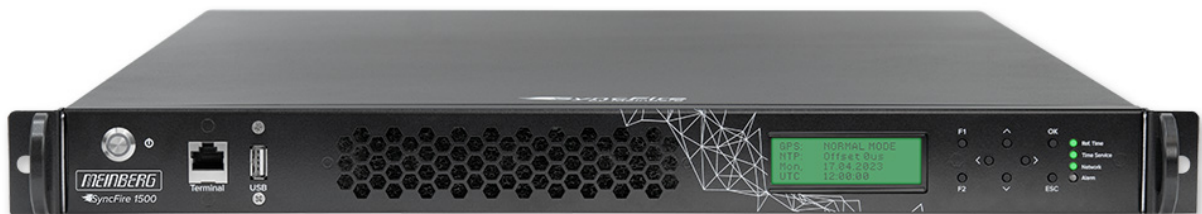# MEINBERG

The Synchronization Experts.

MANUAL

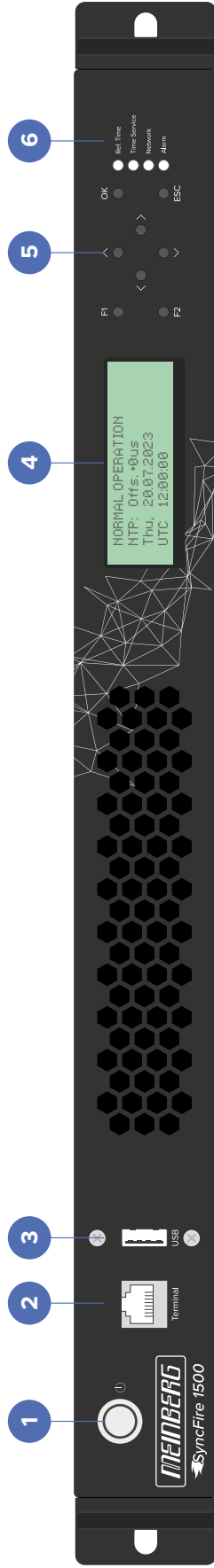## SyncFire 1500

High-Performance NTP Server

September 7, 2023

Meinberg Funkuhren GmbH & Co. KG

Front view (Frontansicht) SyncFire 1500

NORMAL OPERATION
NTP: Offs.+0us
Thu, 20.07.2023
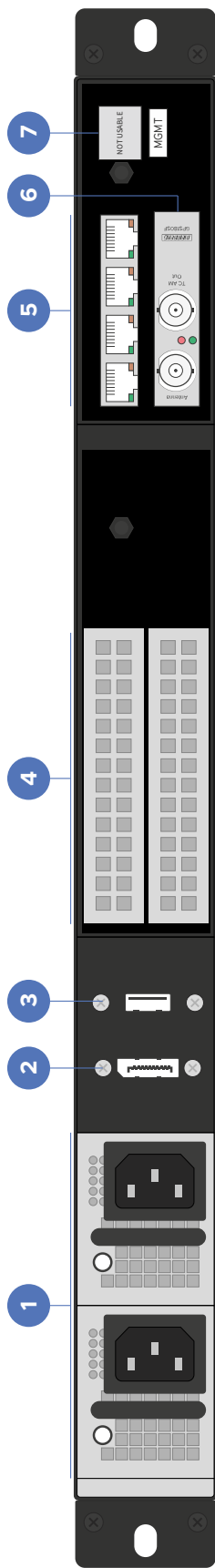UTC 12:00:00

SyncFire 1500

English

1. Power On button
2. 8P8C (RJ45) connector for serial (RS-232) terminal connection
3. USB 3.0 port
4. LC-Display, 4 x 20 characters
5. Function buttons: 4-way navigation; F1, F2, OK, ESC
6. Status LEDs: Ref. Time, Time Service, Network, Alarm

Deutsch

1. Einschalttaste
2. 8P8C (RJ45)-Anschluss für serielle (RS-232) Terminalverbindung
3. USB 3.0-Anschluss
4. LC-Display, 4 x 20 Zeichen
5. Funktionstasten: 4-Wege-Navigation; F1, F2, OK, ESC
6. Status-LEDs: Ref. Time, Time Service, Network, Alarm

Rear view (Rückansicht) SyncFire 1500

Deutsch

1. Netzteilanschluss (redundante Netzgeräte)
2. Display Port 1.2
3. USB 3.0-Anschluss
4. Netzwerk-Erweiterungsoption
   Optionaler Sync-Eingang
5. Netzwerkanschlüsse 10/100/1000BASE-T
6. GPS- oder GNS-Empfänger mit
   AM-Zeitcode-Ausgang (IRIG, AFNOR NF S87-500, IEC 37.118)
7. Netzwerk-Management-Anschluss (nicht verbunden)

English

1. Power supply bay (redundant power supplies)
2. Display Port 1.2
3. USB 3.0 port
4. Network Expansion Option
   Sync Input Option
5. Network connectors 10/100/1000BASE-T
6. GPS or GNS receiver with
   AM time code output (IRIG, AFNOR NF S87-500, IEC 37.118)
7. Network management port (disabled)

Table of Contents

1 Imprint

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Manual
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3 Presentation Conventions in this Manual

3.1 Conventions for the Presentation of Critical Safety Warnings

Warnings are indicated with the following warning boxes, using the following signal words, colors, and symbols:

Caution!

This signal word indicates a hazard with a **low risk level**. Such a notice refers to a procedure or other action that may result in **minor injury** if not observed or if improperly performed.

Warning!

This signal word indicates a hazard with a **medium risk level**. Such a notice refers to a procedure or other action that may result in **serious injury** or even **death** if not observed or if improperly performed.

Danger!

This signal word indicates a hazard with a **high risk level**. Such a notice refers to a procedure or other action that will very likely result in **serious injury** or even **death** if not observed or if improperly performed.

3.2 Secondary Symbols Used in Safety Warnings

Some warning boxes may feature a secondary symbol that emphasizes the defining nature of a hazard or risk.

The presence of an "electrical hazard" symbol is indicative of a risk of electric shock or lightning strike.

The presence of a "fall hazard" symbol is indicative of a risk of falling when performing work at height.

This "laser hazard" symbol is indicative of a risk relating to laser radiation.

3.3 Conventions for the Presentation of Other Important Information

Beyond the above safety–related warning boxes, the following warning and information boxes are also used to indicate risks of product damage, data loss, and information security breaches, and also to provide general information for the sake of clarity, convenience, and optimum operation:

Important!

Warnings of risks of product damage, data loss, and also information security risks are indicated with this type of warning box.

Information:

Additional information that may be relevant for improving efficiency or avoiding confusion or misunder–standings is provided in this form.

3.4 Generally Applicable Symbols

The following symbols and pictograms are also used in a broader context in this manual and on the product.

The presence of the "ESD" symbol is indicative of a risk of product damage caused by electrostatic discharge.

Direct current (DC) *(symbol definition IEC 60417-5031)*

Alternating current (AC) *(symbol definition IEC 60417-5032)*

Ground connection *(symbol definition IEC 60417-5017)*

Protective earth connection *(symbol definition IEC 60417-5019)*

4 Important Safety Information

The safety information provided in this chapter as well as specific safety warnings provided at relevant points in this manual must be observed during every installation, set-up, and operation procedure of the device, as well as its removal from service.

Any safety warnings affixed to the device itself must also be observed.

Any failure to observe this safety information, these safety warnings, and other safety-critical operating instructions in the product documentation, or any other improper usage of the device may result in unpredictable behavior from the product, and may result in injury or death.

Depending on your specific device configuration and installed options, some safety information may not be applicable to your device.

Meinberg accepts no responsibility for injury or death arising from a failure to observe the safety information, warnings, and safety-critical instructions provided in the product documentation.

It is the responsibility of the operator to ensure that the product is safely and properly used.

Should you require additional assistance or advice on safety-related matters for your product, Meinberg's Technical Support team will be happy to assist you at any time. Simply send a mail to **techsupport@meinberg.de**.

4.1 Appropriate Usage

The device must only be used appropriately in accordance with the specifications of the product documentation! Appropriate usage is defined exclusively by this manual as well as any other relevant documentation provided directly by Meinberg.

Appropriate usage includes in particular compliance with specified limits! The device's operating parameters must never exceed or fall below these limits!

4.2 Product Documentation

The information in this manual is intended for readers with an appropriate degree of safety awareness.

The following are deemed to possess such an appropriate degree of safety awareness:

- skilled persons with a familiarity with relevant national safety standards and regulations,
- instructed persons having received suitable instruction from a skilled person on relevant national safety standards and regulations

If there is any safety information in the product documentation that you do not understand, **do not** continue with the set-up or operation of the device!

Read the product manual carefully and completely before you set the product up for use.

Safety standards and regulations change on a regular basis and Meinberg updates the corresponding safety information and warnings to reflect these changes. It is therefore recommended to visit the Meinberg website at **https://www.meinbergglobal.com** regularly to download up-to-date manuals.

Please keep all product documentation, including this manual, in a safe place in a digital or printed format to ensure that it is always easily accessible.

Meinberg's Technical Support team is also always available at **techsupport@meinberg.de** if you require additional assistance or advice on safety aspects of your system.

4.3 Safety when Installing the Device

This rack-mounted device has been designed and tested in accordance with the requirements of the standard IEC 62368-1 (*Audio/Video, Information and Communication Technology Equipment—Part 1: Safety Requirements*). Where the rack-mounted device is to be installed in a larger unit (such as an electrical enclosure), additional requirements in the IEC 62368-1 standard may apply that must be observed and complied with. General requirements regarding the safety of electrical equipment (such as IEC, VDE, DIN, ANSI) and applicable national standards must be observed in particular.

The device has been developed for use in industrial or home environments and may only be used in such environments. In environments at risk of high environmental conductivity ("high pollution degree" according to IEC 60664-1), additional measures such as installation of the device in an air-conditioned electrical cabinet may be necessary.

If the unit has been brought into the usage area from a cold environment, condensation may develop; in this case, wait until the unit has adjusted to the temperature and is completely dry before setting it up.

When unpacking & setting up the equipment, and before operating it, be sure to read the information on installing the hardware and the specifications of the device. These include in particular dimensions, electrical characteristics, and necessary environmental conditions.

Fire safety standards must be upheld with the device in its installed state.

The device with the highest mass should be installed at the lowest position in the rack in order to position the center of gravity of the rack as a whole as low as possible and minimize the risk of the rack tipping over. Further devices should be installed from the bottom, working your way up.

The device must be protected against mechanical & physical stresses such as vibration or shock.

Never drill holes into the device to mount it! If you are experiencing difficulties with rack installation, contact Meinberg's Technical Support team for assistance!

Inspect the device housing before installation. The device housing must be free of any damage when it is installed.

4.4 Electrical Safety

This Meinberg product is operated at a hazardous voltage.

This system may only be set up and connected by a skilled person, or by an instructed person who has received appropriate technical & safety training from a skilled person.

Custom cables may only be assembled by a qualified electrician.

Never work on cables carrying a live current!

Never use cables or connectors that are visibly damaged or known to be defective! Faulty, defective, or improperly connected shielding, connectors, or cables present a risk of injury or death due to electric shock and may also constitute a fire hazard!

Before operating the device, check that all cables are in good order. Ensure in particular that the cables are undamaged (for example, kinks), that they are not wound too tightly around corners, and that no objects are placed on the cables.

Cables must be laid in such a way that they do not present a tripping hazard.

The power supply should be connected using a short, low-inductance cable. Avoid the use of power strips or extension cables if possible. If the use of such a device is unavoidable, ensure that it is expressly rated for the rated currents of all connected devices.

Never connect or disconnect power, data, or signal cables during a thunderstorm! Doing so presents a risk of injury or death, as cables and connectors may conduct very high voltages in the event of a lightning strike!

The device cables must be connected or disconnected in the order specified in the user documentation for the device. Connect all cables only while the device is de-energized before you connect the power supply.

Always pull cable connectors out at both ends before performing work on connectors! Improperly connecting or disconnecting this Meinberg system may result in electric shock, possibly resulting in injury or death!

When pulling out a connector, **never** pull on the cable itself! Pulling on the cable may cause the plug to become detached from the connector or cause damage to the connector itself. This presents a risk of direct contact with live components.

Ensure that all plug connections are secure.

Before the device is connected to the power supply, the device housing must be grounded by connecting a grounding conductor to the grounding terminal of the device.

When installing the device in an electrical enclosure, it must be ensured that adequate clearance is provided, minimum creepage distances to adjacent conductors are maintained, and that there is no risk of short circuits.

Protect the device from the ingress of objects or liquids!

If the device malfunctions or requires servicing (for example, due to damage to the housing, power supply cable, or the ingress of liquids or objects), the power supply may be cut off. In this case, the device must be isolated immediately and physically from all power supplies! Electrical isolation must be performed and confirmed in accordance with the following procedure:

- Pull the power supply plug out of the power source, then disconnect the cable from the device.
- Contact the person responsible for your electrical infrastructure.
- If your device is connected to one or more uninterruptible power supplies (UPS), the direct power supply connection between the device and the UPS solution must be first be disconnected.

4.4.1 Special Information for Devices with AC Power Supply

This device is a Protection Class 1 device and may only be connected to a grounded outlet (TN system).

For safe operation, the installation must be protected by a fuse rated for currents not exceeding 20 A and equipped with a residual-current circuit breaker in accordance with applicable national standards.

The appliance must only ever be disconnected from the mains power supply via the mains socket and not from the appliance itself.

