MANUAL

IMS-GNS181 Setup Guide
Hot-Plug Module

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Meinberg Funkuhren GmbH & Co. KG
# Table of Contents

1 **Imprint** 1  

2 **Safety Instructions for hot pluggable Modules** 2  
   2.1 Additional Safety Hints 3  
   2.2 Supply Voltage 3  
   2.3 Cabling 4  

3 **Replacement or Installation of a Hot-pluggable IMS Module** 5  

4 **GNSS Clock** 6  
   4.1 Configuration of IMS Modules via Web Interface 8  
   4.1.1 Clock 8  
   4.2 General GNSS Antennae 27  
   4.2.1 GNSS Antenna for Stationary Installation 27  
   4.2.2 GNSS Antenna for Mobile Applications 29  
   4.3 Powering up a GNSS Receiver 30
1 Imprint

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2 Safety Instructions for hot pluggable Modules

Check before every maintenance work on the system:

- If a data backup is required?
- Is a backup required, verify the data recovery which is done by this backup.
- Make sure to avoid any static discharge while working - use a grounding cable and/or antistatic gloves during installation and removal of hot pluggable components.
- If you are replacing a hot pluggable power supply, unplug the power cable prior to removing the module from the case.
- Never open a power supply. In power supplies dangerous voltages can still remain even after disconnection from the power supply. Always send power supplies back to the manufacturer for maintenance.

Exchange of hot-swap components

- Ensure that components which will be replaced during operation, always be treated with the utmost care. Avoid contact with live components.
- Electrostatic discharge can damage electronic components. For this reason, ensure protection against electrostatic discharges by wearing anti-static shoes while working with the system.
- Take care when removing and installing the hot-plug modules. Always work with the utmost caution. Touch the modules only at the edges.
- Place the module out of the box or after removal from the system with the component side to the top on a grounded and static-free surface.
- Storage of an IMS module must be done in a dry place.
- Installation or removal from hot-swap components only by authorized personnel!
2.1 Additional Safety Hints

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 operation above the limits specified in this document is considered as improper use.

Keep all documents provided with the device for later reference.

This manual is exclusively for qualified electricians or by a qualified electrician trained personnel who are familiar with the applicable national standards and specifications, in particular for the construction of high voltage devices.

2.2 Supply Voltage

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! Installation, 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 manufacturer.

Supply lines for this device 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.

To ensure safe operation supply mains connected to this device must be equipped with a fuse and a fault-current circuit breaker according to the applicable national standards for safe operation.

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

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.

ALWAYS ENSURE A PROPER INSTALLATION!
3 Replacement or Installation of a Hot-pluggable IMS Module

Please use a Torx screwdriver (T8 x 60) for removal and installation.

1. Follow the safety instructions at the beginning of this manual!

2. (Only for an already built-in module) Pull the module carefully out of the holding rail. Note that the module is firmly anchored in the connector block of the housing. You need a certain amount of force to release the module from this link. Once the connection to the connector block of the system’s backplane is loosened, the module can be easily pulled out.

3. When installing the new IMS module, please ensure that the board is correctly inserted into the two guide rails of the system housing. Non-observance can cause damage to the module and the chassis. Make sure that the module is securely locked into the connector block before you fasten the two screws.

4. Now you can put the installed module into operation.

Attachment points of an 1U IMS system
4 GNSS Clock

Type of receiver: GPS/GLONASS/Galileo/BeiDou receiver
Number of channels: 72
Frequency band: GNSS L1
  GPS: 1575.42 ± 10 MHz
  GLONASS: 1602-1615 MHz
  Galileo: 1542.5 MHz
  BeiDou: 1561.09 MHz
Accuracy of Pulses: Depend on oscillator option
  < ±100ns (TCXO, OCXO-LQ)
  < ±50ns (OCXO-SQ, -MQ, -HQ, -DHQ)
Synchronization Time: Max. 1 minute in normal operation mode, approx. 12 minutes after a cold start
Antenna Cable: shielded coax cable (Belden H155 PE)
Cable Length: max. 100m low-loss cable
Type of Connector: female SMA connector
Power Requirements: 5 V, 100 mA (via antenna cable)

Figure right: GNSS Receiver and GNSS with XHE-SPI Connector (optional)

LED Indicators

Init blue: while the receiver passes through the initialization phase
  green: the oscillator has warmed up
Nav. green: positioning successfully
Ant red: antenna faulty or not connected
  yellow: the clock is synchronized by an external Signal - MRS mode (PPS, IRIG …)
Fail red: time has not synchronized
Pin Assignment of the DSUB9 Connectors (male):

