EVENT TIMER A033/USB AND SYNCHRONIZATION SYSTEM LANTIME M3000

Reception report: specifications and setup instructions

YLARA Project

YLARA-LS-50-I01/YLARA-BS-30-I01 (CDT Technical Report 2019-06)

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July, 2019

Acknowledgments

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EVENT TIMER A033-ET/USB

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March, 6th, 2019

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Applicable and reference documents

[1] Event timer A033-ET/USB Datasheet. Eventech Ldt, Riga. 2014.

[2] Event timer A033-ET/USB - User´s manual.

[3] http://eventechsite.com/en/products/event-timer-a033-etusb/

1. Event Timer A033-ET / USB

1.1. Introduction

A033-ET is the third generation product of the famous Riga Event Timers family.

Distinguishing feature of the product is extremely high precision (better than 5 picoseconds) combined with high measurement rate (up to 20 MSPS) and low price comparing to other similar high-tech instruments.

Combining the A033-ET with application-specific software, a number of top-quality and reasonably priced event timer systems can be created. As it is a custom made instrument, modifications that provide certain special user's requirements are possible upon request.

Figure 1: A033-ET/USB front (19" rack version).

Figure 2: A033-ET/USB back.

A033-ET/USB is a new version of Event Timer A033-ET launched in autumn 2014. New features of A033-ET/USB include:

- New calibration and master clock module. The module provides for more qualitative master clock and calibration repeatability independence in full temperature range from +5 up to +45 °C.

- Inputs for various signal standards. Special high quality switches allow choosing between NIM and LV TTL signal types.
- USB2 interface with computer. USB2 interface allowing to increase the continue average measurement rate up to 1.3 M events per second.

1.1.1. Part list

- A033-SYSTEM/A033-ET/USB (SN: 33201).
- Installation USB flash.
- A033-ET manual.
- Precision test protocol.
- Connecting cable (RS code: 815-8488). The cable connector (micro USB B plug) does not match with the Event timer USB connector (type B jack).
- Power cord.

1.2. Working principle

The Event Timer A033-ET is a computer-based instrument that measures time instants when input events (represented by electrical pulses) occur.

Distinguishing feature of the A033-ET is extremely high precision combined with a high measurement rate. In particular, **single-shot RMS resolution better** than **5 ps** and measurement rate up to 20 MEPS in burst make the A033-ET one of a few best event timers currently available.

Combining the A033-ET hardware (ET-device) with application-specific software, a number of top-quality and reasonably priced event timer systems can be created. As a A033-ET version with Parallel Port interface the A033-ET/USB with USB2 interface is well suited for applications related to **Satellite Laser Ranging** (SLR), but having the higher measurement rate (**1 MEPS continuously**) it can additionally used in many other applications, such as LIDAR and 3-D scan systems, time-of-flight and time-of-life spectroscopy, data transfer by laser link, signal analysis etc.

The ET-device offers **two inputs** (A and B) to measure events on these inputs alternately with 50 ns dead time. Result of every single measurement (epoch time-tag) is represented in digital form with 1 ps LSB resolution. Time-tags appear at the timer's output in order of event measurement. Each time-tag is marked to indicate the input where the measured event came from. It is well suitable to measure the overlapped time intervals between Start and Stop events that come at the separate inputs (either A or B) of the ET-device in arbitrary order.

In particular, this is the case of advanced SLR at KHz repetition rate. The input B can be externally gated by a control signal connected to the input GATE.

The ET-device (with the included networking SW) provides network interface based on TCP/IP communication protocols to interact with any remote application requiring precise event timing.

Such interfacing is well suited for designing distributed multi-user event timer systems where user's application software is separated from the specialized software supporting event measurement. In this case the user's software can remotely control the A033-ET/USB full operation.

Usually the high precision of event timers is provided by an interpolation measurement that is used in addition to the basic measurement performed in a digital way. There are a few wellknown methods for interpolation measurements (such as time interval stretching, time-to amplitude conversion, vernier method, etc). However, mostly the interpolation measurements performed on the basis of these methods are characterised by a high hardware complexity, requiring considerable engineering know-how for designing, manufacturing and adjusting of the hardware. Mainly for this reason the most of top-quality event timers are distinguished by rather high manufacturing costs.

To solve this problem, a specific DSP-based method for event timing is used in the latest designs of Riga Event Timers. According to this method, each input event is converted to an analog signal with some predefined shape. Actually this is simply a generating of such signal at the time instant determined by the respective input pulse. Then, this signal is digitised using typical A/D converter and digitally processed to estimate its position relative to the periodic sampling pulse sequence. If the ordinal numbers of the processed signal samples are known, the signal processing made in the proper way will result in an estimate of the time of event occurring.

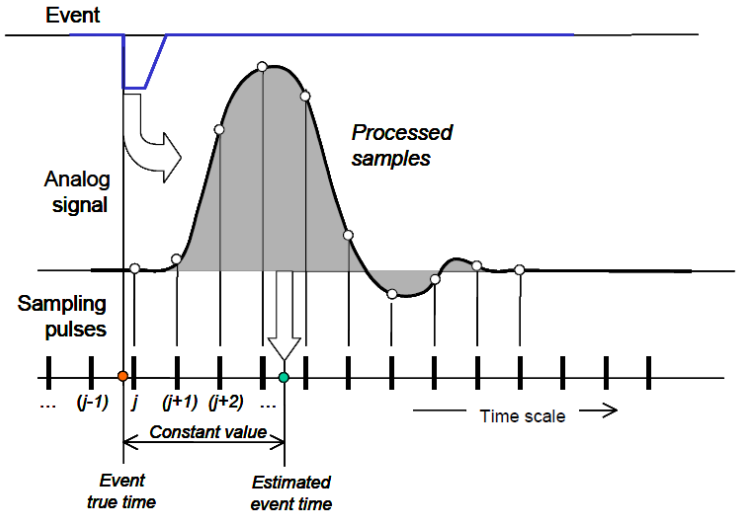

Figure 3: Principle of DSP-based method for event timing.

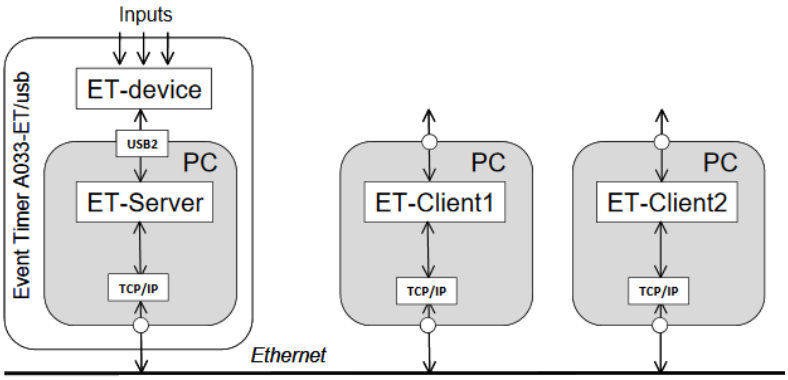

Figure 4: System block diagram.

1.2.1. Performance characteristics

Device performance characteristics:

Device is calibrated at ambient temperature	22.5 °C
The best single-shot RMS resolution	2.5 ps
RMS degradation in temperature +/- 7.5 °C	up to 2.8 ps
Integral non-linearity error (RMS)	0.8 ps
Interval non-linearity error	+/- 0.4 ps (STD 60 fs)
Single-input offset drift (+/- 7.5 °C)	0.6 ps/ °C
Input-to-input offset drift (+/- 2.5 °C)	0.1 ps/ °C

Precision Tests Protocol is attached.

Quality Testing Manager /Eugene Boole/

Figure 5: A033-ET (SN: 33201) test protocol results.

- **Single-shot RMS resolution** is the main parameter specifying the practicable A033-ET precision. For the A033-ET it is defined as the **standard deviation of total error** in measurement of time intervals between events.

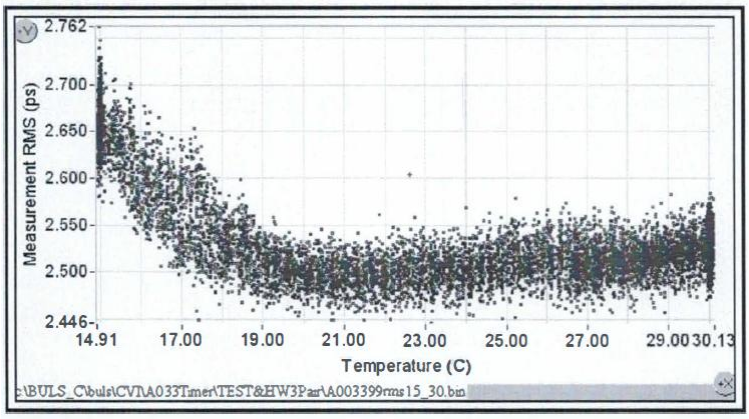

Figure 6: Single shot rms resolution.

- **Integral non-linearity error** is a systematic error in event measurement that depends on the position of measured event over interpolation interval. In the average, this error is specified by the value of **its standard deviation over interpolation interval**.

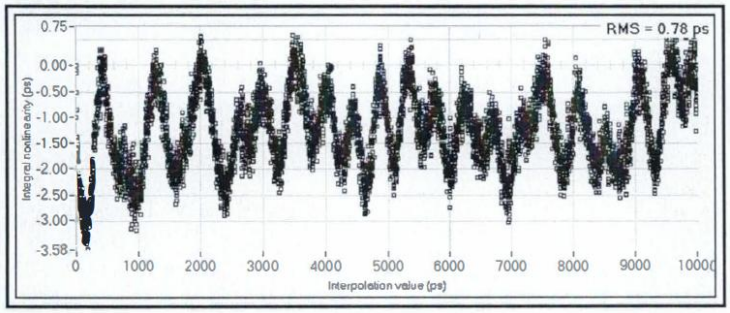

Figure 7: Integral non-linearity error.

- **Interval non-linearity error** is a systematic error in measurement of time interval between adjacent events that depends on the value of this interval.

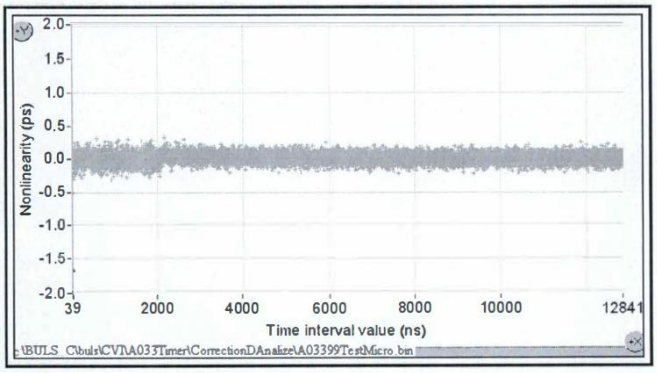

Figure 8: Interval non-linearity error.

- **Single-input offset drift** is seen as **long-term deviation** of systematic error in measurement of events coming at the same input of the event recorder. Such drift reflects long-term instability of the internal time-base relative to the external 10 MHz reference frequency, depending mainly on the ambient temperature variation.