Make sure that the mains socket on the appliance or the mains socket of the house installation is readily accessible for the user so that the mains cable can be pulled out of the socket in an emergency.

Non-compliant cabling or improperly grounded sockets are an electrical hazard!

Only connect the appliance to a grounded shockproof socket using a safety-tested mains cable designed for use in the country of operation.

4.4.2 Special Information for Devices with DC Power Supply

In accordance with IEC 62368-1, it must be possible to disconnect the appliance from the supply voltage from a point other than the appliance itself (e.g., from the primary circuit breaker).

The power supply plug may only be fitted or dismantled while the appliance is isolated from the power supply (e.g., disconnected via the primary circuit breaker).

Power supply cables must have adequate fuse protection and have an adequate wire gauge size (1 mm^2 – 2.5 mm^2 / 17 AWG – 13 AWG)

The power supply of the device must have a suitable on-demand disconnection mechanism (i.e., a switch). This disconnection mechanism must be readily accessible in the vicinity of the appliance and marked accordingly as a cut-off mechanism for the appliance.

4.5 Safety when Handling SFP Modules

The SFP modules recommended by Meinberg are equipped with a Class 1 laser.

- Only use fiber optic SFP modules that are compliant with the definition of a Class 1 laser in accordance with IEC standard 60825-1. Fiber optic products that are not compliant with this standard may emit radiation capable of causing eye injuries.
- Never look into an unconnected connector of a fiber optic cable or an unconnected SFP port.
- Unused fiber optic connectors should always be fitted with a suitable protective cap.
- The safety information and manufacturer specifications relating to the SFP modules used must be heeded.
- The SFP module used must be capable of providing protection against voltage spikes in accordance with IEC 62368-1.
- The SFP module used must be tested and certified in accordance with applicable standards.

4.6 Safety when Maintaining and Cleaning the Device

Only use a soft, dry cloth to clean the device.

<u>Never</u> use liquids such as detergents or solvents to clean the device! The ingress of liquids into the device housing may cause short circuits in the electronic circuitry, which in turn can cause a fire or electric shock!

Neither the device nor its individual components may be opened. The device or its components may only be repaired by the manufacturer or by authorized personnel. Improperly performed repairs can put the user at significant risk!

In particular, **never** open a power supply unit or module, as hazardous voltages may be present within the power supply device even after it is isolated from the upstream voltage. If a power supply unit or module is no longer functional (for example due to a defect), it can be returned to Meinberg for repair.

Some components of the device may become very hot during operation. Do not touch these surfaces!

If maintenance work is to be performed on the device and the device housing is still hot, switch off the device beforehand and allow it to cool.

4.7 Battery Safety

The CR2032 lithium battery on the clock module has a service life of at least 10 years.

Should it be necessary to replace the battery, please note the following:

- The battery may only be replaced by the same type or a comparable type recommended by the manufacturer.
- The battery may only be replaced by the manufacturer or authorized personnel.
- The battery must not be exposed to air pressure levels outside of the limits specified by the manufacturer.

Improper handling of the battery may result in the battery exploding or in leakages of flammable or corrosive liquids or gases.

- <u>Never</u> short-circuit the battery!
- <u>Never</u> attempt to recharge the battery!
- <u>Never</u> throw the battery in a fire or dispose of it in an oven!
- <u>Never</u> dispose of the battery in a mechanical shredder!

5 Important Product Information

5.1 CE Marking

This product bears the CE mark as is required to introduce the product into the EU Single Market.

The use of this mark is a declaration that the product is compliant with all requirements of the EU directives effective and applicable as at the time of manufacture of the product. These directives are listed in the EU Declaration of Conformity, appended to this manual as Chapter ??.

5.2 UKCA Marking

This product bears the British UKCA mark as is required to introduce the product into the United Kingdom (excluding Northern Ireland, where the CE marking remains valid).

The use of this mark is a declaration that the product is in conformity with all requirements of the UK statutory instruments applicable and effective as at the time of manufacture of the product. These statutory instruments are listed in the UK Declaration of Conformity, appended to this manual as Chapter ??.

5.3 Ensuring the Optimum Operation of Your Device

- Ensure that ventilation slots are not obscured or blocked by dust, or else heat may build up inside the device. While the system is designed to shut down safely and automatically in the event of temperature limits being exceeded, the risk of malfunctions and product damage following overheating cannot be entirely eliminated.
- The device is only deemed to be appropriately used and EMC limits (electromagnetic compatibility) are only deemed to be complied with while the device housing is fully assembled in order to ensure that requirements pertaining to cooling, fire safety, electrical shielding and (electro)magnetic shielding are upheld.

5.4 Maintenance and Modifications

⚠️ **Important!**

Before performing any maintenance work on or authorized modification to your Meinberg system, we recommend making a backup of any stored configuration data (e.g., to a USB flash drive from the Web Interface).

5.4.1 Replacing the Battery

Your device's clock module is fitted with a lithium battery (type CR2032) that is used to locally storage almanac data and sustain operation of the real-time clock (RTC) in the reference clock.

This battery has a life of at least ten years. However, if the device exhibits the following unexpected behaviors, the voltage of the battery may have dropped below 3 V, and the battery needs to be replaced as a result:

- The reference clock has the wrong date or wrong date when the system is started.
- The reference clock repeatedly starts in Cold Boot mode (i.e., upon starting, the system has no ephemeris data saved whatsoever, resulting in the synchronization process taking a very long time due to the need to rediscover all of the visible satellites).
- Some configuration options relating to the reference clock are lost every time the system is restarted.

In this case, you should not replace the battery on your own. Please contact the Meinberg Technical Support team, who will provide you with precise guidance on how to perform the replacement.

5.5 Disposal

Disposal of Packaging Materials

The packaging materials that we use are fully recyclable:

Material	Use for	Disposal
Polystyrene	Packaging frame/filling material (e.g., polystyrene peanuts)	Recycling Depot
PE-LD (Low-density polyethylene)	Accessories packaging, bubble wrap	Recycling Depot
Cardboard	Shipping packaging, accessories packaging	Paper Recycling

For information on the proper disposal of packaging materials in your specific country, please inquire with your local waste disposal company or authority.

Disposal of the Device

This product falls under the labeling obligations of the Waste Electrical and Electronic Equipment Directive 2012/19/EU ("*WEEE Directive*") and thus bears this WEEE symbol. The presence of this symbol indicates that this electronic product may only be disposed of in accordance with the following provisions.

Important!

Do not dispose of the product or batteries via the household waste. Inquire with your local waste disposal company or authority on how to best dispose of the product or battery if necessary.

This product is considered to be a "**B2B**" product for the purposes of the WEEE Directive and is also classified as "**IT and Telecommunications Equipment**" in accordance with Annex I of the Directive.

It can be returned to Meinberg for disposal. Any transportation expenses for returning this product (at end-of-life) must be covered by the end user, while Meinberg will bear the costs for the waste disposal itself. If you wish for Meinberg to handle disposal for you, please get in touch with us. Otherwise, please use the return and collection systems provided within your country to ensure that your device is disposed of in a compliant fashion to protect the environment and conserve valuable resources.

Disposal of Batteries

Please consult your local waste disposal regulations for information on the correct disposal of batteries as hazardous waste.

6 Introduction SyncFire 1500

Ultra–High–Performance NTP Time Server

The SyncFire 1500 offers top–of–the–line NTP server performance with no compromises. Constructed to order with an integrated GPS, multi–GNSS ("GNS") receiver specially engineered for optimum synchronization performance, the SyncFire 1500 is designed for large–scale environments which rely on a large number of devices having a single common time reference.

Meinberg's custom Linux–based LANTIME OS, a slim & secure operating system developed specially for the needs of a time server, powers the SyncFire 1500 under the hood, providing access to all the security, network, and monitoring features that you could ever need from an enterprise–grade synchronization appliance.
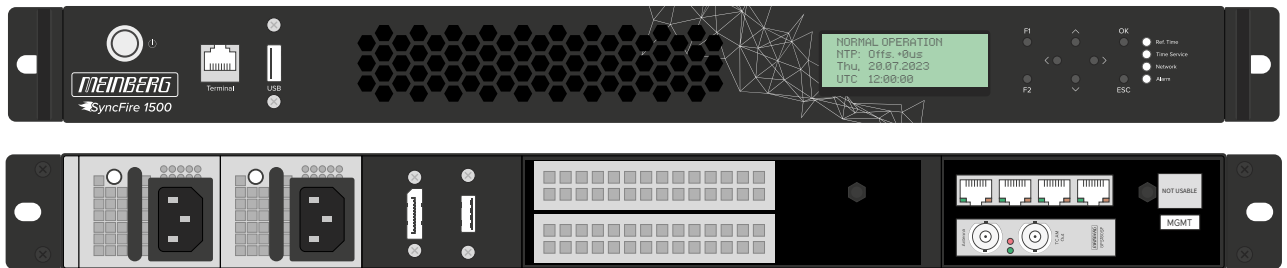
The powerful Web UI enables you to quickly and easily configure and monitor your SyncFire 1500, while the CLI provides power users with unparalleled flexibility and efficiency. The comprehensive LANTIME OS REST API provides a complete toolset for your network orchestration and automation needs, and SNMP support allows you to integrate your Meinberg systems into your existing network management system.

Product Features:

- An ultra–high–end Stratum 1 NTP server designed for deployment in large–scale environments
- Capable of processing up to hundreds of thousands of NTP requests per second
- 1U chassis, specially constructed for installation in a 19" rack
- Available with a selection of sync input cards for GPS–only synchronization, multi–GNSS synchronization, or PTP slave support for synchronization with a PTP master

6.1 Why Use a Network Time Server?

Any situation where accurate time within a local network plays an essential role in ensuring smooth operation calls for the deployment of a dedicated time server. Technically speaking, it is of course possible to synchronize any PC in a network using time servers provided over the internet, but the following arguments illustrate why a dedicated time server in your own local network is recommended:

- A Meinberg time server allows a network administrator to be notified by email or SNMP trap in the event of problems.

- With a dedicated time server, PCs in a local network are not dependent on a functioning internet connection. They are also not dependent on the availability of an external time server, which may fail regardless of the availability of internet access. Even state-run scientific institutions for whom time accuracy and availability is paramount cannot guarantee that a public NTP server will operate flawlessly with 100% availability—the German PTB (Physikalisch-Technisches Bundesanstalt), which provides not only the DCF77 long-wave timing service but also a number of public NTP servers, explicitly warns on its website that 100% availability cannot be guaranteed, despite best efforts. The U.S. Naval Observatory (USNO) provides NTP servers in a similar fashion and has repeatedly had to deal with 'malicious' clients that compromise the availability of the service. Prof. David L. Mills, known as the 'inventor' of NTP, collaborates with the USNO and has discussed this situation in the NTP newsgroup.

- A test of other public time servers (not those of the otherwise impeachable PTB or USNO!) found that many were distributing time that was significantly off-base despite claiming to be Stratum 1. The problems here are usually due to the administrators responsible for these servers.

- With an internet connection working under 'normal' conditions, NTP generally does a good job of calculating the path delays of network packets and compensating for them. However, if unanticipated factors result in the path between client and server (or even just parts of it) being pushed to the limit, heavy fluctuations in the packet transmission times can disrupt time synchronization significantly. Causes for such transmission route overloads might include widespread hacker activities (which may or may not even be directed at your own network), or novel viruses spreading in a flood of emails.

- A dedicated local time server cannot be easily compromised via the internet. One example that caused significant uproar among the NTP community was the case of a manufacturer of low-cost routers that had hard-coded the IP address of a publicly available NTP server to obtain the time, and had even implemented this very poorly. As a result, the NTP server was bombarded with a massive number of queries, incurring significant expense for the operator of the NTP server. In this case not even shutting down the NTP server helped, as the queries were still being sent.

7 Installation of the GNSS Antennas

The following chapters explain how to select a suitable location for a GNSS antenna, how to fit the antenna, and how to implement effective surge protection for your antenna installation.

7.1 Selecting the Antenna Location

There are essentially two ways the GPSANTv2 or the the Multi-GNSS Antenna can be installed using the accessories included: Mounted on a pole or mounted on a wall

In either case, the location must be selected to ensure that the view of the sky is not obstructed in any direction (see Fig .1) in order to ensure that enough satellites can be received.

To ensure that your antenna has the best 360° view possible, Meinberg recommends mounting the antenna on a roof on a suitable metal pole (see Fig. 1, antenna on right). If this is not possible, the antenna may be mounted on the wall of a building, but must be high enough above the edge of the roof (see Fig. 1, antenna on left).