- Pin 2: RxD
- Pin 3: TxD
- Pin 5: GND

Pin Assignment of the optional XHE-SPI Connectors:

- A1: PPS In
- A2: PPS Out
- Pin 1: SCL_Out (SPI Clock)
- Pin 2: CS (Chip Select)
- Pin 3: MOSI (Master Out, Slave In)
- Pin 4: MISO (Master In, Slave Out)
- Pin 5: GND

Attention: Use this plug only to connect a MEINBERG IMS-XHE\textsuperscript{Rb} Rubidium expansion chassis.
4.1 Configuration of IMS Modules via Web Interface

This chapter shows how to configure a IMS clock module, for example a GPS receiver.

4.1.1 Clock

On this page of the web interface, configurations can be made on the respective installed reference clocks or the changeover card.

![Menu "Clock" in case of a single receiver](image)

Depending on the design of the system, which means whether it is a single reference clock or a system with two installed remote clocks and a changeover card, the web interface builds up accordingly. This also applies to the type of reference clock and its options. In case of a redundant receiver configuration the common settings for "IRIG In/Out", "Serial Ports", "Time Zone", "Enable Outputs", "Programmable Pulses" and "Synthesizers" appears into the "Switch Card" menu.

![Menu "Clock" in case of a single receiver](image)
4.1.1.1 MRS Status

Here the states of the reference inputs are shown:

**Priority:** Arrangement of the time source according to your prioritization.

**Source:** Type of reference source.

**Status:**
- No Connection, No signal → the reference source is not available.
- Signal available → the reference source is available.
- Is master → the reference source is used to synchronize the system.
- Is locked → the system synchronizes itself to the reference source.
- Is accurate → Basic accuracy of synchronization reached.

**Offset:** Time difference of the reference clock to the specified time source.

**Statistics:**
- Span → If the difference between the min / max value of the time source is over a defined statistical interval.
- Step-Compensation → Displays a hard time jump of the reference source (currently only available for PTP).
- Auto-Bias → Time offset determined for the source versus an offset-free time source.

![MRS Status Table](image)

*Figure: An example of available reference signals in the priority order.*
4.1.1.2 MRS Settings

The MRS stands for a Multi Reference Source clock. This is a special functionality of a receiver that can in addition to GNSS use also other input signals as a reference for synchronization.

4.1.1.3 MRS Source Priority

In the MRS Settings you can configure a priority list of input signals how the switching will follow in case that a master reference becomes unavailable. The selection of signals in the list is automatically generated by the LANTIME according to the hardware configuration. The priority list of input signals should be configured in a descending order referring to the accuracy of signals.

Here is an example how to configure a priority list in a descending order:
1. Source: GNSS / GPS
2. PPS + String
3. PTP – IEEE1588
4. external NTP Server

![Configuration example of reference signals in a descending order.](image)

*Figure: Configuration example of reference signals in a descending order.*
4.1.1.4 IRSA - Intelligent Reference Selection Algorithm

IRSA stands for an Intelligent Reference Selection Algorithm. In case that a master signal fails the IRSA takes care that the switching to the next reference signal in the priority list runs automatically and smoothly. The IRSA also takes into account the highly stable holdover performance of the local oscillator. It ensures that switching from the superior reference signal to the less accurate one is delayed as long as the highly stable oscillator can provide better accuracy in holdover than the next available reference signal in the priority list.

**Figure: Activated IRSA mode with estimated precision values for available references.**

To ensure that IRSA is working properly, follow these steps:

1. Configure a priority list of available reference signals in descending order from the superior to inferior one in the MRS Settings menu (see chapter MRS Source Priority).
2. Activate IRSA in the IRSA menu. As per default the IRSA is deactivated.
3. Fill in the estimated precision values for the input reference signals in for this provided “Precision” column. According to the estimated precision values the holdover time between current source and the next source from the priority list will be calculated.

Here are some estimated precision values which you can load as defaults:
- GPS / GNSS as the first priority has the highest estimated precision: 100 ns
- ext. Osc. (e.g. Rubidium): 120 ns
- PTP IEEE 1588: 100 ns
- PPS plus string: 100 ns
- NTP: 100 us
4.1.1.5 MRS Features

Advanced Source Selection
A firmware V6.24 and the following versions support a mixed combination of reference signals for synchronization. In the mixed mode you can select one source only for the ToD (Time of Day) synchronization and another source for phase and frequency. The phase and frequency can be provided by a highly stable and accurate source, for example an atomic clock, like Rubidum or Cesium.