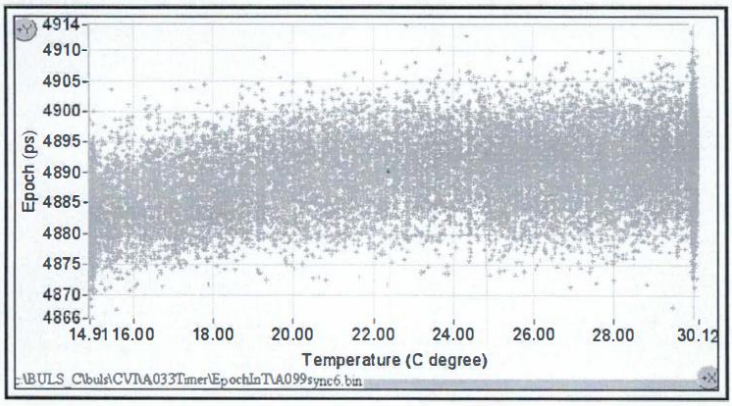

Figure 9: Single-input offset drift.

- **Input-to-input offset drift** is seen as long-term deviation of systematic error in time interval measurement between Start and Stop events coming at the different inputs A and B of the event timer respectively.

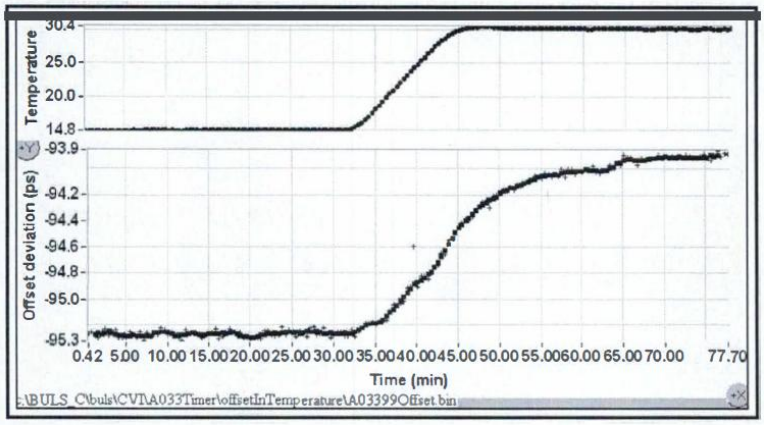

Figure 10: Input-to-input offset drift.

- **Maximum burst rate** means the maximum measurement rate available for a specified amount of sequential events. It is limited by the duration of single measurement and performance of the hardware buffer memory. The A033-ET/USB supports 20 MSPS burst rate for sequences of up to 2600 events and 12.5 MSPS burst rate for sequences of up to 16000 events.
- **Maximum average rate** means the maximum rate of continuous (gapless) event measurement over a long period of time. It is limited by carrying capacity of the timer's hardware interfacing with PC. The A033-ET/USB hardware interacts with the Server PC via USB2 port, providing the average rate more than 1 million events per second.

1.2.2. Summary of specifications

Inputs (BNC, 50 Ω) INPUT A: INPUT B: GATE IN: 1 PPS IN: REF IN:	 Fast-negative NIM logic pulses (> 4 ns width)* Fast-negative NIM logic pulses (> 4 ns width)* Fast-negative NIM logic pulses ("1" enables Input B)* Positive TTL/LVTTL pulses 10 MHz (>0.5 V peak-to-peak)
Single-shot RMS resolution:	3 ÷ 4 ps typically, 5 ps maximum
Dead time:	50 ns
Measurement rate Maximum burst rate: Maximum average rate	 20 MEPS for 2 600 sequential events 12,5 MEPS for 16 000 sequential events 1 MEPS (million events per second)
Integral non-linearity:	<2 ps RMS
Interval non-linearity:	±0.5 ps maximum (for time intervals greater than 100 ns)
Gating of "INPUT B"	by external pulses at the input GATE IN
Internal clock:	100 MHz, locked to 10 MHz external reference frequency
Hardware interface:	via USB2 port
Application interface:	over TCP/IP communication protocols
Server software:	MS-Windows based
Accessory software:	DEMO Client software (project in LabWindows/CVI 8.0)
Hardware dimension, weight:	367x65x265 mm; 2.0 kg
Power supply:	100…240 VAC

* positive LVTTL pulses are possible optionally

Figure 11: ET summary of specifications.

Model	**A032-ET**	**A033-ET**	**A093-ET**	**A033-ET/usb**
Single-shot RMS resolution:				
for intervals	7 – 8 ps	2.5 – 3 ps	<5 ps	2.5 – 3 ps
for time-tags	5 - 6 ps	1.8 - 2.2 ps	<3.5 ps	1.8 - 2.2 ps
Temperature stability of RMS resolution	<1.5 ps/oC	<0.5 ps/oC	<0.5 ps/oC	<0.5 ps/oC
Integral NLE	<2ps	~1 ps	~1 ps	~1 ps
Interval NLE	<1 ps	<0.5 ps	<0.5 ps	<0.5 ps
Single-input offset drift	--	<2 ps/oC	<2 ps/oC	<2 ps/oC
Input-to-input drift	~0.4 ps/oC	~0.1 ps/oC	~0.1 ps/oC	~0.1 ps/oC
FIFO depth (events)	12000 events	16 K events	16 K events	16 K events
Max. rate for <=2600 events	16 MSPS	20 MSPS	20 MSPS	20 MSPS
Max. rate for <=16 K events	17 MSPS	12.5 MSPS	1 MSPS	12.5 MSPS
Max. rate for > 1 M events	10 KSPS	30 KSPS*	1 MSPS	1.3 MSPS

* Increasing up to 60 KSPS is possible by special agreement if the Parallel Port allows 4-bytes groups reading

Figure 12: Performance comparison.

1.3. Preparing the event timer for operation

As mentioned, the A033-ET/usb is configured as the specialized ET-device connected to PC with the ET-server via USB port, and to external signal sources. To achieve the best measurement accuracy and full functionality the A033-ET/usb should be combined with an external high-performance source of 10MHz reference and 1 pps sync pulses (such as GPS Time and Frequency Standard). Although the user program can be executed on the same PC, it is recommended to use a separate PC for the ET-server if high-speed timer operation is especially needed.

1.3.1. Connections

Connectors (front panel)

INPUT A and **INPUT B** (BNC connectors, 50 Ohm impedance) - two electrically identical inputs of the events to be measured. Each event should be represented by a falling edge of a NIMstandard pulse (fall time <2 ns) (or rising edge of LVTTL pulse in the device with inputs TTL configuration1). Width of pulses can be from 5 to 40 ns; the pulses having greater width aren't recommended in view of possible channel-to-channel crosstalk). The input pulses from both inputs are logically equal but the ET-device identifies which input has taken the pulse that was time-tagged. The LEDs located near to connectors indicate presence of these signals at the inputs right after powering the device. However, during calibration procedure and until the start of measurement the indicating LEDs are not flashing.

EXT REF – LED indicating the presence of the external reference connected to the corresponding input at the rear panel.

POWER LED – switch for power On/Off (LED "POWER" indicates when power is On).

Connectors (rear panel)

POWER – connector for device powering.

REF IN (BNC connector, 50 Ohm impedance) – input for the external reference (10 MHz, >0.5 V p-p). Maximum offset of this frequency (including the offset caused by long-term deviation) should not exceed ±0.5 kHz. The external reference replaces the internal one automatically after connecting. Located on the front panel LED "EXT REF" indicates the presence of the external reference.

GATE IN (BNC connector, 50 Ohm impedance) – input of the NIM pulses (or LVTTL pulses in TTL configuration) that define a time window where the events at the **INPUT B** will be recorded by the ET-device (can be used optionally). High level of these pulses (or leaving the input **GATE IN** disconnected) enables the input **B**.

AUX1 OUT and **AUX2 OUT** (BNC connectors) – generate auxiliary signals (for optional use). In particular, the NIM pulses at the **AUX2 OUT** (TTL pulses at the **AUX1 OUT**) can be used for self-test or to trigger related processes. A period of this signal is preset from the ET-client.

USB – for connection with the PC USB host connection. To avoid eventual problems it is recommended shielded cable not more than 3m for this connection.

TRIG IN (BNC connector, 50 Ohm impedance) - input of the TTL pulse that defines an external start of current measurement (can be used optionally).

1 PPS IN (BNC connector, 50 Ohm impedance) – input of TTL sync pulses that define the real time incrementing by 1 s. (Note. It is supposed that both the reference signal and the sync 1 PPS pulses are mutually synchronized).

The ET-device doesn't need any manual controls (except Power On/Off), can operate for long time in the environment temperature range from 0 to 50°C. However, to provide the best performance, it is recommended to maintain ambient temperature in the range from 15 to 30°C.

The ET-device should be warmed after power-On during 1 hours approx. to support the specified precision and long-term stability of the measurement. For highest-accuracy applications it is recommended to protect the ET-device against abrupt changes of the ambient temperature and from direct electromagnetic radiation (for example, mobile telephone in active mode).

1.3.2. PC requirements

The PC supporting exclusively the ET-server should conform to the following requirements:

- 1GHz or faster processor.
- Windows XP/Vista/7/8 installed.
- Video adapter and monitor supporting at least 800x600 pixel @ 256 color mode.
- Free USB high-speed port.
- Network Card supporting TCP/IP standards.
- At least 512MB of RAM.
- Free space on hard disc at least 10 MB.

1.3.3. ET-server software installation

See user´s manual (page 13).

- A033usbServer. Server software providing remote control and application for A033/USB via TCP/IP.
- A033usbClient. DEMO for Client software interacting with the Server via TCP/IP and Project in LabWindow/CVI with program codes.
- SampleUSB. Sample program in C working with A033-ET/USB via USB.

WARNING!

- LINUX drivers only from DIGOS: not supplied by Eventech.
- Install always as Administrator.
- For USB drivers setup: follow the unsigned drivers procedure.
- Once the server software is correctly installed: the folders ..\A033usb\Clien\Client files and ..\SampleUSB\Sample files can be simply copied to PC HDD. Executable programs in these copied folders will work without additional installation.
- Event timer must be ON before running program.

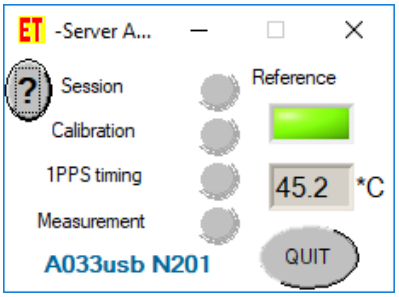

Figure 13: ET server.

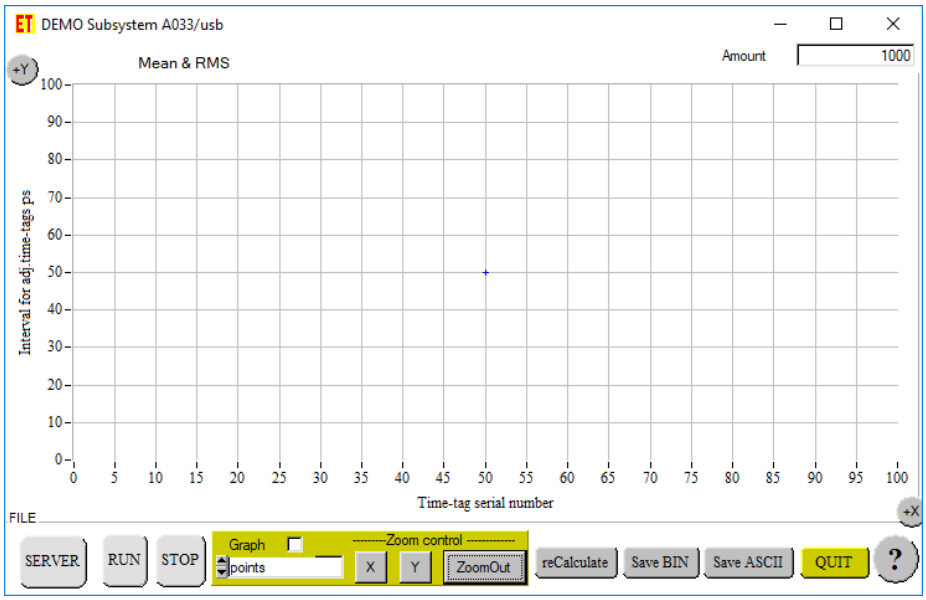

Figure 14: ET client.

