Minimizing Interference in Simultaneous Operations between GPS and Other Instrumentation Systems

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Background

- **Most airborne vehicles (e.g. missiles, planes, target drones) carry multiple instrumentation systems**
  - **GPS**
  - **Telemetry**
  - **Flight Termination**

- **Issue with RF interference between these systems**

Steps to minimize interference between GPS & TM systems

- **Determine GPS minimum sensitivity**
  - **Minimum input power to not cause interference (P_{min})**
  - **GPS Receiver manufacturer specification sheets**

P_{min} = Min. acq. level – Min acq pwr req – Margin
(dBm) (dB-Hz) (dB)

Min. acq. level- Minimum RF level needed for acquisition

Min acq pwr req- Minimum input level needed for acquisition

Margin- Operational margin (usually 10 dB)

Steps to minimize interference between GPS & TM systems

- **Determine items needed to achieve GPS minimum sensitivity**
  - **Measurement of Transmitter and Antenna properties**

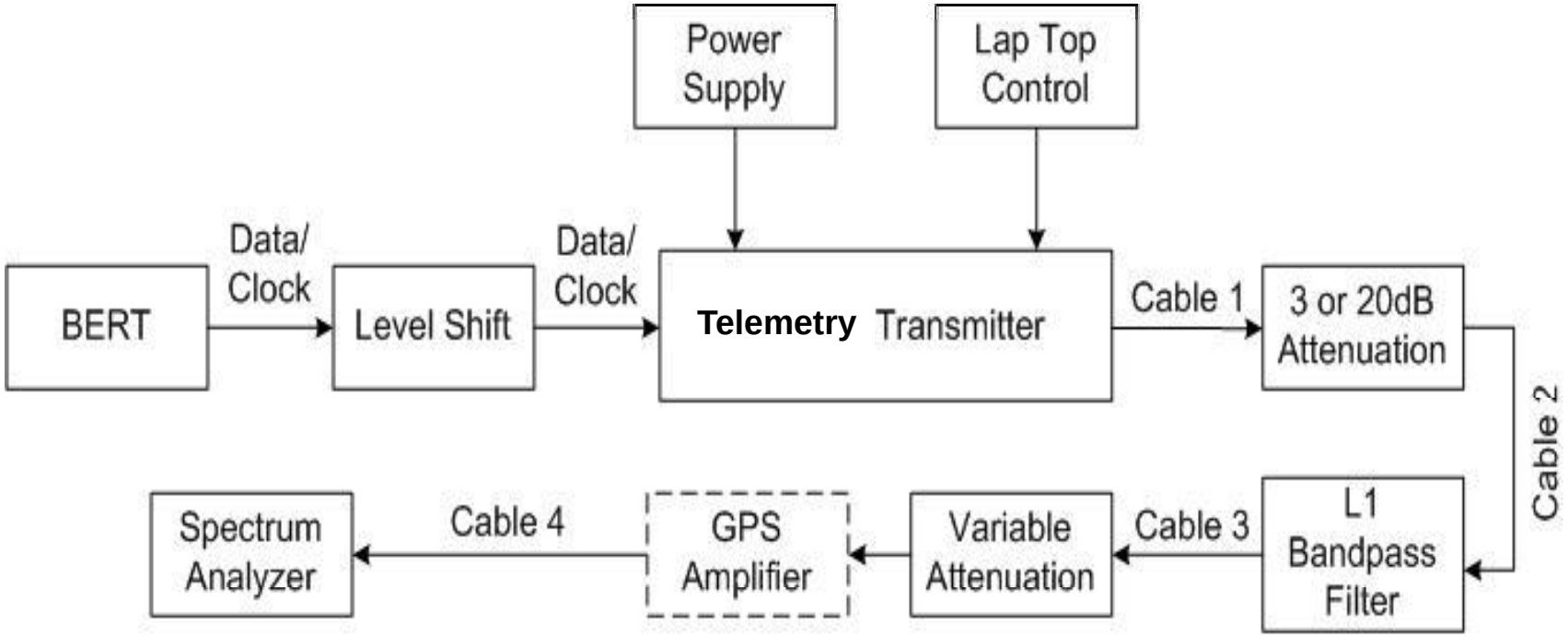
$$P_{min} = \underset{(dBm)}{\text{GPS AN}} - \underset{(dB)}{\text{Antenna Iso}} - \underset{(dB)}{\text{Filter Attn}}$$

