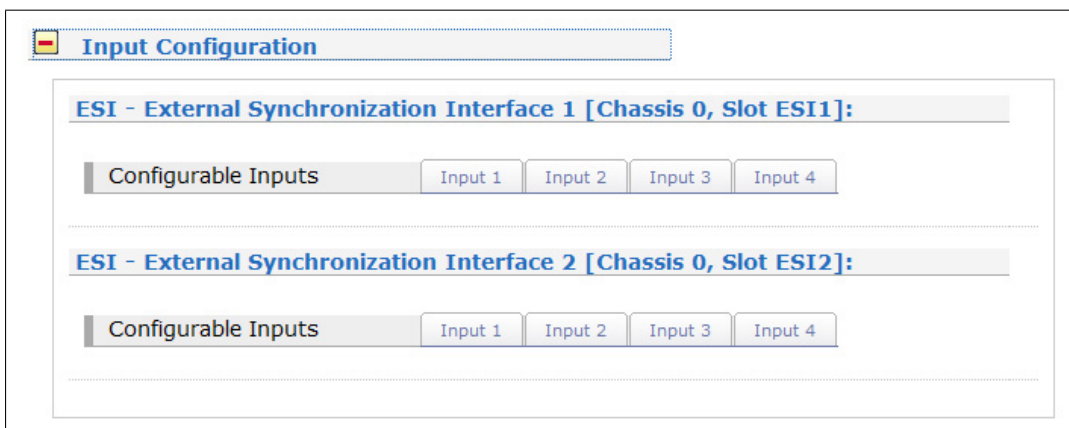
The ESI (External Synchronization Input) card is capable of adding additional synchronization sources to an IMS system. It accepts E1 and T1 sources, both as a Bitstream (2.048MBit/s/1.544Mbit/s, supporting SSM/BOC) or Frequency (2.048MHz/1.544MHz).

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

Quality Maximum SSM / Maximum BOC (quality levels for T1 framed signal)

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 lower is the bit sequence the higher is quality of the source clock. The clock source quality levels according to G.704-1998 are as follows:

0000	Quality unknown, existing synchronization network
0001	reserved
0010	Rec. G.811
0011	reserved
0100	SSU-A
0101	reserved
0110	reserved
0111	reserved
1000	SSU-B
1001	reserved
1010	reserved
1011	Synchronous Equipment Timing Source (SETS)
1100	reserved
1101	reserved
1110	reserved
1111	Do not use for synchronization

With Maximum SSM you can select the highest bit sequence level which quality is still acceptable as input signal coming from a given source clock. If clock exhibits lower quality than the configured Maximum SSM level the system will not use it for synchronization.

Example:

User configured 1000 (SSU-B) as Maximum SSM level for his system. E1 input signal coming from 0010 (Rec. G.811) or 0100 (SSU-A) will be allowed for synchronization, whereas signal coming from 1011 quality unit (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.

TSU-GbE

TSU - IEEE 1588 Time Stamp Unit
The Meinberg time stamping unit provides a platform for your IEEE 1588 / SyncE / Carrier Grade NTP infrastructure. The high-power dual-core processor, the 1-step master clock and the 1GE interface with SFP slot supports a large number of PTP clients.

IMS-HPS100

The HPS100 ("High Performance Synchronization" for networks) offers the ability to support up to 2048 PTP-Clients in Unicast (at 128 Sync/Delay Requests per second), as well as more than 250.000 DelayRequests per second in Multicast or Hybrid or 250.0000 NTP requests per second mode due to a powerful FPGA-based Packet Generator engine. It is the successor of the TSU-GbE card and includes all of its features as a basic feature set.

TSU-GbE and HPS100 configuration in PTP menu

11.11.2 Configuration: Output

With the pull-down menu "Output Configuration" the available outputs of the I/O slots can be configured:

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.