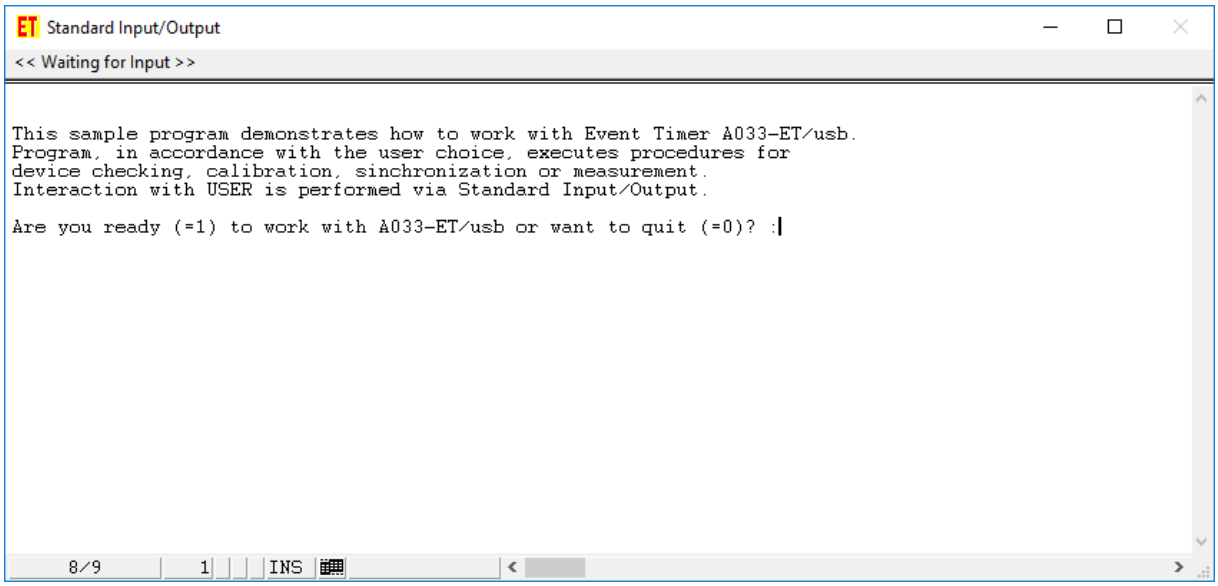

Figure 15: ET DEMO.

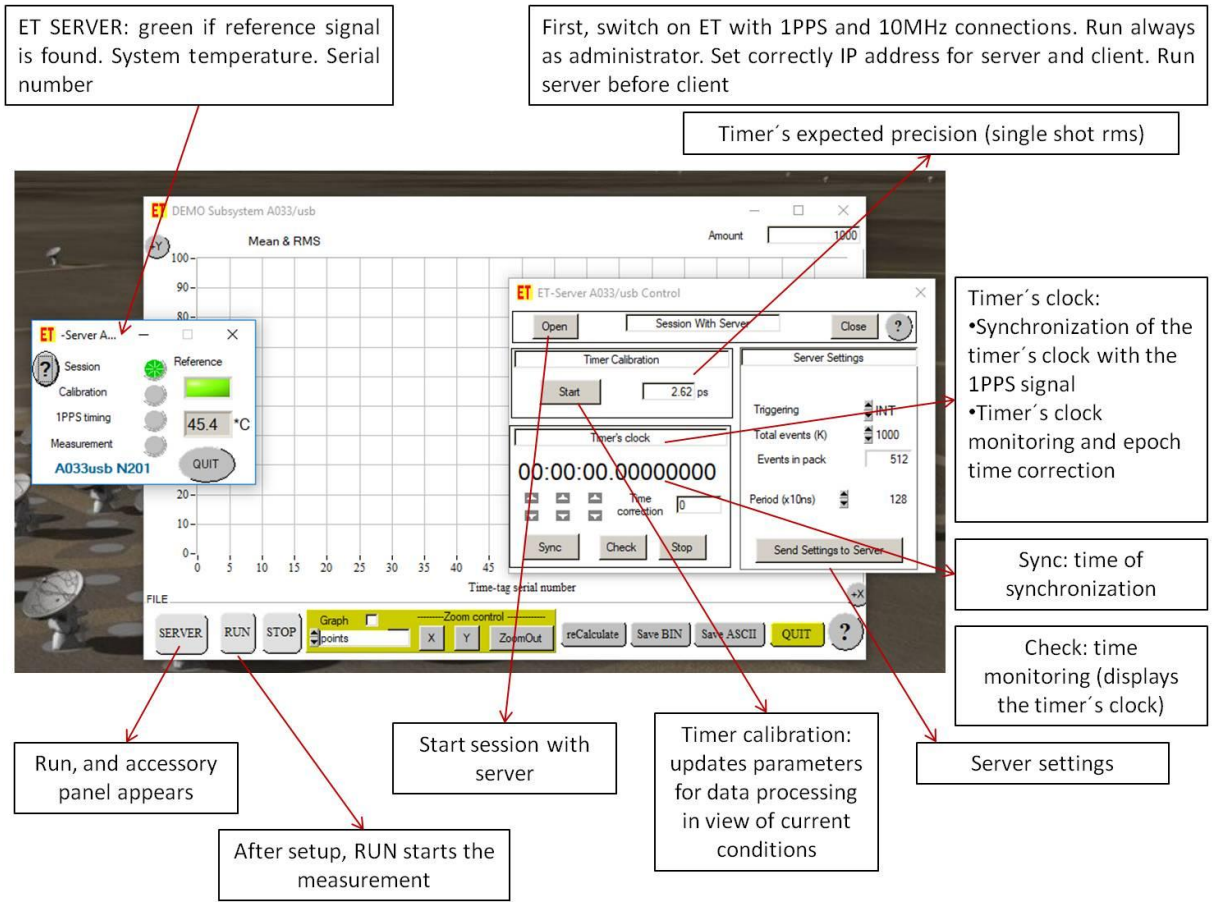

Figure 16: Software Windows.

1.4. Demo client software

An example of user program providing the remote control of the A033-ET/USB device and measurement data simple processing is supplied. This “DEMO Client software” program allows checking ET-device functionality and A033-ET/USB timing possibilities directly after the device purchase. It also can be used for creating various event timing systems tailored to the specific user’s requirements. The formal protocol description for exchange with A033-ET/USB via TCP/IP network is supplied, too.

Additionally, a sample of console program in ANSI C language is supplied with instrument driver DLL and corresponding library. This program presents all necessary calls for DLL functions executing the device identification, calibration, synchronization and measurement. As result this sample together with the A033-ET hardware represent a basis for creating various event timing systems, integrating the event timing software with user-specific functions within one application system.

See user´s manual for details (page 15).

2. Annexes

2.1. Event Timer Daemon

The Event Timer Daemon (ETD) is a complete replacement for the ET Server software running on Linux. It is based on the original ET Server software from developers of the Riga Event Timer and allows a seamless integration into existing SLR systems.

The ETD was developed by SpaceTech (STI) initially for the SLR station of the German Research Centre for Geosciences (GFZ) in Potsdam and is in operational use since 2012.

Linux real time capability of the ETD supports running the software on the same workstation that also executes the real time command & control of the telescope as well as the GUI of the observer.

Main features of the ETD

- Increased performance with Linux real time support: Allows safe operation of additional software on the same workstation, Non-blocking TCP communication.
- Support for Event Timers A032-ET and A033-ET with parallel port.
- Embedded system support. For mobile applications of the Event Timer. Low performance and memory requirements.
- Seamless replacement of Windows ET Server software. Provides the same TCP/IP communication protocol (API). Compatible with all existing ET client software.

ETD integration

The ETD package is provided together with an installation manual, an ET Client software and example code for easy integration. Additionally, basic initial installation support is included in the A032-ET+ and A033-ET+ package for fast integration.

2.2. Certificate of origin A033-ET (Yebes)

Eventech SIA
Un. reg. No.: 40103495910
VAT reg. No.: LV40103495910
Legal address: Dzerbenes street 14
Riga, LV-1006
Phone: +37129266199
e-mail: info@eventechsite.com
Web: www.eventechsite.com

Riga

08.01.2019

CERTIFICATE OF ORIGIN

With this letter, SIA "Eventech", unified registration No. 40103495910, certifies that A033-ET-RACK/usb with serial number: 33201 is produced in Latvia.

Member of the Board _____Nikolajs Adamovics

The Company does not use company seal

Event Timer A033-ET / USB

Observatorio de Yebes, March 2019

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SYNCHRONIZATION SYSTEM
LANTIME M3000

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January 24th, 2019

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Applicable and reference documents

[1] Meinberg IMS Lantime M3000 – Datasheet. 2017.

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[4] GPS Timing Reference Antennas – Datasheet. PCTEL. 2011. (http://www.meinbergglobal.com/download/docs/other/pctel_gpsl1gl.pdf)

[5] SETUP GUIDE - LANTIME NTP SERVER. Meinberg. 2019.

[6] Lantime Slot-Configuration 30002253. Meinberg. 2018.

[7] https://www.meinbergglobal.com/english/products/modular-3u-sync-system.htm

1. Synchronization System LANTIME M3000

1.1. Introduction

LANTIME M3000 is a versatile and modular time and frequency synchronization platform

Figure 1: M3000 front.

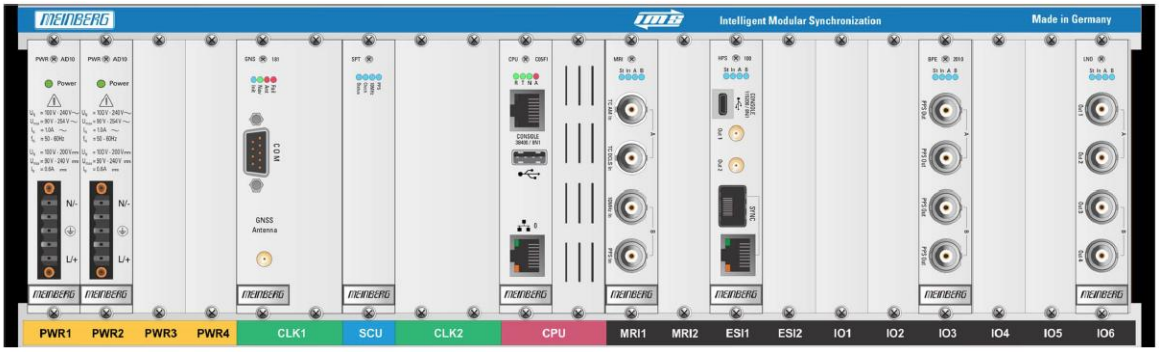
The new LANTIME M3000 is a field-upgradeable and extremely flexible system that covers the synchronization needs.

