The Synchronization Experts.

MANUAL
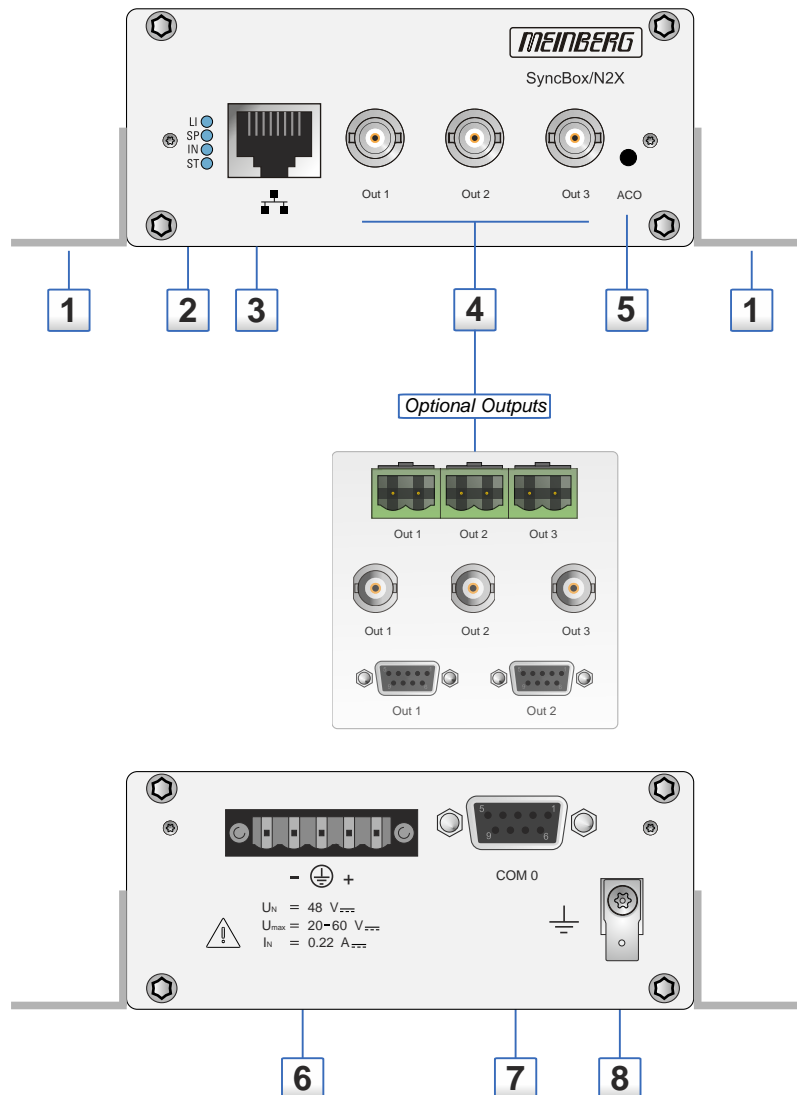
SyncBox N2X

17th September 2019

Meinberg Funkuhren GmbH & Co. KG

Front view (Frontansicht) SyncBox N2X

Optional Outputs

ENGLISH
1. Wall Mount Brackets
2. LED Indicators
3. Signal In / Remote / (Option: PoE) - RJ45 connector
4. **Out 1 - Out 3:**
   IRIG AM, Freq.Synth.sine,PPOs
   via BNC female, FO ST or 2pin DFK connector
5. ACO - Access Control Override - Access without Protection
6. Power Supply: 20-60 V DC
7. COM 0 serial port, 9pin. D-SUB
8. Protective Earth

DEUTSCH
1. Winkel für Wandmontage
2. LED Statusanzeigen
3. Signaleingang / Remote / (Option: PoE) Anschluss über RJ45
4. **Out 1 - Out 3:**
   IRIG AM, Freq.Synth.sine, PPOs über
   BNC Buchse, FO ST oder 2pol. DFK Buchsen
5. ACO - Access Control Override - Zugriff ohne Passwortschutz
6. Netzteil: 20-60 V DC
7. COM 0 serieller Anschluss, 9pol. D-SUB
8. Schutzleiter

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1 Imprint

Meinberg Funkuhren GmbH & Co. KG
Lange Wand 9, 31812 Bad Pyrmont / Germany

Phone: + 49 (0) 52 81 / 93 09 – 0
Fax: + 49 (0) 52 81 / 93 09 – 230

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

Date: 2019-02-21

2 General Details

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

Certain operating conditions may require the observance of additional safety regulations not covered by this manual. Nonobservance of this manual will lead to a significant abatement of the security provided by this device. Security of the facility where this product is integrated lies in the responsibility of the installer. The device must be used only for purpose named in this manual, any other use especially opteration above the limits specified in this document is considered as improper use.

Keep all documents provided with the device for later reference.

Target Audience
This manual aims to qualified personnel only. Qualified personnel are those persons who are authorized to install, commission and operated electrical systems and circuits in accordance with the respective national laws and safety regulations.

3 Safety Hints

3.1 Important Safety Instructions and Protective Measures

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

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

The device satisfies the requirements of the following EU regulations: EMC-Directive,
Low Voltage Directive, RoHS Directive and - if applicable - the Radio Equipment Directive.

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

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

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

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

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

3.2 Used Symbols

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

Symbol	Beschreibung / Description
⎓	IEC 60417-5031 Gleichstrom / *Direct current*
∼	IEC 60417-5032 Wechselstrom / *Alternating current*
⏚	IEC 60417-5017 Erdungsanschluss / *Earth (ground) terminal*
⏦	IEC 60417-5019 Schutzleiteranschluss / *Protective earth (ground) terminal*
⚠	ISO 7000-0434A Vorsicht / *Caution*
⚡	IEC 60417-6042 Vorsicht, Risiko eines elektrischen Schlages / *Caution, risk of electric shock*
♨	IEC 60417-5041 Vorsicht, heiße Oberfläche / *Caution, hot surface*
⚙	IEC 60417-6056 Vorsicht, Gefährlich sich bewegende Teile / *Caution, moving fan blades*
	IEC 60417-6172 Trennen Sie alle Netzstecker / *Disconnection, all power plugs*
	IEC 60417-5134 Elektrostatisch gefährdete Bauteile / *Electrostatic Sensitive Devices*
ⓘ	IEC 60417-6222 Information generell / *Information general*
	2012/19/EU Dieses Produkt fällt unter die B2B Kategorie. Zur Entsorgung muss es an den Hersteller übergeben werden. *This product is handled as a B2B category product. In order to secure a WEEE compliant waste disposal it has to be returned to the manufacturer.*

The manuals for a product are included in the scope of delivery of the device on a USB stick. The manuals can also be obtained via the Internet. Enter www.meinbergglobal.com into your browser, then enter the corresponding device name in the search field at the top.

