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USER MANUAL

TW5398
Smart GNSS Antenna High Precision Full Band with u-blox ZED-X20P

Date of Publication: November 26, 2025
Service Update: 1.0

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Calian GNSS Ltd.
175 Terence Matthews Crescent
Ottawa, ON Canada
K2M 1W8
Tel: +1-613-591-3131

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CHAPTER 1

Introduction

The TW5398 is a multi-band (L1/L2/L5/L6), multi-constellation integrated GNSS receiver/antenna with RTK, PointPerfect®-Flex (PPPRTK) augmentation. The TW5398 is capable of providing sub 1.2 meter accuracy stand-alone, sub 6 cm accuracy with PPP-RTK and sub 1 cm with RTK corrections (service or localized). TW5398 also authenticates Galileo OSNMA anti-spoofing messages. TW5398 can be configured to act as a base or rover for RTK operation. See **Figure 1**.

The incorporated GNSS antenna technology is based on the Calian TW3990XF full band Accutenna® antenna. Calian's eXtended Filtering mitigates out-of-band signal interference (LTE, WIFI, BlueTooth, Ligado) by employing multi-stage precipitous filtering, offering > 60 dB protection. The stacked, precision tuned, dual-feed ceramic patch increases multi-path resiliency by attenuating first order reflections. The Accutenna patch has linear phase response and tight phasecenter variation for better accuracy and excellent axial ratio.

TW5398 integrates u-blox's latest generation full-band ZED-X20P GNSS receiver. TW5398 supports GPS, BeiDou, Galileo satellites plus SBAS, NavIC and QZSS (configurable) across L1/L2/L5/L6 including L-Band. Integrated RTK support attains sub 1 cm precision with fast convergence times and high dynamic update rates (to 25 Hz).



Figure 1. TW5398 antenna

Integrating the GNSS receiver on the TW5398 with a short, deterministic signal path mitigates RF interference that can be induced between the antenna and the receiver, both from the external environment as well as high speed busses and other noise sources collocated in a host application. The ZED-X20P digital interface is presented to host systems via RS-232 or RS-422, allowing long cable lengths resistant to noise; alleviating design constaints and promoting plug and play, future-proof designs. Upgrade PNT sub-system capabilities by plugging in the next generation Smart GNSS antenna solution.

TW5398 includes jamming/interference and spoofing detection and monitoring. The device may be configured to generate event messages to alert the host system. In addition the TW5398 may be configured to support Galileo Open Service Navigation Message Authentication (OSNMA) offering enhanced detection of complex spoofing and delayed attacks, also known as meaconing or record-and-replay.

CHAPTER 2

Equipment Installation and Operation

This section provides guidance for the proper installation and operation of the TW5398 GNSS antenna system to ensure optimal performance and reliable positioning accuracy.

Correct installation orientation, secure mounting, and adherence to operating recommendations are essential for maintaining GNSS signal quality. Improper setup or handling may result in reduced performance, particularly in challenging environments.

Please follow the instructions carefully to achieve the best results in your deployment scenario. Comprehensive configuration information for the ZED-X20P integrated within the TW5398 is available in the ZED-X20P Integration Manual.

Details of the communication interface are provided in the X20 HPG 2.02 Interface Description.

Installation Considerations

The TW5398 is mounted using the integrated 19mm (3/4”) fixed mount feature. For optimal performance, the device should be securely mounted to a rigid surface with a minimum ground plane diameter of 10cm, included with Smart GNSS Antenna.

The antenna can be installed in any suitable orientation that supports optimal GNSS performance. Improper or loose mounting to the vehicle structure can negatively impact the performance.

When operating the receiver in the high precision RTK mode (cm precision), the antenna should be deployed only with the optimized ground plane (10cm) as provided. Deploying the antenna on large conductive surface such as the roof of a car or truck should be avoided as induced surface currents can generate phase center dispersion, reducing the precision of the solution. To overcome this effect, the antenna with a 10cm ground plane should be mounted approximately 5 cm above the large metallic surface, as shown below in **Figure 2**. In this example facilitated by using the Calian 23-0374-00 automotive mount.



Figure 2. Automotive mount

CHAPTER 3

Hardware Interface

The standard TW5398 is provided with a 5 m cable terminated in a RJ45 connector, as shown below in **Figure 3**.

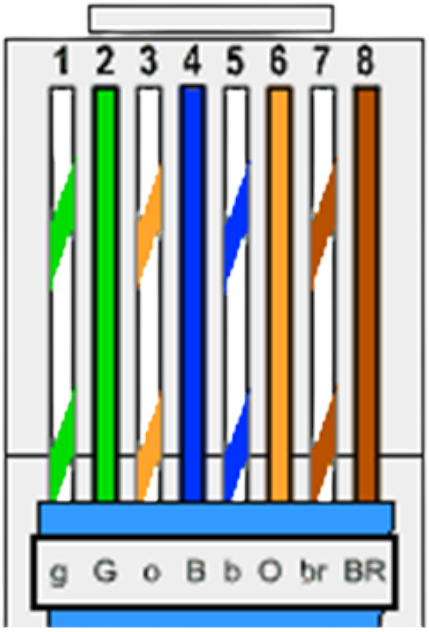


Figure 3. RJ45 connector

The following table details the pin assignments, signal functions, voltage levels, and wire colour codes for the TW5398 RS-422 model.

