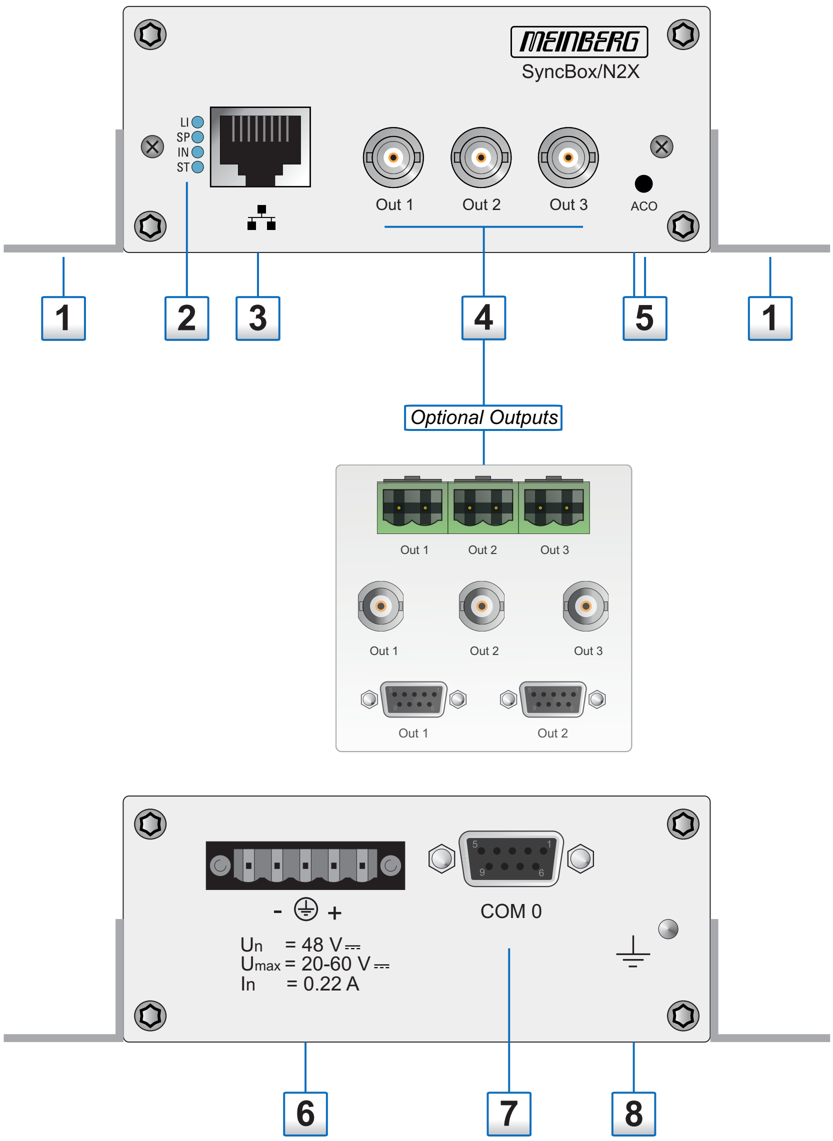
MANUAL

SyncBox N2X

16th March 2018

Meinberg Funkuhren GmbH & Co. KG

Front view (Frontansicht) SyncBox N2X



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: 19 - 72 VDC
7. COM 0 serial port, 9pin. D-SUB
8. 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: 19 - 72 VDC
7. COM 0 serieller Anschluss, 9pol. D-SUB
8. Erdanschluss

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1 Imprint

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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.

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.

Please note the following symbols:

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 Schutzleiterklemme / *Protective Conductor Terminal*
⚠	Vorsicht, Risiko eines elektrischen Schlages / *Caution, possibility of electric shock*
⚠	ISO 7000-0434 Vorsicht, Risiko einer Gefahr / *Caution, Danger*
	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.*

3 Safety Hints

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

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

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

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

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

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

WARNING! DANGER TO LIFE BY ELECTRICAL SHOCK!
NO LIVE WORKING!