This manual contains important safety instructions for the installation and operation of the device. Please read this manual completely before using the unit.

This device may only be used for the purpose described in this manual. In particular, the given limits of the device must be observed. The safety of the installation in which the unit is integrated is the responsibility of the installer!

Non-observance of these instructions can lead to a reduction in the safety of this device!

Please keep this manual in a safe place.

This manual is intended exclusively for electricians or persons trained by an electrician who are familiar with the applicable national standards and safety rules. Installation, commissioning and operation of this device may only be carried out by qualified personnel.

3.3 Security during Installation

⚠ WARNING!

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

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

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

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

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

The fire protection must be ensured in the installed state.

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

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

The device must be protected against mechanical stress such as vibration or shock.

Connecting Data Cables

During a thunderstorm, data transmission lines must not be connected or disconnected (risk of lightning).

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

Install the cables in way that they do not constitute a hazard (danger of tripping) and are not damaged, i.e. kinked.

Connecting Power Supply

This equipment is operated at a hazardous voltage. Non-observance of the safety instructions in this manual may result in serious personal injury or property damage.

Before connecting to the power supply, a grounding cable must be connected to the earth connection of the device.

Before operation, check that all cables and lines work properly and are undamaged. Pay particular attention to the facts that the cables do not have kinks or that they are not too short around corners, and no objects are placed on the cables. Also make sure that all connections are secure.

Faulty shielding or cabling will endanger your health (electrical shock) and may destroy other equipment.

Ensure that all necessary safety precautions have been taken. Make all connections to a unit before turning on the power. Observe the safety instructions on the device (see safety symbols).

The metal housing of the device is grounded. It must be ensured that enough air and creepage distances to neighboring voltage-carrying parts are provided during assembly in the control cabinet and no short circuits are caused.

In the case of malfunctions or servicing (e.g. in the event of a damaged housing or power cable or when fluids or foreign objects enter), the current flow can be interrupted. Questions about the house installation, need to be clarified with your house administration.

The power supply should be connected with a short, low-inductance line.

AC Power Supply	DC Power Supply
• The device is a device of protection class 1 and may only be connected to a grounded outlet (TN system). • For safe operation, the device must be protected by an installation fuse of max. 16 A and equipped with a residual current circuit breaker in accordance with the applicable national standards. • The unit must always be disconnected from the mains and not from the appliance. • Devices with mains plugs are equipped with a safety-tested mains cable of the country of use and may only be connected to a grounded shockproof socket, otherwise electric shock may occur. • Make sure that the mains socket on the appliance or the mains socket of the house installation is freely accessible to the user so that the mains cable can be pulled out of the socket in case of emergency.	• Outside the assembly group the device must be disconnectable from the power supply in accordance with the provisions of IEC 60950-1 (e.g. by the primary line protection). • Installation and disassembly of the power supply plug is only permitted if the assembly group is switched off (e.g. by the primary line protection). • The supply lines must be adequately secured and dimensioned. *Connection Cross Section:* *1 mm² – 2.5 mm²* *17 AWG – 13 AWG* • The device must be supplied with a suitable disconnector (switch). The separation device must be easily accessible, placed near the device and marked as a separation device for the unit.

3.4 Protective Conductor- / Ground-Terminal

ATTENTION!

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

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

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

3.5 Safety during Operation

WARNING!

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

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

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

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

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

3.6 Safety during Maintenance

⚠️ **WARNING!**

When you are expanding the device, use only device parts that are approved for the system. Non-observance may result in injury to the EMC or safety standards and cause malfunction of the device.

If device parts, which are released for the system, are extended or removed there may be a risk of injury in the area of the hands, due to the pull-out forces (approx. 60 N).

The service informs you which device parts may be installed.

The device must not be opened, repairs to the device may only be carried out by the manufacturer or by authorized personnel. Improper repairs can result in considerable danger to the user (electric shock, fire hazard).

Unauthorized opening of the device or of individual parts of the device can also lead to considerable risks for the user and result in a loss of warranty as well as an exclusion of liability.

– Danger due to moving parts - keep away from moving parts.

– Device parts can become very hot during operation. Do not touch these surfaces! If necessary, switch off the unit before installing or removing any equipment, and allow it to cool down.

3.7 Handling Batteries

⚠️ **CAUTION!**

The lithium battery on the receiver modules has a service life of at least 10 years. If an exchange is necessary, the following notes must be observed:

The device is equipped with a lithium battery. The battery must not be short-circuited or recharged. Replacement of the lithium battery may only be carried out by the manufacturer or authorized personnel.

Risk of explosion if the battery is not replaced correctly. Replace only with the same or equivalent type recommended by the manufacturer.

When disposing used batteries, observe the local regulations for the disposal of hazardous waste.

3.8 Antenna Mounting

WARNING!

No antenna mounting without effective fall protection.

Risk of death by falling!
–   Make sure you that have an effective occupational safety during antenna installation!
–   Never work without effective fall protection!

WARNING!

Working on the antenna system during thunderstorms.

Danger to life due to electric shock!
–   Do not carry out any work on the antenna system or the antenna cable if there is a risk of lightning strikes.
–   Do not carry out any work on the antenna system if the safety distance to overhead lines is not guaranteed.

3.9 Cleaning and Care

ATTENTION!

Do not wet clean the appliance! Penetrating water can cause considerable dangers to the user (e.g., electric shock).

Liquid can destroy the electronics of the device! Liquid penetrates into the housing of the device and can cause a short circuit of the electronics.