The M3000 chassis has four power supply slots, two clock module slots, a seamless switchover card slot, a CPU slot and ten slots for additional input and output modules. Adding a second clock module and the required RSC switch module will turn the M3000 into a fully redundant solution. Up to four power supplies can be installed, offering protection against the failure of one or more power sources or power supply failures. Both wide range AC and a 20-60 V DC power supply model can be mixed and matched as required.

The possibility to add input and output modules as well as specialized communication cards for NTP and PTP/IEEE1588 network synchronization and remote management ensures that a LANTIME M3000 will fulfill all synchronization requirements and the scalability and flexibility of the IMS platform concept enables it to cope with the changing demands of critical applications.

The LANTIME M3000 provides the following slot types:

- IMS-CLK: Up to two reference clock modules (redundant mode).
- IMS-SCU: Accepts an RSC module for redundant operation (two CLK modules installed) or an SPT module for a single CLK configuration.
- IMS-PSU: Up to four high efficiency redundant power supplies (AC and DC versions available).
- IMS-CPU: Central processor module providing NTP / SNTP time synchronization as well as remote and local management and configuration interfaces.
- IMS-IO: A variety of output signals for all types of synchronization tasks: electrical and optical pulses, frequencies, time codes and serial time messages as well as additional network interfaces for network synchronization (IEEE-1588, NTP, Synchronous Ethernet) and additional remote management capabilities.



Slot-Configuration: 30002546 (2018-10-22)

#1	[PWR1]	PWR-AD10 :: Power Supply 100-240 V AC (50-60 Hz) / 100-200 V DC
#2	[PWR2]	PWR-AD10 :: Power Supply 100-240 V AC (50-60 Hz) / 100-200 V DC
#5	[CLK1]	GNS-DHQ :: GPS/GLONASS/Galileo/BeiDou Clock DHQ Timebase with L1 antenna, 20m pre-assembled cable - Belden H155
#7	[SCU]	SPT :: Standard Signal Distribution
#10	[CPU]	CPU-C05F1 :: LANTIME Processor Unit
#12	[MRI1]	MRI-CLK1 :: Standard Reference Inputs - TC DCLS, TC AM, PPS, 10MHz
#14	[ESI1]	HPS100 (PL-A: 8 Clients) :: PTP / SyncE / Hardware NTP Interface - GBIT RJ45 + SFP, PPS, 10MHz or 2048kHz via SMA
#18	[IO3]	BPE-2010 :: BNC Connectors (Out 1 - Out 4: PPS)
#21	[IO6]	LNO-HQ-12dBm :: 4 x 10 MHz Sine - Low Phase Noise Option, OCXO-HQ Oscillator

Figure 2: System setup.

High-End NTP Network Time Server for your Network

With several thousand NTP requests per second (depening on the installed CPU module), the system is able to provide time for hundreds and thousands of NTP clients. The LANTIME CPU module supports the following protocols: NTP / SNTP (v2, v3, v4), HTTP (S), SSH, Telnet, SNMP (v1, v2, v3), FTP, SFTP, DHCP/DHCPv6. For each system, up to 99 logical network interfaces are available (99 IPv4 and 99 IPv6 addresses). Enterprise-grade features such as IPv6/Dual Stack support, IEEE 802.1Q VLAN support, LACP/high availability bonding as well as DSCP and IEEE802.1p QoS/CoS traffic prioritization ensure that this product can be installed and operated in almost every critical environment, from a financial data center to a electrical substation or NGN telecommunication network to digital broadcasting infrastructure or air traffic control systems.

Scalable Synchronization Solution

All modules are hot-pluggable and can be configured via a central web interface or CLI. An almost endless number of combinations of input and output modules handle almost any synchronization task. The field-upgradeable and therefore highly scalable and flexible IMS concept will grow with your demands and adjusts to any future changes of your synchronization requirements. New technologies can be easily integrated into your existing devices as soon as a corresponding module is available.

Flexible Synchronization References

IMS-MRI: Standard reference input cards supporting a number of different input signals like 1PPS, 10MHz, IRIG DCLS, IRIG AM IMS-ESI: Extended reference inputs for synchronization sources like E1/T1 framed and unframed signals. Both of these slot types can alternatively accept I/O cards and therefore can be used to add output modules or network interfaces.

Front Panel

The front panel of the LANTIME M3000 integrates an LC-Display with 4x16 characters and the LANTIME menu panel with 4 directional and 4 functional buttons. The LCD menu is extremely useful for an easy and fast local configuration of key parameters and for a quick check of the status of the system without the need of an additional external device. The full set of configuration options can be controlled and reviewed using the powerful graphical web interface or the extensive scriptable command line interface.

Due to the hot-plug capabilities of the IMS platform it is possible to add additional modules or replace modules with zero downtime and no negative impact on the system and its modules.

An optional Active Cooling Module (ACM) adds redundant fans to the system if airflow cannot be guaranteed due to blocked top/bottom cover or in high temperature environments. Two LED indicators on the front panel show the state of the Active Cooling Modules (Fan 1 and Fan 2). Of course the fan state is also accessible via the web interface, CLI and SNMP. ACM and power supply failures and a large number of additional synchronization related alarms can be communicated using several different protocols, for example mail/SMTP messages, SNMP traps, SYSLOG messages, or alarm relay cards.

IMS modules

Most standard output signals like pulses (1PPS, 1PPM, programmable pulses) and frequencies (10 MHz, 2.048 MHz, frequency synthesizer 1 kHz-10 MHz) are provided by two versatile I/O cards named BPE and CPE. Both of these two modules have been designed to cover a wide range of interface and signal/protocol requirements. They feature a two-tier architecture with a back-end and front-end. While the back-end is responsible for internally routing the backplane IMS synchronization signals (in case of the BPE) or for autonomously generating a wide range of different signals by using a microprocessor (on a CPE), the front-end makes a selection of the signals available on physical connectors. Due to this design, it is very easy to support a large number of different electrical or optical physical interfaces, like BNC, SMA, Twinax, 2-pin DFK, DSUB9 and ST/SC FO connectors.

An impressive number of specialized IMS modules covers other application requirements, for example E1/T1 framed/unframed synchronization signals with full SSM/BOC support or low phase noise 10 MHz sine wave frequency outputs. Additional network interfaces for NTP, PTP/IEEE 1588, SyncE and remote management access are available, too.

Part list:

- LANTIME M3000 (SN: 061011023480).
- GNSS antenna. PCTEL model GPSGL-TMG-SPI-40N (SN: 188082-0363). With lightning protection.
- GNSS antenna cable, H155, 20 m, SMAm-Nm.

- Antenna installation kit.
- Power supply cables.

1.2. IMS modules

All IMS Modules will report their status to the LAN-CPU and are easily replaceable in the field.

The management CPU can automatically apply the configuration of a replaced card to a newly inserted replacement module. New or removed CLK and I/O modules will be recognized automatically.

PWR – Power Supply Options

IMS-PWR AD10: 100-240 V AC/DC, 50 W
IMS-PWR DC20: 20-72 V DC, 50 W

- Power supply modules indicate operational status to CPU.
- Redundant configuration possible.
- All power supplies are operating in load sharing mode.

CLK – Clock and central timing modules

IMS-GPS: GPS C/A-code receiver (12 channels)
Antenna/Converter System (IF 35.4 MHz)
Max. Cable lengths: 300m (RG58), 700m (RG213)

IMS-GLN: Combined GPS/GLONASS receiver (32 channels)
Antenna: GPS/GLONASS L1
Max. Cable length: 100m (H155 low loss)

Accuracy of pulse outputs for IMS-GPS and IMS-GLN:
< ±100 ns to UTC (TCXO, OCXO LQ)
< ±50 ns to UTC (OCXO-SQ, -MQ, -HQ, -DHQ)

IMS-PZF: DCF77 Correlation Receiver
Accuracy of pulse outputs:
< ±50 µs to UTC

Redundant clock configurations possible (requires switch card RSC).

SCU – Signal Changeover Unit

IMS-RSC: Redundant Switching of timing signals coming from the IMS-CLK modules. High availability of basic timing signals used for all I/O modules (1-PPS, 10 MHz, TOD).
Seamsless switching of 2.048kHz signals for telecom applications.

IMS-SPT: Signal Path Through (passive card used in non-redundant systems forwarding all signals from the clock).

CPU – NTP and Management Module

IMS-C051F: 500 MHz, 1 x 10/100BASE-T Fast Ethernet Port
NTP Server: 10.000 NTP req/s
Protocols: SNMP, SSH, Telnet, DHCP,
IPv4, IPv6, 802.1q, RADIUS, TACACS+
Management user interface via web interface or CLI

MRI – Multiple Reference Input

IMS-MRI: Basic reference input signals (BNC)
- 1PPS
- 10 MHz
- IRIG-AM (B, AFNOR, IEEE1344 / C37.118)
- IRIG-DCLS (B, AFNOR, IEEE1344 / C37.118)

ESI – Extended Synchronization Interface

IMS-ESI: Extended reference input signals
- 1PPS, BNC
- var. frequencies (1kHz-10MHz) unframed, BNC
- var. frequencies (1kHz-10MHz) unframed, RJ45
- BITS E1/T1 framed, RJ45

LNE – LAN Network Expansion

IMS-LNE: Additional network ports for NTP and management.
LNE-GbE: 4x 10/100/1000BASE-T Gigabit RJ45 Ports.

TSU – PTP / SyncE / Hardware NTP Interface

IMS-TSU-GbE: Gigabit Ethernet (RJ45 / SFP Combo Port).
10 ns time stamp resolution
1-Step/2-step clock
IEEE 1588v2 multi profile support:
- Default 1588v2 profile
- ITU-T G.8265 and G.8275 Telecom profiles
- IEEE C.37.238-2011 Power Profile
- SMPTE ST 2059-2 Broadcast Profile

Layer 2 / Layer 3 / IPv4 / IPv6
E2E/P2P
Synchronous Ethernet In/Out
(ITU-T G.8261, G.8262, G.8264 ESMC)
Carrier Grade NTP (10 ns time stamp resolution)

LNO – Low Noise Option

IMS-LNO: 10 MHz sine wave outputs (low phase noise).
Integrated PLL and low phase noise oscillator (OCXO-MQ/HQ).

SCG – Studio Clock Generator

IMS-SCG: Word Clock frequencies for professional Audio Equipment.
- programmble word clock rates: 24Hz – 24,576MHz
- default rates: 44,1kHz, 48 kHz, 88,2 kHz, 96 kHz
- 4x BNC (2.5V TTL into 50Ω)

VSG – Studio Clock Generator
- synchronized by an external 10MHz signal
- Bi-Level Sync (black burst)
- Tri-Level Sync

CPE – Configurable Port Expansion

This module consists of a half-size standard controller card (Back-End) and a dockable port expander card (Front-End), allowing a large variety of available and programmable output signals and physical connectors, including various electrical and optical interfaces.

IMS-CPE available Signals:
- 1PPS, 10MHz
- Time Codes: IRIG A/B/E/G/AFNOR/IEEE1344/C37.118/NASA36/XR3 AM and DCLS
- Frequency Synthesizer (sine-wave + TTL)
- Programmable Pulses: 1PPS, 1PPM, 1PPH, Timer, Single Shot,
- Cyclic Pulses, DCF77 Mark, Sync Status
- Serial Timestrings (RS232 or RS422 / 485)

BPE – Basic Port Expansion

Back-End uses unmodified standard signals provided by a backplane.