This prevents the line of sight between the antenna and the satellites from being partially or fully obstructed and limits the impact of GNSS signal reflections from other surfaces such as house walls.
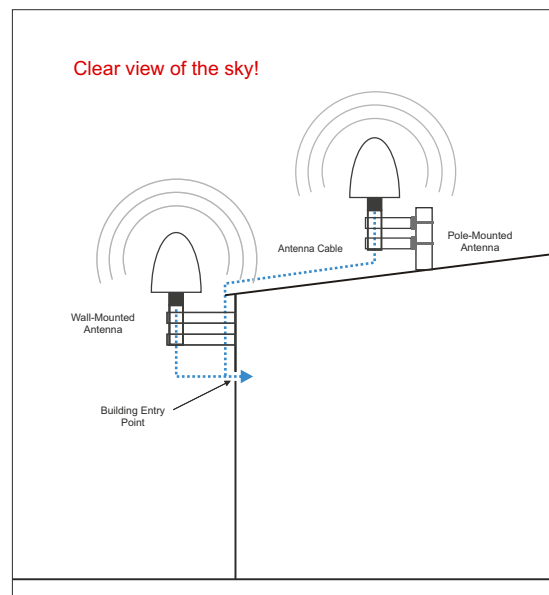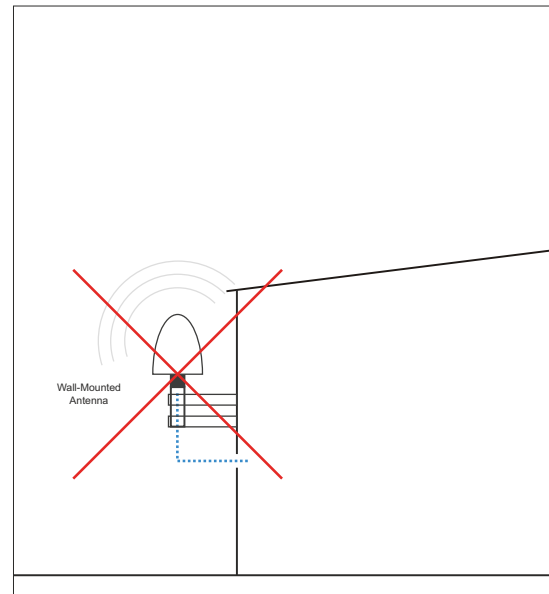

Fig. 1: Ideal Positioning

If there is a solid obstacle (a building or part of a building) in the line of sight between the antenna and each of the satellites (see Fig. 2), it is likely that the satellite signals will be partially or fully obstructed or reflected signals will cause interference, causing problems with signal reception.

Fig. 2: Poor positioning of a wall-mounted antenna

In addition, there must be no conductive objects, overhead power lines, or other electrical light or power circuits within the antenna's aperture angle (approximately 98 degrees for a Meinberg GPS antenna and 120 degrees for a multi-GNSS antenna), as these will cause interference with the already weak signals in the satellite transmission frequency band.

Other Installation Criteria for Optimum Operation:

- Vertical installation of antenna (see Fig. 1)
- At least 50 cm (1.5 ft) distance to other antennas
- Free view in the direction of the equator
- Free view between 55th south and 55th north latitudes (satellite orbits).

Information:

Problems may arise with the synchronization of your Meinberg time server if these conditions are not met, as four satellites must be located to calculate the exact position.

7.2 Installation of the GPSANTv2 Antenna

Please read the following safety information carefully before installing the antenna and ensure that it is observed during the installation.

Danger!

Do not mount the antenna without an effective fall arrester!

Danger of death from falling!

- Ensure that you work safely when installing antennas!
- <u>Never</u> work without an effective fall arrester!

Danger!

Do not work on the antenna system during thunderstorms!

Danger of death from electric shock!

- <u>Do not</u> carry out any work on the antenna system or the antenna cable if there is a risk of lightning strike.
- <u>Do not</u> carry out any work on the antenna system if it is not possible to maintain the prescribed safe distance to exposed lines and electrical substations.

Mount the GPSANTv2 (as shown in Fig. 3) at a distance of at least 50 cm to other antennas using the mounting kit provided, either onto a vertical pole of no more than 60 mm diameter or directly onto a wall.
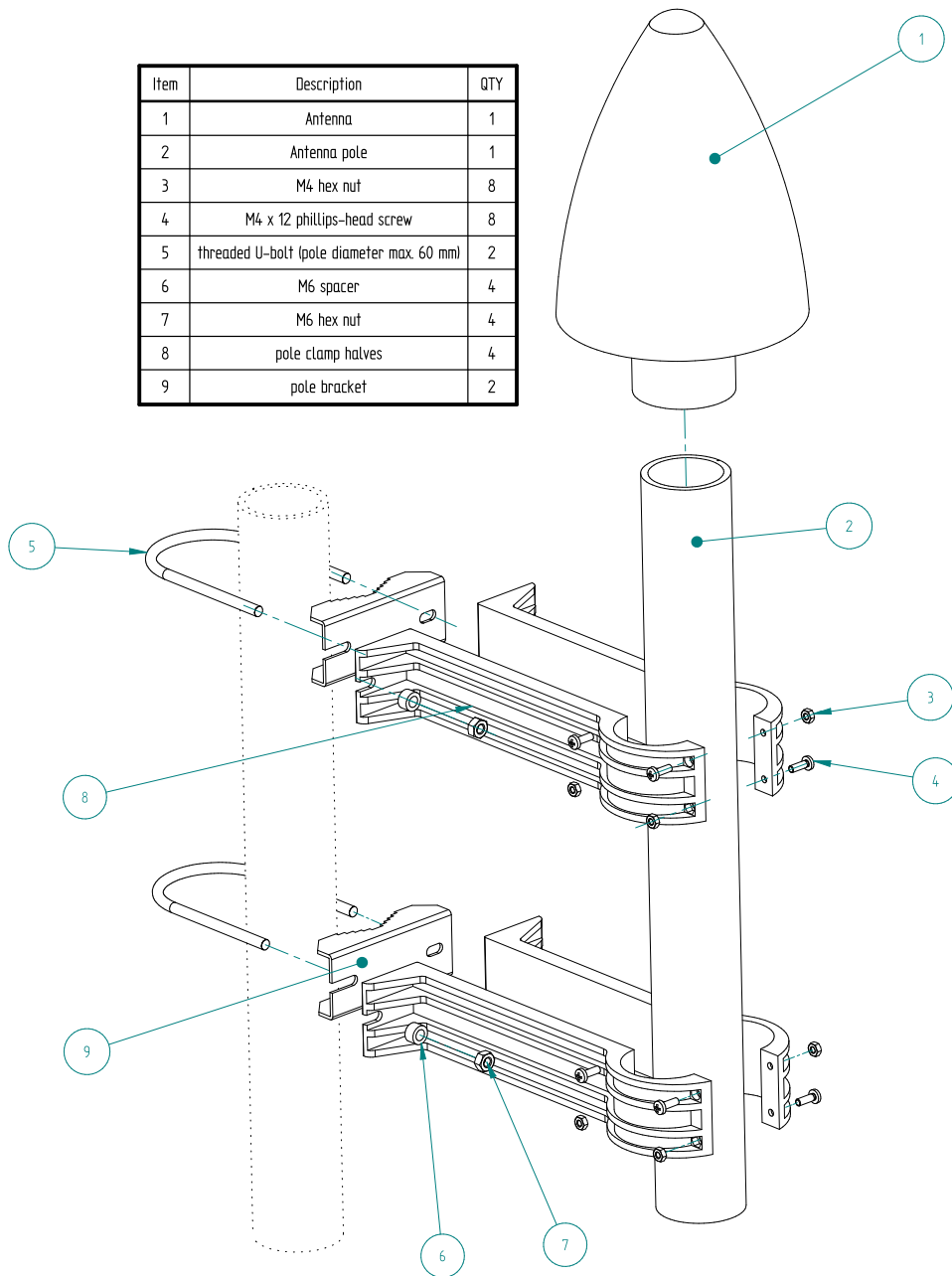
Item	Description	QTY
1	Antenna	1
2	Antenna pole	1
3	M4 hex nut	8
4	M4 x 12 phillips–head screw	8
5	threaded U–bolt (pole diameter max. 60 mm)	2
6	M6 spacer	4
7	M6 hex nut	4
8	pole clamp halves	4
9	pole bracket	2

Fig. 3: Mounting a GPSANTv2 antenna onto a pole

Fig. 3 illustrates the mounting of a GPSANTv2 on a pole by way of example. When mounting the antenna on a wall, the four wall plugs and M6x45 screws should be used to mount the two halves of the pole clamp (Fig. 3, Pos. 9) using the provided screw slits.

7.3 Installation of the GNS L1 Antenna

Please read the following safety information carefully before installing the antenna and ensure that it is observed during the installation.

	Danger!
⚠️ 🚶	Do not mount the antenna without an effective fall arrester! **Danger of death from falling!** • Ensure that you work safely when installing antennas! • <u>Never</u> work without an effective fall arrester!

|	Danger!
⚠️ ⚡	Do not work on the antenna system during thunderstorms! **Danger of death from electric shock!** • <u>Do not</u> carry out any work on the antenna system or the antenna cable if there is a risk of lightning strike. • <u>Do not</u> carry out any work on the antenna system if it is not possible to maintain the prescribed safe distance to exposed lines and electrical substations.

Use the included mounting kit to mount the L1 antenna at a distance of 50 cm from other antennas on a vertical pole of a diameter of between 60 mm and 215 mm ($2\frac{1}{2}$"–$8\frac{1}{2}$").

Detailed assembly instructions can be found under the item "Downloads" on the manufacturer's product page.

https://www.pctel.com/antenna-product/gps-timing-reference-antenna-2/
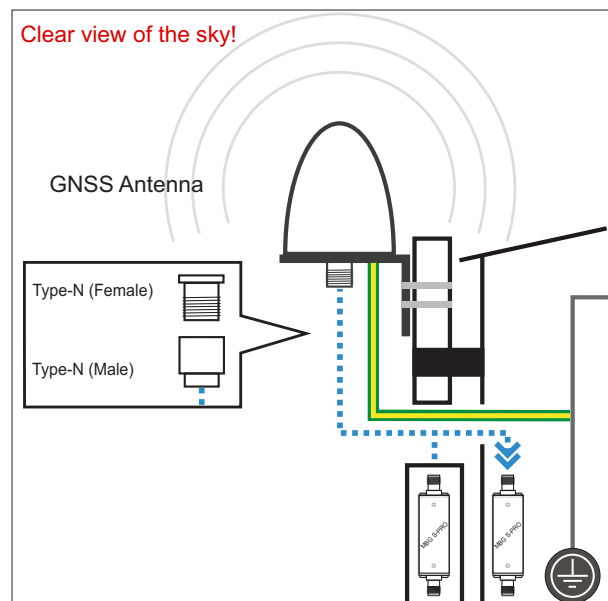
The next chapter explains how the antenna cable should be laid.

7.4 Antenna Cable

Selecting the Appropriate Cable

Meinberg provides suitable cable types with its antennas and these are ordered together with the antenna to match the length you need from your antenna to your Meinberg reference clock. The route to be covered for your antenna installation should be determined and the appropriate cable type selected accordingly before confirming your order.

The cable is shipped with both ends fitted with the appropriate connectors as standard, although the cable can also be shipped without any pre-fitted connectors if so requested.

GPS Clocks

The table below shows the specifications of the supported cable types for the transmission of the 35 MHz intermediate frequency:

Cable Type	RG58C/U	RG213	H2010 (Ultraflex)
Signal Propagation Time at 35 MHz	503.6	509.61	387.45
Attenutation at 35 MHz (dB/100 m)	8.48	3.46	2.29
DC Resistance (Ohm/100 m)	5.3	1.0	1.24
Cable Diameter (mm)	5	10.3	7.3
Max. Cable Length (m)	300	700	1100

Tab. 1: Specifications of Cable Types Recommended by Meinberg

* The propagation times are specified on the basis of 100 m cable; these values can be used as a reference to calculate the propagation time of any other arbitrary length of cable.

GNS Clocks

The table below shows the specifications of the supported cable types for the transmission of the typical GNSS frequency bands:

Cable Type	H155	H2010 (Ultraflex)
Signal Propagation Time at 1575 MHz	423.56	386.93
Attenuation at 1575 MHz (dB/100 m)	40.20	17.57
DC Resistance (Ohm/100 m)	3.24	1.24
Cable Diameter (mm)	5.4	7.3
Max. Cable Length (m)	70	1100

Tab. 1: Specifications of Cable Types Recommended by Meinberg

* The propagation times are specified on the basis of 100 m cable; these values can be used as a reference to calculate the propagation time of any other arbitrary length of cable.

Important!

Please avoid using a mixture of different cable types for your antenna installation. This should be taken into consideration in particular when purchasing additional cable, for example to extend an existing cable installation.

Laying the Antenna Cable

When laying the antenna cable, ensure that the specified maximum cable length is not exceeded. This length will depend on the selected cable type and its attenuation factor.

If the specified maximum length is exceeded, correct transmission of the synchronization data and thus proper synchronization of the reference clock can no longer be guaranteed.

Lay the coaxial cable from the antenna to the point of entry into the building as shown in Figures 5 and 6 in the chapter "**Surge Protection and Grounding**". Like any other metallic object in the antenna installation (antenna and pole), the antenna cable must be integrated into the grounding infrastructure of the building and also connected to the other metallic objects.

Lay the coaxial cable from the antenna to the point of entry into the building. Like any other metallic object in the antenna installation (antenna and pole), the antenna cable must be integrated into the grounding infrastructure of the building and also connected to the other metallic objects.

Caution!

When laying the antenna cable, ensure that sufficient distance is maintained from live cables (such as high-voltage power lines), as these can cause severe interference and compromise the quality of the antenna signal significantly. Surges in power lines (caused, for example, by lightning strike) can generate induced voltages in a nearby antenna cable and damage your system.

Further Points to Consider when Laying Antenna Cable:

- The minimum bend radius of the cable must be observed.[1]
- Any kinking, crushing, or other damage to the external insulation must be avoided.
- Any damage or contamination of the coaxial connectors must be avoided.

[1]*The bend radius is the radius at which a cable can be bent without sustaining damage (including kinks).*

The next chapter "**Surge Protection and Grounding**" explains how to implement effective surge protection for an antenna installation.