Only clean with a soft, dry cloth. Never use solvents or cleaners.

3.10 Prevention of ESD Damage

ATTENTION!

The designation ESD (Electrostatic Sensitive Devices) refers to measures which are used to protect electrostatically endangered components from electrostatic discharge and thus to prevent destruction. Systems and assemblies with electrostatically endangered components usually have the following characteristics:

Indicator for assemblies with electrostatic endangered components
The following measures protect electrostatically endangered components from destruction:

Prepare removal and installation of assemblies
Unload yourself (for example, by touching a grounded object) before touching assemblies.

Ensure that you wear a grounding strap on the wrist when working with such assemblies, which you attach to an unpainted, non-conductive metal part of the system.

Use only tools and devices that are free from static electricity.

Transporting Assemblies
Assemblies may only be touched at the edge. Do not touch any pins or conductors on assemblies.

Installing and Removing Assemblies
Do not touch persons who are not grounded while removing or installing components. This could result in a loss of grounding protection from your electrostatic discharge.

Storing Assemblies
Always keep assemblies in ESD protective covers. These protective covers must be undamaged. ESD protective covers, which are extremely wrinkled or even have holes, no longer protect against electrostatic discharge.

ESD protective covers must not be low-resistance and metallically conductive if a lithium battery is installed on the assembly.

3.11 Return of Electrical and Electronic Equipment

ATTENTION!

WEEE Directive on Waste Electrical and Electronic Equipment 2012/19 / EU
(WEEE Waste Electrical and Electronic Equipment)

Separate Collection
Product Category: According to the device types listed in the WEEE Directive, Appendix 1, this product is classified as an IT and communication device.

This product meets the labeling requirements of the WEEE Directive. The product symbol on the left indicates that this electronic product must not be disposed of in domestic waste.

Return and Collection Systems
For returning your old equipment, please use the country-specific return and collection systems available to you or contact Meinberg.

The withdrawal may be refused in the case of waste equipment which presents a risk to human health or safety due to contamination during use.

Return of used Batteries
Batteries marked with one of the following symbols may not be disposed of together with the household waste according to the EU Directive.

MEINBERG

4 Quick Start Guide for Initial Operation

After the SyncBox / N2X was connected to the power supply and the network, it can be configured and monitored by using "Meinberg Device Manager" software.

The Meinberg Device Manager program can be downloaded here:

Windows: https://www.meinbergglobal.com/download/utils/windows/mbgdevman_setup.exe
Linux: https://www.meinbergglobal.com/download/utils/linux/mbgdevman.tar.gz
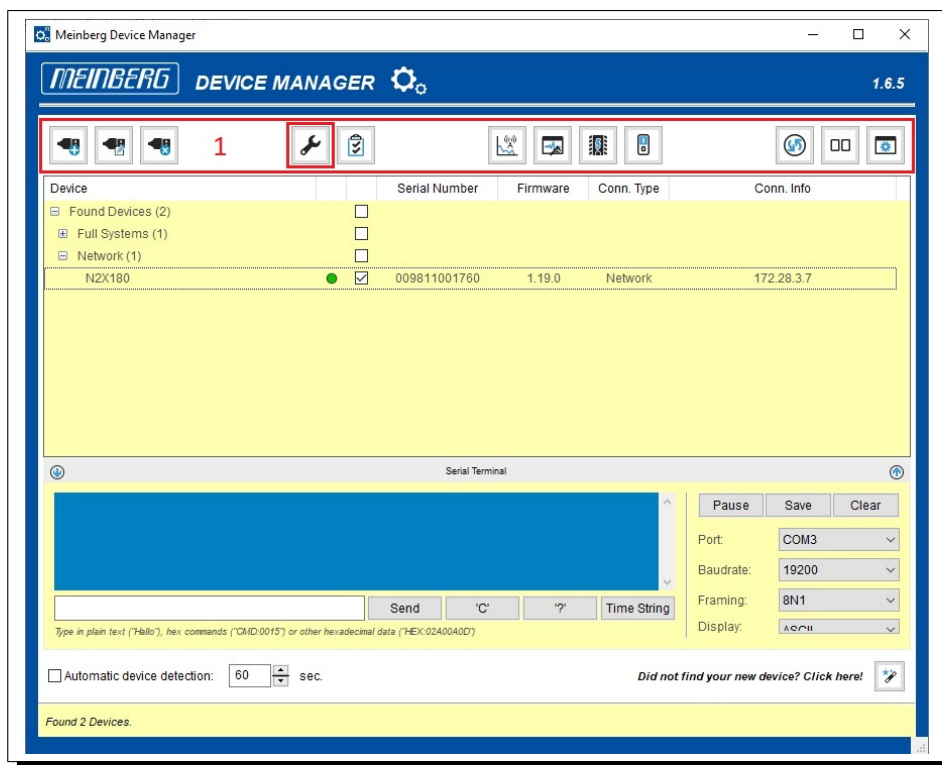
Configuration via the Network with the MEINBERG DEVICE MANAGER

After the start of *"mbgdevman"* all connected modules are displayed in a tree-structured list and can be selected by clicking on them. The list also displays basic information about them, such as the serial number, hostname, firmware version, type of connection (network, serial) and connection parameters (e.g. IP and MAC address).

If the module/assembly group is not displayed it can be manually connected via the menu button "Add Device." In addition, a new password can be set here.

In the menu area (see 1 figure) the menu button "Configure Device." is located. All important configurations of the connected module/system can be made here. You can reach all important status menus by using the "Show Device Status" menu button.

The N2X supports the following menus and possibilities of configuration and status monitoring.

Configuration

System	Saving of current configuration
Reference Source	Selection of reference sources (NTP or PTP)
Clock	Configuration of system time
Serial connectors	Configuration of serial parameter (Baud Rate, Framing,...)
Network	Configuration of network parameter (IP, DHCP, virtual Interface,...)
NTP	Configuration of NTP parameter (Ext. Server, Hostname, Polling,...)
PTP	Configuration of PTP parameter (Role, PTP Modus, Profile, Protocol, ...)
Outputs	Configuration of provided outputs (IRIG Codes, IRIG Timescale, Synth. Freq,...)
Time Zone	Configuration of time zone (UTC, CET/CEST, Daylight Saving,...)