GPS AN- Worse Case GPS Additive Noise from Transmitter

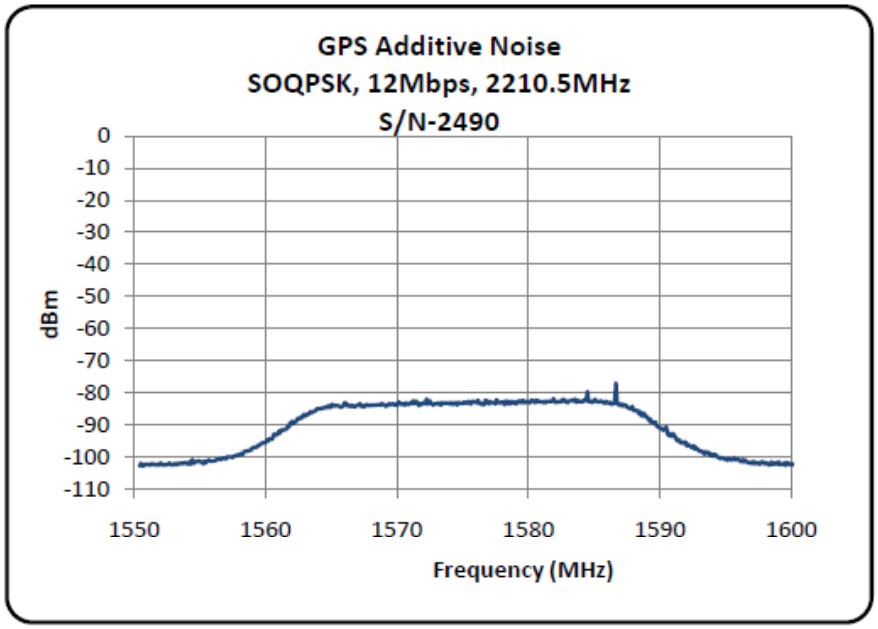
Antenna Iso- Isolation between antenna systems (determined by measuring with Network Analyzer)

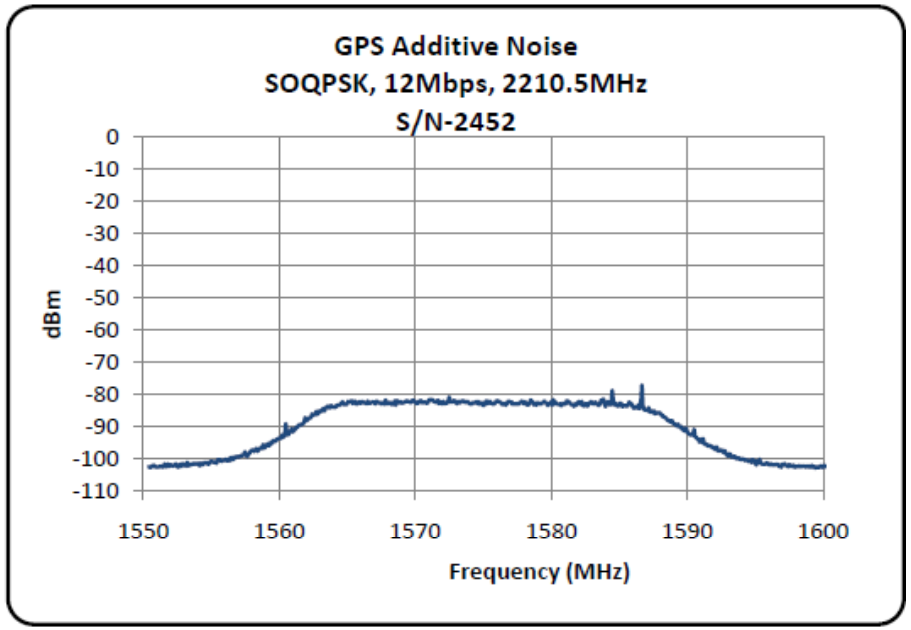
Filter Attn- Bandstop Filter for GPS spurious emissions from TM transmitter (used as design parameter)