Compensating for Signal Propagation Time

The propagation of the signal from the antenna to the receiver (reference clock) can incur a certain delay. This delay can be compensated for in the LTOS Web Interface.

To do this, log into the Web Interface of your SyncFire 1500 system and proceed as follows:

1.   Open the menu "**Clock**" → "**State & Configuration**".
2.   Select the corresponding clock module.
3.   Click on the "Miscellaneous" tab.
4.   Select the compensation method and enter the appropriate value.

If you are using standard RG58 or RG213 cable, the length of the cable can be simply entered in meters by selecting "By Length". This will provide a reliable, automatically calculated offset based on the known specifications of standard RG58 and RG213 cable.

Alternatively, a fixed offset can be entered in nanoseconds by selecting "By Delay". This may be necessary if you are using a different type of coaxial cable (in which case, the delay is calculated based on the data provided in the data sheet of your cable) and/or you wish to apply an offset based on your own delay measurements.
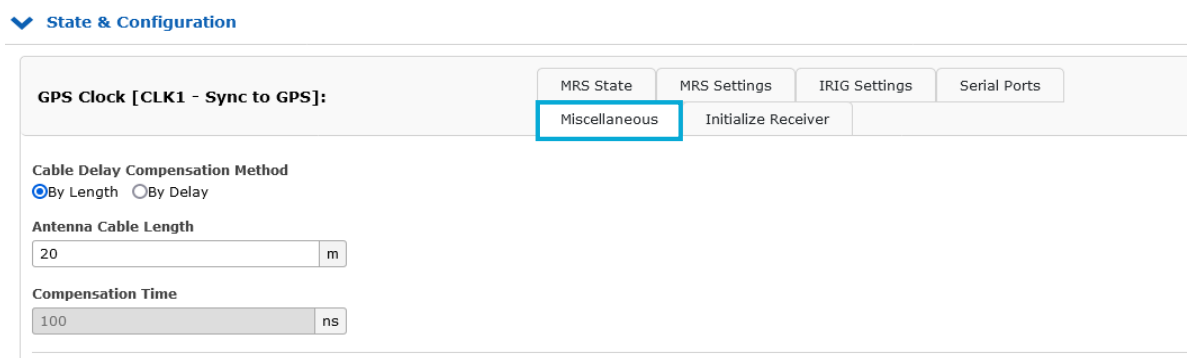

Fig. 4.1: "Clock" menu in LANTIME OS Web Interface

7.5 Surge Protection and Grounding

The greatest risk to an antenna installation and the electronic devices connected to it is exposure to lightning strikes. An indirect lightning strike in the vicinity of the antenna or coaxial cable can induce significant surge voltages in the coaxial cable. This induced surge voltage can then be passed to the antenna and to the building interior, which can damage or even destroy both your antenna and your Meinberg system.

This is why antennas and antenna cables must always be integrated into a building's equipotential bonding infrastructure (Fig. 5, Item 5) as part of an effective lightning protection strategy to ensure that voltages induced by lightning strikes directly on or indirectly near the antenna are redirected safely to ground.

> ⚠️ **Warning!**
>
> Surge protection and lightning protection systems may only be installed by persons with suitable electrical installation expertise.

Surge Protection

VDE 0185-305 (IEC 62305) (relating to buildings with lightning protection systems) and VDE 0855-1 (IEC 60728-11) (addressing bonding strategies and the grounding of antenna installations in buildings with no external lightning protection system) are the lightning protection standards applicable to antenna installations on a building. Antennas must generally be integrated into a building's lightning protection system or bonding infrastructure.

If the antenna represents the highest point of a building or pole, the lightning protection strategy should incorporate a safe zone (safe angle α, Fig. 5 and 6), formed by a lightning rod positioned above the antenna. This increases the likelihood of lightning being 'caught' by the lightning rod, allowing surge currents to be safely passed from the lightning rod along a grounding conductor to ground.

The pole itself is connected to the bonding infrastructure. Any metallic objects in the antenna installation, such as the pole and antenna, or the shelding of the antenna cable, must be connected together.

Meinbergs GPSANTv2

Meinberg's new-generation "GPSANTv2" antenna features integrated surge protection in accordance with IEC 61000-4-5 Level 4 to reliably shield the antenna against surge voltages.

However, in order to preserve the safety of the building and to protect your Meinberg system, Meinberg recomends the use of the MBG-S-PRO surge protector, which is addressed in more detail later in this chapter.

The drawings below illustrate how a GPSANTv2 can be installed in accordance with the above conditions on a pole (e.g. antenna pole) or building roof.

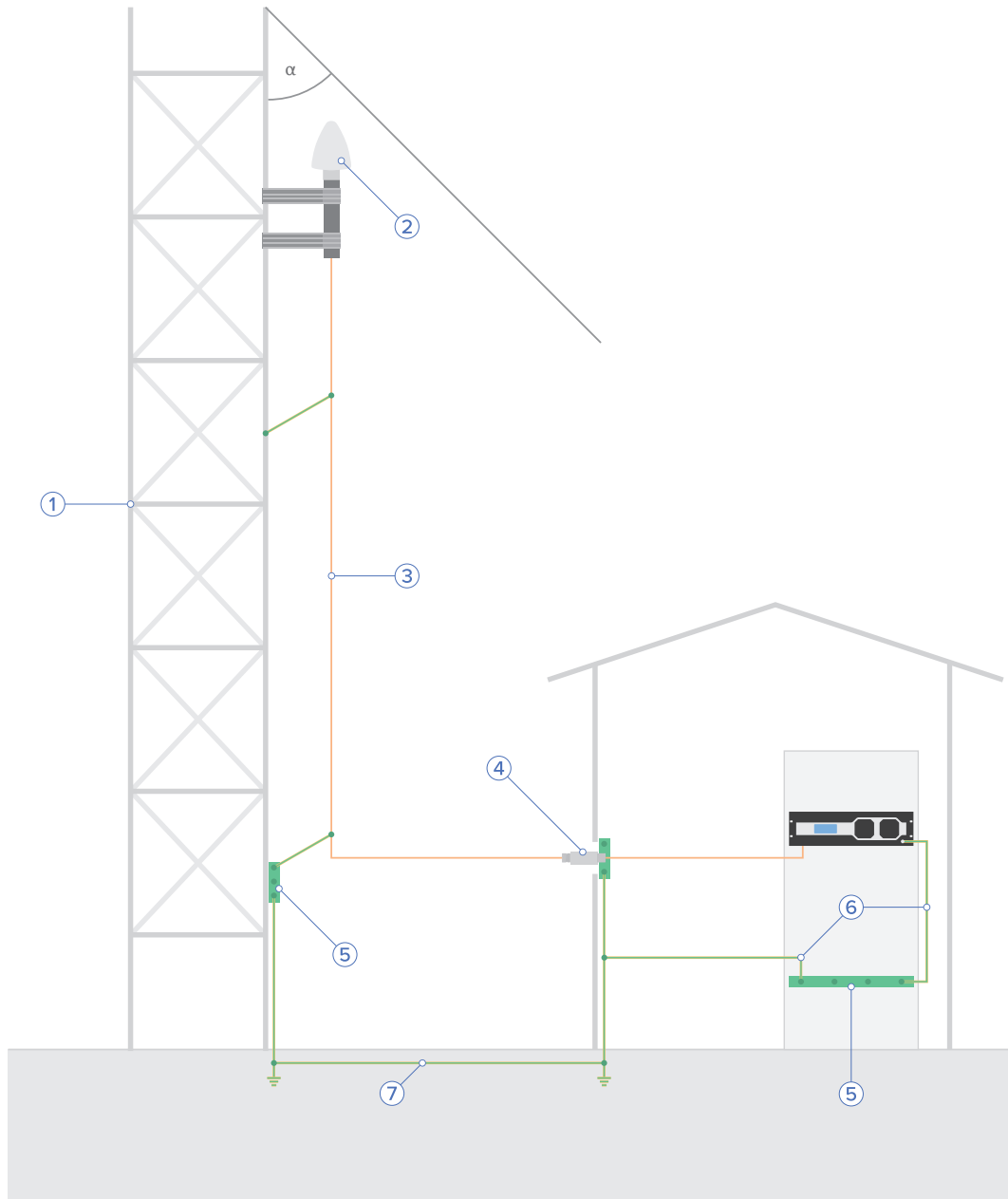**Antenna Installation without Insulated Lightning Rod System**

Fig. 5: Installation on a Pole

1	Antenna Pole
2	GPSANTv2 Antenna
3	Antenna Cable
4	MBG S-PRO Surge Protector
5	Bonding Conductor
6	Bonding Bar
7	Foundation Electrode
α	Safety Zone

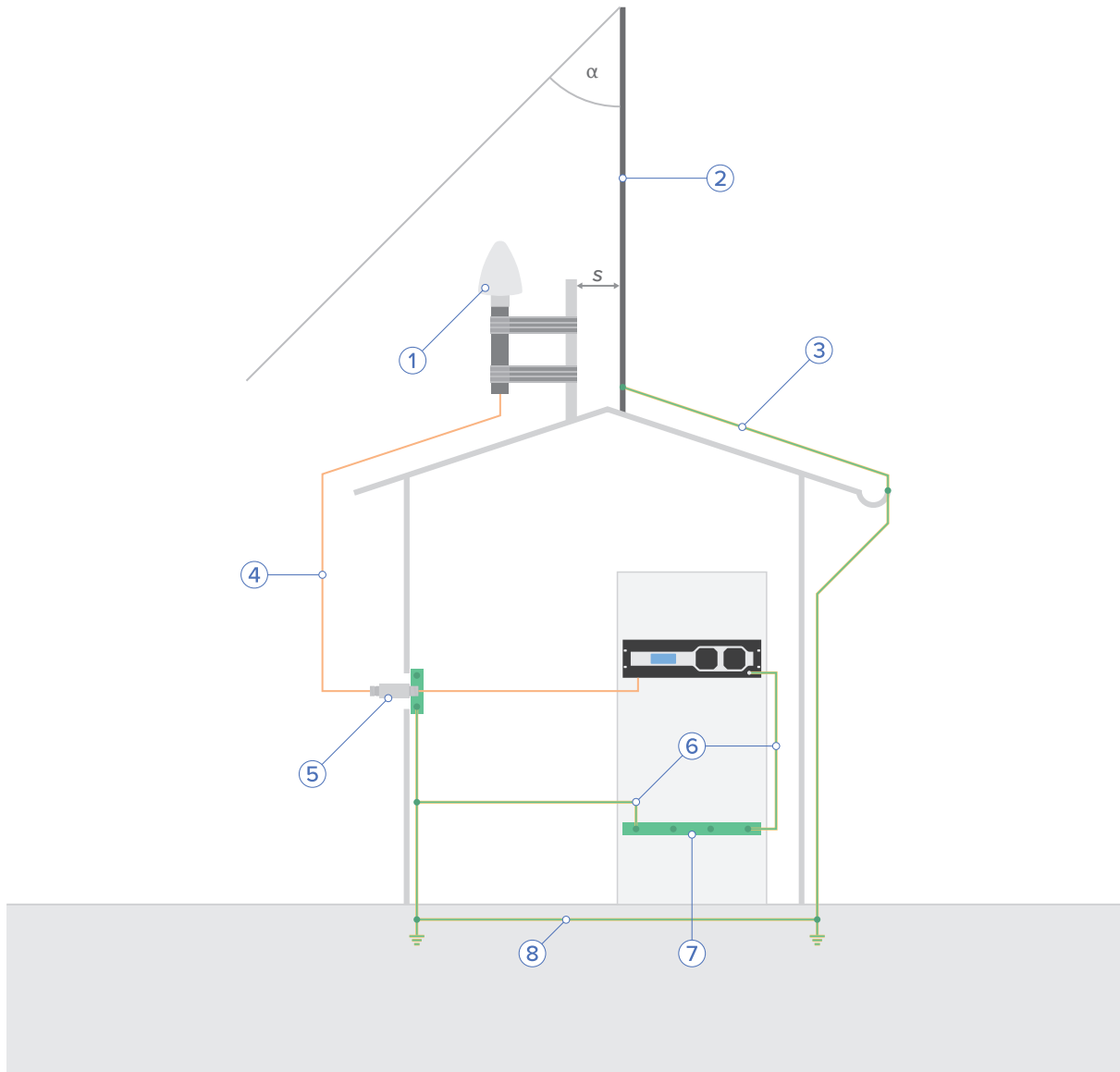**Antenna Installation with Insulated Lightning Rod System**

Fig. 6: Roof Installation

1   GPSANTv2-Antenne
2   Lightning Rod
3   Lightning Rod Conductor
4   Antenna Cable
5   MBG S-PRO Surge Protector
6   Bonding Conductor
7   Bonding Bar
8   Foundation Electrode
α.   Safety Zone
s.   Safe Distance (between lightning rod and antenna installation)

MBG S-PRO Surge Protector

<table>
<tr>
<td>ⓘ</td>
<td>

Information:

The surge protector and suitable coaxial cable are not included as standard with the GPSANTv2, but can be ordered as an optional accessory.

</td>
</tr>
</table>

Construction

The MBG-S-PRO is a surge protector (Phoenix CN-UB-280DC-BB) for coaxial connections. It is patched directly into the antenna line and consists of a replaceable gas discharge tube that redirects the energy from the cable shielding to the ground potential when ignited.

Installation Conditions

To protect the building from possible surge voltages, the MBG-S-PRO is installed at the point of entry of the antenna cable into the building. The MBG-S-PRO must be shielded against water spray and water jets, either by means of a suitable enclosure (IP65) or a protected location.