All parameters can be configured as follows. With a right-hand click on the module/the assembly a dialogue window will be opened. Select "Configure Device" here. Now you are in the configuration menu of the module/assembly group.

To configure the network parameters, select "Network" in the Drop Down menu. By default, the DHCP service is enabled so an IP address is automatically assigned.
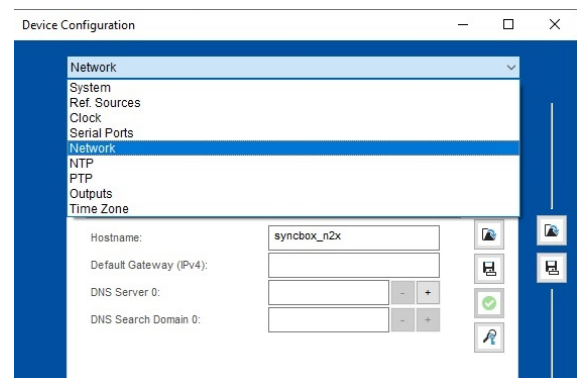
If no DHCP server could be found or no IP address has been assigned via DHCP by any other reason, a fallback IP address 169.254.xxx.yyy will be set automatically (Zeroconf [1]).

Depending on whether the N2X should synchronize via PTP or NTP, further parameters need to be configured for this purpose.

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[1]Zeroconf: If a computer configures a link local IP address, it selects an IP address between 169.254.1.0 and 169.254.254.255 by using a random number generator.

To configure the PTP parameters, select "PTP" in the Drop Down menu.

- You can determine the role of the PTP stack in the "Role" parameter.
- Under the "Profiles" parameter, either industry-specific PTP profiles can be selected, which then unlock further parameters.
- If you choose the "Role" Custom, you have the option to configure all PTP parameters freely.

In addition, for example, the parameters network protocol or the delay mechanism can be configured.

Status

Overview	Comprehensive informationen about module-/assembly group status
System	General system information (serial number, firmware,...)
Ref. sources	Status of the reference sources (NTP, PTP,...)
Clock	Status of the internal clock (synchronisation status, oscillator,...)
Network	Status of the network connection (Link, IP, DHCP, virtual interface,...)
NTP	Status of NTP (Offset, Stratum,...)
PTP	Status of PTP connections (Path Delay, Offset, Clock Accuracy,...)
Event Log	Listing of the event logs (Event with timestamp)
Sensors	Status of the sensors

5 The System SyncBox

The Meinberg SyncBox N2X is synchronized by a PTP Grandmaster or by a NTP Server and can be used as a time source for equipment that requires IRIG AM, Freq.Synth/sine, PPO (PPS, PPM, PPH, IRIG DCLS, Cyclic Pulses, Single Shot, Timer, DCF77 Mark, Time Sync, Freq. Synth./TTL, Time Slots) or serial time string for synchronization.

The SyncBox/N2X operates as a IEEE-1588 multicast slave clock or NTP client in a PTP / NTP network and with its interfaces this converter can synchronize many different systems. Our IEEE-1588 Grandmaster or LANTIME NTP Server, such the LANTIME M600, can be used as a reliable time source.

In order to support network management systems the SyncBox offers an extensive SNMP interface, which can be accessed by SNMP V1. It allows the monitoring of all relevant system parameters – including operating system parameters, network interface statistics, detailed NTP status information as well as the complete system configuration.

The SyncBox N2X is equipped with a high precision oscillator "TCXO". The oscillator determines the long-term stability in holdover mode, ie when the synchronization with the time source is disturbed. Oscillator update to OCXO-HQ is possible.

6 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).

6.1 Functionality in Slave Systems

SyncBox N2X - PTP Slave
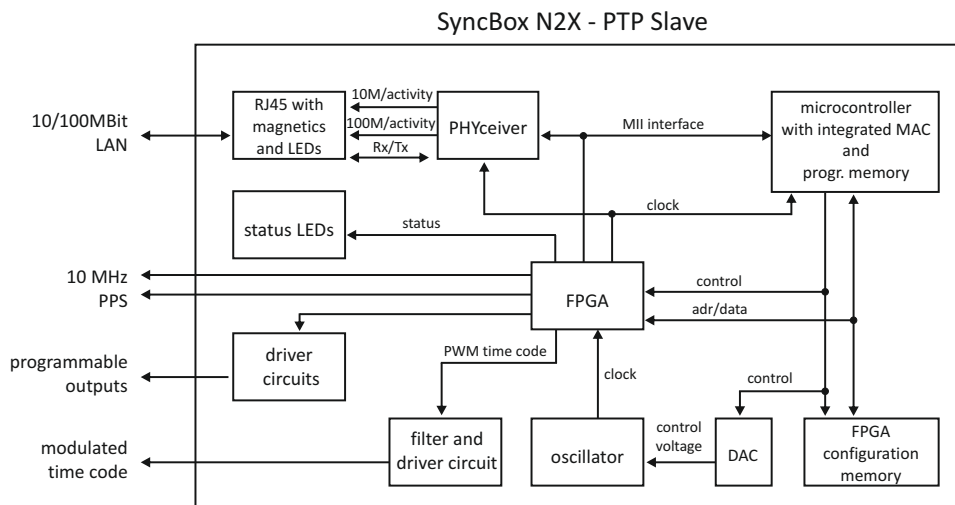
After decoding valid time information from a PTP Master, the system sets its own PTP seconds and nanoseconds accordingly. The PTP offset calculated by the PTP driver software is used to adjust the master oscillator of the SyncBox N2X. This allows the PTP Slave to generate very high accuracy output signals (10 MHz/1PPS/IRIG).

6.2 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.

6.2.1 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.

6.2.2 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.

6.2.3 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.

6.2.4 (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.

7 Introduction: 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 board &PROD-UCT however only decodes IRIG-A, IRIG-B or AFNOR NFS 87-500 formats. The AFNOR code is a variant of the IRIG-B format. Within this code the complete date is transmitted instead of the "Control Functions" of the IRIG telegram.

