TA-Series NTP Network Time Server

GNSS Antenna Installation Guide

Antenna Models Covered: TW3040

Ducument Number: T1211-01
28 January 2025

The latest version of this user guide can be obtained from TimeToolsLtd.com.

WARNING:

Comply with all health and safety standards when installing a GNSS antenna.

Do not work at heights without a fall protection device.

Do not install or maintain the antenna or cabling when there is a risk of lightning or electrical storms.

CAUTION:

Before installing and configuring any TimeTools NTP server appliance, please read the manuals and retain for future reference. Please follow all instructions and heed all warnings.

Full product documentation can be found at:
https://timetoolsltd.com/manuals/

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Revision History

Date	Doc. Rev.	Changes
28-Jan-25	T1211-01	Initial release.

1. Introduction

A good antenna, together with a good installation, is vital for getting the best performance from a GNSS receiver. This guide explains the requirements for the antenna and provides recommendations for a good installation.

TimeTools TA-Series NTP Servers have an integrated GNSS receiver. An external antenna provides synchronisation with global navigation satellite systems. GNSS solutions can be utilised anywhere in the world.

Ideally, the GNSS antenna should be roof mounted with a 360-degree unobscured view of the sky. The better the view of the sky, the more chance of a good consistent signal lock.

2. GNSS Antennas

A GNSS antenna receives the GNSS satellite signals and amplifies them for transmission along a coax cable to the receiver. The GNSS signals are spread spectrum signals in the 1575.42MHz ±10 MHz range and do not penetrate conductive or opaque surfaces. Therefore, ideally, the antenna should be located outdoors with a clear view of the sky.

TimeTools supplies the TW3040 permanent-mount GPS L1, Galileo E1 antenna with the TA-Series models.

The TA210 and TA310 models can receive GPS L1 frequency bands. The TA610 can concurrently, or selectively, receive GPS L1 and Galileo E1 frequency bands.

2.1. TW3040 Permanent-Mount GNSS Antenna

The TW3040 antenna is a professional grade, permanent mount GPS L1, Galileo E1 antenna, specially designed for precision timing applications. The antenna features a custom high-performance, wide band patch element, a 40dB gain LNA stage and a high rejection out-of-band SAW filter. It provides ±10MHz bandwidth centred on 1575.42 MHz covering the GPS L1 and Galileo E1 signals. It provides great axial ratio, excellent circular polarized signal reception, great multipath rejection and great out-of-band signal rejection.

The TW3040 is housed in a permanent mount industrial-grade weather-proof enclosure. It has a metal base with two nickel coated securing nuts. A TNC jack RF connector on the base of the antenna is provided for a coax cable connection.

2.2. TW3040 Dimensions

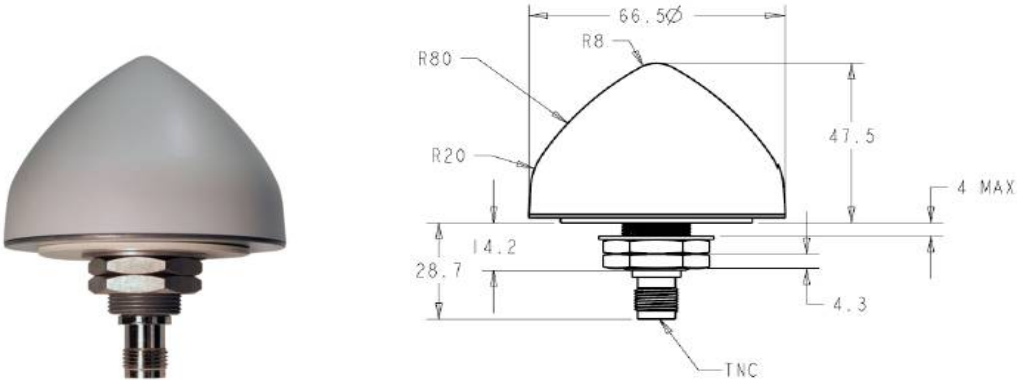


Fig. TW3040 Antenna and Dimensions. Dimensions (mm).