Ideal Installation Conditions:

- Installation of the point of entry of the antenna cable into the building
- Ground conductor cable from surge protector to bonding bar as short as possible

Installation and Connection

This surge protector has no dedicated input or output polarity and therefore has no preferred installation orientation. It features Type-N female connectors at both ends.

Installation

1.
Fit the surge protector to the supplied mounting bracket as shown in the illustration.
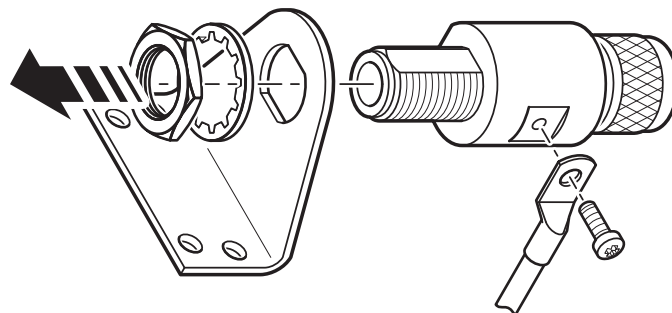

Fig. 7: Installation of the surge protectorrotector

2.
Connect the MBG-S-PRO to a bonding bar using a ground conductor cable that is as short as possible. It is also important for the bonding connection of the surge protector to be connected to the same bonding bar as the connected Meinberg system to prevent destructive potential differences.

3.
Connect the coaxial cable from the antenna to one of the surge protector connectors, then connect the other surge protector connector to the coaxial cable leading to the Meinberg reference clock.

Caution!

If no other devices (e.g. power splitter) are installed between the overvoltage protection and the downstream electronics with fine protection, the antenna cable must not exceed a certain length for safety reasons.

Please refer to the document "**Technical Specifications: MBG-S-PRO Surge Protector**" in the appendix as well as the manufacturer's data sheet for detailed installation instructions and technical specifications for the surge protector.

Data Sheet (Download):
https://www.meinberg.de/download/docs/shortinfo/german/cn-ub-280dc-bb_pc.pdf

8 SyncFire 1500 Indicators and Function Keys on the Front Panel
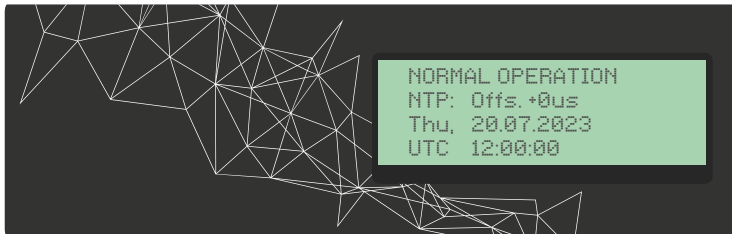
LCD Panel
- – 4 x 20 character backlit display for clarity even in low-light conditions.
- – Status display (as shown above) indicates the status of the receiver clock, the current date and time of the clock, and the current offset of the NTP server.
- – Provides status readouts and allows basic configuration processes to be performed using the front-panel function keys.
- – Shows alarms and alerts requiring user intervention.
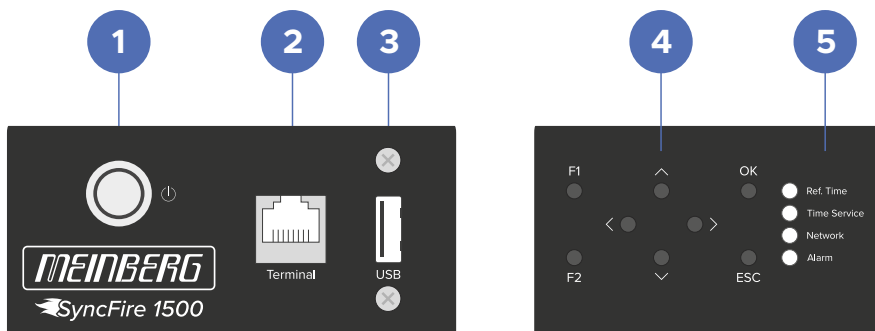
Function keys and Connectors on the Front Panel

1. **Power On/Off Button**
   allows the system to be shut down and started as necessary via ACPI *.

2. **Terminal Interface**
   The serial console port is a standard RS-232 interface with an 8P8C ("RJ45-like") female connector that can be used to establish a direct serial connection (38400 baud, 8N1 framing) between the SyncFire 1500 and any device running suitable terminal software (e.g., a laptop) for direct command line access. The connection can be established using any suitable RS-232 cable or adapter (e.g., RJ45 to D-Sub 9, Yost wiring standard).

_____

* The Advanced Configuration and Power Interface (ACPI) is an open industry standard for power management in desktop computers, notebooks and servers. The interface provides hardware discovery, device configuration, and power management.

3. **USB Interface**

   This USB 3.0 interface can be used for:
   – connecting an input device (e. g., keyboard)
   – saving a backup of the LANTIME OS configuration to an external storage medium
     (such as a USB flash drive) and restoring this backup (or copying a standard configuration
     between multiple LANTIME servers)
   – creating a backup of logfiles (such as SyncMon logs)
   – loading and saving cryptographic certificates
   – creating a physical USB "security key" that can be used to enable and disable the local
   function keys on the device

4. **Function Keys**   –   "F1", "F2", "OK", "ESC", and arrow keys allow for local navigation
                              of configuration menus and status readouts to enable many configuration
                              processes to be performed directly from the device during installation.

5. **Status LEDs**   –   <u>Ref. Time</u>
                              Indicates whether the reference clock is providing a valid timebase.

                         –   <u>Time Service</u>
                              Specifies whether the internal NTP service of the server is synchronized with the
                              reference clock.

                         –   <u>Network</u>
                              Shows whether there is a valid link–up on the network interface.

                         –   <u>Alarm</u>
                              Advises of a general system fault that requires attention.

9 SyncFire 1500 Rear Connectors
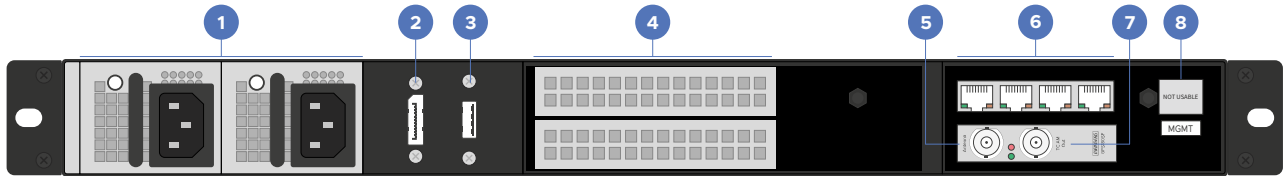
1. Redundant Power Supplies

Connector Type:	IEC 60320 C14 male connector for C13 plug
Voltage Range:	100–240 V AC (50–60 Hz), 145–350 V DC
Maximum Output:	400 W
Nominal Current Input:	6.3 A (240 V AC, 350 V DC)

2. Video Output

Connector Type:	DisplayPort 1.2
Output:	1920x1080

3. USB Interface

This USB 3.0 interface can be used for:

– connecting an input device (e. g., keyboard)
– saving a backup of the LANTIME OS configuration to an external storage medium (such as a USB flash drive) and restoring this backup (or copying a standard configuration between multiple LANTIME servers)
– creating a backup of logfiles (such as SyncMon logs)
– loading and saving cryptographic certificates
– creating a physical USB "security key" that can be used to enable and disable the local function keys on the device

4. Expansion Card Spaces

Space for two officially supported expansion cards (PCI Express) for expanding network connectivity.

1 Gbit Network:	4-port RJ45 Gigabit Ethernet card
10 Gbit Network:	2-port SFP+ 1/10 Gbit/s Ethernet card
25 Gbit Network:	2-port SFP28 1/10/25 Gbit/s Ethernet card
40 Gbit Network:	2-port QSFP+ 10/40 Gbit/s Ethernet card

5. Sync Input Connector

GPS Sync Input

Connector:	BNC female or Type-N female
Termination:	50 Ω
Cable:	RG58 (max. 300 m) or RG213 (max. 700m)
Voltage Output:	15 V

GNS Sync Input

Connector:	SMA female
Termination:	50 Ω
Cable:	Belden H155 (max 70 m), H2010 Ultraflex (max 150 m)
Voltage Output:	5 V

PTP Sync Input

Connector:	SFP module – also see chapter Oregano syn1588 PCIe NIC

6. Network Interfaces

Network Interfaces:	4x 1000BASE-T (Gigabit Ethernet) RJ45
Network Protocols:	IPv4 (with DHCP support), IPv6 (with DHCPv6 and Autoconf support)
Network Services:	HTTP(S) for web interface and REST API access FTP for access to log files and uploading firmware updates Telnet and SSH for command line access SNMP for monitoring
Other Networking Features:	Full Parallel Redundancy Protocol (PRP) support as Doubly Attached Node Support for network link aggregation ("bonding") with multiple modes for load balancing or link redundancy

7. Time Code Output (with GNSS reference receivers only)

Output Signal: IRIG AM sine signal via BNC female (see chapter Time Code AM Output)

8. BMC Interface

The BMC (Baseboard Management Controller) interface **is not** intended for end-user access and, as a security precaution, has been disabled both at a hardware level and via the BIOS of the server platform.

10 Booting the System for the First Time

When the system is switched on, the following message will be displayed; the row of periods in the lower line indicate the progress:

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

Once the boot process is complete, the main status display will be shown, indicating the operating mode of the receiver, the current offset of the NTP server, the current date, and the current UTC time:

```
NORMAL OPERATION
NTP : Offs.-1us
Tue, 09.02.2021
UTC  10:06:38
```

If the GPS receiver does not synchronize (Refclock LED is still red after 25 minutes), a review of the number of satellites in view and the good satellites is recommended; to do this press $\downarrow, \rightarrow, \rightarrow, \downarrow\downarrow$ and then "OK" from the main screen:

```
SV CONSTELLATION
SVs in view :  11
Good SVs    :  10
Sel : 00 00 00 00
```

Four satellites are required for the receiver to determine its position and perform synchronization. If the antenna is not properly installed (e.g., it must have a clear view of the sky), it may experience difficulties with performing geolocation.

The SyncFire 1500 is shipped with DHCP enabled out of the box. However, if you wish to manually configure your IP address from the device itself, press F2 to view the current configuration, then F2 again to open the setup page.

```
-> Interfaces <-        Use Up and Down
Global Cfg.      OK     to select Port:
Services                lan0:0    #1of4 i
Add Interf.             >172.27.80.213
```

Then press the OK button three times to open the IPv4 LAN0 configuration page, where you can modify the IP address, netmask, and default gateway:

NOTE: This procedure relates to the first Ethernet connection (LAN0).

```
>IPv4 Parameter<        > LAN Address <         Set LAN Address
IPv6 Parameter   OK     LAN Netmask      OK     IPv4 lan0:0  :
Link Mode               Gateway                 -> DHCP: disable<-
                                                164.48.40.100
```

Once a network connection is in place, all subsequent configuration can be performed over the network, either via the Web Interface or an SSH session:

Default User: `root`
Default Password: `timeserver`

11 Initialization Process of the GPS Receiver

Once both the antenna and the power supply have been connected, the system is ready for operation. The oscillator of the receiver will have been adjusted after around two minutes of operation to ensure that it is operating with the required accuracy. If the receiver contains a valid almanac with the ephemerides in its battery-backed memory for the last known position of the receiver, and the position of the receiver has not changed significantly since last operation, the receiver will be able to determine which satellites should be presently in view. Synchronization requires only one satellite to be locked, so it is possible for synchronization to be achieved within a minute of power-on.

If the receiver's position has changed by more than 60 miles (or 100 km) since the last time it was in operation, the actual orbital position of the satellites and Doppler shift of the transmitted signals might not match those values expected by the receiver. This will force the receiver into **Warm Boot** mode, in which the receiver uses its valid almanac data to identify the ID numbers of known satellites. Once the receiver has identified four satellites in view, it can determine its new position and will then switch to **Normal Operation**. If no valid almanac is available (for example, because the battery used to power the RAM is depleted), the receiver will switch to **Cold Boot** mode, in which it scans for a satellite and imports the full up-to-date almanac. It generally takes between 13 and 24 minutes to complete this process; the full almanac is transmitted over a period of 12.5 minutes, and the receiver may need to wait for the next transmission to begin.

Once the full almanac has been acquired, the system will switch to **Warm Boot** mode, in which it uses the newly-acquired almanac data to scan for other satellites.

12 Configuration and Monitoring via the WebUI

The Meinberg SyncFire 1500 runs under LANTIME firmware 7.08 or higher. A detailed description of the web interface and display menu navigation can be found in the current LANTIME firmware manual at: http://www.mbg.link/doce-fw-ltos.

Also read the chapter "Security User Guide" for a secure configuration of your SyncFire system in the network. In addition, you will find information about problem solving in the chapters "Troubleshooting & Alarming" and "Support Information".

All relevant documents can also be found in the LANTIME web interface under "Docs & Support", or you can download the documents from our Customer Portal, stating the system serial number: https://meinberg.support.

The following menus are available for the SyncFire 1500:

- Main
- Network
- Notification
- Security
- NTP
- System
- Clock
- SyncMon
- Docs & Support

 For detailed documentation about the menus in the web interface, please refer to the LANTIME firmware manual.

12.1 Initial Configuration via Web Interface

The Web Interface of the SyncFire 1500 is complex and your system can be configured in a multitude of ways. The manual for your SyncFire 1500's LTOS version provides detailed guidance in this regard.