7.1 Description of IRIG-Codes

The specification of individual IRIG time code formats is defined in IRIG Standard 200-04. 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):

character	bit rate designation	A	1000 pps
		B	100 pps
1st digit	form designation	0	DC Level Shift pulse width modulated
	1		sine wave carrier amplitude modulated
2nd digit	carrier resolution	0	no carrier (DC Level Shift)
	1		100 Hz, 10 msec resolution
		2	1 kHz, 1 msec resolution
	3		10 kHz, 100 μsec resolution
3rd digit	coded expressions	0	$BCD_{(TOY)}$, CF, SBS
		1	$BCD_{(TOY)}$, CF
		2	$BCD_{(TOY)}$
		3	$BCD_{(TOY)}$, SBS
	4		$BCD_{(TOY)}$, $BCD_{(YEAR)}$, CF, SBS
	5		$BCD_{(TOY)}$, $BCD_{(YEAR)}$, SBS
	6		$BCD_{(TOY)}$, $BCD_{(YEAR)}$
	7		$BCD_{(TOY)}$, $BCD_{(YEAR)}$, SBS

BCD: time of year, BCD-coded
CF: Control-Functions (user defined)
SBS: seconds of day since midnight (binary)

7.2 IRIG Standard Format

TYPICAL MODULATED CARRIER

IRIG-A : 10000 Hz
IRIB-B : 1000 Hz
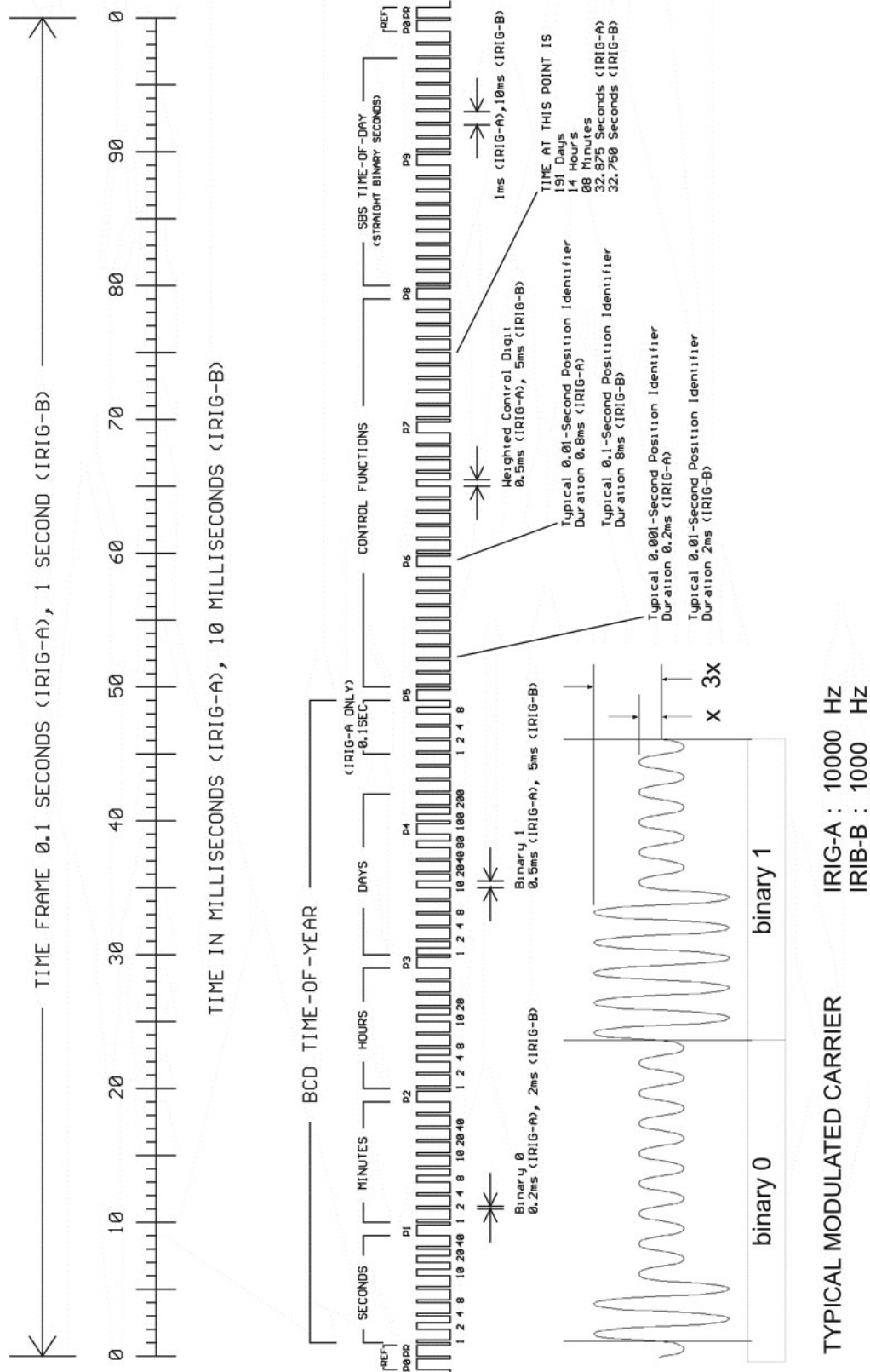
7.3 AFNOR Standard Format
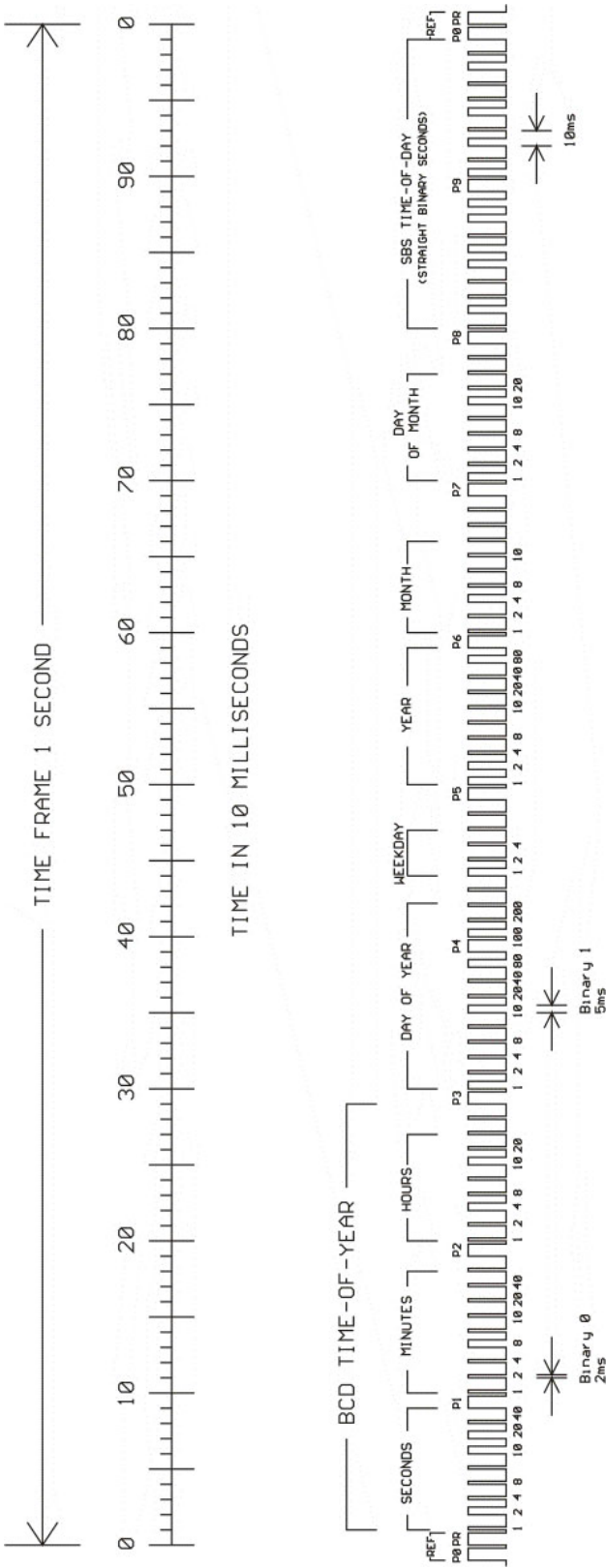
7.4 Generated Time Codes