2.3. Mounting bracket (MT4-GPS)

TimeTools provides a mounting bracket for use with the TW3040 antenna. The bracket can be used to mount the antenna to a vertical surface such as a wall or fascia. The mount is also supplied with a 1.5” V-bolt, which can be used to mount the antenna to a pole or mast, if required.

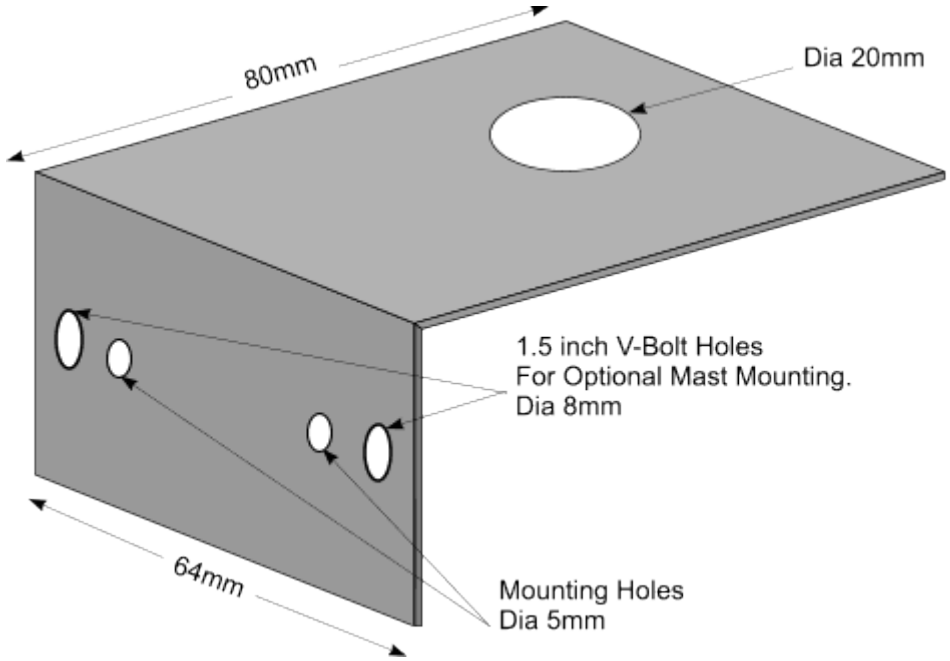


Fig. MT4-GPS Mounting Bracket – Supplied 1.5 inch V-Bolt Not Shown.

3. Antenna Placement

GNSS signals can only be received with a direct line of sight between antenna and satellite. Therefore, the antenna should be located where it can see as much as possible of the total sky.

More satellites orbit near the equator. Therefore, seen from the northern hemisphere of the earth, more satellites will be visible in the southern direction. The antenna should, ideally, therefore have open view to the southern sky. If the installation site is in the southern hemisphere, then more satellites will be visible in a northern direction. For installations near to the equator, satellites are visible directly overhead.

Avoid proximity with high power transmitters.

When installing multiple GNSS antennas separate them by at least 1 m.

WARNING:

Any local installation regulations for rooftop antennas in the country where the antenna is installed must be observed.

4. Antenna Cabling

GNSS antenna systems utilise coax cable and are sensitive to both cable type and length. Only coax cable and connectors with an impedance of 50 ohms and an operating frequency of at least 2 GHz should be used.

4.1. Connector Types

All TA-Series models are fitted with a TNC jack connector for connecting a GNSS antenna. The TW3040 GNSS antenna also has a TNC jack connector.

The optional Phoenix Contact CN-UB-280DC-SB surge suppressor has two N-Type connectors - one plug and one jack connector. This allows the suppressor to be easily linked-out, if required.