Wiring or any other work done the connectors particularly when connectors are opened may never be carried out when the installation is energized.

All connectors must be covered to prevent from accidental contact to life parts.

ADVICE: ALWAYS ENSURE A PROPER INSTALLATION!

Additional safety information for installation devices

- This device was developed in accordance with the requirements defined in IEC60950-1.
- When the device is installed and operated in an end user device (e.g a cubicle), additional requirements defined in IEC60950-1 must be fulfilled. Particularly the general standards for electrical safety (IEC, VDE, DIN, ANSI e.g.) as well as the applicable national standards must be observed.
- Protection against fire must be ensured.
- The device was developed for industrial environments with a pollution grade 2 according to IEC60950-1. Environments with a higher degree of pollution require additional measures such as installation in a control box with air condition for example.
- The device was designed and tested for a maximum ambient temperature of 50°C.

Hints for Installation

- The device may only be operated inside a building.
- The device must be protected from moisture and heat.
- The housing of the device must not be damaged for installation.
- It is not allowed to drill holes in the housing.
- The device must be protected from mechanical stress such as vibrations or shock.
- The metal housing of the device is connected to the protective earth connector. Make sure not to underrup crepage distances to energized parts close to the device. Make sure not to cause short circuits.

Safety Advice for the Lithium-Battery

This device is equipped with a Lithium-Battery Type CR2032 (3 V , 230 mAh). The battery may not be short-circuited, charged or exposed to heat. Battery exchange may only be carried out by the manufacturer.

Hints for cleaning and maintenance

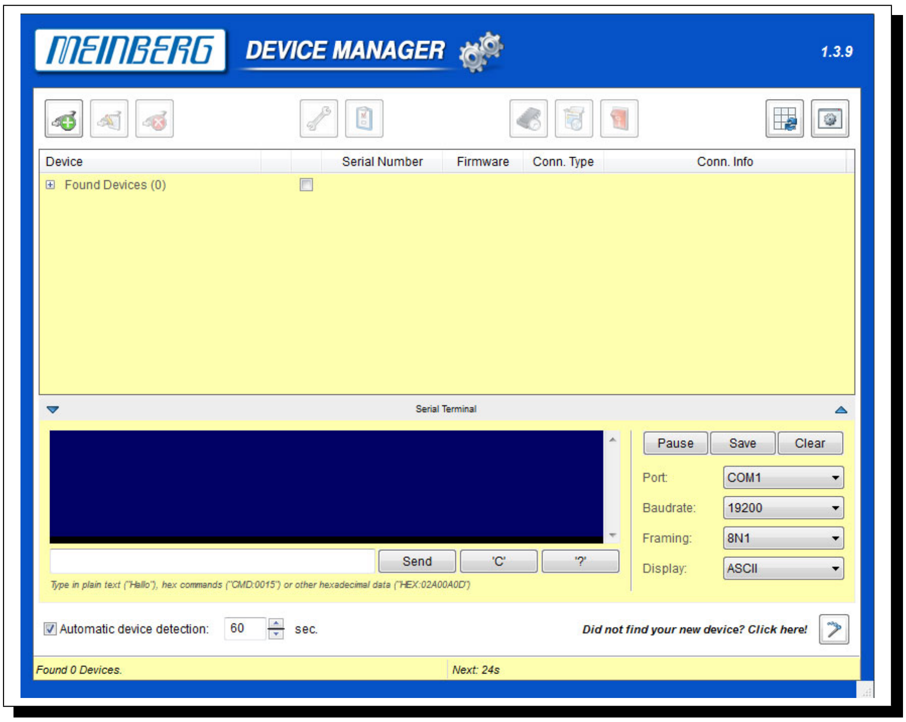
Attention!
Liquids can damage the electronics of the device! Liquid enters the housing of the system and can cause a short circuit. Clean the device with a soft, dry or slightly damp cloth. Do not use any solvents or detergents.

