GSA.30

GPS Acquisition & Tracking Sensitivity

Outcomes and Deliverables

- Measurement of Conducted Receiver Sensitivity.
- Measurement of Radiated Receiver Sensitivity (acquisition and tracking).
- Comparison of Radiated Receiver Sensitivity to Reference Devices.
- A High Sensitivity Spectrum Analyzer Sweep of the GPS bands.
- Recommendations to maximize performance.
- Technical Report detailing all test results.

Duration

2 weeks (this is a typical estimated duration – actual duration on quote may differ).

What We Need

- 2 fully functioning samples.
- Instructions for operating device.

What is the problem or concern we are addressing?

GPS receiver systems are unlike any other consumer radio product. These devices are more sensitive to RF energy than any other product in general consumer use. This makes them highly susceptible to interference from even the smallest radio signals given off by any modern electronic device.

It's important to clarify that simple unintentional radiator testing done as part of FCC, CE or PTCRB testing isn't sufficient. A device can easily pass those test suites and have poor GPS performance due to interference. Like any other part of a new product the GPS system implementation needs to be properly tested. Design Verification Test (DVT) for a GPS is similar to any other radio receiver except the expected signal levels are much lower.

GPS can't be tested repeatably outside. The signal strengths of the real satellites are constantly changing as they move through the sky and will be different at every location. The goal of DVT is to directly measure the radiated receive sensitivity of the GPS receiver to ensure the product functions properly. This requires a repeatable and controlled test setup, including isolation from the real GPS system. Taoglas provides controlled, repeatable radiated receiver sensitivity measurement on a GPS device.

GPS DVT needs a GPS constellation simulator, anechoic chamber and a skilled and experienced RF engineer to perform the testing to ensure consistent results. Taoglas has years of experience with integration of antennas and radio systems as well as the special equipment to make the measurements quickly and efficiently. We find that unless a customer is in the GPS business, these special tools can be cost prohibitive to have in-house, so Taoglas offers this testing as a service to our customers.

This service offering is not intended to measure passive performance or field testing of the GPS antenna. Taoglas offers a separate service product for these measurements. It is important to separate this testing to ensure each part of the system is measured and optimized in a controlled way.

The Process

Part 1 – GPS In-Chamber Measurements

- Taoglas will use our GPS constellation simulator and anechoic chamber to measure conducted tracking sensitivity.
- Taoglas will modify a unit and measure the antenna passively on a VNA to determine the return loss. This will confirm that the antenna integration into the product has been done correctly.
- Taoglas will use this same modified unit and a spectrum analyzer to capture a high sensitivity sweep of the signals received by the GPS antenna in the GPS band and surrounding frequencies with the

device fully powered and running. This is done to isolate any noise from the board.

- Taoglas will then use our GPS constellation simulator and anechoic chamber to measure radiated tracking sensitivity. Using the substitution principal and the measured path loss from the network analyzer measurement we can measure the signal strength at the output of the GPS antenna, which is normally the input of the GPS receiver.
- If a comparison with the development board for the GPS chip/module is desired, Taoglas will make conducted and radiated measurements on that dev board as well.
- Taoglas will compare this sensitivity data to previously measured devices, the dev board if present and the GPS solution's data sheet to compare the performance and recommend further actions as necessary.

What does Taoglas need?

In all cases Taoglas will require two complete functioning devices. The devices need to be functional enough to enable the GNSS modem and enable AT command access to the modem. The devices should include as many of the final components as possible. Batteries, displays, and metallic sub-assemblies will impact the test results and should be included.

One complete set of any support devices such as spare battery packs, battery charger, interface cables, etc.

Instructions on how to connect the device, power on the device, and connect to the AT command interface, if applicable. If the battery will need to be charged or replaced, include instructions on how to do so.

The product must output NMEA strings to a COM port on a Windows PC. Taoglas has adapters for USB, Ethernet and DB9. The DB9 adapter is typically used for RS-232 or logic level UARTs. Once outside the box, the test PC has USB, Ethernet and RS-232 physical interfaces. If the device is using USB or Ethernet, you must provide any software required for the device's GPS port to show up as a logical COM port in Windows.

It is critical that the GPS receiver power up when power is applied to the device, that the host processor not talk to the GPS receiver or take any other action that affects the GPS receiver during testing. Testing can take several hours.

Your firmware should support delivery of NMEA messages for GNSS. If you want the device compared to the GPS module's development kit, you will need to provide the development kit sample. Taoglas will require written instructions on how to connect the cables, power the device, charge the battery, and configure the device (as required).

We require any 3D CAD and 2D design files you may have. We require these files to do cross sections, hide components and make accurate measurements. We accept a variety of 3D files formats, but STEP files are preferred.

We also require any documents you have relating to the PCB of the device. These documents should define the PCB stack-up, later thicknesses, materials and finishes for the PCB. A bill of materials for each PCB is also recommended. Ideally these files should be native Altium files.

Circuit schematics of all the PCBs in your device are also required. This is to better understand the RF paths in your design. Once again, these files should ideally be native Altium files.

Part 2 – Reporting

From the test data, your engineers will be able to determine if the GPS is performing within a reasonable range compared to the comparison devices. If the GPS performance is reasonable and the GPS antenna performance (separate test) is reasonable, no further effort is required.

If the GPS performance is not in an acceptable range, a mitigation effort will be required to improve performance. The data taken during this testing is necessary and sufficient to guide that mitigation effort. Testing any changes made to the device will require the same equipment used for this testing.

Taoglas will support your engineering team by repeating the radiated sensitivity portion of this testing as needed to measure changes in performance from their mitigation efforts. The results will be added as an appendix to the original report.

Part 3 – Next Steps

Taoglas offers a number of services which would typically follow on from this service. These services are intended to optimize the RF performance and maximize likelihood of certification for your design.

These services include:

- **GSA.40:** GNSS Field Testing
- **CSA.70:** Failure Mode Mitigation
- **CSA.20:** Passive Antenna Testing, Matching and Fine Tuning

Visit Taoglas Website or contact Taoglas sales for further information.

Please note - devices, systems and equipment falling within the scope of Annex I of the EU Dual Use Regulation 821/2021 are not eligible for this service. For queries, please consult your legal department or contact exportcompliance@taoglas.com.