IMS-BPE available signals:
- 1PPS, 10 MHz square-wave
- 2.048 MHz square-wave
- IRIG DCLS+AM (B, AFNOR, IEEE1344 / C37.118)
- Programmable Pulses provided by clock module

Figure 3: Modules basic information.

For more details about the modules, see the annex, user´s manual or webpage.

1.3. System setup

1.3.1. Safety instructions

NOTE: First attach the case to protective earth before you connect the M3000 with the power line.

To ensure a safe operation and to fulfil the requirements in accordance with IEC 60950-1, the system must be correctly connected to an equipotential grounding bus. On the front panel of the system a grounding connector is provided (the M3000S chassis provides the grounding stud on the side of the housing).

NOTE:

- Use a grounding cable with ≥ 1.5 mm^2.
- Please ensure a correct crimp connection!
- Observe torque when mounting the grounding cable! (1.2 Nm)

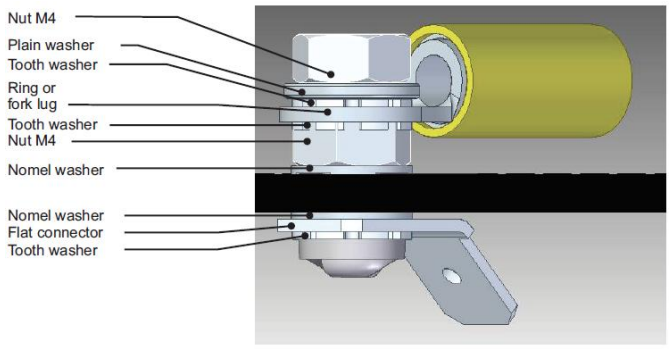


Figure 4: M3000 grounding.

General Safety instructions

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

For AC Supply 100-240 VAC

- 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.

GNSS antenna

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

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

1.3.2. GNSS antenna setup

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).

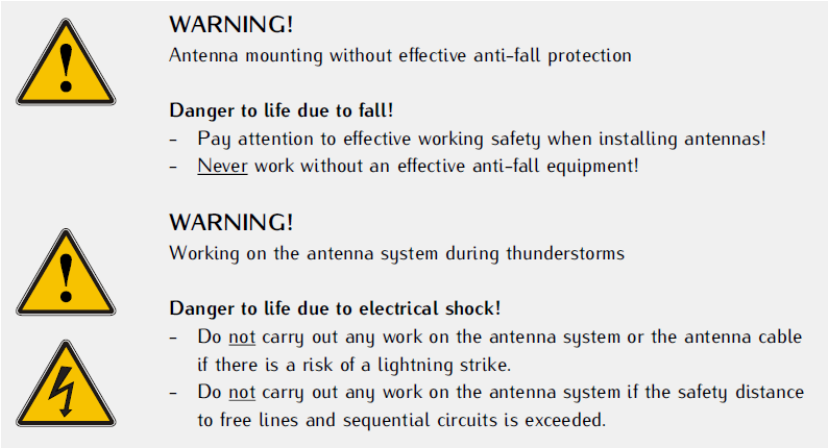
See data sheet "40 dB Multi GNSS Timing Antenna with Integrated Lightning Protection" (pctel_gpsl1gl.pdf) or download this document:

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

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

Up to four receivers can be run with one antenna/downconverter unit by using an optional antenna splitter.

The total length of an antenna line from antenna to receiver must not be longer than the max. length shown in the table below.



WARNING!
Antenna mounting without effective anti-fall protection

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

WARNING!
Working on the antenna system during thunderstorms

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

Figure 5: GNSS antenna safety issues.

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

Figure 6: GNSS antenna cable maximum lengths.

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 15VDC.

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.

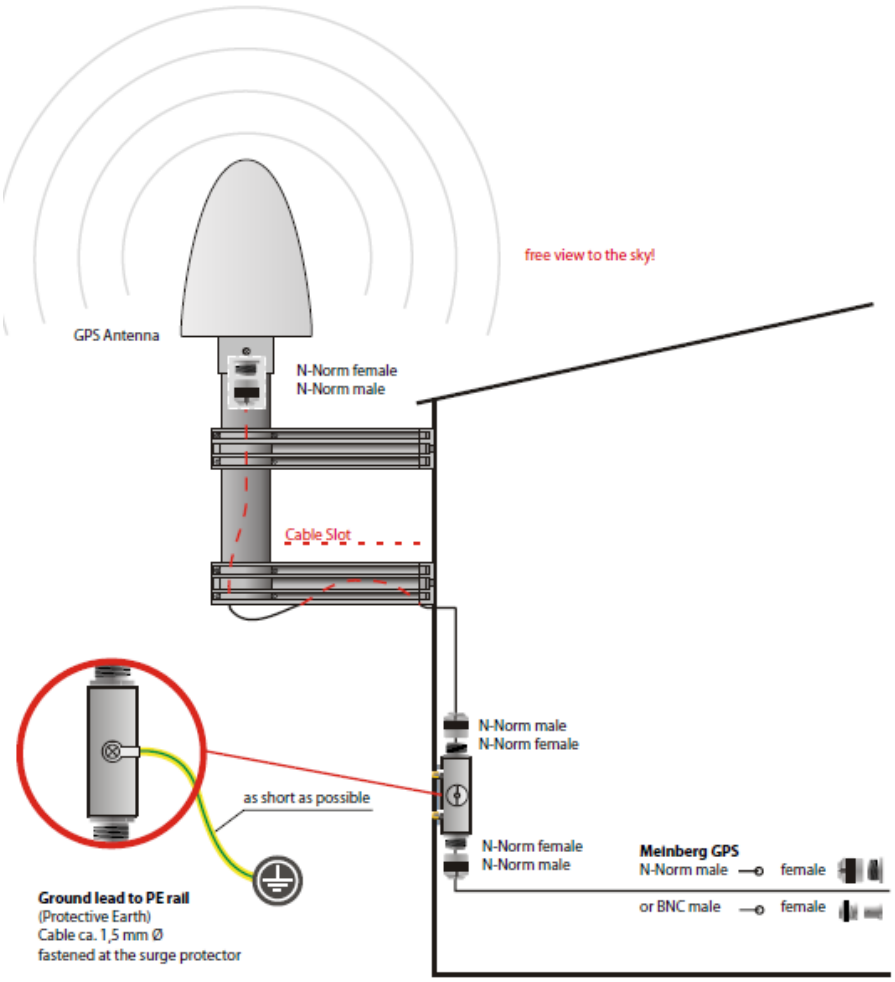
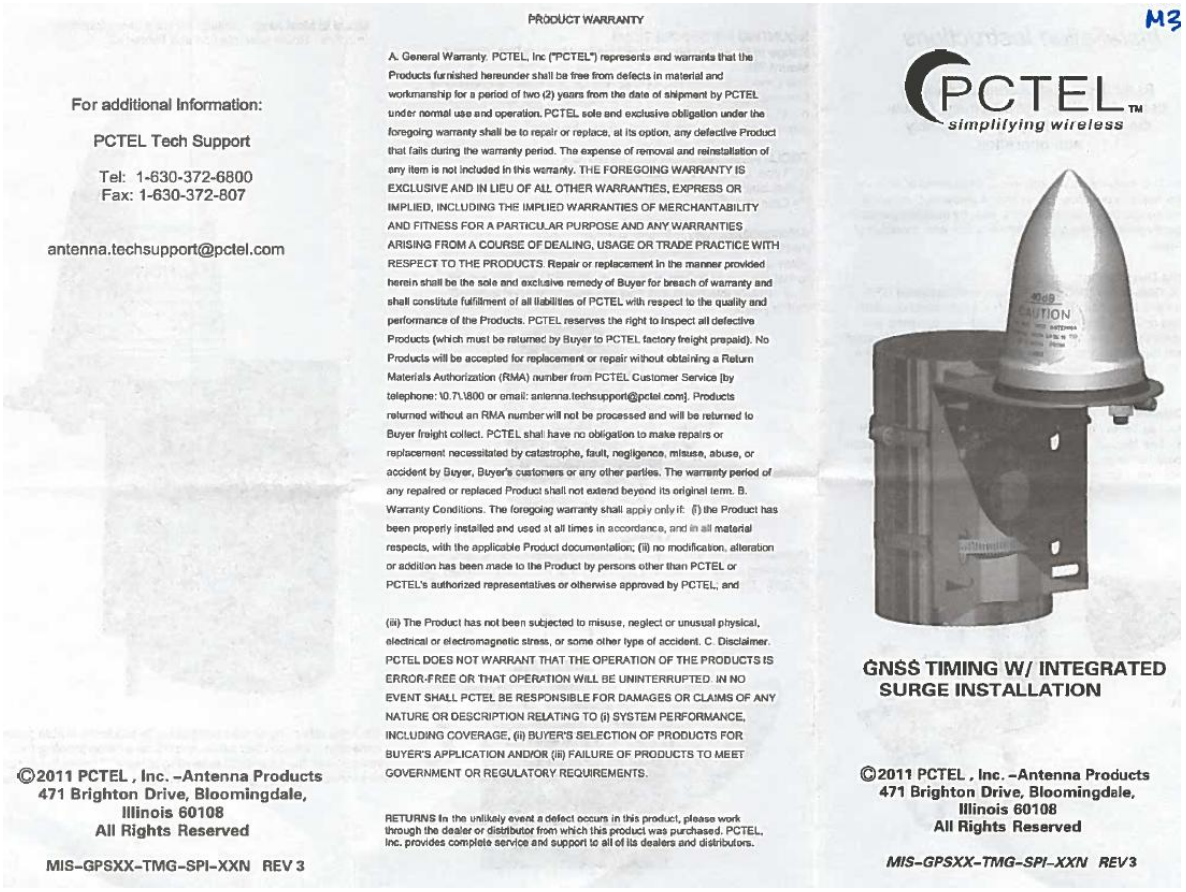


Figure 7: Antenna assembly.



For additional Information:

PCTEL Tech Support

Tel: 1-630-372-6800
Fax: 1-630-372-807

antenna.techsupport@pctel.com

MIS–GPSXX–TMG–SPI–XXN REV 3

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M3

PCTEL™
simplifying wireless

GNSS TIMING W/ INTEGRATED SURGE INSTALLATION

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MIS–GPSXX–TMG–SPI–XXN REV 3

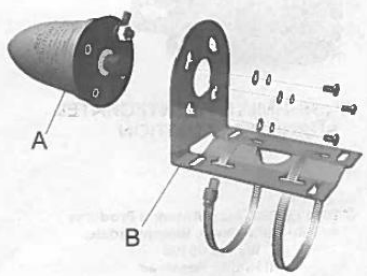
Installation Instructions

Read these instructions thoroughly before installation or assembly. Follow the sequence for proper assembly and operation.

Notice - The installation, maintenance, or removal of antenna systems requires qualified, experienced personnel. Antenna systems should be inspected once a year by qualified personnel to verify proper installation, maintenance, and condition of equipment.

Antenna Description:
GPSXX-TMG-SPI- XXNCB (cover) is a self-contained GPS antenna and mount kit. The kit includes a right hand circularly polarized antenna that incorporates a high performance, low noise amplifier. It also includes a medium duty L mount bracket to attach the antenna to a vertical and horizontal pipe within a range of diameters detailed below.

Contents:
A - 1ea Timing Antenna w/ surge and watershed gasket.
B - 1ea Medium Duty Mount Kit - ** Mount kit may contain extra hardware and gasket depending on product Type installed. Extra components can be discarded.