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's Device Manager program.

The Meinberg Device Manager program can be downloaded here:

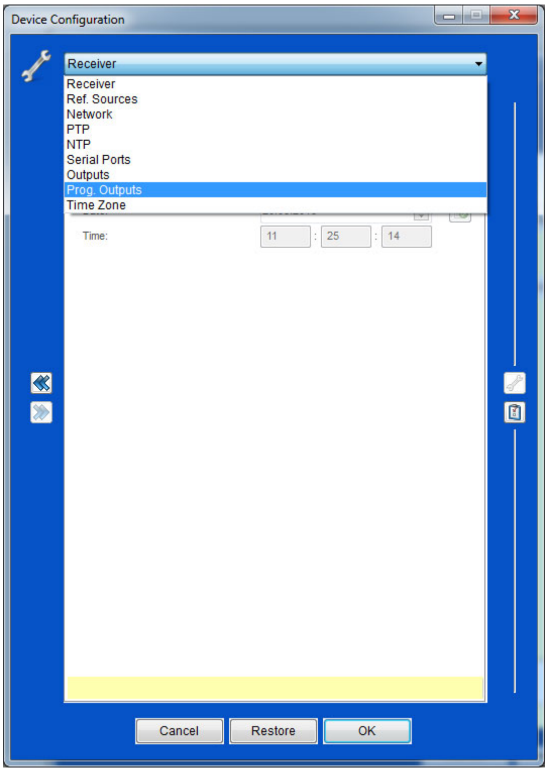
Windows: https://www.meinbergglobal.com/download/utils/windows/mbgdevman_setup.exe
Linux: https://www.meinbergglobal.com/download/utils/linux/mbgdevman.tar.gz



Configuration via the Network with the MEINBERG DEVICE MANAGER
After starting the "mbgdevman" all devices found in the network will be shown in the main window. By selecting the icon on the left side of the entry, all network addresses can be displayed. The LED icon indicates the status of the device. After selecting the checkbox, the edit / delete buttons are activated in the top left of the window. You can now use the edit button to adjust the connection type (network or serial connection). Here you can also set a new password (default: mbg).

The upper part (center) of the window also contains the buttons "Edit Device" and "Status". The Edit button opens the "Device configuration" window. All important settings can be made for all of the listed devices, or for the selected system:

Receiver	Initialisation of the receiver
Reference Source	NTP or PTP
Network	Netzwork settings (IP, DHCP ...)
PTP	PTP Settings (PTP Mode, Profile, Protocol ...)
NTP	NTP Settings (Role, Server, Polling, Bond ...)
Serial Connectors	Baud Rate, Framing, Sring Type, COM0 Mode
Outputs	IRIG Codes, IRIG Timescale, Synth. Freq, Enable/Disable Outputs
Programm. Outputs	Mode, Invert, Enable Outputs (Always, If Sync)
Time Zone	Time Zone (UTC, CET/CEST, Custom with Offset), Daylight Saving



To adjust the network parameters of the N2X, press the tab with the assigned IP. By default, the DHCP service is enabled so that an IP address is assigned automatically.

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]).

By selecting the menu item PTP, the PTP mode can be changed. Via the tab "Role" you can select between multicast and unicast slave. Via the profiles tab you can select the PTP - Profile (Custom, Power and Telecom). In this area it is also possible to enter the Unicast Master and the intervals of the messages (Announce, Sync, DelayRequest).

[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.

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.