Only 50 ohm connectors with an operating frequency of at least 2 GHz should be used.

INFORMATION:

TNC and N-Type connectors are weatherproof when installed with glued shrink-wrap strain relief. However, adding additional protection using self-amalgamating tape is recommended.

4.2. Supplied Antenna Cables

TimeTools provides a 20m pre-terminated LLA195 cable for use with the TW3040 GNSS antenna and optional Phoenix Contact CN-UB-280DC-SB surge suppressor. The cable is provided in 2 segments to accommodate the CN-UB-280DC-SB surge suppressor. The first segment is 5m, the second segment is 15m.

The 5m segment is terminated with TNC plug and N-type jack connectors. The 15m segment is terminated with TNC plug and N-type plug connectors.

The TNC connectors attach to the TA-Series NTP server or GNSS antenna. The N-type connectors attach to the surge suppressor.

If a surge-suppressor is not required, the N-type connectors on the two cable segments can be linked together to form a continuous 20m cable.

INFORMATION:

Customised Antenna Cables to accommodate specific installation requirements are available on request.

Customers are free to source and utilise their own cables, if required, provided TimeTools recommendations are observed.

4.3. Typical Minimum and Maximum Cable Length

GNSS antenna systems utilise coax cable and are sensitive to both cable type and length. Only 50 ohm connectors and cable with an operating frequency of at least 2 GHz should be used.. The table below provides the minimum and maximum cable lengths for the recommended LMR type cables.

Cable Type	Minimum Cable Distance	Maximum Cable Distance
LMR195	10m	50m
LMR400	30m	130m
LMR600	45m	210m

Table: Minimum and maximum cable lengths for TW3040 antenna (supplied with TA Series NTP Servers).

4.4. Routing Cable

CAUTION:

Be careful not to damage cables. Take care to avoid sharp bends or kinks in the cable, hot surfaces (for example, exhaust manifolds or stacks), rotating or reciprocating equipment, sharp or abrasive surfaces, door and window jambs, and corrosive fluids or gases.

4.5. Coax Cable Minimum Bend Radius

Coax cables can be quite easily damaged. Bending, stretching and kinks in the cable can affect the characteristics of the cable.

Observing the minimum bend radius for a cable can be critical to the correct installation of coax cables. This is especially so if the cable passes through walls or other structures.

In order to maintain the specified characteristics of the coax cable, each cable type has a recommended minimum bend radius. As a general rule, the minimum bend radius is five times the diameter of the cable. For a list of cable types and there associated typical minimum bend radius, please see the table below.

Cable Type	Minimum Bend Radius
LMR195	13mm
LMR400	26mm
LMR600	39mm

Table: Typical minimum bend radius of common cable types.

An installer must take care to only use moderate force on the cable, especially when feeding cables through walls and other structures.

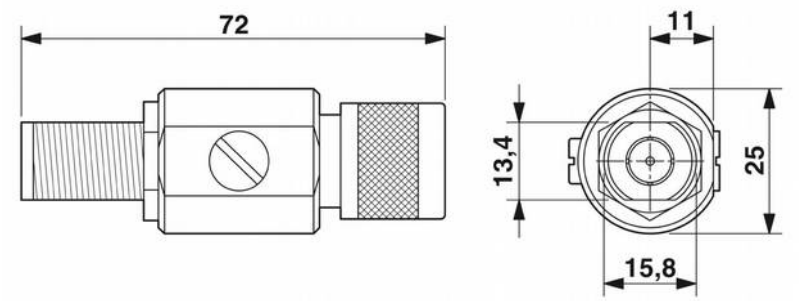
A particular weak spot is where the coax connector mates with the cable. Exerting force on the connector can not only damage the cable, but also damage the termination of the connector itself.

Where cable routing involves tight bends, it may be prudent to utilise a right-angle connector.