11.12 NTP Monitoring
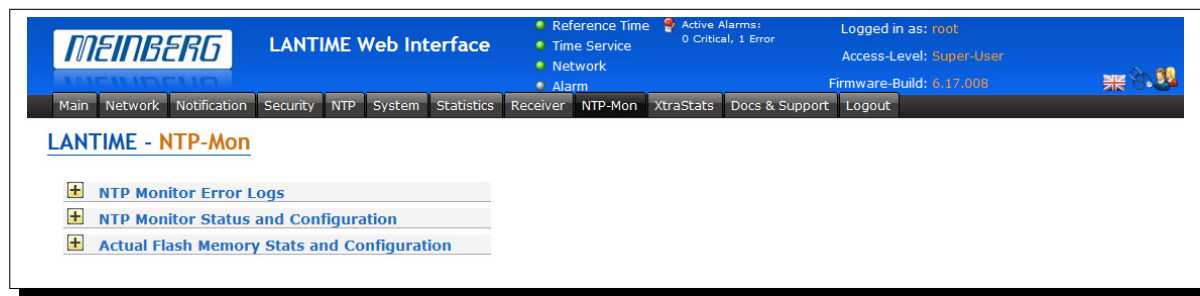
In this NTP-Mon menu the following points can be monitored or executed:

– NTP Monitor Error Logs
– Open Box NTP Monitor Status and Configuration
– Open Box Actual Flash Memory Stats and Configuration

Menu Open Box Actual Flash Memory Stats and Configuration
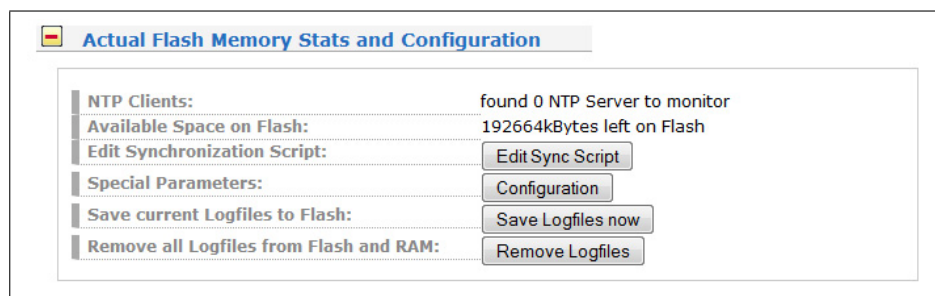
– A list of detected clients in the network.
– Available free space on the flash card of the time server.
– Editor window for your own synchronization scripts.
– Special parameters: SRC port for outgoing packets, Base Path for log files.
– The current log files can be stored on the flash card.
– All log files can be removed from the flash card.

11.13 Configuration: Documentation

This page gives you access to the documents stored on your LANTIME, especially the manuals and your own notes. The two lists include filename, language, file type, date and size of the documents/notes.

The LANTIME documents can be downloaded from here in order to read / print them on your workstation. The customer notes are a way of storing small pieces of information on your LANTIME, for example if you want to keep track of configuration changes and want to comment them, you can create a note called "config_changes" and show or edit it from here. If you want to get rid of one of your notes, you are able to delete it by choosing the appropriate button.

If you want to add a note (you can maintain more than one note on your LANTIME), after choosing the button "add note" you have to enter a filename (without a directory path, all notes are stored in a fixed directory on the flash disk of your LANTIME) and the language of your note first. After you confirmed these parameters with "Add document", you are able to edit the text of your new note.

12 Time Strings

Our integrated receivers provides the following adjustable time telegrams:

	GPS	GLN	PZF	IRIG
Meinberg Standard	☑	☑	☑	☑
Meinberg GPS	☑	☑	☒	☒
Meinberg Capture	☑	☑	☒	☑
Uni Erlangen	☑	☑	☑	☑
NMEA RMC	☑	☑	☑	☒
NMEA GGA	☑	☑	☒	☒
NMEA RMC GGA	☑	☑	☒	☒
NMEA ZDA	☑	☑	☒	☒
ATIS	☑	☑	☑	☒
SAT	☑	☑	☑	☑
SPA	☑	☑	☑	☒
ION	☑	☑	☒	☒
RACAL	☑	☑	☒	☒
Computime	☑	☑	☑	☒
Sysplex 1	☑	☑	☑	☒

12.1 Format of the Meinberg Standard Time String

The Meinberg Standard Time String is a sequence of 32 ASCII characters starting with the STX (start–of–text) character and ending with the ETX (end–of–text) character. The format is:

<STX>D:*dd.mm.yy;T:w;U:hh.mm.ss;uvxy*<ETX>

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

<STX>   Start–Of–Text, ASCII Code 02h
           sending with one bit accuracy at change of second

dd.mm.yy   the current date:

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

w   the day of
          the week   (1..7, 1 = Monday)

hh.mm.ss   the current time:

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

uv   clock status characters (depending on clock type):

u:	'#'	GPS: clock is running free (without exact synchr.)
		PZF: time frame not synchronized
		DCF77: clock has not synchronized after reset
	' '	(space, 20h)
		GPS: clock is synchronous (base accuracy is reached)
		PZF: time frame is synchronized
		DCF77: clock has synchronized after reset
v:	'*'	GPS: receiver has not checked its position
		PZF/DCF77: clock currently runs on XTAL
	' '	(space, 20h)
		GPS: receiver has determined its position
		PZF/DCF77: clock is syncronized with transmitter

x   time zone indicator:

'U'	UTC	Universal Time Coordinated, formerly GMT
' '	CET	European Standard Time, daylight saving disabled
'S'		(CEST) European Summertime, daylight saving enabled

y   anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:

'!'	announcement of start or end of daylight saving time
'A'	announcement of leap second insertion
' '	(space, 20h) nothing announced

<ETX>   End–Of–Text, ASCII Code 03h

12.2 Format of the Meinberg GPS Time String

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

\<STX\>D:*tt.mm.jj;T:w;U:hh.mm.ss;uvGy;lll*\<ETX\>

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

\<STX\>	Start–Of–Text (ASCII code 02h)

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

w   the day of the week (1..7, 1 = monday)

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

uv   clock status characters:
        u: '#'   clock is running free (without exact synchr.)
             ' '   (space, 20h)
                       clock is synchronous (base accuracy is reached)

        v: '*'   receiver has not checked its position
             ' '   (space, 20h)
                       receiver has determined its position

G   time zone indicator 'GPS–Time'

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

lll   number of leap seconds between UTC and GPS–Time
        (UTC = GPS–Time + number of leap seconds)

\<ETX\>   End–Of–Text, (ASCII Code 03h)

12.3 Format of the Meinberg Capture String

The Meinberg Capture String is a sequence of 31 ASCII characters terminated by a CR/LF (Carriage Return/-Line Feed) combination. The format is:

CH*x_tt.mm.jj_hh:mm:ss.fffffff*<CR><LF>

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

x	0 or 1 corresponding on the number of the capture input
_	ASCII space 20h

dd.mm.yy the capture date:

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

hh:mm:ss.fffffff the capture time:

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

<CR>	Carriage Return, ASCII Code 0Dh
<LF>	Line Feed, ASCII Code 0Ah

12.4 Format of the Uni Erlangen String (NTP)

The time string Uni Erlangen (NTP) of a GPS clock is a sequence of 66 ASCII characters starting with the STX (start–of–text) character and ending with the ETX (end–of–text) character. The format is:

<STX>*tt.mm.jj; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.lllle hhhhm*<ETX>

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

<STX>   Start–Of–Text, ASCII Code 02h
           sending with one bit occuracy at change of second

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

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

v   sign of the offset of local timezone related to UTC

oo:oo   offset of local timezone related to UTC in hours and minutes

ac   clock status characters:
           a: '#'   clock has not synchronized after reset
                    ' '   (space, 20h) clock has synchronized after reset

           c: '*'   GPS receiver has not checked its position
                    ' '   (space, 20h) GPS receiver has determined its position

d   time zone indicator:
           'S'   CEST   European Summertime, daylight saving enabled
           ' '   CET   European Standard Time, daylight saving disabled

f   anouncement of discontinuity of time, enabled during last hour
           before discontinuity comes in effect:
           '!'   announcement of start or end of daylight saving time
           ' '   (space, 20h) nothing announced

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

i   leap second insertion
           'L'   leap second is actually inserted
                    (active only in 60th sec.)
           ' '   (space, 20h) no leap second is inserted

bbb.bbbb   latitude of receiver position in degrees
           leading signs are replaced by a space character (20h)

n   latitude, the following characters are possible:

'N'	north of equator
'S'	south d. equator

lll.lllll	longitude of receiver position in degrees leading signs are replaced by a space character (20h)

e	longitude, the following characters are possible: 'E' east of Greenwich 'W' west of Greenwich

hhhh	altitude above WGS84 ellipsoid in meters leading signs are replaced by a space character (20h)

<ETX>	End-Of-Text, ASCII Code 03h

12.5 Format of the NMEA 0183 String (RMC)

The NMEA String is a sequence of 65 ASCII characters starting with the '$GPRMC' character and ending with the characters CR (carriage return) and LF (line-feed). The format is:

$GPRMC,*hhmmss.ss,A,bbbb.bb,n,lllll.ll,e,0.0,0.0,ddmmyy,0.0,a*hh*<CR><LF>

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

$	Start character, ASCII Code 24h	
	sending with one bit accuracy at change of second	

hhmmss.ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	ss	fractions	
		of seconds	(1/10 ; 1/100)

A	Status	(A = time data valid)
		(V = time data not valid)

bbbb.bb	latitude of receiver position in degrees
	leading signs are replaced by a space character (20h)

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

lllll.ll	longitude of receiver position in degrees
	leading signs are replaced by a space character (20h)

e	longitude, the following characters are possible:	
	'E'	east of Greenwich
	'W'	west of Greenwich

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

a	magnetic variation

hh	checksum (EXOR over all characters except '$' and '*')

<CR>	Carriage Return, ASCII Code 0Dh

<LF>	Line Feed, ASCII Code 0Ah

12.6 Format of the NMEA 0183 String (GGA)

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

$GPGGA,*hhmmss.ss,bbbb.bbbbb,n,lllll.ll,e,A,vv,hhh.h,aaa.a,M,ggg.g,M,,0*cs*<CR><LF>

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

$	Start character, ASCII Code 24h sending with one bit accuracy at change of second

hhmmss.ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	ss	fractions of seconds	(1/10 ; 1/100)

A	Status	(A = time data valid) (V = time data not valid)

bbbb.bbbbb	latitude of receiver position in degrees leading signs are replaced by a space character (20h)

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

lllll.lllll	longitude of receiver position in degrees leading signs are replaced by a space character (20h)

e	longitude, the following characters are possible:	
	'E'	east of Greenwich
	'W'	west of Greenwich

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

12.7 Format of the NMEA 0183 Telegram (GLL)

GLL – Geographic Latitude and Longitude is a holdover from Loran data and some old units may not send the time and data active information if they are emulating Loran data.

$GPGLL,*bbbb.bb,n,llll.ll,e,hhmmss,d,*cs*<CR><LF>

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

$ Start character, ASCII Code 24h
            sending with one bit accuracy at change of second

bbbb.bb   latitude of receiver position in degrees
            leading signs are replaced by a space character (20h)

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

lllll.ll   longitude of receiver position in degrees
            leading signs are replaced by a space character (20h)

e   longitude, the following characters are possible:
            'E'   east of Greenwich
            'W'   west of Greenwich

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

d   Data valid A or V (not valid)

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

<CR>   Carriage Return, ASCII Code 0Dh

<LF>   Line Feed, ASCII Code 0Ah

12.8 Format of the NMEA 0183 String (ZDA)

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

$GPZDA,*hhmmss.ss,dd,mm,yyyy,HH,II*cs*<CR><LF>
ZDA – Time and Date: UTC, day, month, year and local timezone.

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

$	Start character, ASCII Code 24h		
	sending with one bit accuracy at change of second		
hhmmss.ss	the current UTC time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59 or 60 while leap second)
HH,II	the local timezone (offset to UTC):		
	HH	hours	(00..+-13)
	II	minutes	(00..59)
dd,mm,yy	the current date:		
	dd	day of month	(01..31)
	mm	month	(01..12)
	yyyy	year	(0000..9999)
cs	checksum (EXOR over all characters except '$' and '*')		
<CR>	Carriage Return, ASCII Code 0Dh		
<LF>	Line Feed, ASCII Code 0Ah		