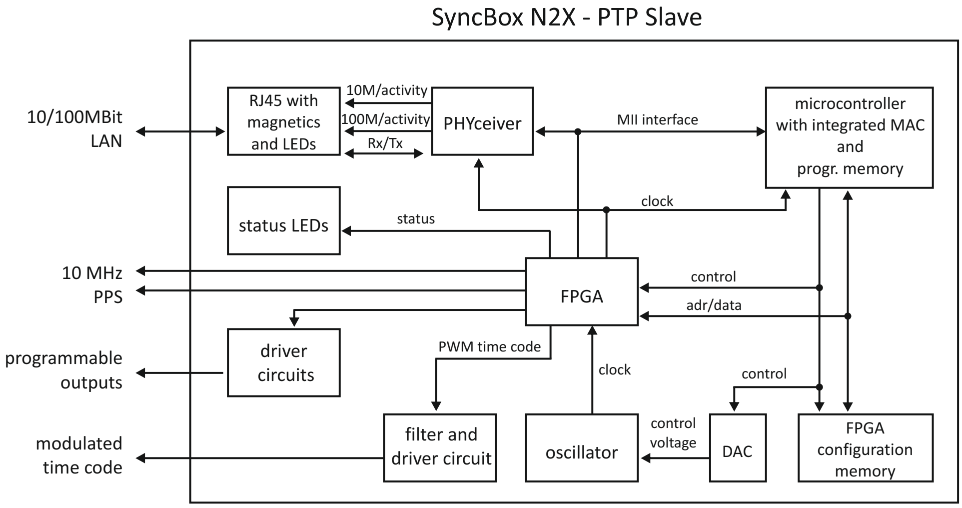
6 Precision Time Protocol (PTP) / IEEE1588

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



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 &PRODUCT 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.