5. GNSS Antenna Surge Protection

Externally mounted antennas can be prone to lightning strikes and other electrical surges. The RF input of the TA-Series is ESD protected, but not protected against external, larger, over voltage peaks. In order to suppress higher energy levels from lightning and other surges, a coax surge suppressor is required.

TimeTools can provide a Phoenix Contact CN-UB-280DC-SB surge protection device for use with the TA-Series NTP Server.



GNSS Surge Suppressor (Phoenix Contact CN-UB-280DC-SB). Dimensions (mm).

5.1. Surge Suppressor Installation

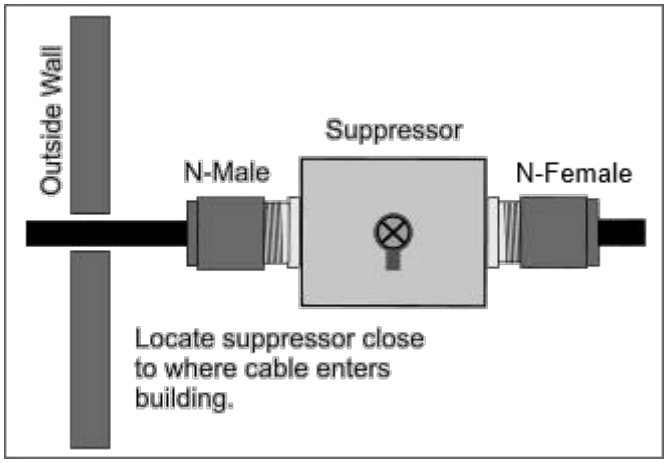
A surge-suppressor should be installed with all outdoor located antennas.

The surge suppressor provides surge protection and grounding of coax cables.

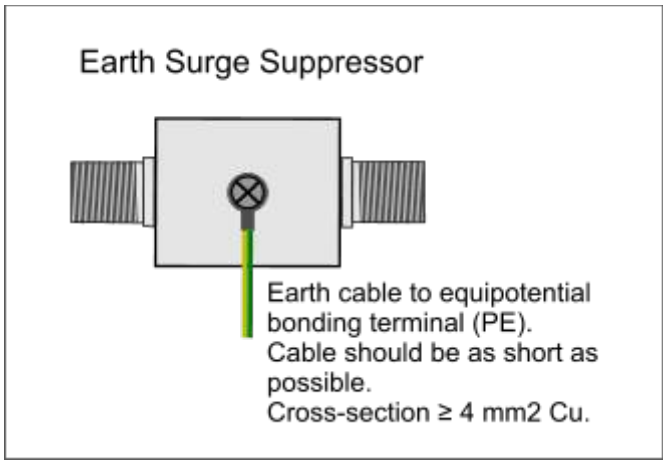
The Phoenix Contact CN-UB-280DC-SB surge suppressor is weather-proof. It is suitable for indoor or outdoor installation.

The surge suppressor should be fitted as close to where the coax cable enters the building as possible. Unprotected cables should not cross or be located near to other cables.

The Phoenix Contact CN-UB-280DC-SB surge suppressor has a N-type plug connector on one side and a N-type jack on the other. No specific orientation is required.



Ground the surge-suppressor by connecting it to an equipotential bonding rail. The bonding conductor should be as short as possible and have a cross-section ≥ 4 mm2 Cu.



For more information about installing surge suppressors, see the supplied manufacturers installation guide for detailed installation instructions and the Phoenix Contact web site at: https://www.phoenixcontact.com/.

WARNING:

Please refer to the surge suppressor manufacturers engineering specification and installation guide for further information on installation best practice.

5.2. Grounding Coax Cables

A surge-suppressor should be fitted to all outdoor located antennas.

If for any reason a suppressor is **NOT** fitted, then the coaxial cable shield must be grounded using a coax cable grounding kit. Most grounding kits clamp to an exposed section of the coax braid:

1. Select a straight cable section. Cut the cable sheath to expose a section of the coax outer braiding. Be careful to avoid damaging the coax braiding.