Internal timecode generator may be configured to produce various pulse width coded IRIG-B or AFNOR signals.

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 number (0...99)

g) B007: 100 pps, DCLS Signal, no carrier
BCD time-of-year, Year, SBS time-of-day, year number (0...99)

h) B127: 100 pps, AM sinw wave signal, 1 kHz carrier frequency
BCD time-of-year, SBS time of day, year number (0...99)

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: Code according C37.118, 100 pps, 1 kHz carrier frequency, BCD time-of-year,
SBS time-of-day,C37.118 extensions for date, timezone, daylight
saving and leap second in control functions (CF) segment
(also see table 'Assignment of CF segment in IEEE1344 mode' but
sign bit of local offset is inverted)

8 Time Strings

8.1 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

8.2 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)

8.3 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

8.4 Format of the SAT Time String

The SAT Time String is a sequence of 29 ASCII characters starting with the STX (start–of–text) character and ending with the ETX (end–of–text) character. The format is:

<STX>*dd.mm.yy/w/hh:mm:ssxxxxuv*<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)

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

8.5 Format of the Uni Erlangen String (NTP)

The time string Uni Erlangen (NTP) of a GPS clock is a sequence of 66 ASCII characters starting with the STX (start–of–text) character and ending with the ETX (end–of–text) character. The format is:

<div align="center">

<STX>*tt.mm.jj; w; hh:mm:ss; voo:oo; acdfg i;bbb.bbbbn lll.lllle hhhhm*<ETX>

</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:

<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.llll   longitude of receiver position in degrees
               leading signs are replaced by a space character (20h)

e   longitude, the following characters are possible:
           'E'   east of Greenwich
           'W'   west of Greenwich

hhhh   altitude above WGS84 ellipsoid in meters
               leading signs are replaced by a space character (20h)

<ETX>   End-Of-Text, ASCII Code 03h

8.6 Format of the NMEA 0183 String (RMC)

The NMEA String is a sequence of 65 ASCII characters starting with the '$GPRMC' character and ending with the characters CR (carriage return) and LF (line-feed). The format is:

$GPRMC,*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		

8.7 Format of the NMEA 0183 String (GGA)

The NMEA (GGA) String is a sequence of characters starting with the '$GPRMC' character and ending with the characters CR (carriage return) and LF (line-feed). The format is:

$GPGGA,*hhmmss.ss,bbbb.bbbbb,n,lllll.ll,e,A,vv,hhh.h,aaa.a,M,ggg.g,M,,0*cs*<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

8.8 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,ll*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,ll   the local timezone (offset to UTC):

HH	hours	(00..+–13)
ll	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

8.9 Format of the ABB SPA Time String

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

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

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

yy-mm-tt   the current date:

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

_   Space (ASCII code 20h)

hh.mm;ss.fff   the current time:

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

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

<CR>   Carriage Return, ASCII Code 0Dh

8.10 Format of the Computime Time String

The Computime time string is a sequence of 24 ASCII characters starting with the T character and ending with the LF (line feed, ASCII Code 0Ah) character. The format is:

T:*yy:mm:dd:ww:hh:mm:ss*<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

8.11 Format of the RACAL standard Time String

The RACAL standard Time String is a sequence of 16 ASCII characters terminated by a X (58h) character and ending with the CR (Carriage Return, ASCII Code 0Dh) character. The format is:

<X><G><U>*yymmddhhmmss*<CR>

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

<X>	Control character sending with one bit accuracy at change of second		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

8.12 Format of the SYSPLEX-1 Time String

The SYSPLEX1 time string is a sequence of 16 ASCII characters starting with the SOH (Start of Header) ASCII 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:

<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)	

8.13 Format of the ION Time String

The ION time string is a sequence of 16 ASCII characters starting with the SOH (Start of Header) ASCII 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)

8.14 Format of the IRIG J Time String

The time code consists of ASCII characters, send in the format 7O1

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

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

<SOH>*DDD:HH:MM:SS***<CR><LF>**

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

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

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

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

CR   ASCII code „Carriage Return" (0x0Dh)

LF   ASCII code „Line Feed" (0x0Ah)

9 Pulses

9.1 Pulse Outputs

Idle Mode
Selecting "Idle" deactivates the output.