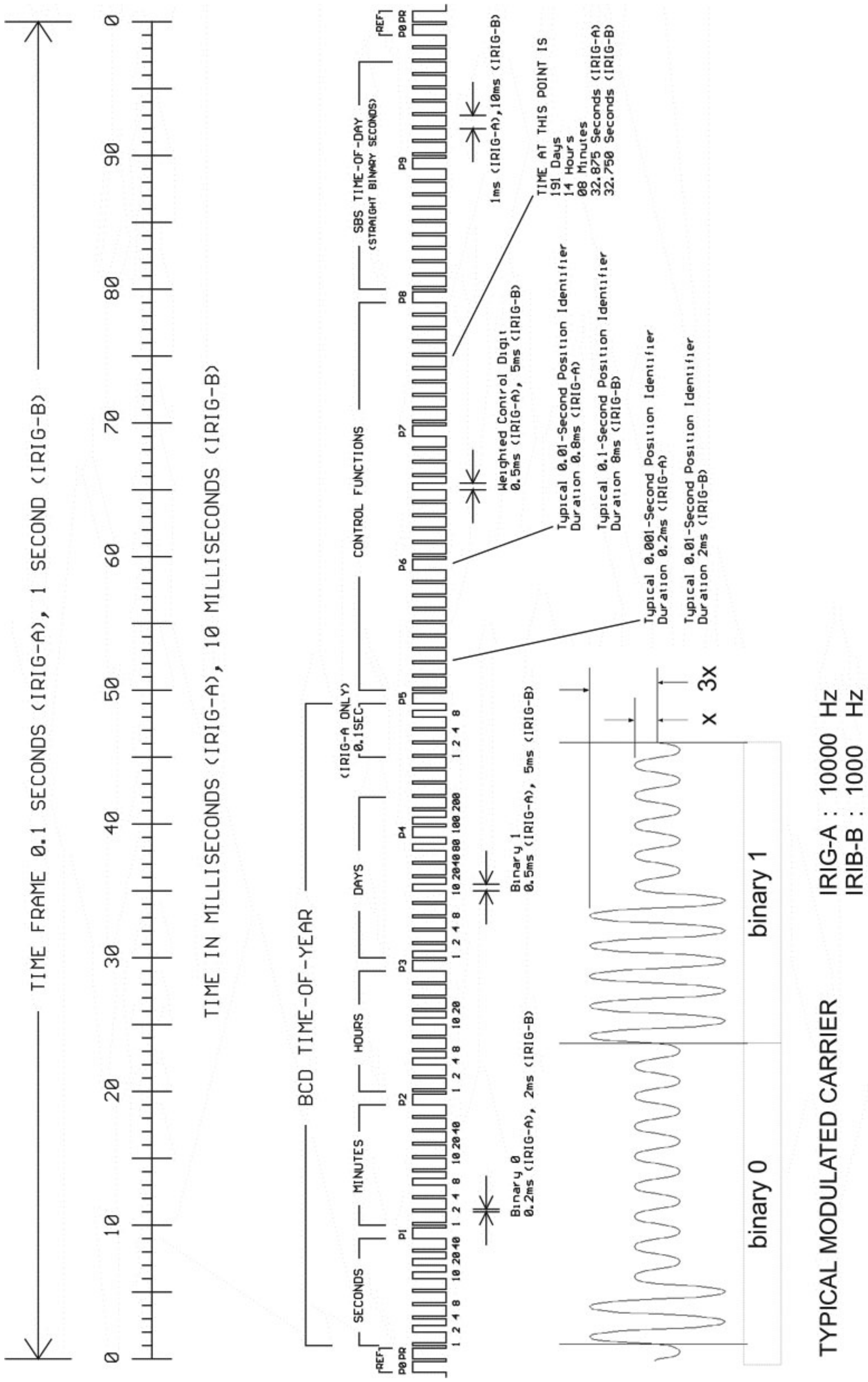
7.1 Description of IRIG-Codes

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):

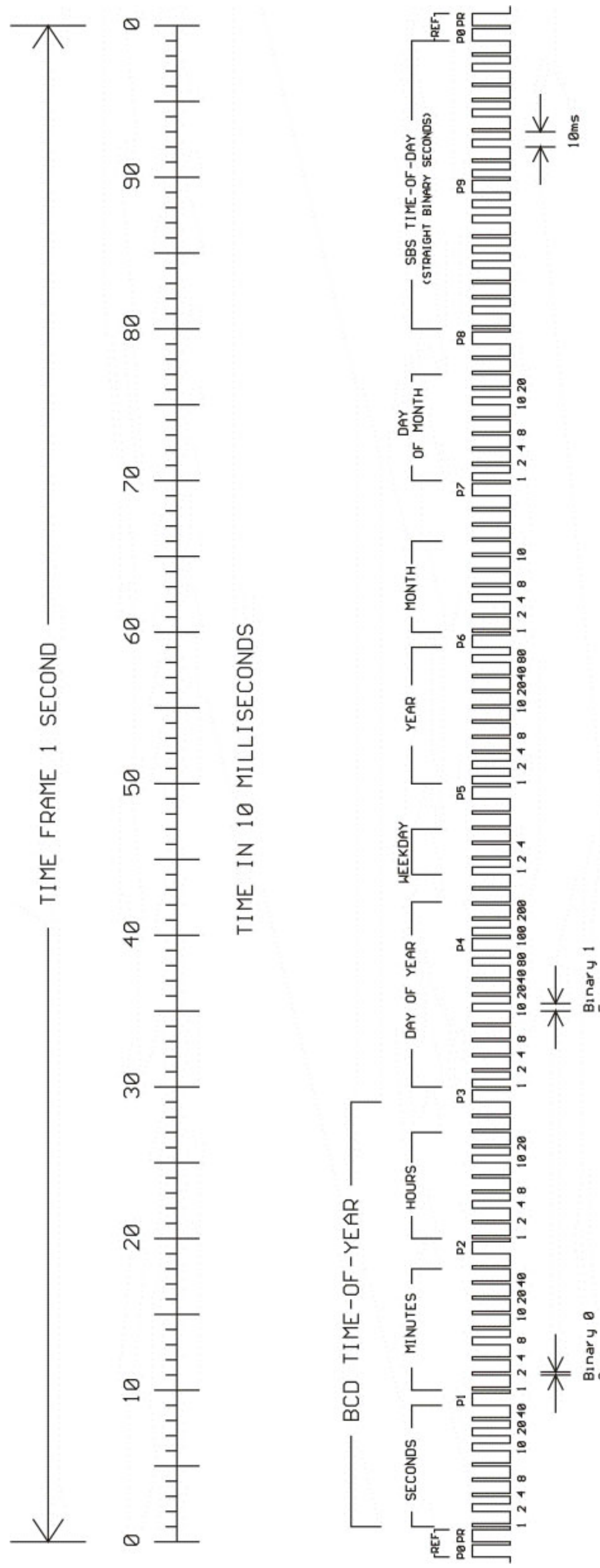
character	bit rate designation	A	1000 pps
		B	100 pps
1st digit	form designation	0	DC Level Shift pulse width modulated
		1	sine wave carrier amplitude modulated
2nd digit	carrier resolution	0	no carrier (DC Level Shift)
		1	100 Hz, 10 msec resolution
		2	1 kHz, 1 msec resolution
		3	10 kHz, 100 μsec 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