2. Remove the section of sheath. Clean the exposed coax outer conductor braiding to ensure a good electrical contact.

3. Open the contact clip of the Grounding-Kit carefully and place it over the the exposed braided outer conductor of the cable. Close the clamp and tighten the fixing screw. Ensure that the clamp tightly grips the coax outer braiding.

4. Fix the Grounding-Kit cable lug to an equipotential bonding terminal (PE). The DC resistance to the nearest point of equipotential bonding (PE) shall be lower than 5 Ω.

6. Typical GNSS Installation

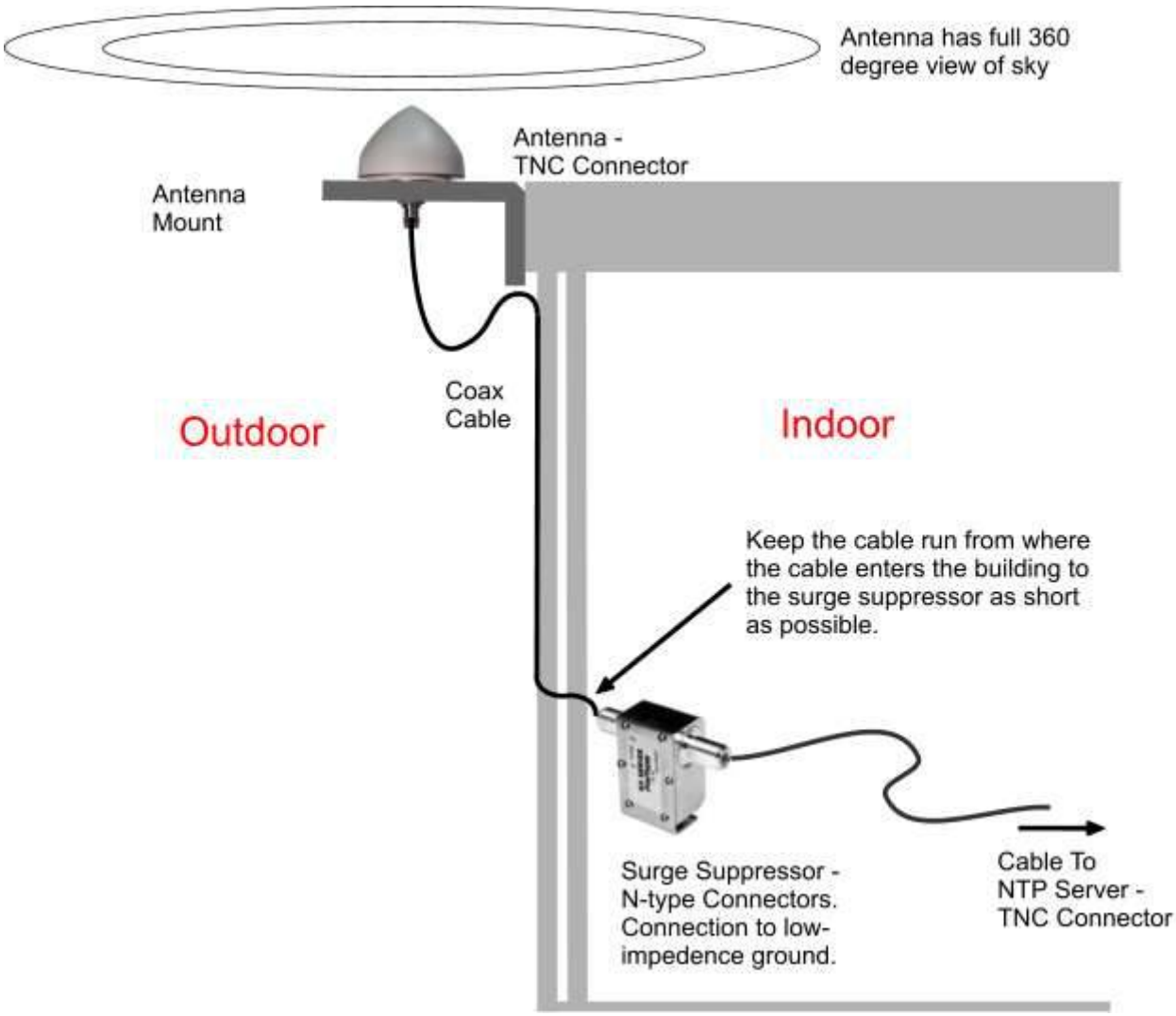


Fig: Typical Antenna installation

7. GNSS Receiver Signal Lock

At power-on, the TA-Series GNSS receiver will “search the sky” in order to collect satellite orbital information. This process is fully automatic and, under normal circumstances, will take 3-4 minutes to achieve a signal lock. Additionally, the receiver may need to download almanac information from the orbiting satellites, which can take a further 10-15 minutes. However, it can take much longer in challenging reception conditions.

INFORMATION:

A GNSS signal lock may take as long as 20-25 minutes, longer in challenging conditions.

7.1. Signal Lock Problems

GNSS Signal Reception Information

The TA-Series status and configuration web pages provides detailed satellite status information, useful for installation debugging. See the TA-Series user guide for more information.

Multipath-reflections

Multipath occurs when the GNSS signals are reflected by objects, such as metallic surfaces, walls and shielded glass for example. The antenna should not be placed near a wall, window or other large vertical objects if it can be avoided.

Jamming

Jamming occurs when the receiver function is disturbed by external RF sources that interfere with GNSS signals or saturate the antenna LNA or receiver front-end. A good indicator to detect jamming is switching off all other equipment except the GNSS. Watch the satellite signal levels in this condition. Then switch on other equipment and see if the signal levels go down. A drop of signal levels indicates interference to GNSS from the other equipment.