Table 3-1: TW5398 RS-422 (33-5398-09-10-05-PC0) Interface Pinout and Signal Description

Wire Colour	Signal	Notes	Pin #
Green/White	Differential TPB output	1PPS OUT (RS-485/RS-422)	1
Green	Differential TPA output	1PPS OUT (RS-485/RS-422)	2
Orange/White	Differential TXB output	TX Serial OUT (RS-485/RS-422)	3
Blue	Differential RXA output	RX Serial IN (RS-485/RS-422) (Terminated 120Ohm)	4
Blue/White	Differential RXB output	RX Serial IN (RS-485/RS-422) (Terminated 120Ohm)	5
Orange	Differential TXA output	TX Serial OUT (RS-485/RS-422)	6
Brown/White	Ground	0V	7
Brown	Power	5V	8

The following table details the pin assignments, signal functions, voltage levels, and wire colour codes for the TW5398 RS-232 model.

Table 3-2: TW5398 RS-232 (33-5398-69-10-05-PC0) Interface Pinout and Signal Description

Pin #	Description	Notes	Colour
1	1PPS_B	RS422 0-2V DC	White/Green
2	1PPS_A	RS422 0-2V DC	Green
3	RXD2	RS232 +/- 5V DC	White/Orange
4	TXD2	RS232 +/- 5V DC	Blue
5	RXD1	RS232 +/- 5V DC	White/Blue
6	TXD1	RS232 +/- 5V DC	Orange
7	GND	0V DC	White/Brown
8	PWR	5V DC	Brown

CHAPTER 4

Device Communication

Before proceeding to the connection steps, ensure that the appropriate drivers are installed on your PC as shown below, if a Calian 33-0095-xx serial to USB adaptor is used to communicate with the TW5398, as shown below in **Figure 4**.

Install Required Drivers

1. The VCP driver from Silicon Labs must be installed to communicate with the serial output when communicating with the TW5398 Smart GNSS Antenna via a Calian 33-0095-xx serial to USB adaptor.
   - Downloads for Windows, Macintosh, Linux and Android: HERE

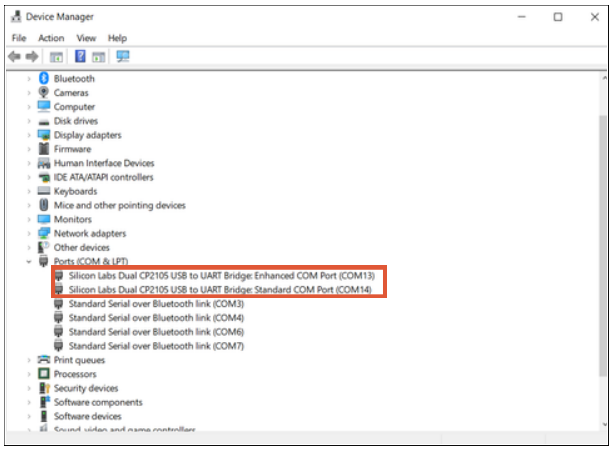


Figure 4. Device manager

Serial Port Connection (when using a Calian 33-0095-xx serial to USB adaptor)

1. **Connect** the TW5398 (RS-422 or RS-232 versions) to a Calian 33-0095-xx serial to USB adaptor (supplied with TP5398SDK or procured separately) via the RJ45 connector.
   - **Connect** USB cable supplied with the 33-0095-xx serial to USB adaptor to the adaptor with the USB type B connector plugged into the adaptor and the USB type A connector plugged into the PC.
2. **Open** Windows Device Manager to identify the specified COM ports, as highlighted in red above in **Figure 4**.
3. **Download** TruPrecision; see section **TruPrecision Application** within this manual.
4. **Download** Calian's u-blox Gen9 Configurator, see section **Evaluation Tools** within this manual.
5. **Select** the appropriate COM port for the TW5398 Smart GNSS Antenna in TruPrecision or Calian's u-blox Gen9 Configurator, as identified in **Figure 4**.

TruPrecision™ Application

The TruPrecision Windows application offers system integrators a streamlined solution for connecting the TW5398 antenna receiver to local or commercial corrections services, such as: u-blox PointPerfect, Point One Navigation Polaris, and Swift Navigation Skylark corrections. Install the TruPrecision Windows application.

The TruPrecision application offers the ability to:

- Configure the Smart GNSS Antenna.
- Connect to the specified augmentation service.
- Monitor and display operation status.

The following screenshot (see **Figure 5.** below) displays the configuration interface of the TruPrecision application. In this example, PointPerfect Flex is selected as the augmentation source. Configuration by the TruPrecision Application is reset to default settings unless specifically selected to be persistent.