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 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

8.3 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		

8.4 Format of the Uni Erlangen String (NTP)

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

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

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

<STX>	Start-Of-Text, ASCII Code 02h sending with one bit occuracy at change of second		
dd.mm.yy	the current date:		
	dd	day of month	(01..31)
	mm	month	(01..12)
	yy	year of the century	(00..99)
	w	the day of the week	(1..7, 1 = Monday)
hh.mm.ss	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
v	sign of the offset of local timezone related to UTC		
oo:oo	offset of local timezone related to UTC in hours and minutes		
ac	clock status characters:		
	a:	‘#’	clock has not synchronized after reset
		‘ ’	(space, 20h) clock has synchronized after reset
	c:	‘*’	GPS receiver has not checked its position
		‘ ’	(space, 20h) GPS receiver has determined its position
d	time zone indicator:		
	‘S’	CEST	European Summertime, daylight saving enabled
	‘ ’	CET	European Standard Time, daylight saving disabled
f	anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:		
	‘!’	announcement of start or end of daylight saving time	
	‘ ’	(space, 20h) nothing announced	
g	anouncement of discontinuity of time, enabled during last hour before discontinuity comes in effect:		
	‘A’	announcement of leap second insertion	
	‘ ’	(space, 20h) nothing announced	
i	leap second insertion		
	‘L’	leap second is actually inserted (active only in 60th sec.)	
	‘ ’	(space, 20h) no leap second is inserted	
bbb.bbbb	latitude of receiver position in degrees leading signs are replaced by a space character (20h)		
n	latitude, the following characters are possible:		

	‘N’	north of equator
	‘S’	south d. equator

lll.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

8.5 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		

8.6 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)		

8.7 Format of the SPA Time String

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

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

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

jj-mm-tt	the current date:		
	jj	year of the century	(00..99)
	mm	month	(01..12)
	tt	day of month	(01..31)
	_	Space	(ASCII-code 20h)
hh.mm;ss.fff	the current time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59, or 60 while leap second)
	fff	milliseconds	(000..999)
cc	Checksum. EXCLUSIVE-OR result of the previous characters, displayed as a HEX byte (2 ASCII characters 0..9 or A..F)		
<CR>	Carriage Return		ASCII Code 0Dh

8.8 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		

8.9 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,IIcs<CR><LF>**
ZDA - Time and Date: UTC, day, month, year and local timezone.

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

$	Start character, ASCII Code 24h sending with one bit accuracy at change of second		
hhmmss.ss	the current UTC time:		
	hh	hours	(00..23)
	mm	minutes	(00..59)
	ss	seconds	(00..59 or 60 while leap second)
HH,II	the local timezone (offset to UTC):		
	HH	hours	(00..+-13)
	II	minutes	(00..59)
dd,mm,yy	the current date:		
	dd	day of month	(01..31)
	mm	month	(01..12)
	yyyy	year	(0000..9999)
cs	checksum (EXOR over all characters except '$' and '*')		
<CR>	Carriage Return, ASCII Code 0Dh		
<LF>	Line Feed, ASCII Code 0Ah		

8.10 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)		

8.11 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

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.

