# PTP Testing with xGenius: Utility Profile

xGenius optionally supplies IEEE 1588 version 2, also known as *Precision Time Protocol (PTP)*, emulation and analysis features. This document focuses in the tests to be done in the application end, where the PTP slave is installed. It is assumed that the IEC 61850-9-3 PTP profile (Utility profile) is used. The clock reference used is derived from GNSS.

1. SETTING UP THE REFERENCE

xGenius may be equipped with a built in GNSS receiver. These units have a SMA female connector suitable for connecting an antenna. Units with the built in GNSS receiver are also supplied with a compact antenna with 5 m of coaxial cable plus a 10 m extension cable. Using a different antenna is possible as long as the specifications of the GNSS module are taken into account. To use the built in GNSS module follow these steps:
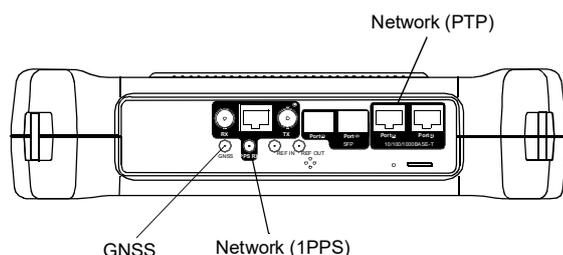
Figure 1 *Albedo xGenius test and clock reference interfaces used in this testing scenario.*

1. Attach the antenna to the unit. Make sure that the antenna sees as much of the sky as possible. The unit may fail to achieve synchronization if there are not enough satellites in sight. Some tests may loss accuracy if the number of satellites in sight is reduced.

2. From the *Home* panel, go to *Config*, The port setup panel is displayed.

3. Go to *Reference clock*.

4. Configure *Input clock* to *GNSS*.

5. Press *LEDS* to display the test status.

6. Wait for the REF and LOCK LEDs to become green.
   Note: The locking process for the OCXO version of xGenius may take around 10 minutes. The coarse locking process in Rubidium units requires around 20 minutes.
   Note: Both Rubidium and OCXO versions of xGenius are ready for testing once the LOCK LED is green but Rubidium units are not yet prepared to supply their maximum accuracy. These units go to a *Fine locking* status before being fully *Locked* to the reference. The *Fine locking* status may last for around four hours in Rubidium units. OXCO units do not have fine locking status and they go directly to the *Locked* when they finish the coarse locking procedure. The user could check the current locking status (*Locking*, *Fine locking*, *Locked*, *Holdover*, etc.) from the *Oscillator* menu in the *Reference clock* menu.

Configuring the GNSS Properties

The user could optionally configure the GNSS interface in the test unit. Despite being not mandatory, the increase in accuracy it could be obtained in this way is quite important. This is the required procedure:

1. From the *Home* panel, go to *Config*, The port setup panel is displayed.

2. Go to *Reference clock*.

3. Go to *GNSS receiver*.

4. Configure a compensation for the antenna cable through the *Antenna delay correction* field.

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5. Enable or disable any of the *GPS, GLONASS, Beidou* or *Galileo* constellations through the *Active GNSS* setting.

6. Go to *Fixed-position mode*.

7. Adjust the *Position averaging time* and enable position averaging by configuring *Fixed-position mode* to *Auto-average*.
The *Fixed-position status* field now displays *Averaging*
Note: At least one hour of position averaging is required for a reasonable accuracy.
Note: The position averaging procedure should be run only once as long as the test unit geographical location is not changed. The unit checks any change in position (longitude, latitude, altitude) every time it is connected to a GPS antenna. If a change in the coordinates is detected, then an error message is displayed in the status field and the mode is disabled.

8. Wait to the *Fixed position status* to become *Active*. The unit is now ready for testing.
Note: Theoretically, testing could start before the end of the position averaging process. The improved time estimation due to this function would be automatically applied starting from the end of the auto-averaging process.

2. PTP TEST

xGenius can be configured to behave as PTP slave clocks. There is no difference between any standard PTP clock and these equipments but the testers supply measurement results that are useful to qualify the stability of a PTP timing source.

In the pseudo-slave emulation mode the equipment behaves as a PTP slave but keeping an independent synchronization source that enables the unit to compute TE and other performance metrics based on the comparison of the test signal phase and frequency with the clock reference input. The following description assumes that the equipment is configured with the factory defaults.