The Time of Day (ToD) information represents a "wall clock time" – a specific time with hours, minutes, seconds and the corresponding date. The ToD information cannot be delivered by an atomic clock alone. Therefore, if you need the ToD in your system, you need to select one of the reference signal which includes the ToD information, for example GPS, NTP, PTP, PPS plus string.

If you use the mixed mode the reference clock will be steered first by a reference signal which includes the ToD. The oscillator will be roughly adjusted until it reaches the highest level of accuracy that can be achieved by this reference. After that the reference clock switches automatically to a more accurate source, for example a 1PPS coming from an external atomic clock that provides highly stable phase or a 10MHz signal to provide a stable frequency.

As per default both ToD and Phase are enabled for each available reference source. If you want to use the mixed mode, then select the ToD for one reference signal and phase for another. The reference sources you wish to use should be configured first in the Source Priority list. See MRS Settings → MRS Source Priority.

Here is one configuration example for Advanced Source Selection:

![Advanced Source Selection](image)

*Figure: An example for a mixed combination of ToD and Phase source for given reference signals.*
4.1.1.6 Extended Options

The Trusted Source (TRS) feature is a powerful tool to protect the GNSS\(^1\) receiver from spoofing attacks. For the moment, the Trusted Source feature is supported only in combination with a Meinberg GPS or GNSS receiver and a Meinberg XHE external Rubidium holdover unit.

To activate this feature, select "Use Trusted Source" check box for the GPS reference signal. It means that GPS reference will be checked for consistency by another reference source which is acknowledged as a Trusted Source. In our case the trusted source is a Rubidium atomic clock. It is denoted as ext.Osc. (external oscillator) in the table of Extended Options. Therefore select this check box "Is Trusted Source".

![Extended Options](image)

*Figure: An example of a Trusted Source mode of operation with an external rubidium.*

The external Rubidium acts as an external oscillator that is synchronized by the GPS or GNSS Master as long as the master is available and its precision is better than the precision of the XHE. If the Master fails or for some reason uses corrupted or manipulated data the TRS will detect this as an offset limit violation. Consequently, the reference selection algorithm will discard the current master and the XHE Rubidium source will become the new master for synchronization.

Both GNSS and Rubidium reference signals need to be configured first in the Source Priority list, GPS or GNSS as "Source 1" and external Oscillator as "Source 2". All other positions should be left empty (see chapter MRS Source Priority).

Second, the IRSA Reference algorithm should be activated with corresponding precisions (see chapter IRSA - Intelligent Reference Selection Algorithm).

The precision for GPS or GNSS is at same time also the TRS limit, that the reference should comply with. If the TRS limit is violated the reference selection algorithm discards the current master and switches automatically to the Trusted Source – XHE Rubidium. For the GPS or GNSS precision value we take 250ns which is maximum time deviation allowed for the receiver.

Finally, the GPS or GNSS source should have enabled "Time of Day Source" and "Phase Source", which means that the receiver is a source for both Time of Day and Phase. At the XHE Rubidium only the Phase Source should be enabled, since the atomic clock alone does not deliver the ToD information (see chapter MRS Features).

**Auto Bias Master / Auto Bias Slave**

"Auto Bias" provides a technology for a situation where a constant offset which is present with a given input signal can be measured and compensated against a trusted reference automatically. The reasons for this constant offset could be a cable delay which introduces a fix offset (5ns per each m of coax cable and 3ns for fiber), a delay caused by an IRIG generator if IRIG is used as an input, or a constant offset via PTP due to a network or traffic asymmetry.

So, if you choose for example GPS as a reference signal at priority 1 while having "Auto Bias Master" activated for GPS, then GPS will be used as a measurement reference for all other sources as long as GPS is available.

If PTP is configured as a secondary priority with "Auto Bias Slave" activated, the constant offset of the PTP input signal is measured against the current "Auto Bias Master" reference (e.g. GPS) and will be compensated automatically.

\(^1\)GPS / GNSS: The Trusted Source (TRS) feature will only work with GPS180 and GNS181 receivers.
Furthermore, even if PTP becomes a reference signal in case that a Master is not available, the PTP offsets will include a compensation for the initial offset measured against the previous Master automatically. In this operating mode a smooth transition from GPS to PTP will be possible without a time step in case GPS becomes unavailable.