12.9 Format of the ATIS standard Time String

The ATIS standard Time String is a sequence of 23 ASCII characters terminated by a CR (Carriage Return) character. The format is:

<GID><ABS><TSQ><CC><CS><ST>*yymmddhhmmsswcc*<GID><CR>

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

<GID>	Address of the receiver		code 7Fh
<ABS>	Originator of message	ASCII '0'	code 30h
<TSQ>	Telegram number	ASCII '0'	code 30h
<CC>	Command code	ASCII 'S' for SET	code 53h
<CS>	Command code	ASCII 'A' for ALL	code 41h
<ST>	Time status	ASCII 'C' for valid time	code 43h

yymmdd	the current date: yy year of the century mm month dd day of month	(00..99) (01..12) (01..31)
hh:mm:ss	the current time: hh hours mm minutes ss seconds	(00..23) (00..59) (00..59, or 60 while leap second)
w	the day of the week	(1..7, 1 = 31h = Monday)
cc	checksum in hex, built from all characters including GID, ABS, TSQ, CC, ST, ...	
<CR>	Carriage Return, ASCII code 0Dh	

(The standard interface configuration for this string type is 2400 baud, 7E1)

12.10 Format of the SAT Time String

The SAT Time String is a sequence of 29 ASCII characters starting with the STX (start-of-text) character and ending with the ETX (end-of-text) character. The format is:

<center>**<STX>***dd.mm.yy/w/hh:mm:ssxxxxuv***<ETX>**</center>

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

<STX>	Start-Of-Text, ASCII Code 02h	
	sending with one bit accuracy at change of second	

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

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

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

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

v	anouncement of discontinuity of time, enabled during last hour	
	before discontinuity comes in effect:	
	'!'	announcement of start or end of daylight saving time
	' '	(space, 20h) nothing announced

<CR>	Carriage Return, ASCII Code 0Dh

<LF>	Line Feed, ASCII Code 0Ah

<ETX>	End-Of-Text, ASCII Code 03h

12.11 Format of the SPA Time String

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

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

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

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

12.12 Format of the ION Time String

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

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

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

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

ddd   day of year   (001..366)

hh:mm:ss the current time:
          hh   hours   (00..23)
          mm   minutes   (00..59)
          ss   seconds   (00..59, or 60 while leap second)
          q   Quality
                  indicator   (space) Time Sync (GPS lock)
                                         (?) no Time Sync (GPS fail)

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

<LF>   Line-Feed (ASCII code 0Ah)

12.13 Format of the RACAL standard Time String

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

<div align="center">

<X><G><U>*yymmddhhmmss*<CR>

</div>

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

<X>	Control character sending with one bit accuracy at change of second	code 58h
<G>	Control character	code 47h
<U>	Control character	code 55h

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

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

<CR>	Carriage Return, ASCII code 0Dh

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

12.14 Format of the Computime Time String

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

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

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

T   Start character
            sending with one bit accuracy at change of second

yy:mm:dd   the current date:
            yy   year of the century   (00..99)
            mm   month   (01..12)
            dd   day of month   (01..31)
            ww   the day of the week   (01..07, 01 = monday)

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

<CR>   Carriage Return, ASCII Code 0Dh

<LF>   Line Feed, ASCII Code 0Ah

12.15 Format of the SYSPLEX-1 Time String

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

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

The format is:

<p align="center"><SOH>ddd:hh:mm:ssq<CR><LF></p>

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

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

ddd   day of year   (001..366)

hh:mm:ss   the current time:
            hh   hours   (00..23)
            mm   minutes   (00..59)
            ss   seconds   (00..59, or 60 while leap second)
            q   Quality
                   indicator   (space) Time Sync (GPS lock)
                                (?) no Time Sync (GPS fail)

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

<LF>   Line-Feed (ASCII code 0Ah)

13 USB Stick

Most LANTIME M-Series products come with a USB interface for connectiong 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

When connecting the USB stick the LC Display will – after a few seconds – signal that the USB stick has been detected and allows you to enter the USB menu with the „OK" button.

```
       USB
   MEMORY STICK
     MAIN MENU
```

The desired menu function can be chosen by using ↑ and ↓ keys and it will be activated with the „OK" button. You can leave this menu with removing the USB storage or with the "ESC" button.