This method cannot, however, detect all possible kinds of jamming. Spurious events are hard to catch. Low frequency fields, like 50 Hz, are unlikely to jam the receiver. Broadband sparks are a potential source of spurious jamming. There's no general installation rule or specification though, because the effect of jamming highly depends on the nature of the jamming signal and there are uncountable many variations possible, so that it's not possible to standardize a test scenario.

8. Tips and Trouble Shooting

Provided a GNSS antenna has a good view of the sky, generally, a signal lock should be achieved within a few minutes. However, in challenging conditions, such as indoor antenna location, or if the antenna has a much reduced view of the sky, it can take much longer to acquire a signal lock. In such circumstances, TimeTools recommends that the device be left for around 1 hour after power-up in order to try to achieve a signal lock.

INFORMATION:

Check the TA-Series GNSS status web page – if satellites are listed and they have a high SNR (>35 dBHz), then leave the device for at least one hour until it obtains a signal lock.

If after 1 hour the unit has still not achieved a signal lock, here's a few things to check:

1. GNSS systems utilise the global positioning system, which is a constellation of satellites orbiting the Earth. Therefore, ideally, an antenna should have the best possible view of the sky – ideally, 360 degrees.

2. If the antenna is located indoors, metal structures can block the weak GNSS signals and prevent a signal lock. Ensure the antenna is mounted away from metal frames, structures or enclosures. Also, sun-dimmed glass contains metal flecks that reflect sunlight and also reflect GNSS signals which can cause problems.

3. Check the TA-Series GNSS status web page which provides detailed receiver status information, satellites currently in view along with their associated 'signal to noise' ratio and position in the sky.

4. If available, a volt-meter can be used to check that approximately 3.3 volts is present at the GNSS antenna connector between the inner pin and the outer shell of the TNC connector. If a voltage is not present, it indicates an open-circuit or short-circuit fault along the cable.

5. Check the cable and connectors for any visible signs of damage that may have occurred during installation, particularly where the cable has been fed through conduit or holes in walls.

6. If you have sourced your own cable and connectors, ensure that they are of the correct type and that cable is not too long or too short.