If PTP is then a primary sync source and an asymmetry step suddenly occurs in the network (due to path rearrangements e.g.), the occurring asymmetry step will therefore be automatically compensated as well in case “Asymmetry Step Detection” is activated.

**Asymmetry Step Detection**

When Asymmetry Step Detection is activated, the PTP slave does not follow hard time jumps. The soft synchronization is retained and the time jump is displayed as an offset in the MRS statistics.
4.1.1.7 Fixed Offset and Limit

The "Fixed Offsets" and "Limits" can be entered by using the corresponding fields. The "Fixed Offset" specifies a fixed offset for each reference clock to the reference time. With this value, known and constant deviations of a reference time source can be compensated. No constant offset can be set for GNSS references - this can only be done indirectly with the antenna cable compensation time.

Limit:
Here you can configure a limit value. If the reference source exceeds this limit, a notification is triggered. A configuration in the Web Interface is required on the Notification page "Notification → Notification Event → XMR Limit Exceed".

Figure: Configuration dialog for known offsets and limits.
4.1.1.8 IRIG Settings

Depending on the system configuration, the configuration of the incoming and / or outgoing time codes can be configured in this menu. There are three common time codes:

**IRIG**

B002+B122 – IRIG-B 100pps:
- DC Level Shift (DCLS), No carrier(DCLS),
- Time coding (HH,MM,SS,DDD)

Modulated, 1 kHz / 1 millisecond resolution,
Time coding (HH,MM,SS,DDD), Control Functions

B003+B123 as well as B002+B122, with second of day (0...86400)

**AFNOR NF S87-500**

AFNOR NFS 87-500 is a standardized French timecode similar to the IRIG code, but with additional information such as day, day of month and year.

**IEEE1344**

In addition to a two-digit year, the offset to the UTC time, the current daylight saving time status and announcements from the start and the end of the summer time, as well as information about an upcoming leap second are transmitted.

**Input Code:**
Configuration of the incoming IRIG / AFNOR / IEEE 1344 time code (MRS systems only).

**UTC Offset:**
If the applied timecode is impinged with a constant time offset to UTC, this time offset must be configured here, so that the clock can convert the received time to UTC.

**Output code:**
If the system has direct TC output options, you can set the parameters in this menu section.

**Time Scale:**
The output of the selected time code can be done with UTC or the local time. When "LOCAL TIME" is used, it refers to the configuration of the menu point "Time zone".
4.1.1.9 Serial Interfaces

Depending on the number and version of the system, the parameters for the serial interfaces can be configured in this menu.

**Baudrate:** The speed with which the serial telegram is to be transmitted:
- 300, 600, 1200, 2400, 4800, 9600, 19200

**Framing:** Structure of the telegram:
- 7E1, 7E2, 7N2, 7O1, 7O2, 8E1, 8E2, 8N1, 8N2, 8O1

**String Type:** Configuration of the time telegram to be sent.

**Mode:** You can configure an interval (per second, per minute, on request "?" Only) for the outgoing time string. If the operating mode is set on "Request", a connected client must send a "?" to receive the time telegram in response.

**Features:**

**MRS PPS Plus String**
If the system has the MRS "PPS plus string" option, the baudrate and framing for the incoming time string must be configured via this submenu.

**Meinberg Capture *only for specific units***
This option is for systems that have a cap input. The event is triggered by a negative edge.

Two operating modes are available for the output of the capture time stamps, "on request ? Only" and "automatically".

**on request "?" only**
The triggered events are stored in a buffer of the reference clock. As soon as a "?" is sent to the reference clock via a serial connection, the stored events are transferred from the buffer.

**automatically**
In this mode, the capture events are output directly on the serial interface.
4.1.1.10 Time Zone

In this menu, you can configure the time zones (offsets) for the output signals (IRIG, serial interface, programmable pulses) of the reference clock.

The data of the time zone are used from the time zone table (see chapter ?? System → Display).

4.1.1.11 Enabling the Outputs

Optionally, the outputs of the reference clock can be set to always supply a signal when the device is switched on, or only when the internal clock is running synchronously.
4.1.12 Programmable Pulses

If the system has programmable switching outputs, you can configure the parameters in this menu.

**Mode:** Output signal configuration.

**Pulse length (ms):** Pulse length configuration.

**Cycle:**

For "Cycle Pulse" mode, an interval can be configured in hh:mm:ss.

**Time:**

In the configured mode “Single Shot”, the time for the pulse can be parameterized in hh:mm:ss.