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. "Pulse length" determines the pulse duration (10 msec...10 sec).

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.

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

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 "pulse length" determines the pulse duration. The pulse duration can vary from 10 msec to 10 sec in steps of 10 msec.

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.

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

Time code
The un–modulated IRIG or AFNOR signal of the built in time code generator is made available at the respective output.

Time sync
The output is switched on if the internal timing is synchronous to the GPS–system

Synthesizer
The included synthesizer generates a frequency from 1/8 Hz up to 10 MHz synchronous to the internal timing frame. The phase of this output can be shifted from 0° to 359° for frequencies <10 kHz.

10 MHz
Selecting "10 MHz" directly from the oscillator.

Time Slots
In this mode, you can select defined time slots. "Number of Time Slots" determines the number and length of

the time slots based to one minute. The "Slot Length Reduction" allows to set a premature shutdown. This can be configured in the range between 50ms and 500ms to prevent overlap of time slots.

Example:

- Number of Time Slots = 10
- Slot Length Reduction = 500ms

Time slots 1 and 2 are enabled (0 – 6s and 6 – 12s).
In fact, the outputs triggers from 0 – 11,5s.

10 Attachment: Technical Information

10.1 Technical Specifications SYNCBOX N2X

|	
Power Supply:	Nominal: 48 V DC (max. 20 - 60 V DC)
Input Fuse:	Medium Slow 500 mA / 250 V
Protection Rating:	IP20
Power Consumption:	7,5 W
Humidity:	max. 85%
Ambient Temperature:	0 ... 50°C
Accuracy of pulse outputs:	PTP: +/- 100 ns (relative to the used IEEE 1588 Grandmaster Clock, after initial synchronization phase) NTP: +/- 1 ms (relativ to NTP when using a local time server) * after warm-up period
Precision Time Protocol (IEEE 1588)	UDP/IPv4 (L3) or IEEE802.3 (L2) Multicast E2E, E2E Hybrid or P2P Delay Mechanism PTP Subdomains (0-255) Power Profile compatible
Network Time Protocol (NTP)	Up to seven configurable external NTP Time Server Min. and max. polling interval (8s – 1024s) Standard NTP options (noselect, true, prefer, iburst)
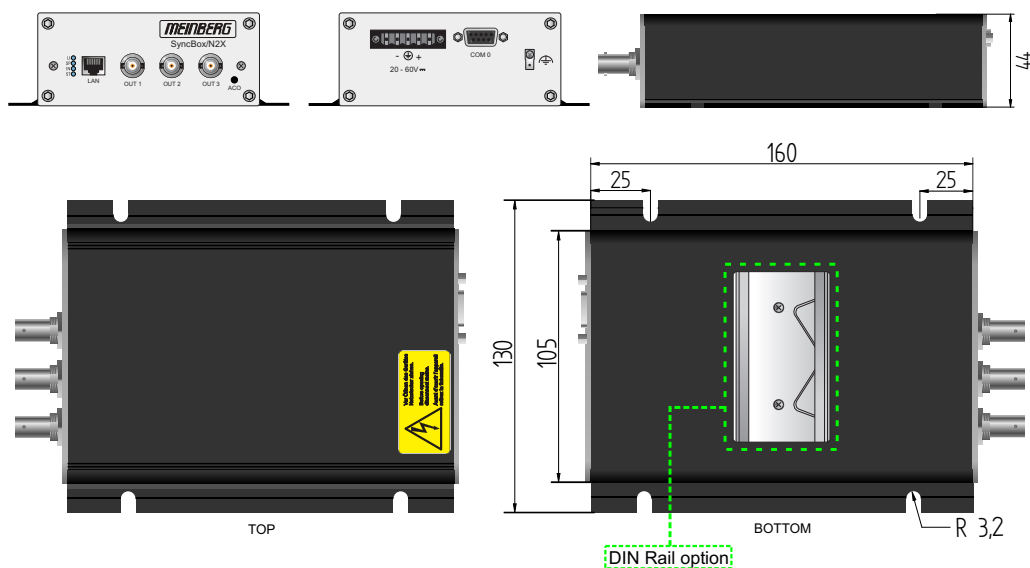
10.2 SYNCBOX N2X Connectors

Name	Type	Signal	Cable
FRONT			
Network	RJ-45	10/100 BaseT	CAT 5 network cable
Out 1 – 3	BNC connector	TTL into 50 Ohm	shielded coax line
(Optional outputs)	ST connector	FO	Fiber Optic
	2pin DFK	Photo-MOS	2pin. MSTB clamp
	9pin. SUB-D	RS-232	shielded data line
REAR			
COM 0	9pin. SUB-D	RS-232	shielded data line
Input Voltage	5pin DFK clamp	max. 20 – 60 V DC	Power supply cord
(Optional power)	PoE	10/100 BaseT	CAT 5 network cable

10.3 Power connect

Connector: 5pin DFK

Pin Assignment: 1: not connected
2: V_{in} –
3: Protective Earth
4: V_{in} +
5: not connected
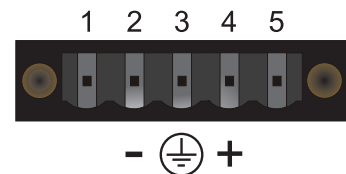
Input Parameter
_____

Nominal voltage range:	U_N	= 48 V ⎓
Maximum voltage range:	U_{max}	= 20 – 60 V ⎓
Nominal current:	I_N	= 0.22 A

Output Parameter
_____

Maximum power:	P_{max}	= 10 W
Maximum heat:	E_{therm}	= 36.01 kJ/h (34.13 BTU/h)

10.4 RS232 COMx Timestring / Configuration

Connector: D–SUB female 9pin.