However, to get your system operational on a basic level after start-up, the following basic configuration processes must be completed:

- Virtual network interfaces
- Time zone
- Antenna cable length or the delay offset to account for signal propagation time

12.1.1 Network Interfaces

In this menu the virtual interfaces of the LANTIME are managed. Up to 99 virtual interfaces can be assigned to the available physical ports. The name of the virtual interface consists of a consecutive number of a physical interface and the number of a virtual interface (starting with zero). The example above shows a configuration in which a single virtual interface is assigned to the physical interface **LAN0**, in this case the default **lan0:0**.

Add Interface
This button is used to create a new virtual interface. The new interface is assigned by default to the physical port *lan0* and is appended to the end of the list of virtual interfaces. The physical interface to which the new virtual interface is to be assigned can be set under the "Miscellaneous" tab.

IPv4 Tab

This tab is used to configure the IPv4 parameters or, if DHCP is used, view the configuration assigned by the DHCP server.

TCP/IP address: IPv4 address of the interface.

Netmask: The subnet mask for the interface.

Gateway: Configuration of an interface-specific gateway. This only needs to be configured if the IP address of the interface is not in the same subnet as the default gateway and the interface needs to communicate with other (sub)networks via this gateway.

Enable DHCP Client: If set, the network configuration will be acquired automatically by broadcasting a DHCP request.
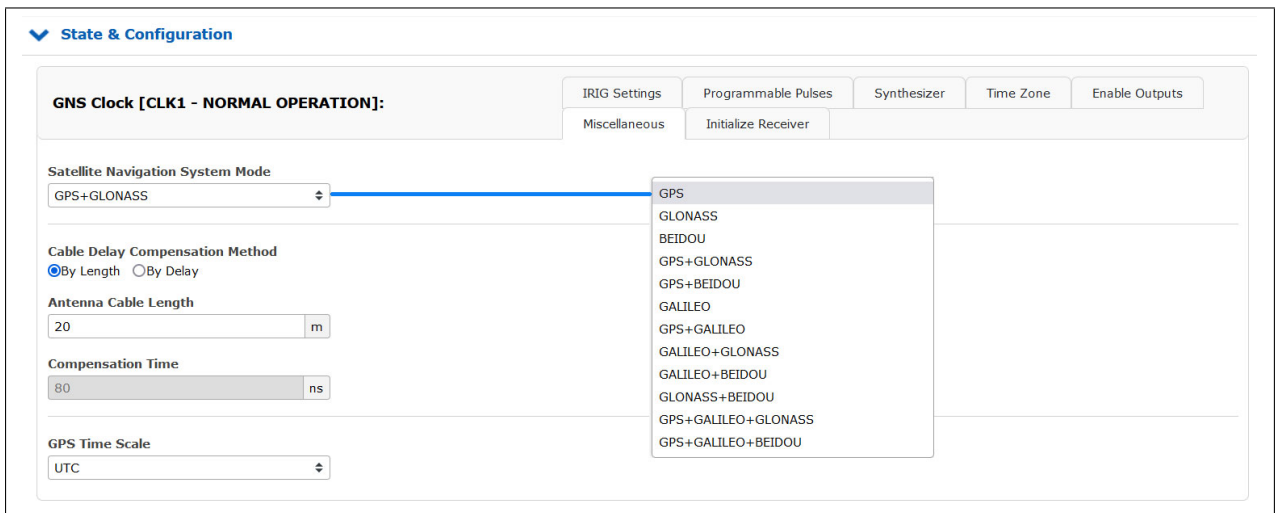
12.1.2 Clock - Time Zone

This menu is used to configure the time zones (UTC offset) for the signals output by the reference clock (IRIG, serial time string, programmable pulses).
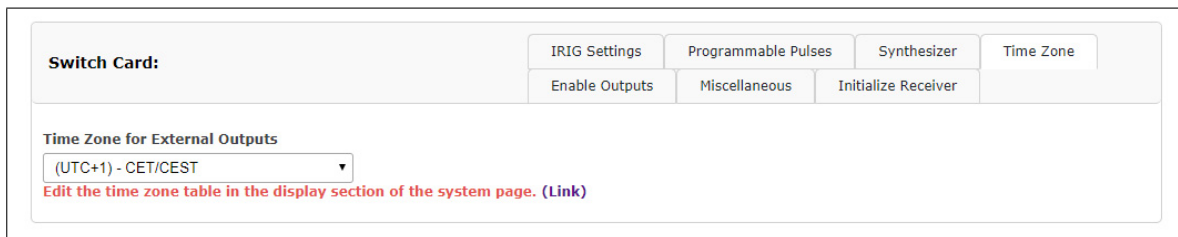
12.1.3 Clock - **Miscellaneous**

This menu is used to configure other operational parameters of the reference clock—in this case only the delay offset is relevant. Please refer to the LTOS manual for further information.

Satellite Navigation System Mode
When using a GNS receiver, the satellite systems to be used for time signal reception can be selected here. It is possible to use up to three different navigation systems simultaneously (see figure above).

Antenna Cable Length / Compensation Time:
An incoming signal from an antenna takes around 4–5 ns to travel along one meter of a coaxial cable. Therefore, if your SyncFire 1500 is connected to the antenna over 300 m of coaxial cable, a delay of 1.5 μs will be incurred. Because this delay is a constant, however, the clock can compensate for this delay.

If **By Length** is selected and the length of the antenna cable (or the combined length of any antenna cables separated by passive distributors) is entered in meters, the SyncFire 1500 will automatically calculate the offset to be applied. Alternatively, the offset can be set manually by selecting **By Delay** and entering the propagation time in nanoseconds.

> ⓘ **Information:**
>
> A maximum cable length of 2000 m or a maximum manual offset of 10000 ns can be set here.

13 Technical Appendix

13.1 Technical Specifications: SyncFire 1500

Chassis Specifications

Form Factor	1U / 19″ rack mounted, 84 HP
Dimensions	439 mm x 42 mm x 602 mm (17.28 in x 1.54 in x 23.7 in) [W x H x D]
Total Weight	12.3 kg / 27.1 lb (as rack–mounted; including receiver, additional network card, and rack mounting kit)
Material	Sheet steel
IP Rating	IP20

Operating Specifications

Supported Operating Temp.	0 °C to 45 °C (32 °F to 113 °F)
Supported Storage Temp.	–40 °C to 70 °C (–40°F to 158°F)
Supported Relative Humidity (Operation)	Max. 90 % at 40 °C (104 °F), non–condensing
Supported Relative Humidity (Storage)	Max. 95 % at 50 °C (122 °F), non–condensing
Supported Altitude	Max. 5000 m / 16400 ft (above sea level)

Basic System Specifications

Server Platform	Intel® Server Mainboard M10JNP
Processor	Intel Xeon E2276G quad–core CPU (4.90 GHz, 6 cores, 12 threads, 12 MB cache, 80 W TDP)
Operating System	Custom LANTIME OS based on Linux 4.x LTS kernel
Main Memory	16 GB DDR4 3200 MT/s ECC
Internal Storage	SSD hard disk, 120 GB

Management Features

Web Interface   (HTTP/HTTPS TLS v1.3, network)

SSH v2   (command line interface, network/serial)

Telnet   (command line interface, network/serial)

REST API   (HTTP/HTTPS TLS v1.3, network)

Serial Console   8P8C ("RJ45-like") connector for serial terminal access

Local   Front display & function keys

Monitoring & Alarms

Supported Protocols   SNMP v1, SNMP v2, SNMP v3

Notification Channels   Email (SMTP), syslog

Log Access   Logs can be viewed and downloaded in the Web Interface, downloaded via the
                               FTP service, or accessed via the command line interface

NTP Support
NTP Protocols   NTP v2 (RFC 1119), NTP v3 (RFC 1305),
                               NTP v4 (RFC 5905), SNTP v3 (RFC 1769), SNTP v4 (RFC 2030)

Security Features   Symmetric key-based authentication using MD5, SHA-1,
                               or AES-128-CMAC hashes
                               NTP v4 Autokey (private/public key pairs)
                               NTS encryption (RFC 8915) for NTP v4

Oscillator Options

SyncFire 1500 systems fitted with a GPS or GNS receiver are shipped as standard with a "TCXO" (temperature-controlled crystal oscillator), which provides excellent holdover performance if your server loses synchronization with its upstream reference for any reason. The SyncFire 1500 may also be shipped on request with a more powerful holdover solution; the options available and their performance metrics are listed below:

Type	Holdover Performance (1 Day)*	Holdover Performance (1 Year)*
TCXO	+- 4.3 ms	+- 16 s
OCXO LQ	+- 865 μs	+- 6.3 s
OCXO SQ	+- 220 μs	+- 4.7 s
OCXO MQ	+- 65 μs	+- 1.6 s
OCXO HQ	+- 22 μs	+- 788 ms

* Full holdover performance requires the system to have been synchronized for 24 hours previously.

Sync Input Options

GPS Sync Input**   12-channel L1 C/A code input for reception of synchronization signals from the GPS satellite constellation

GNS Sync Input***   72-channel input for reception of synchronization signals from the GPS (L1), Galileo (E1 B/C), BeiDou (B1I), and GLONASS (L1OF) satellite constellations

PTP Sync Input   PTP input for operation of SyncFire 1500 as PTP slave based on Oregano Systems syn1588 PCI Express PTP technology

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** Requires a Meinberg GPS antenna (included with the system as standard)
*** Requires an L1 Multi GNSS antenna (included with the system as standard)

Support & Compliance

Technical Support   Free lifetime support via telephone and email, including firmware updates

Warranty   Three-year warranty, extendable upon request

Firmware Updates   Firmware is field-upgradable; updates can be installed from a connected USB storage medium, via the Web UI (upload via a web browser), or via the CLI (download from a server).

    LANTIME OS allows you to install multiple firmware versions onto the device concurrently and select which one should be used when the system starts.

13.2 1000BASE-T Gigabit Network Port

Signal   1000BASE-T

Data transmission rate: 10/100/1000 Mbit/s

Connection Type: 8P8C (RJ45)

Cable: Copper twisted pair

Duplex Modes: Half/Full/Autonegotiaton
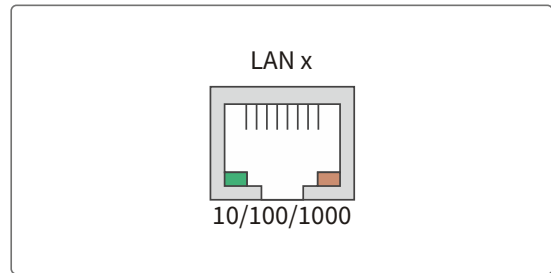
13.3 10 Gigabit SFP+

Transceiver Interface Type   SFP+

Bus Interface: PCI Express v1.1, x8

Network: 10 Gigabit Ethernet

Power consumption: Dual Port 10GBase-SR, typ. 10 W, max. 10.7 W

                            Dual Port SFP+ Twinax typ. 7.9 W, max. 8.6 W

Operating Temperature: 0 – 55 °C
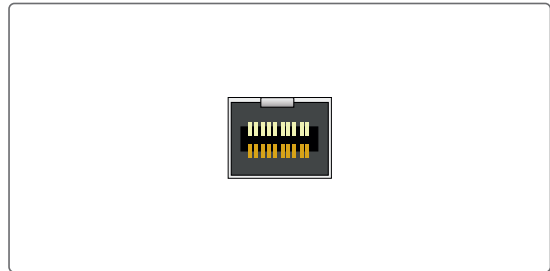
13.3.1 SFP Transceiver

Recommended and tested Transceivers from other Vendors

connectivity	Mode	Vendor/Type	Distance
10 Gbit/s	Multimode	E10GSFPLR (Intel 1/10G)	400 m (with OM4 fibre)
25 Gbit/s	Singlemode	E25GSFP28LRX (Intel E25G)	10 km
40 Gbit/s	Multimode	FlexOptix (Q.1640G.03)	150 m

Warning!

Prevention of Eye Injuries

- Fiber optic SFP modules that are not compliant with the definition of a Class 1 laser in accordance with IEC standard 60825-1 may emit radiation capable of causing eye injuries.
- Never look into an unconnected connector of a fiber optic cable or an unconnected SFP port, and ensure that unused fiber optic connectors are always fitted with a suitable protective cap.

13.4 Antenna Input: GPS Reference Clock

Antenna Input: Antenna Circuit, Galvanically Isolated

Dielectric Strength: 1000 V

Receiver Type: 12-Channel GPS Receiver

Signal Support: L1 C/A (1575.42 MHz)

Mixing Frequency: 10 MHz [1]
Reference Clock
to Antenna
(GPS Converter):

Intermediate 35.4 MHz [1]
Frequency:
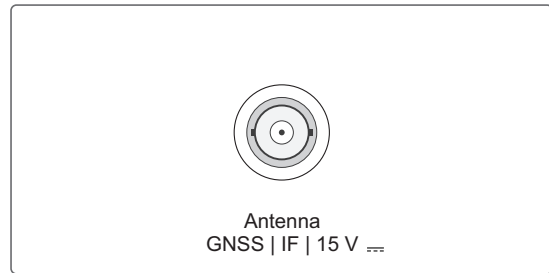Antenna
(GPS Converter)
to Reference Clock

Voltage Draw 15 V (via Antenna Cable)
of Antenna:

Power Consumption 100 mA (via Antenna Cable)
of Antenna:

Connection Type: BNC Female/Type-N Female

Cable Type: Coaxial Cable, Shielded

Cable Length: Max. 300 m to RG58,
Max. 700 m to RG213

Antenna
GNSS | IF | 15 V ⎓

[1] These frequencies are transferred via the antenna cable

Danger!