**DCF Suspend After (min):**

In the “DCF77 Marks” mode, you can configure a shutdown time for the output port, so that in the case of an asynchrony of the reference clock, no DCF mark is available at the output.

**On / Off Time:**

For the "Timer" mode, it is possible to configure start and stop times in hh:mm:ss.

**Signal:**

Configuration of the output signal active in high or low.

**Disable output in Holdover mode:**

If the reference clock is asynchronous, the output signal is immediately deactivated when the checkbox is activated.
4.1.1.13 Synthesizer

The output frequency and phase of the integrated synthesizer can be set here.

**Frequency:** Frequencies from 1/3 Hz up to 10 MHz can be set by entering four digits and a frequency range. By entering the frequency 0 Hz, the synthesizer can be switched off.

**Phase:** With phase you can enter the phase position of the set frequency in the range $-180^\circ$ to $+180^\circ$ with a resolution of 0.1. When the phase angle is increased, the delay of the output signal gets bigger. If a frequency higher than 10 kHz has been set, the phase cannot be changed.
4.1.1.14 Miscellaneous

This menu item displays specific options of the reference clock.

**Antenna Cable Length (m):**
The signal propagation time of the antenna cable can be compensated by this value. The received time grid is delayed by approx. 5ns / m antenna cable. This time error is automatically compensated by entering the cable length. The default value is 20m. The maximum input value should not exceed 500m.
GPS Simulation Mode:
This menu allows the user to operate the time server without an antenna. Normally, the NTPD loses synchronization when the antenna or the external reference source is disconnected (red FAIL LED is turned on). By activating the simulation mode, the corresponding status information for the NTPD is permanently set to SYNC. This also makes it possible to transmit other times, which have been entered via the menu item "Initialize the receiver", to the NTPD. In normal cases, the checkbox should remain empty. If this box is activated, the status "Simulation mode" is displayed under "Info of the receiver" in the main menu.
GPS Time Scale:
UTC  Coordinated Universal Time (including leap seconds which are continuously updated)


Log Satellite Visibility (GPS Receiver):
If this item is activated, a graphic is generated on which the constellation of the visible satellites are displayed.

SSM Quality Level in GPS Lock Mode:
If the system has E1 / T1 outputs, the quality level of the SSM can be configured here.

Satellite Navigation System Mode (GNS Receiver):
Depending on the receiver module type, you can configure different navigation satellite systems.

Distance to the Transmitter (km) - PZF / AM Receivers only:
In the menu item “Distance to the Transmitter” you can enter the transmitter distance in km, which is used for the delay compensation of the incoming PZF-signal. The adjustment of the distance should be made as precisely as possible, because it has a direct influence on the absolute accuracy of the time raster.

PZF Simulation Mode:
This menu allows the user to operate the time server without an antenna. Normally, the NTPD loses synchronization when the antenna or the external reference source is disconnected (red FAIL LED is turned on). By activating the simulation mode, the corresponding status information for the NTPD is permanently set to SYNC. This also makes it possible to transmit other times, which have been entered via the menu item “Initialize the receiver”, to the NTPD. In normal cases, the checkbox should remain empty. If this box is activated, the status “Simulation mode” is displayed under “Info of the receiver” in the main menu.
4.1.1.15 Initialize Receiver

Warm Boot Mode only for GNSS receiver:
This menu allows the user to switch the receiver to WARMBOOT MODE. This may be necessary if the satellite
data in the battery-buffered memory is too old, or if the device is operated at a location that is several hundred
kilometers away from the last operating location, since the calculation of the visibility of the satellites yields
incorrect results.

Cold Boot Modus only for GNSS receiver:
This menu allows the user to reinitialize all GPS system values, this means that all stored satellite data will
be deleted. Please note that the receiver takes about 15 minutes to read-in the information of the satellites
again, to complete the cold boot!

Coordinates (latitude, longitude, and altitude) *only GNSS receiver:
The absolute position of the GPS antenna can be entered here and can be sent to the GPS reference clock
with "initialize Position". This option is useful when the system is operated at a different location and if started
with the previously battery-buffered satellite data.

Time/Date:
With this function, the reference clock can manually be set to a specific date and time.
4.1.1.16 Receiver Information

This menu item lists all the important information and options of the reference clock.
4.1.1.17 Switch Card

The RSC (SCU) switch card is an automatic multiplexer for redundant systems with two Meinberg radio clocks. The card is used for the automatic switching of the pulse and frequency outputs as well as the serial interfaces of the connected clocks. The selection of the respectively active system is made, based on the state of the clock's generated TIME_SYNC signals, which show the synchronous state of the clocks.