Cabel: shielded data line

Assignment:
Pin 2:   TxD (transmit)
Pin 3:   RxD (receive)
Pin 5:   GND (ground)
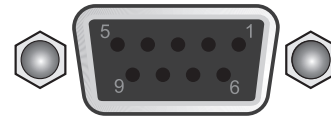
COM x

10.5 Programmable pulse Output

Level: TTL into 50 Ohm

Connector: BNC, female

Cable: shielded coax line

Pulse outputs: Pulse Per Second
                       Cyclic Pulse
                       Single Shot
                       Timer
                       Idle
                       All Sync
                       Time Sync
                       Position OK
                       DCF77 Marks
                       Pulse Per Hour
                       Pulse Per Min
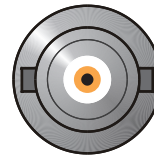
Out x

10.6 Status LEDs

LED Indicators

LI – Link:	lights up in the same color as SP–Speed, on or off, if no link is available

SP – Speed:	red	no link available
	yellow	10Mbit
	green	100Mbit

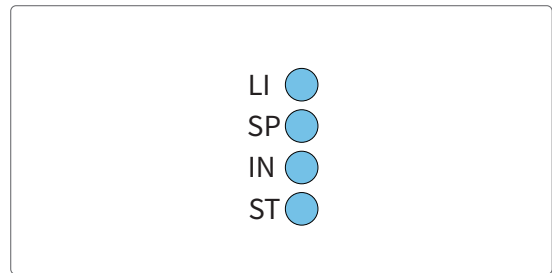| IN – Input:	red	no reference
	yellow	reference is available
	green – blinking	synchronous
	green	oscillator has locked

ST – Status:	blue	during initialization
	green	normal operation
	red	error

10.7 10/100base-T Ethernet (IEEE 803.2) / Configuration

Link speed:	10/100 MBit
Connector Type:	8P8C (RJ45)
Cable:	CAT 5.0
Duplex Modes:	Half/Full/Autonegotiaton

10.8 SyncBox N2X - optional outputs

10.8.1 Fiber optic - Programmable pulse Output

Output: Fiber optic output, 850nm

Connector: ST-connector

Cable/Connection: GI 50/125μm or 62,5μm gradient fibre

Pulse outputs: Pulse Per Second
                     Cyclic Pulse
                     Single Shot
                     Timer
                     Idle
                     All Sync
                     Time Sync
                     Position OK
                     DCF77 Marks
                     Pulse Per Hour
                     Pulse Per Min
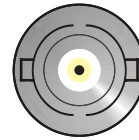
Out x

10.8.2 Programmable pulse Output

Level: TTL

Connector: 9pin. D-SUB, female

Pin assignment:

                     Pin 2:   Signal (Programmable pulse)
                     Pin 5:   GND (Ground)

Cable: shielded data line

Progr. Pulse

Pulse outputs: **Optional**
                     Pulse Per Second
                     Cyclic Pulse
                     Single Shot
                     Timer
                     Idle
                     All Sync
                     Time Sync
                     Position OK
                     DCF77 Marks
                     Pulse Per Hour
                     Pulse Per Min
                     10MHz (not possible if use RS232)
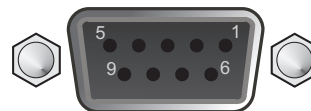
10.8.3 PMO6

Function

The expansion board PMO6 decouples pulses or signals by PhotoMOS Relays. The circuit inputs are connected to the TTL output.

Technical Specifications

INPUT: TTL (e.g. PPS; PPM; progr. pulses out)

Technical details PMO6

LOAD
VOLTAGE: 250 V AC/DC

LOAD
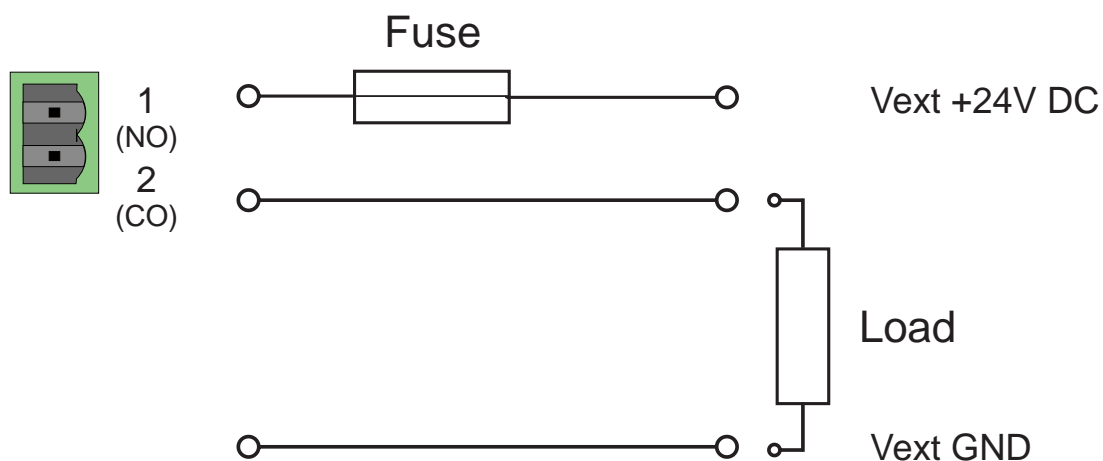CURRENT: 150mA (Peak AC, DC)

TOTAL
POWER
DISSIPATION: 410mW

ISOLATION
VOLTAGE: 1.500V AC

SWITCHING
SPEED: turn on time: 180μs
                   turn off time: 70μs

11 Declaration of Conformity

Konformitätserklärung
Doc ID: SyncBox N2X-2019-02-21

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

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

Produktbezeichnung   **SyncBox N2X**
Product Designation

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

EMV – Richtlinie	DIN EN 61000-6-2:2005
EMC – Directive	DIN EN 61000-6-3:2007 + A1:2011
	DIN EN 55032:2012
2014/30/EU	DIN EN 55024:2010

———

Niederspannungsrichtlinie	DIN EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 +
Low-voltage Directive	AC:2011 + A2:2013
2014/35/EU	

———

RoHS – Richtlinie	DIN EN 50581:2012
RoHS – Directive	
2011/65/EU	

———

Bad Pyrmont, den 2019-02-21

Stephan Meinberg
Production Manager

SYNCBOX_N2X_21022019