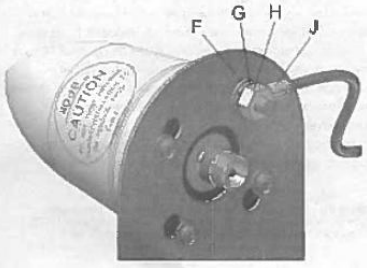
MOUNTING KIT DESCRIPTIONS
Range of Mounting Pipe Diameters for Medium Duty Bracket Mount Kit.
The L mount Bracket Kit attaches the GPS antenna on vertical or horizontal pipes and beams with a diameter ranging from 2 ½-8½ in [60mm-215mm] diameter. **Note - installation of antenna requires an unobstructed clear view to the sky.**

TOOLS REQUIRED FOR INSTALLATION
(1) Type II Crossed Recessed Screw Driver
(2)Adjustable Wrench or 3/8 wrench.
(3) Crimping pliers

Antenna/Mount Assy - remove protective cap and grounding hardware from antenna. Align Water Shed Gasket to mounting holes and orient antenna onto bracket - Gasket may distort prior to installation. Install screw hardware[C,D,E] opposite ground stud. Rotate into place and tighten - Recommended torque 5-8lbf*in [1Nm.

[C,D,E]

Repeat for remaining screws x2. Assemble (AWG-6/16mm^2 min) Grounding cable to crimp lug [J] fasten with supplied hardware [F,G,H]. Do not over tighten - Recommended torque 5-8lbf*in [1Nm.



Mount to Mast Assy - position antenna onto Mounting structure. Route hose clamps and tighten x2.

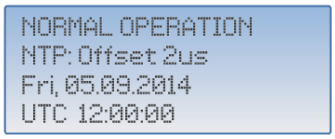
Attach the other end of grounding cable to shortest possible ground connection. Attach coax cable, and Install weatherproofing (not provided with the Mount Kit) extending at least 2" below the bottom of the connector to directly underneath the base plate of the antenna.

Figure 8: Antenna installation instructions.

1.4. System startup

- Make sure that the power switch is in the "0" position (off), and plug the power cord into the power socket of your LANTIME. Then connect the device to your computer network using a suitable network cable.
- After switching on power, the following message is displayed.

- After running a number of power-on self tests, the time server is in operation mode and the main screen appears.



- Connection diagram.

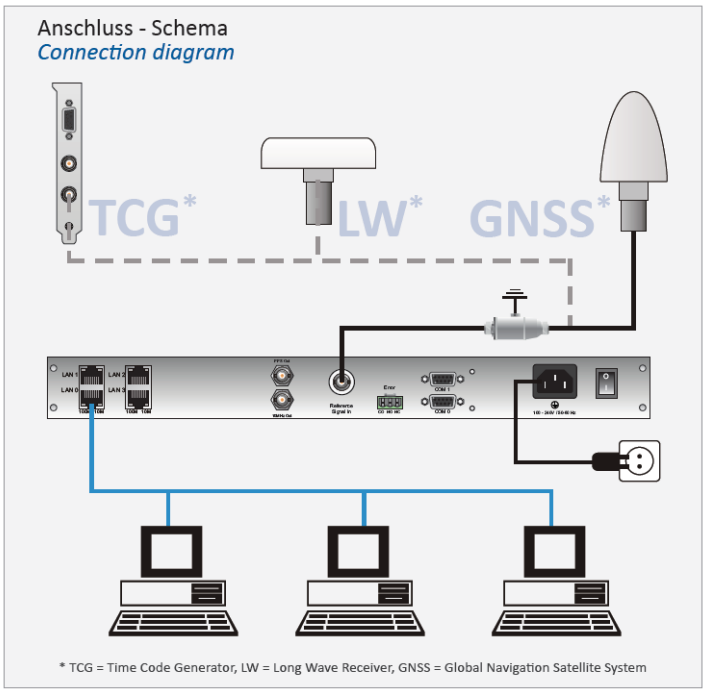


Figure 9: Connections diagram.

1.4.1. Connecting the antenna

Connect the antenna cable with the antenna socket of your LANTIME. In case of a short-circuit, the following message appears in the display.

In such a case, switch off the device and check the antenna cable.

The system configuration can now be changed via the network using a WEB browser or a Telnet / SSH client.

1.4.2. Menues details

The root menu is shown when the receiver has completed initialization after power-up. With the four arrow buttons and the buttons „OK“, „ESC“, „F1“ and „F2“ the navigation and setting of parameters can be managed.

Main menu can be reached by pressing „ESC“ some times. The main menu reflects some of the main parameters of the time server.

First line shows the name of the device and the status of the Reference Clock (GPS). The text "GPS: NORMAL MODE" might be replaced by "COLD BOOT", "WARM BOOT" or "UPDATE ALMANAC". If the antenna is disconnected or not working properly, the text "ANTENNA FAULTY" is displayed instead.

Figure 10: Main menu.

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

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

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

- **„Time Service“**
  - green: NTP has been synchronized to reference clock.
  - red: NTP is not synchronous to reference clock or sync to „local clock“.
- **„Network“**
  - green: all watched network ports has been “link up“ detected.
  - red: at least one of the watched network ports (look at „Setup Device Parameter / Check Network Linkup“) is not connected.
- **„Alarm“**
  - off: no error at moment.
  - red: general error – more information will be shown on display.

When pressing „F1“ from main menu a short description for menu navigation will be displayed.

1.4.3. Entering the IP address

Initial installation requires setting up an IP address, netmask and (in most network environments) a default gateway. To get an overview of the current configuration, press F2. Press F2 again to enter the Network SETUP screen.

Navigate to "Interfaces" using the arrow keys and press OK to change to the configuration menu of the connected network interface.

You can select the network port with the Down and Up arrow keys.

IP: 172.16.3.147

Entering the IP Address manually (not using DHCP).

Deactivate DHCP and set up a valid IP address, netmask and (if required) a default gateway. This can be done by selecting a field with the arrow keys. Then press OK to switch to edit mode.

The cursor can be moved using the left/right arrow keys, the value underneath the cursor can be modified with up/down. Confirm your changed values with OK and F2.

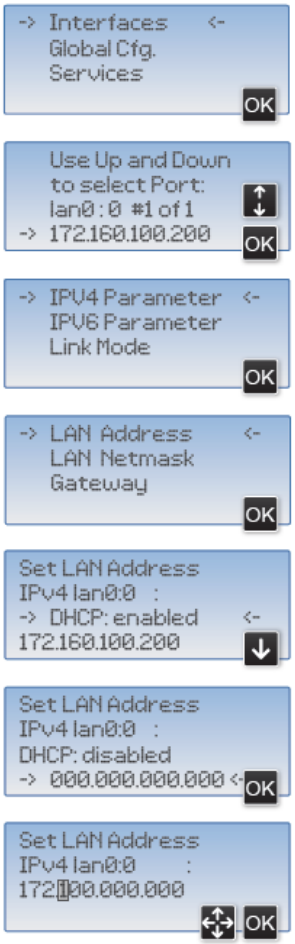


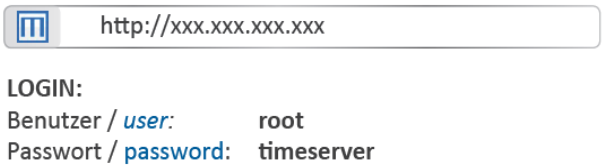
Figure 11: Entering the IP address

1.4.4. Web interface

Accessing the Web Interface

Connect to the web interface by entering the IP address of the LANTIME into the address field of your web browser.

http://172.16.3.147



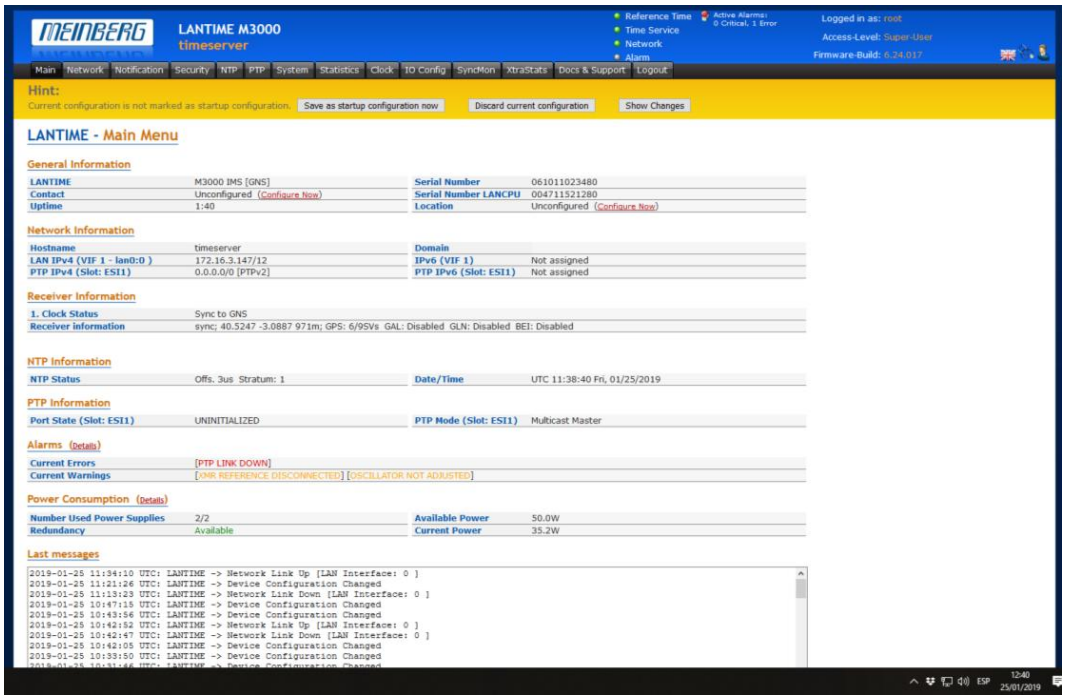


Figure 12: Web interface screenshot.

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.

System information and Status messages.

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

By using the navigation on top of the page you can reach a number of configuration menus.

MRI Configuration via the Web Interface

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

The provided input signals can be monitored and selected in the "Clock" menu after initializing.

GPS Clock #1

MRS Status

Priority	Source	Status	Offset	Statistics
01	GPS	Signal available, Is master, Is locked, Is accurate	-1.0ns	
02	PPS plus string	No connection, No signal	N/A	
03	NTP	Signal available	+40.00us	
04	PTP (IEEE1588)	No signal		
05	PPS in	Signal available	-60.0ns	
06	IRIG	Signal available	+998.5us	
07	Fixed Freq. in	Signal available	+0.0ns	

Figure 13: MRS status: displays the available input signals.