In order to avoid unnecessary switching operations, for example during periodic free running of a system, the order of the active and the reserve system is exchanged at every change-over. For example, if the active system switches to the free running mode while the reserve system is operating synchronously, it is switched over to the synchronous reserve system. A reset to the old state occurs only if the now active system (formerly the reserve system) loses synchronization, while the reserve system (previously active system) operates synchronously. If both systems operate in the free-running mode, no changeover is made and the current state is retained.

4.1.1.18 Receiver Information Switch Card

This menu item lists all the important information and options of the switch card.
4.2 General GNSS Antennae

Some Meinberg devices use alternate GNSS receivers which support other satellite systems like GLONASS, Galileo or BeiDou, in addition to GPS. These receivers can’t be operated directly with the standard Meinberg antenna/converter unit described in chapter "Meinberg GPS Receiver", so they require a different kind of antenna.

There are two different antenna versions available, one of which is more suited for stationary installation, while the other one should be preferred for mobile applications.

4.2.1 GNSS Antenna for Stationary Installation

The Multi GNSS Antenna is an active GNSS antenna which can receive the signals of the GPS, GLONASS, Galileo and Beidou satellite systems. It is very well suited for stationary installations, operates with a 5V DC supply voltage provided by the receiver, and has an integrated surge protection.

The antenna cable length can be up to 70 meters if a H155 low-loss coaxial cable is used.

Mounting and Installation of the GNSS/L1 Antenna

![Diagram of Multi GNSS Antenna mounting]

**Figure: Schematic diagram of mounting the Multi GNSS Antenna**
**WARNING!**
Antenna mounting without effective anti-fall protection

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

**WARNING!**
Working on the antenna system during thunderstorms

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

The RV-76G is an active GNSS antenna which can receive the signals of the GPS, GLONASS, and Galileo satellite systems. It operates with a 5V DC supply voltage provided by the receiver, and should be preferred for mobile applications. However, the maximum length of the antenna cable is limited depending on the cable type, e.g. 5 meters with RG174/U cable, so this antenna is less suitable for stationary installations.

Figure: Installation drawing RV-76G antenna
4.3 Powering up a GNSS Receiver

If both the antenna and the power supply have been connected the system is ready to operate. Depending on the type of oscillator installed in the receiver it takes about 10 seconds (OCXO-LQ) until 3 minutes (OCXO-MQ / HQ) until the oscillator has warmed up and reached the required frequency accuracy.

If the receiver has some valid almanac data in its battery buffered memory and the receiver’s position has not changed significantly since its last operation the receiver can determine which satellites are in view. Only a single satellite needs to be received to synchronize and generate output pulses, so synchronization can be achieved at least one minute (OCXO-LQ) until 10 minutes (OCXO-MQ / HQ) after power-up. After 20 minutes of operation the OCXO is fully adjusted and the generated frequencies are within the specified tolerances.

If the receiver position has changed by some hundred kilometers since last operation, the expected satellites may not be in view after power-up. In this case the receiver switches to Warm Boot mode where it starts scanning for all possible satellites one after the other. Once the receiver can track at least 4 satellites at the same time it updates its own position and switches to Normal Operation.

If no valid data can be found in the battery buffered memory, e.g. because the battery has been disconnected or replaced, the receiver has to scan for satellites and collect the current almanac and ephemeris data first. This mode is called Cold Boot, and it takes at least 12 minutes until all required data have been collected. The reason is that the satellites send all data repeatedly once every 12 minutes. After data collection is complete the receiver switches to Warm Boot mode to scan for more satellites, and finally enters Normal Operation.

In the default configuration neither pulse and synthesizer outputs, nor the serial ports are enabled after power-up until synchronization has been achieved. However, it is possible to configure some or all of those outputs to be enabled immediately after power-up.

If the system starts up in a new environment (e.g. receiver position has changed or new power supply has been installed) it can take some minutes until the oscillator’s output frequency has been adjusted properly. In this case the accuracy of the output frequency and pulses is also reduced until the receiver’s control loops have settled again.

On the frontpanel (“Reference Time → Info GPS → GPS Satellites”) as well as via the Web GUI (“Clock → Receiver Information”) you can check the number of satellites that are in view (i.e. above the horizon) and considered good (i.e. are healthy and can be tracked).