13.1 Menu Backup Configuration to USB Stick

In this submenu you can copy the configuration file from your LANTIME to the USB storage device.Now you can find this configuration on your USB storage device under */Lantime/Config/*. To use this configuration file for other LANTIMEs, the directory name */Lantime/Config/USB_Backup/***your-serial-number** must be changed to **ANY_SN**.

```
copy configuration
to memory stick
INC  -> YES
MENU -> NO
```

13.2 Menu Write Diagnostic File to USB Stick

```
USB Stick Menu
(OK to confirm)
Write Diagnostic
File to USB Stick
```

This submenu is an easy way to get the contents of the LANTIMEs diagnostic files. After you push the OK button, the system will copy a file archive to your USB device: */ltdiag.tgz*

13.3 Keypad locking

The USB stick can be used for locking the function buttons of the LANTIME LC Display. Activating this feature the user cannot use the buttons without connecting the USB stick to the LANTIME. The access authorisation has been realized with a password file on the USB stick */Lantime/keypad_lock*. This password file will be compared with. So it is possible to manage different LANTIME with one USB stick.

The keypad locking will be activated with a submenu from the USB stick:

```
SETUP: USB STICK
prepare frontpanel
keypad locking
```

```
SETUP: USB STICK
remove frontpanel
keypad locking
```

When activating this submenu the file */mnt/flash/config/keypad_lock* will be copied to the internal flash. When de-activating the keypad locking this file will be removed from the internal flash.

NOTE:
Make sure, that you never loose the "Keypad_Lock" file or the USB storage device! If you have problems, please contact Meinberg Radio clocks: Mail an info@meinberg.de .

13.4 Menu Restore Configuration

With this command the LANTIME configuration can be restored. Caution: Configuration is active now but not persistent. One of the following steps saves the configuration persistently:

Via the Web Gui	->	Save as Startup Configuration
Via CLI	->	savenconfig command
Via the Display	->	toggling to a menu item like as Network -> Global Configuration -> Hostname confirm with OK, then save with F2 function key.

```
USB Stick Menu
(OK to confirm)
Restore Config.
and REBOOT!
```
OK →
```
rebooting System
...
```

Please remove the USB storage device when the display shows "rebooting system..."

13.5 Menu LANTIME Firmwareupdate

In this submenu you can update the firmware of your LANTIME via USB Stick.

To do so, the update file must be copied onto the USB Stick. After inserting the stick into the LANTIME please confirm to install the new firmware (Install xx.xx.xxx). The new firmware is active after rebooting the system.

```
USB Stick Menu
(OK to confirm)           OK         rebooting System
Install xx.xx.xxx     ----------->   ...
```
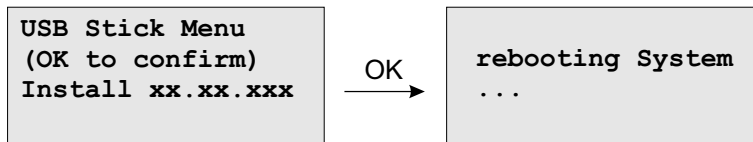
14 List of Literature

[**Mills88**]   Mills, D. L., "Network Time Protocol (Version 1) – specification and implementation",
DARPA Networking Group Report RFC-1059, University of Delaware, July 1988

[**Mills89**]   Mills, D. L., "Network Time Protocol (Version 2) – specification and implementation",
DARPA Networking Group Report RFC-1119, University of Delaware, September 1989

[**Mills90**]   Mills, D. L., "Network Time Protocol (Version 3) – specification, implementation and analysis",
Electrical Engineering Department Report 90-6-1, University of Delaware, June 1989

Kardel, Frank, "Gesetzliche Zeit in Rechnernetzen", Funkuhren, Zeitsignale und Normalfrequenzen,
Hrsg. W. Hilberg, Verlag Sprache und Technik, Groß-Bieberau 1993

Kardel, Frank, "Verteilte Zeiten", ix Multiuser-Multitasking-Magazin, Heft 2/93,
Verlag Heinz Heise, Hannover 1993