Figure 5. TruPrecision configuration interface

Evaluation Tools

The TW5398 smart antenna is fully compatible with **u-blox's u-center 2** GNSS evaluation software, a powerful and user-friendly platform designed for evaluating, configuring, and monitoring u-blox GNSS receivers. See **Figure 6.**

u-center 2 provides a comprehensive graphical interface that allows users to visualize satellite constellations, monitor signal quality, and configure advanced receiver features such as dynamic models, NMEA message outputs, augmentation settings, and sensor fusion parameters. It is particularly well-suited for developers, system integrators, and field engineers working with high-precision GNSS solutions.

A Windows compatible version of the evaluation software is available at the following link: u-blox | u-center 2 GNSS



Figure 6. u-blox | u-center 2 GNSS evaluation software

Simplified Configuration Tool

The TW5398 includes onboard flash memory to store custom configuration settings. These settings can be modified over the serial link.



CAUTION: Storing invalid configuration settings may cause the TW5398 to become unresponsive or inoperable.

The Calian uBlox Gen9 Configurator is a specialized tool for configuring advanced aspects of a uBlox receiver integrated into a Smart Antenna. Download the TW5398 Simplified Configuration Tool to assist with configuration.

Please contact Calian GNSS for assistance regarding factory programmed custom configuration requirements.

Developer References

The TW5398 incorporates an all-band, all-constellation GNSS receiver, delivering best-in-class positioning accuracy and availability across diverse environments. Powered by advanced RTK, PPP-RTK, and PPP algorithms that push the limits of GNSS performance, it provides the highest quality GNSS raw data for precise processing. In addition, u-blox end-to-end hardened security ensures reliable protection against signal manipulation and data vulnerabilities throughout the entire solution.

The u-blox X20 all-band high precision GNSS module for the TW5398 antenna is shown below in **Figure 7**.

Detailed protocol specifications for the TW5398's GNSS receiver engines, developed by u-blox, can be found here: ZED-X20P module specifications

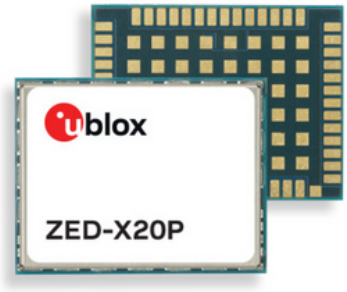


Figure 7. u-blox ZED-X20P

CHAPTER 5

TW5398 Mechanical

The TW5398 antenna assembly contains the following essential components (see **Figure 8.** below):

- TW5398 receiver Antenna with 5 Meter cable and RJ45 termination.
- Two 0.75" (19mm) panel nuts.
- One metal washer.
- A rubber gasket installed on the lower side of the TW5398.
- Aluminum Ground Plane (PN: 23-0067-0). (Not shown in diagram)
  NOTE: Ground Plane should be installed between the rubber washer and the steel washer.

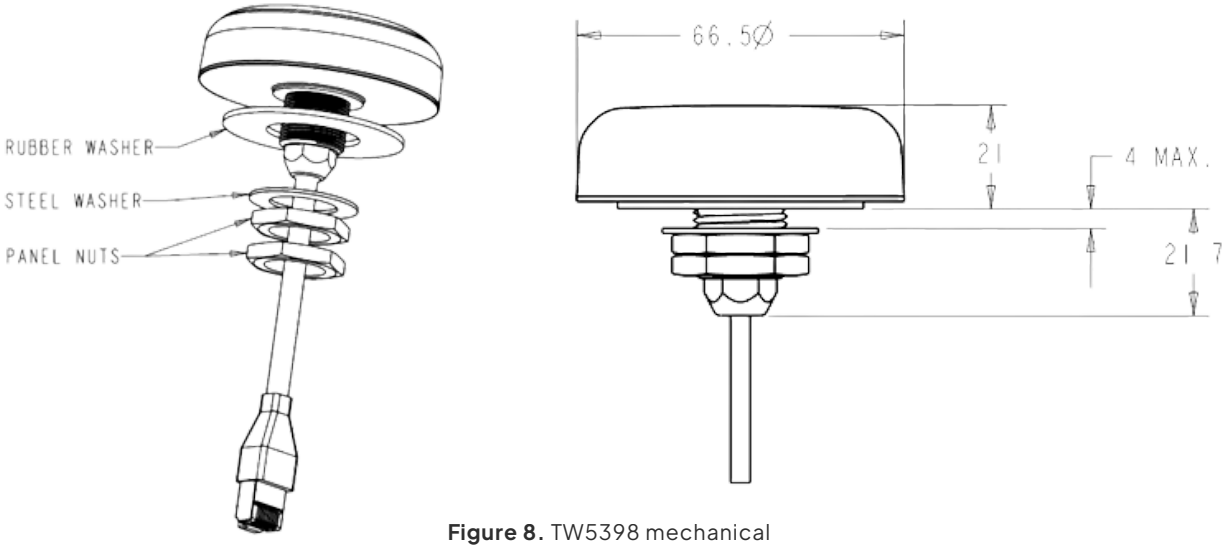


Figure 8. TW5398 mechanical

Calian Headquarters – Ottawa

175 Terence Matthews
Crescent Ottawa, Ontario
Canada K2M 1W8

E: INFO.GNSS@CALIAN.COM
T: +1 613-591-3131

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WWW.CALIAN.COM/GNSS