Do not work on the antenna system during thunderstorms!
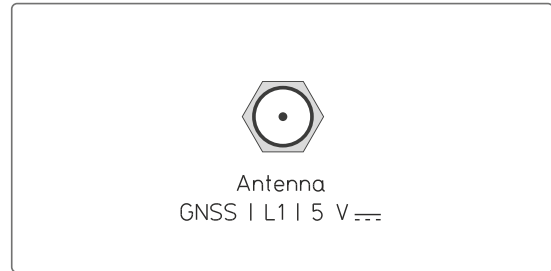
Danger of death from electric shock!

- <u>Do not</u> carry out any work on the antenna system or the antenna cable if there is a risk of lightning strike.
- <u>Do not</u> carry out any work on the antenna system if it is not possible to maintain the prescribed safe distance to exposed lines and electrical substations.

13.5 Antenna Input: GNSS Reference Clock

Antenna Type: Multi-GNSS L1 Antenna with
integrated Lightning Protection

Receiver Type: 72-Channel Receiver
GPS/GLONASS/Galileo/BeiDou

Signal Support: GPS: L1 C/A (1575.42 MHz)

                    Galileo: E1-B/C (1575.42 MHz)

                    BeiDou: B1I (1561.098 MHz)

                    GLONASS: L1OF (1602 MHz +
                              k*562.5 kHz)

                    where k represents the channel number (–7 – 6)
                    within the corresponding GLONASS
                    frequency band

Signal Gain: 40 dB

Antenna Gain: $\geq$ 3.5 dBic / $\geq$ 3 dBic

Rated Impedance: 50 Ohm

DC Voltage: 5 V (Power Supply via Antenna Cable)

DC Current: Max. 100 mA

Connector Type: SMA, Female

Cable: Coaxial cable, shielded

Cable Length: Max. 70 m with Belden H155 Coaxial Cable,
max. 150 m with H2010 Ultraflex Coaxial Cable

Antenna
GNSS | L1 | 5 V ⎓

Danger!

Do not work on the antenna installation during thunderstorms!

Danger of death from electric shock!

- **Do not** carry out any work on the antenna installation or the antenna cable if there is a risk of lightning strike.
- **Do not** perform any work on the antenna installation if it is not possible to maintain the prescribed safety distance from exposed power lines or electrical substations.

13.6 Time Code AM Output

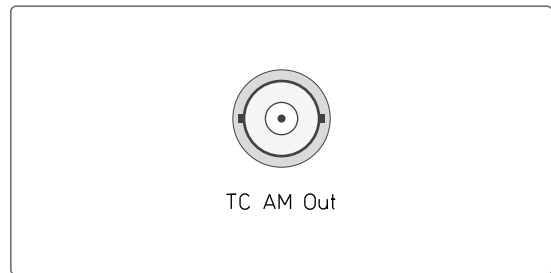**Output Signal:** AM Time Code (Amplitude–Modulated Sine Wave Signal)

Signal Level: 3 V$_{pp}$ / 1 V$_{pp}$ (MARK/SPACE), 50 Ω Termination

Carrier Frequency: 1 kHz (IRIG–B)

Connector Type: BNC Female

**Cable:** Coaxial Cable, Shielded

TC AM Out

13.7 Oregano syn1588 PCIe NIC

The syn1588® PCIe NIC is a standard 100/1000 Mbit PCI Express Ethernet network interface card with enhancements to provide highly accurate clock synchronization via the IEEE1588 standard.

The syn1588® PCIe NIC provides all real-time functions required for an IEEE1588 node to operate in slave mode.

Key Features

- 100/1000 Mbit Ethernet network interface card (PCI Express card, half height)
- IEEE1588-2002, IEEE1588-2008 and IEEE1588-2019 compliant
- Slave capable PTP Node (with syn1588® PTP Stack)
- IEEE1588 hardware timestamping
- Patented on-the-fly timestamping (1-step mode)
- Clock accuracy up to +-4 ns
- syn1588® PTP Stack binary run-time license included
- Up to 4 programmable I/O signals available on SMA jacks
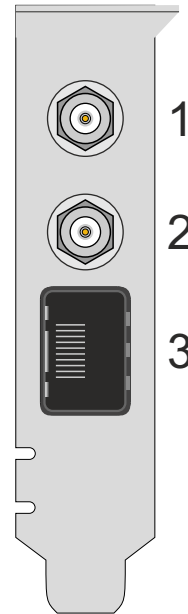
Connectors

1   Period Output
2   1PPS Output
3   SFP, 1000BASE-X

Supported SFP Modules

Type	Mode	Connector Type	Max. Connection Length
Avago FBR-5710PZ	Fiber-optic (1000BASE-X)	Duplex LC	550 m
Avago AFCT-5710PZ	Fiber-optic (1000BASE-X)	Duplex LC	10,000 m
Fiberstore SFP1G-SX-85	Fiber-optic (1000BASE-X)	Duplex LC	550 m
Fiberstore SFP1G-LX-31	Fiber-optic (1000BASE-X)	Duplex LC	10,000 m
Finisar FTLF1318	Fiber-optic (1000BASE-X)	Duplex LC	10,000 m
Fiberland FLD-SG-MMD-1	Fiber-optic (1000BASE-X)	Duplex LC	550 m
Fiberland FLD-SG-SMD-10	Fiber-optic (1000BASE-X)	Duplex LC	10,000 m
Fiberland FLD-SASG-T	Copper (1000BASE-T)	RJ45	100 m

13.8 Technical Specifications: GPSANTv2 Antenna

Physical Dimensions:
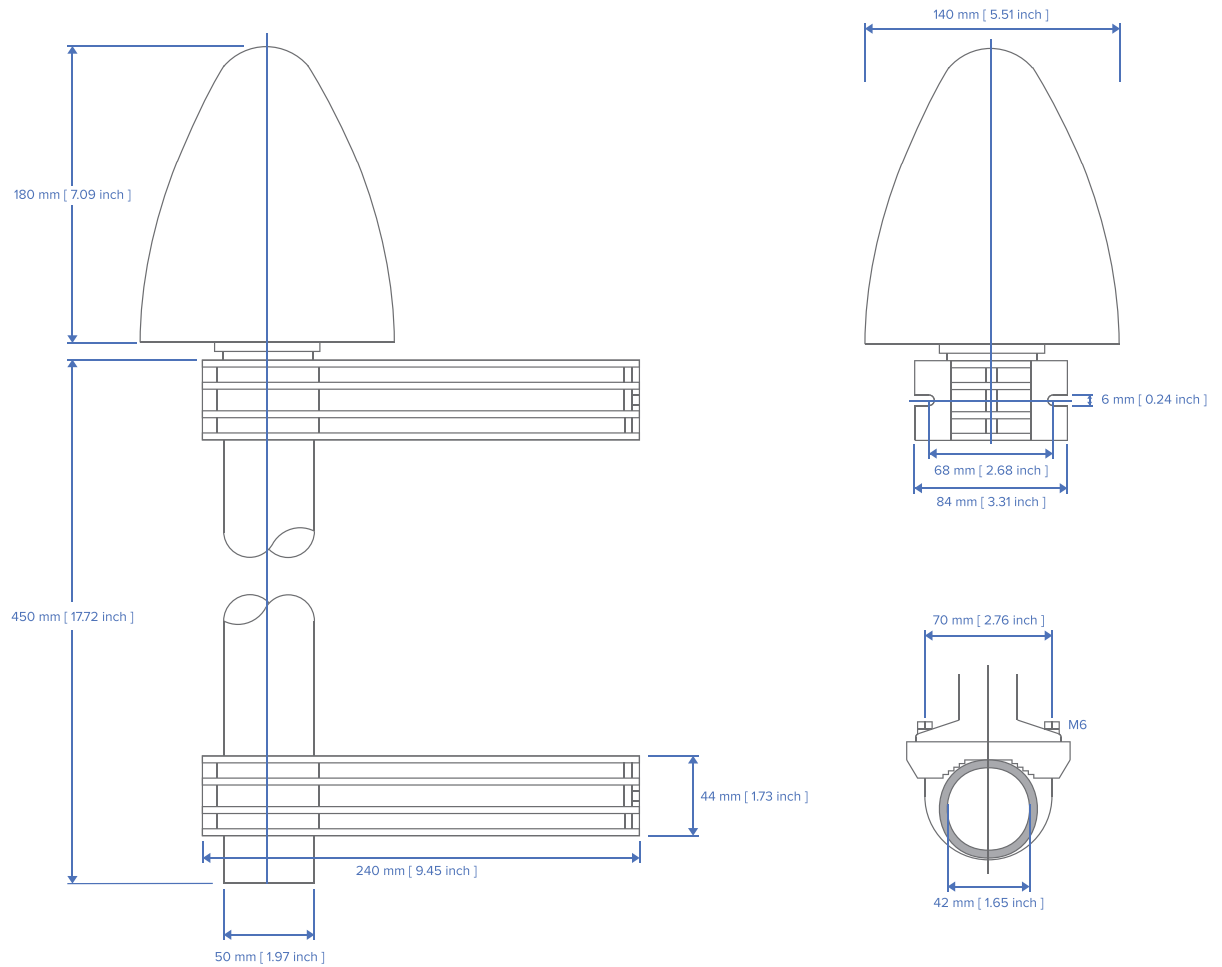
Specifications:

Power Supply: 15 V, 100 mA (provided via antenna cable)

Reception Frequency: 1575.42 MHz (GPS L1/Galileo E1 Band)

Bandwidth: 9 MHz

Frequencies: Mixing Frequency: 10 MHz
Intermediate Frequency: 35.4 MHz

Element Gain: Typically 5.0 dBic at zenith

Polarization: Right-Hand Circular Polarization

Axial Ratio: $\leq$ 3 dB at zenith

Nominal Impedance: 50 Ω

VSWR: $\leq$ 1.5 : 1

Conversion Gain: 56 dB $\pm$ 3 dB

Out-of-Band Rejection: $\geq$ 70 dB @ 1555 MHz
$\geq$ 55 dB @ 1595 MHz

Noise Figure: Typically 1.8 dB max. 3 dB @ +25 °C

Surge Protection: Level 4 (per IEC 61000-4-5)
Test Voltage: 4000 V
Max. Peak Voltage @ 2 Ω: 2000 A

ESD Protection: Level 4 (per IEC 61000-4-2)
Contact Discharge: 8 kV
Air Discharge: 15 kV

Connector Type: Type-N Female

Housing Material: ABS Plastic Case for Outdoor Installation

IP Rating: IP65

Temperature Range: –60 °C to +80 °C (-76 °F to 176 °F)

Weight: 1.4 kg (3.53 lbs), including mounting kit

13.9 Technical Specifications: 40 dB Multi GNSS Antenna

GPS L1 / GLONASS L1 / Galileo E1 / BeiDou B1 Frequency Band
GPS, GLONASS, Galileo and BeiDou satellites do not hold a geostationary orbit, but circle the Earth once roughly every 12 hours. Satellites can only be received as long as there is nothing obstructing the line of sight between the antenna and the satellite. Detailed installation requirements can be found in the chapter **Antenna Installation**.

This active L1 antenna incorporates a high-performance antenna and low-noise amplifier in a weatherproof housing. The connected GPS/GLONASS receiver supplies the antenna with a 5.0 V DC voltage via the antenna cable.

A standard coaxial cable with 50 Ohm impedance can be used to connect the antenna to the receiver. The length of the cable between the antenna and receiver should not exceed 70 meters (H155, Low-Loss). A mounting kit is provided with the product as shipped.

Please refer to the data sheet, which can be downloaded here:

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

13.10 Technical Specifications: RV-76G GPS/GLONASS Antenna for Mobile Applications

Installation of the Antenna
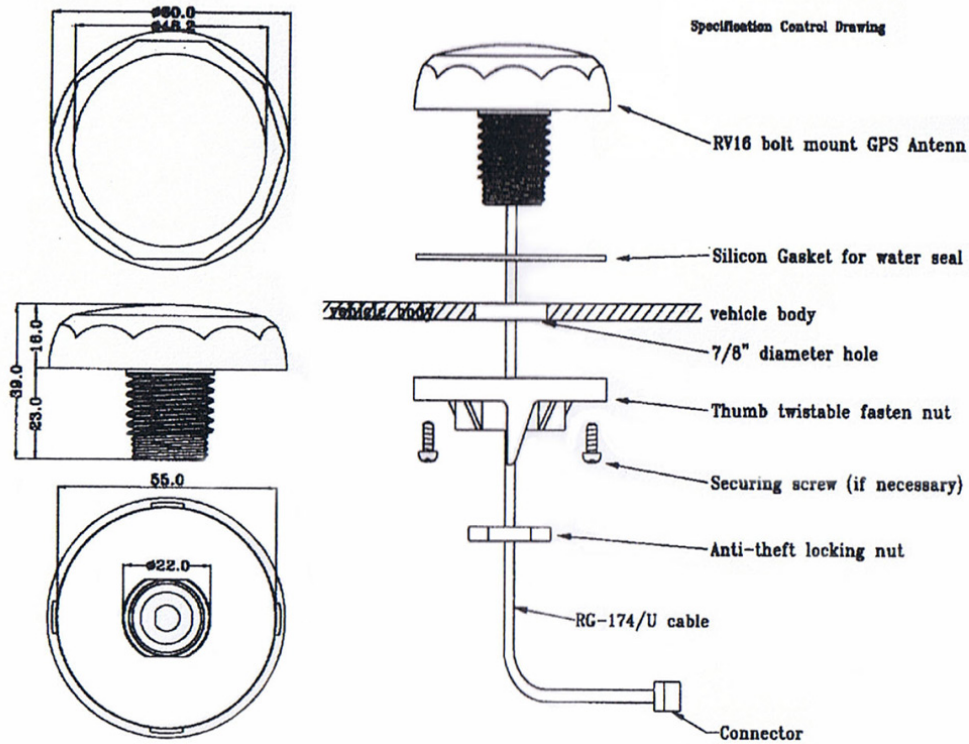
Further Information on the Product

Detailed specifications are provided in the manufacturer's data sheet.