9.2 Time Capture Inputs

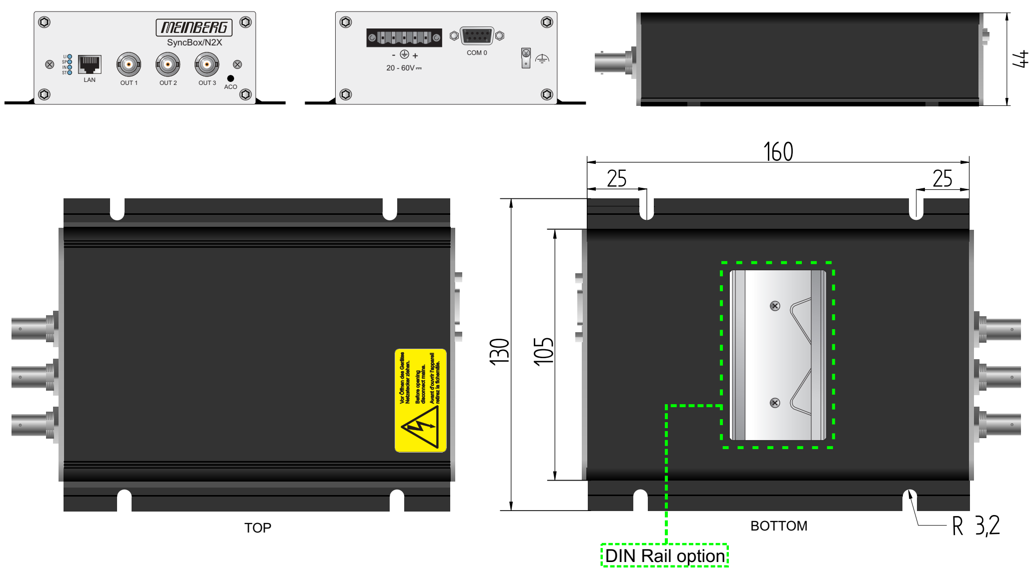
Two time capture inputs called User Capture 0 and 1 are provided at the rear connector (CAP0 and CAP1) to measure asynchronous time events. A falling TTL slope at one of these inputs lets the microprocessor save the current real time in its capture buffer. From the buffer, capture events are transmitted via COM0 or COM1 and displayed on LCD. The capture buffer can hold more than 500 events, so either a burst of events with intervals down to less than 1.5 msec can be recorded or a continuous stream of events at a lower rate depending on the transmission speed of COM0 or COM1 can be measured.

The format of the output string is ASCII, see the technical specifications at the end of this document for details. If the capture buffer is full a message "** capture buffer full" is transmitted, if the interval between two captures is too short the warning "** capture overrun" is being sent.

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)



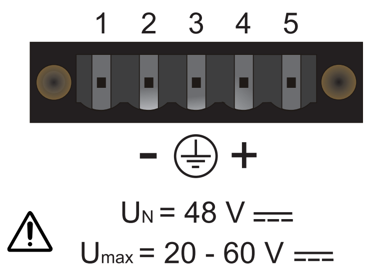
10.2 SYNCBOX N2X Connectors

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: PE
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

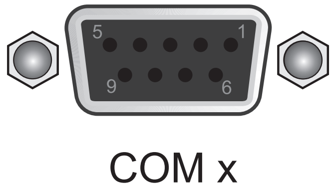
Maximum power:	P_{max}	= 10 W
Maximum heat:	BTU	= 34.13 BTU/h

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)



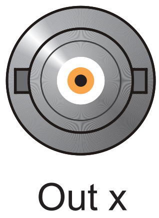
10.5 Programmable pulse Output

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



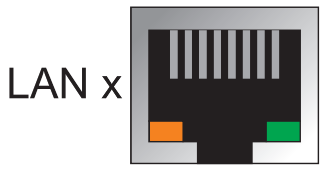
10.6 10/100base-T Ethernet (IEEE 803.2) / Configuration