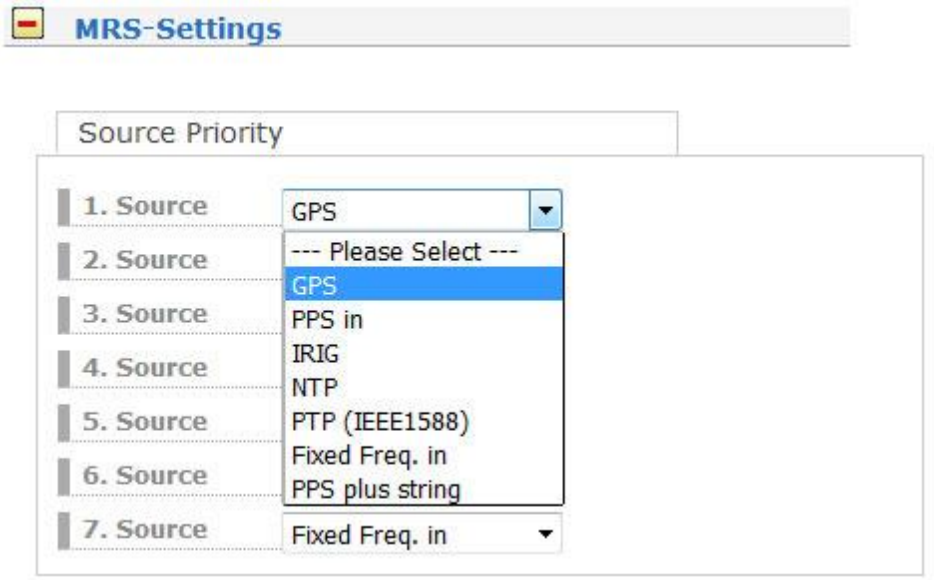


Figure 14: MRS-Settings: selection and priorization of existing input sources.

- 1 x PPS input: TTL, pulse duration >= 5us, active high, female BNC connector.
- 1 x 10 MHz input: sine (1.5 Vpp - 5Vpp) or TTL, female BNC connector.
- 1 x Time Code modulated input: BNC connector, isolated by transformer, Insulation voltage 3000 VDC, Input signal: 600mV to 8 V (Mark, peak-to-peak).
- 1 x Time Code unmodulated input BNC connector, isolated by opto-coupler. Insulation voltage: 3750 Vrms. Internal series resistor: 330 Ohm, Max. input current: 25 mA, Diode forward voltage: 1.0 V...1.3 V.

HPS-100: PTP / SyncE / Hardware NTP Interface configuration

A detailed configuration guide you will find in the corresponding firmware manual of the system. See chapter "The Web Interface -> Configuration: PTP V2".

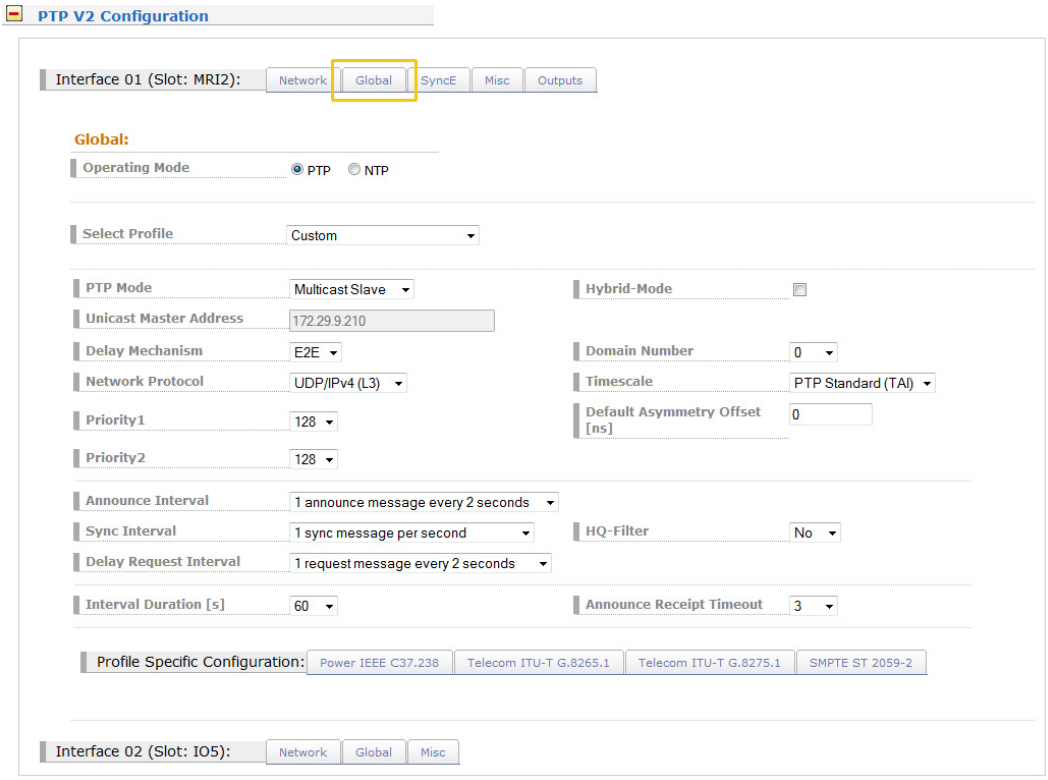


Figure 15: PTP V2 configuration.

BPE expansion card configuration

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

If an output signal has to be changed, this must be done via the pre-connected receiver-in the menu "Clock → Switch Card" if you have a redundant system or in the menu "Clock → Receiver" in systems with only a single receiver.

The BPE modules have no direct configuration options. This information is also displayed in the "IO Config" menu.

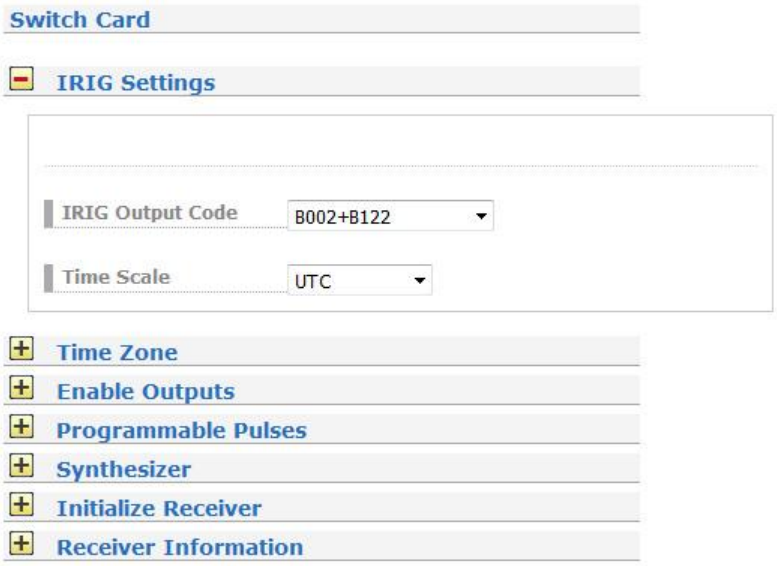


Figure 16: Menu clock/switch card/IRIG settings.

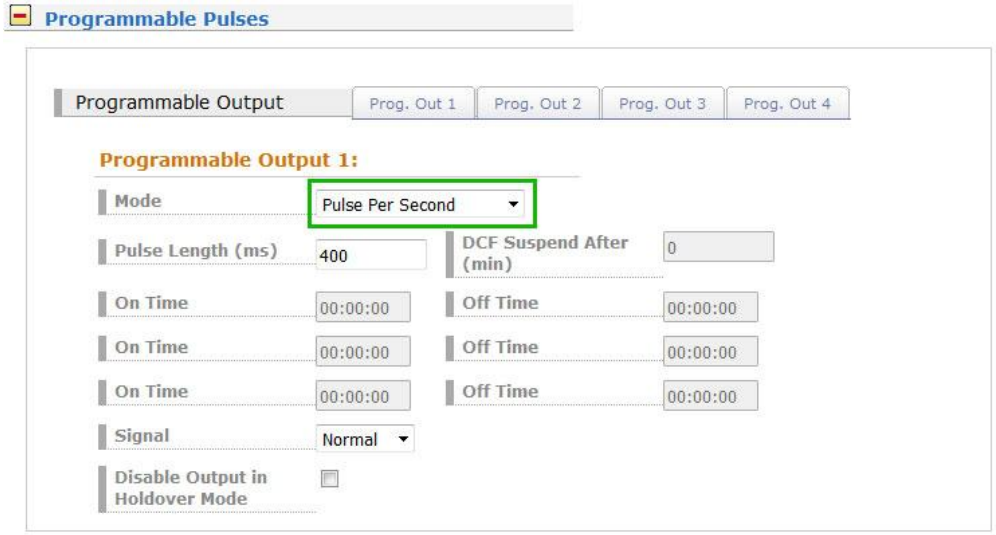
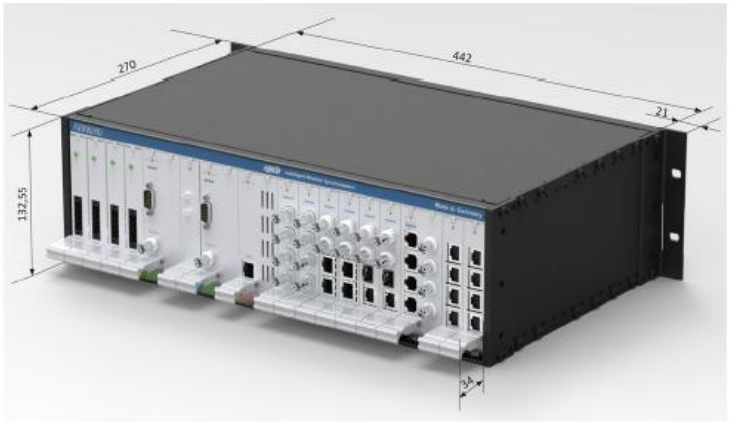


Figure 17: Menu clock/programmable pulses/selection of pulse per second.

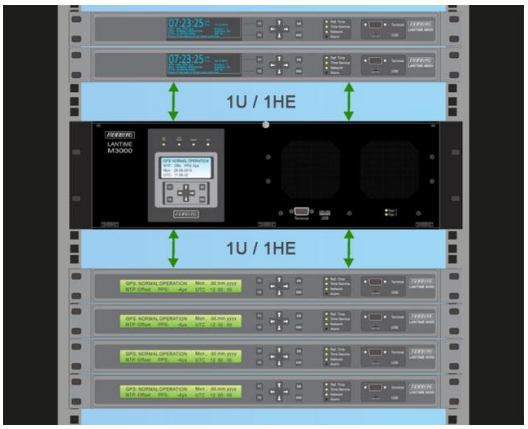
2. Annexes: system technical information

2.1. Technical Specifications LANTIME M3000 Chassis

Housing:	Metal 19"Modular chassis, Schroff EUROPAC lab HF Front panel: 3U/84HP (128 mm high / 426 mm wide) Hinged front panel, prepared for subsequent fan installation (see chapter Retrofit the System with an Active Cooling Module)
Protection Rating:	IP20
Physical Dimensions:	442 (484) mm wide x 132,25 mm high x 270 (304) mm deep
Ambient Temperature:	0 ... 50 °C
Storage Temperature	-20 ... 70 ° C
Humidity:	85 % max.