Connecting the Unit

Connect the Port A RJ-45 port to the network in the same interface where DUT is connected and follow these steps to enable the Ethernet transport in the port:

1. From the *Home* panel, go to *Config*,
The port configuration panel is displayed.

2. Select *Mode* to enter in the mode selection menu.

3. Choose *Ethernet endpoint* and confirm by pressing ENTER.

Configuring PTP

Follow this procedure to enable the IEEE 1588-2008 protocol in test port A. It is assumed that most simple test port configuration is used (1000BASE-T interface, no VLANs) and hence no port specific configuration is required.

1. From the *Home* panel, go to *Test*,
The test configuration panel is displayed.

2. Go to *PTP (IEEE 1588)*.

3. Configure the equipment to become an IEEE 1588 pseudo-slave by configuring *PTP mode* to *Test*.
A label with the text PTP is displayed in the top notification area.

4. Configure *Path delay mechanism* to *Peer-to peer*.

5. Configure the timing of the different messages associated to PTP from the *Message timing* menu: *Sync TX interval* must be set to *1 pkt/s*, *Peer Delay Request TX interval* to *1 pkt/s*, *Announce TX interval* to *1 pkt/s*, *Announce RX timeout (#msgs)* to *3*.

6. Configure the *Domain* to the right value for your network.

If the previous settings are correct, the *PTP* indication in the top of the screen will change from yellow to green and the *S* indication will be displayed next to the *PTP* label.

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Running the Test

Te test is now ready to start. Press *RUN* in the test unit to do that. Now the TE and MTIE / TDEV are computed in real time. To check the TE results follow these steps:

1. From the *Home* panel, go to *Results*,
   The test port results panel is displayed.

2. Select *Port A* to enter in the port specific results.

3. Enter in *PTP* to display results about the PTP protocol.

4. Go to *Time Error statistics* to get the 2-way TE results.

5. Check the maximum and minimum values of *Total*, *Low frequency* and *High frequency* TE and check that these are under the limits defined in IEC 61850-9-3.
   Note: For a PTP grandmaster, the IEC 61850-9-3 limit is 250 ns. Each BC adds up to 200 ns and each TC adds up to 50 ns

To stop the TE test press *RUN* a second time at any moment.

3. 1PPS TEST

TE test results are available either from the Ethernet / IP output (PTP test) or in a frequency / time output from the PTP slave.

In xGenius, monitored signals include both frequency (2048 kb/s, 2048 kHz, 1544 kb/s, 1544 kHz, 10 MHz) and time (1 PPS, IRIG-B and ToD). The performance metrics in these interfaces are similar to that in Ethernet / IP ports. The TE definition for packet interfaces can be reused with almost no modification. This example assumes that the clock signal is 1 PPS over unbalanced (SMA) interface.

Connecting the Unit

Connect the Port C SMA port to a T-TSC clock output and follow these steps to enable the 1 PPS clock analysis in the port.

1. From the *Home* panel, go to *Config*,
   The port configuration panel is displayed.

2. Select *Mode* to enter in the mode selection menu.

3. Choose *Clock monitor*.

Configuring the Port

1. From the *Home* panel, go to *Config*,
   The *Setup* configuration panel is displayed.

2. Select *Port C* to enter in the port specific configuration menu.

3. Configure *Clock frequency* to *PPS (Port C)*.

4. Configure the *Connector* to Balanced to use the Port C RJ-48 test interface or *Unbalanced* to use the Port C SMA interface.

Configuring the Test

Once the 1 PPS clock interface is configured, the user still has to configure the tests to be run. In this setup this is the MTIE / TDEV test. To enable this test, the correct procedure is as follows:

1. From the *Home* panel, go to *Test*,
   The test configuration panel is displayed.

2. Go to *Wander test.*

3. Enable the test by setting the *Mode* control to *MTIE/TDEV*.

Running the Test

Te test is now ready to start. Press *RUN* in the test unit to do that. The test results are computed by the test unit in real time and they can be checked at any moment in the following way:

1. From the *Home* panel, go to *Results*,
   The test port results panel is displayed.

2. Select *Port C* to enter in the port specific results.

3. Go to *Wander*.

4. Go to Wander analysis.

5. Check the *TE*, *Min. TE*, *Max. TE*, *Offset*, *Max. offset*, *Drift* and *Max. drift* results.

To stop the test press *RUN* a second time at any moment.