Link speed: 10/100 MBit

Connector Type: 8P8C (RJ45)

Cable: CAT 5.0

Duplex Modes: Half/Full/Autonegotiaton



10.7 SyncBox N2X - optional outputs

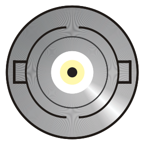
10.7.1 Fiber optic - Programmable pulse Output

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

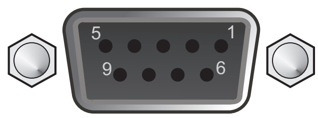


10.7.2 Programmable pulse Output

Level: TTL

Connector: 9pin. D-SUB, female

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



Cable: shielded data line

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)

10.7.3 PMO6

Function

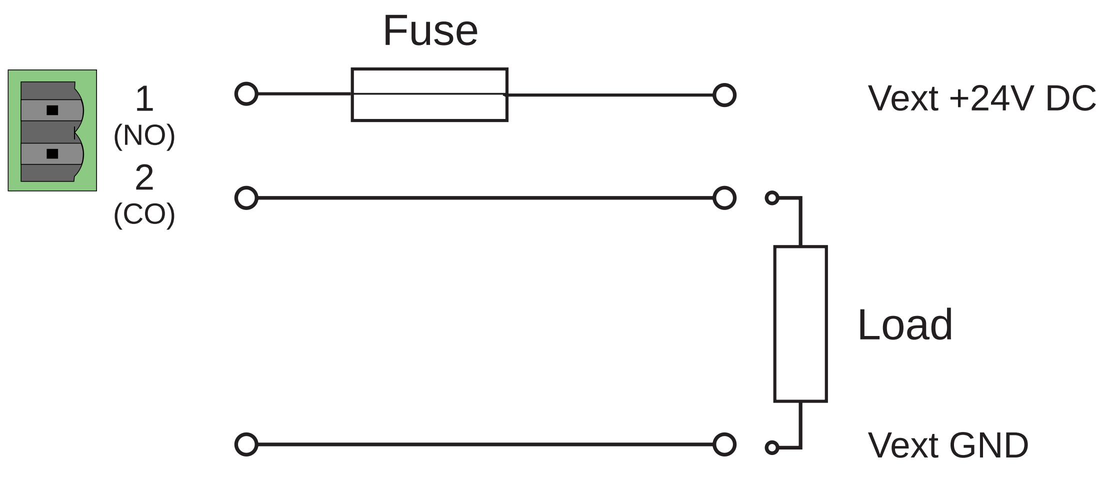
The expansion board PMO6 decouples pulses or signals by PhotoMOS Relays. The circuit inputs are connected to the TTL output.

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-2017-04-06

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

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

Produktbezeichnung *Product Designation*	**SyncBox N2X**

auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt
to which this declaration relates is in conformity with the following standards

EN55022:2010	Limits and methods of measurement of radio interference characteristics of information technology equipment
EN55024:2010	Limits and methods of measurement of Immunity characteristics of information technology equipment
EN 60950-1:2006 (A11:2009 + A1:2010 + A12:2011 + AC:2011 + A2:2013)	Safety of information technology equipment
EN 50581:2012	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

gemäß den Richtlinien 2014/30/EU (Elektromagnetische Verträglichkeit), 2014/35/EU (Niederspannungsrichtlinie), 2011/65/EU (Beschränkung der Verwendung bestimmter gefährlicher Stoffe) und 93/68/EWG (CE Kennzeichnung) sowie deren Ergänzungen.
following the provisions of the directives 2014/30/EU (electromagnetic compatibility), 2014/35/EU (low voltage directive), 2011/65/EU (restriction of the use of certain hazardous substances) and 93/68/EEC (CE marking) and its amendments.

Bad Pyrmont, 2017-04-06

Günter Meinberg
Managing Director

SYNCBOX_N2X_060417