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

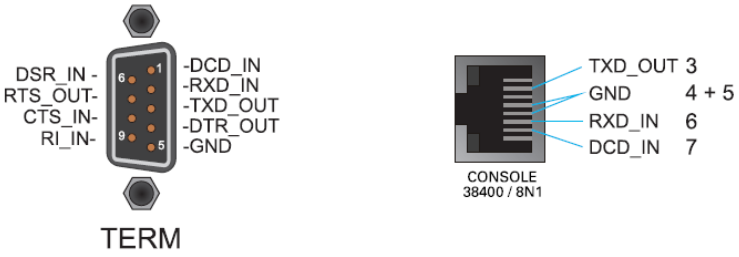


2.2. Available modules and connectors

Name	Type	Signal	Cable
Front Connectors			
Terminal	9pin. D-SUB male	RS-232	shielded data line
USB	USB Port		USB Stick
Rear Connectors			
Power supply	5pin. DFK male	100-240 V AC / 50-60Hz 100-200 V DC	5pin. MSTB clamp
GPS Antenna	BNC	10MHz / 35.4MHz	shielded coaxial line
or			
Multi GNSS Antenne	SMA	L1 Frequency band: GPS/GLONASS/Galileo/BeiDou	shielded coaxial line
Terminal	RJ45		CAB-CONSOLE-RJ45
USB	USB Port		shielded data line
Network LAN-CPU	RJ45	10/100 MBit	shielded data line
Module Options			
Power			
DC power supply	5pin. DFK male	20-60 V DC	5pin. MSTB clamp
Network			
LNE-GbE	RJ45	10/100/1000 MBit	shielded data line
TSU-GbE	RJ45	10/100/1000 MBit	shielded data line
	SFP	10/100/1000 MBit	shielded data line
Signal Outputs:			
CPE - configurable	BNC, DFK-2, DSUB9, ST	PPOs, serial TS, TC FO ...	shielded data line
BPE - fixed	BNC, ST	PPS, 10MHz, TC, 2,048kHz ...	shielded data line
LIU:	RJ45 jack	E1/T1 balanced 120 Ohm (Clock)	shielded data line
	BNC	E1/T1 unbalanced 75 Ohm (Bits)	shielded data line
LNO	BNC	10MHz sine	shielded data line
REL	DFK-3	Error Relay	
Signal Inputs:			
ESI	BNC, RJ45	E1/T1, var. Freq.	shielded data line
MRI	BNC / FST	10MHz, PPS, IRIG, PP	shielded data line
Input / Output Modules:			
PIO	BNC	PPS, 10MHz	shielded data line

2.3. 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 CABCONSOLE-RJ45 cable to establish a connection to your PC or Laptop computer.



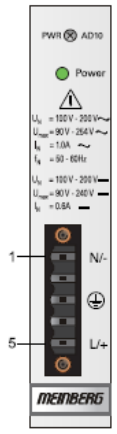
2.4. USB connector

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

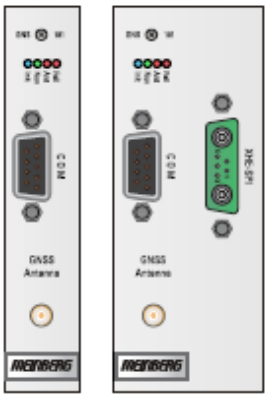
2.5. Power Supply 100-240 VAC

Operational Voltage:	U_N = 100 - 240 V~ I_N = 1.0 A~ f_N = 50 - 60 Hz U_{max} = 90 - 254 V~ f_{max} = 47 - 63 Hz --- U_N = 100 - 200 V ⎓ I_N = 0.6 A ⎓ U_{max} = 90 - 240 V ⎓
Output Current:	max. 10.0 A min. 0.15 A
Fuse:	internal, T2.5 A / 250 V
Protective Class:	Class 1
LED:	green, diameter 5mm, on if output OK
Power Connector:	5pin DFK
Hotplug:	It is possible to remove or install the power supply out of the terminal equipment during operation.
Pin Assignment:	1: N/- 2: not connected 3: PE (Potential Earth) 4: not connected 5: L/+



2.6. GNSS clock

Type of receiver:	GPS/GLONASS/Galileo/BeiDou receiver Number of channels: 72 Frequency band: GNSS L1 GPS: 1575.42 +– 10 MHz GLONASS: 1602-1615 MHz Galileo: 1542.5 MHz BeiDou: 1561.09 MHz
Accuracy of Pulses:	Dependant on oscillator option < +–100nsec (TCXO, OCXO-LQ) < +–50ns (OCXO-SQ, -MQ, -HQ, -DHQ)
Synchronization Time:	Max. 1 minute in normal operation mode, approx. 12 minutes after a cold start



Antenna

Antenna Cable:	shielded coax cable (Belden H155 PE)
Cable Length:	max. 70m low-loss cable
Type of Connector:	female SMA connector
Power Requirements:	5 V, 100 mA (via antenna cable)
Figure right:	GNSS Receiver and GNSS with XHE-SPI Connector (optional)

LED Indicators

Init	blue: green:	while the receiver passes through the initialization phase the oscillator has warmed up
Nav.	green:	positioning successfully
Ant	red: yellow:	antenna faulty or not connected the clock is synchronized by an external Signal - MRS mode (PPS, IRIG ...)
Fail	red:	time has not synchronized

2.7. SPT - Single Path Through

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

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

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

PPS:	red:	the signal was not provided to the system by the receiver, yet.
	green:	the signal is generated by the receiver and distributed in the system.
10MHz:	red:	the signal was not provided to the system by the receiver, yet.
	green:	the signal is generated by the receiver and distributed in the system.
Clock:	red:	as long as the receiver is not synchronized, yet.
	green:	when the receiver is synchronized.
Status:	blue:	during the initialization phase.
	green:	after initialization of the receiver.
Current Consumption:	40 mA	

2.8. CPU

As the central management and control element, the CPU module in an LANTIME system is responsible for management, configuration and alarm notifications. It additionally provides NTP and SNTP services on its network interface. The CPU model C05F1 comes with one integrated 10/100base-T port, additional network ports can be added by installing LNE cards.

Processor:	AMD Geode™ LX 800 (500 MHz, 128 KB L2 cache, 3.6 W)
Main Memory:	onboard 256 MByte
Cache Memory:	16 KB 2nd Level Cache
Flash Disk:	1 GB
Network Connector:	10/100 Base-T with RJ45-Jack
Serial Interface:	RJ45 connector console: 38400 / 8N1, connection via CAB-CONSOLE cable
USB Port:	install firmware upgrades backup and restore configuration files copy security keys lock / unlock front keys
Operating System:	GNU/Linux 4.x
State LEDs:	**LAN 0 Interface** LED - Connect, Activity and Speed of the network connection **LAN-CPU** R - Reference Time T - Time Service N - Network A - Alarm

2.9. MRI: standard reference input signals

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

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

Reference Inputs:	10MHz, PPS, IRIG, TC-AM / TC-DCLS
Status Indicators	
LED St:	MRI status
LED In:	Status of the backplane's reference signals
LED A:	Status of the input signals (TC-AM/DCLS) at the board
LED B:	Status of the input signals (10MHz/PPS) at the board
Initialisation:	LED St: blue until USB is configured LED In - LED B: off until USB is configured
USB is configured:	LED St: blue LED In - LED B: 0,5 sec. red -> 0,5 sec. yellow -> 0,5 sec. green -> 0,5 sec. off
Normal Operation:	LED St + LED In: green LED A: green, if timecode AM or timecode DCLS or both signals are available at the same time LED B: green, if 10 MHz or PPS or both signals are available at the same time
Power Requirements:	5 V +-5%, 50 mA

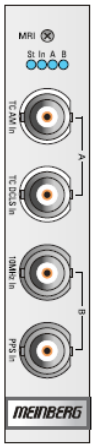


Figure right: *MRI - standard input signals via BNC female connectors*

2.10. HPS-100: PTP / SyncE / Hardware NTP Interface

IEEE 1588 v2 compatible

Profiles:	IEEE 1588v2 Default Profile IEEE 1588v1 (option) Enterprise Profile IEC 61850-9-3 Power Profile IEEE C.37.238-2011 Power Profile IEEE C.37.238-2017 Power Profile ITU-T G.8265.1 Telecom Frequency Profile ITU-T G.8275.1 Telecom Phase / Time Profile (full timing support) ITU-T G.8275.2 Telecom Phase / Time Profile (partial timing support) SMPTE ST 2059-2 Broadcast Profile IEEE 802.1AS TSN/AVB Profile AES67 Media Profile DOCSIS 3.1
PTP Modes:	Multicast/Unicast Layer 2 (IEEE 802.3) Multicast/Unicast Layer 3 (UDP IPv4/IPv6) Hybrid Mode E2E / P2P Delay Mechanism Up to 128 messages/second per client
NTP Mode:	NTP Server mode (8 ns time stamp accuracy)
1588 Clock Mode:	1-Step, 2-Step for both Master and Slave operation
Synchronous Ethernet:	Master and Slave Capability Compliant to ITU-T G.8261, G.8262 and G.8264 Ethernet Synchronization Messaging Channel (ESMC)
Network Protocols:	IPv4, IPv6 DHCP, DHCPv6 DSCP IEEE 802.1q VLAN filtering/tagging IEEE 802.1p QOS
Ethernet Interface:	Combo Port: 1 x 100/1000BASE-T RJ45, 1 x GBIT SFP - Slot
USB Interface:	USB 1.1 / USB 2.0 full-speed, Micro USB female connector
Signal Outputs:	2x SMA (50 Ohm) connectors configurable signals: 1PPS, 10MHz, 2048kHz
CPU:	825 MHz Cortex A9 Dual Core on SOC
Time Stamp Accuracy:	8 ns

LED Indicators

LED St:	Init	lights blue during initialisation, off in normal operation mode
LED In:	red	Error - TSU does not work correctly, PTP services stopped
	yellow	No link, but initialized
	green	link up
	red	stopped
LED A - LED B:	Shows the current State of the TSU	
	yellow - yellow	Listening
	green - off	Master Mode
	off - green	Slave Mode
	yellow - off	Passiv Mode
	off - yellow	uncalibrated
	red - red	stopped

Client Licenses:

License	Unicast Clients	Delay Req./s	NTP Req./s	PTPv1	PTP Monitoring
PL-A	8	1024	1600	NO	NO
PL-B	256	32768	51200	NO	NO
PL-C	512	65536	102400	YES	NO
PL-D	1024	131072	204800	YES	YES
PL-E	2048	262144	409600	YES	YES

2.11. BPE - Backplane Port Expander

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

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

Output Signals: fixed:
10MHz, PPS, IRIG DCLS, IRIG AM, 2,048 MHz,
PPOs (selectable via receiver)

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

Status Indicators

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

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

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

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

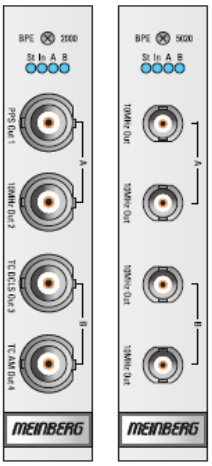


Figure right: BPE Outputs

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

BPE 5000 Fiber Optic ST-Connectors
PPS, 10MHz, TC DCLS und TC AM

2.12. LNO – 10 MHz Sinusoidal Output Module

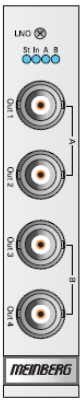
The card has a microprocessor system, which monitors the output signals and generates status signals for the upper-level management system accordingly.

Function of Operation

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

Technical Specifications:

Frequency Input:	10 MHz, sine ($1V_{pp}$ min.) or TTL
Output Level:	5 dBm +/- 1 dBm at 50Ω Option: LNO-12dB with 12 dBm output level
Warm-up time:	< 3 @ 25°C within accuracy of < +-1 x 10^{-7}
Electrical Connectors:	BNC female
LED Status Indicators:	
All LEDs red	Outputs disabled PLL not locked, OCXO in warm up phase
	10MHz reference not available Quality of the reference signal is not sufficient
All LEDs green:	Normal operation, outputs activated
Associated LED red:	defect output or short circuit during normal operation



Synchronization System Lantime M3000

Observatorio de Yebes, January 2019