Source: *RV-76G_Catalog_V1.0_20130502 Data Sheet (Sanav)*

Download: *https://www.meinberg.de/download/docs/other/rv-76g_en.pdf*

13.11 Technical Specifications: MBG-S-PRO Surge Protector

The MBG-S-PRO is a surge protector (Phoenix CN-UB-280DC-BB) for coaxial connections. It is patched directly into the antenna line and consists of a replaceable gas discharge tube that redirects the energy from the cable shielding to the ground potential when ignited. Connect the MBG-S-PRO using a ground conductor cable that is as short as possible.

The MBG S-PRO has no dedicated input/output polarity and no preferred installation orientation.

Phoenix CN-UB-280DC-BB

Features:

- Excellent RF Performance
- Multiple Strike Capability
- 20 kA Surge Protection
- Bidirectional Protection

Contents of Package:	Surge Protector with Mounting Bracket and Accessories
Product Type:	Surge Protector for Transmission and Receiver Devices
Construction:	In-Line Breaker
Connectors:	Type-N Female/Type-N Female

The original product page of the supplier (see link) of the CN-UB-280DC-BB surge protector provides detailed specifications, as well as a variety of product-specific documents under the link below:

Data Sheet (Download):
https://www.meinbergglobal.com/download/docs/shortinfo/german/cn-ub-280dc-bb_pc.pdf

13.12 How Satellite Navigation Works

The use of a receiver for location tracking and time synchronization relies on the ability to measure the satellite-to-receiver propagation delay as precisely as possible. It is necessary to have simultaneous reception from four satellites so that the receiver can determine its relative spatial position in three dimensions (x, y, z) and measure the deviation of its clock against the system clock. Monitoring stations around the planet track the orbital trajectory of the satellites and detect deviations between the local atomic clocks and the system time. The collected data is transmitted up to the satellites, which then send navigation data back to Earth.

The high-precision trajectory data of each satellite, known as the satellite's ephemeris, is needed by the receiver to continuously calculate the precise location of the satellites in space. A roughly defined ephemeridal schedule based on empirical data, referred to as an almanac, is used by a receiver to identify which satellites are visible above the horizon given a known location and time. Each satellite transmits its own ephemeridal schedule as well as the almanacs of all existing satellites.

Satellite Systems

GPS was installed by the United States Department of Defense (US DoD) and operates at two performance levels: the Standard Positioning Service, or SPS, and the Precise Positioning Service, or PPS. The structure of the messages transmitted by the SPS has been openly published and reception is provided for public use. The timing and navigation data of the more precise PPS is encrypted and is thus only accessible to certain (usually military) users.

GLONASS was originally developed by the Russian military for real-time navigation and ballistic missile guidance systems. GLONASS satellites also send two types of signal: a Standard Precision Signal (SP) and an encrypted High Precision Signal (HP).

BeiDou is a Chinese satellite navigation system. The second-generation system, officially referred to as the BeiDou Navigation Satellite System (BDS) and also known as "COMPASS", consists of 35 satellites. BeiDou entered service in December 2011 with ten satellites and was made available to users in the Asia-Pacific region. The system was completed in June 2020 with the launch of the final satellite.

Galileo is an in-development global European satellite navigation and time reference system controlled by a civilian authority (European Union Agency for the Space Programme, EUSPA). Its purpose is the worldwide delivery of high-precision navigation data and is similarly structured to the American GPS, Russian GLONASS and Chinese BeiDou systems. The main differences in the systems lie in their approaches to frequency usage & modulation and the satellite constellation.

13.12.1 Time Zones and Daylight Saving Time

GPS System Time is a linear timescale that was synchronized with the international UTC timescale (Coordinated Universal Time) when the satellite system became operational in 1980. Since it has entered service, however, several leap seconds have been introduced to the UTC timescale to adjust UTC time to irregularities in the Earth's rotation. While GPS System Time deviates from UTC time by several seconds for this very reason, satellite messages do incorporate the number of seconds by which these timescales deviate from one another, allowing GPS receivers to be synchronized internally with the international UTC timescale.

The receiver's microprocessor can identify any time zone based on UTC time and automatically apply Daylight Saving Time adjustments over several years if so configured by the user.

13.13 General Information about Time Code

The need to transmit encoded time information became a topic of some importance as early as the 1950s. The U.S. space program in particular was a key driver of advancement in this field, using time code information to correlate different sets of measurements. However, the formats and usage of these signals were defined arbitrarily at the whims of the specific users. This resulted in the development of hundreds of different time code formats, some of which were standardized by the "Inter Range Instrumantation Group" (IRIG) in the early 1960s. These standardized time code formats are referred to as "IRIG Time Codes" today.

In addition to these, there are also other codes in use designed for specific applications, among them NASA36, XR3, or 2137. These differ in terms of the data transmission rates and the type of data actually transmitted. The SyncFire 1500, however, limits itself to the output of IRIG-A, IRIG-B, IEEE1344, C37.118, and AFNOR NF S87-500 formats.

The AFNOR time code is a variant of the IRIG-B format that replaces the "control functions" of the IRIG time string with full date information.

Besuchen Sie unsere Homepage um detaillierte Informationen zu IRIG-Time-Codes zu erhalten: https://www.meinbergglobal.com/english/info/irig.htm.

13.13.1 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
		E	10 pps
		G	10000 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)

13.13.2 IRIG Standard Format
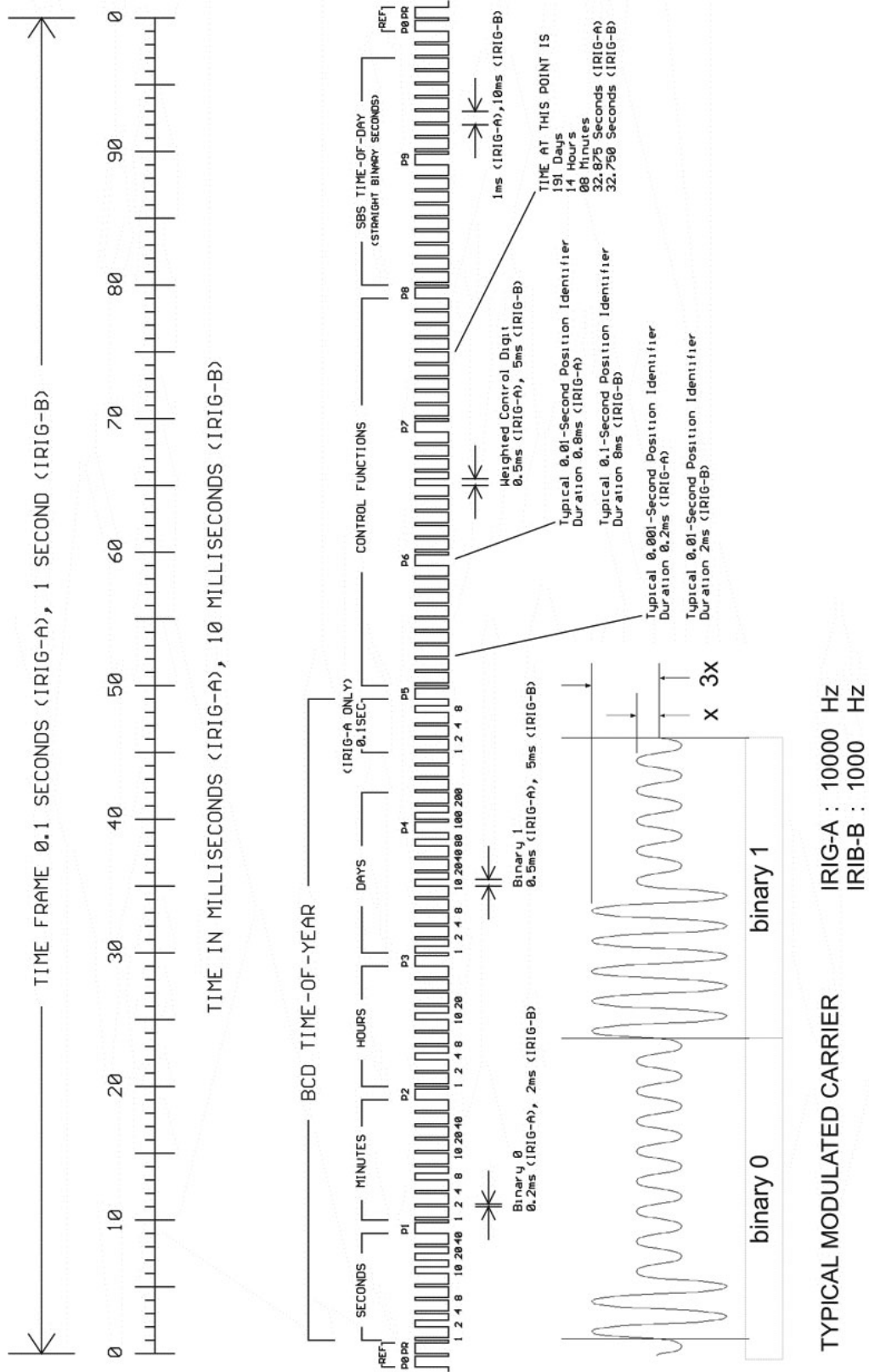
13.13.3 AFNOR Standard Format
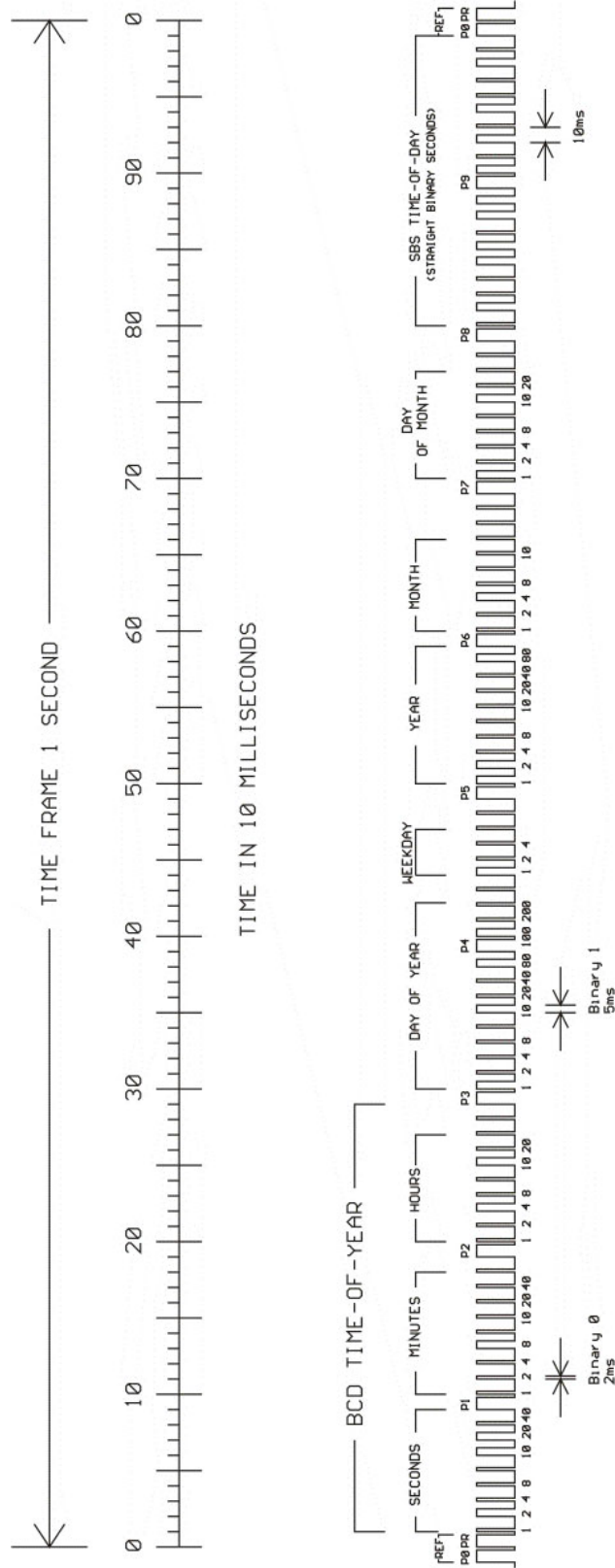
14 RoHS Conformity

Compliance with EU Directive 2011/65/EU (RoHS)

We hereby declare that this product is compliant with the European Union Directive 2011/65/EU and its delegated directive 2015/863/EU "Restrictions of Hazardous Substances in Electrical and Electronic Equipment".

We warrant that electrical and electronic products sold in the EU do not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs), bis(2-ethylhexyl)phthalat (DEHP), benzyl butyl phthalate (BBP), dibutyl phthalate (DBP), or diisobutyl phthalate (DIBP) above the legal limits.

RoHS
2011/65/EU