GPS Additive Noise Test Setup

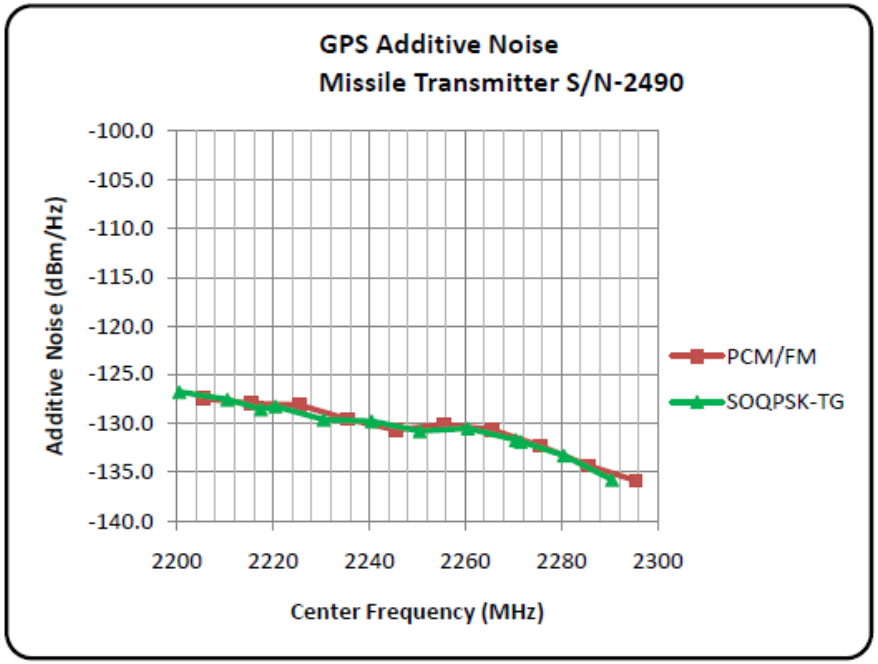


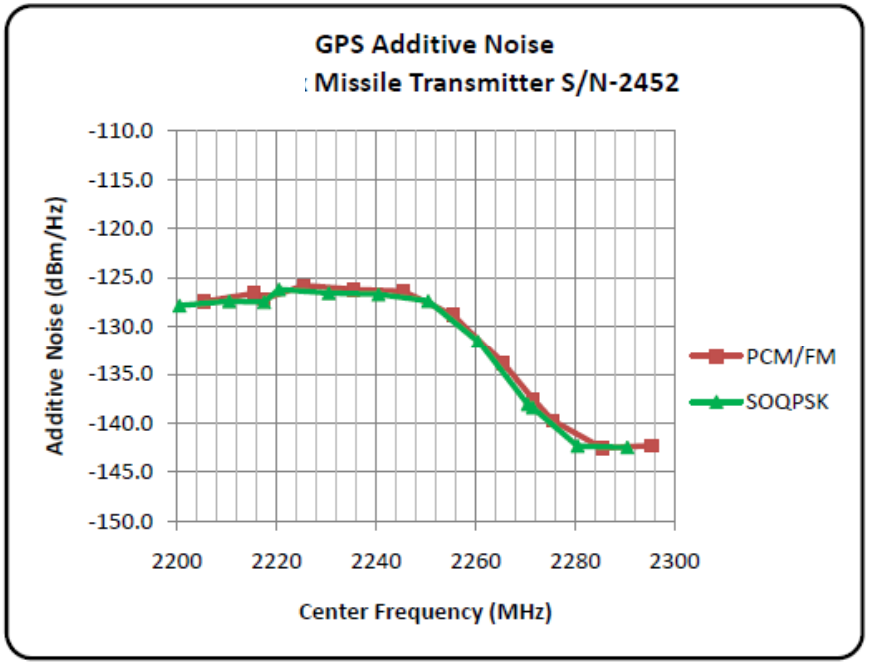
GPS Additive Noise Results (con't)





GPS Additive Noise Results





Example Calculation

- **Using the spec for a sample GPS Receiver and a 10 dB margin, we get the following:**

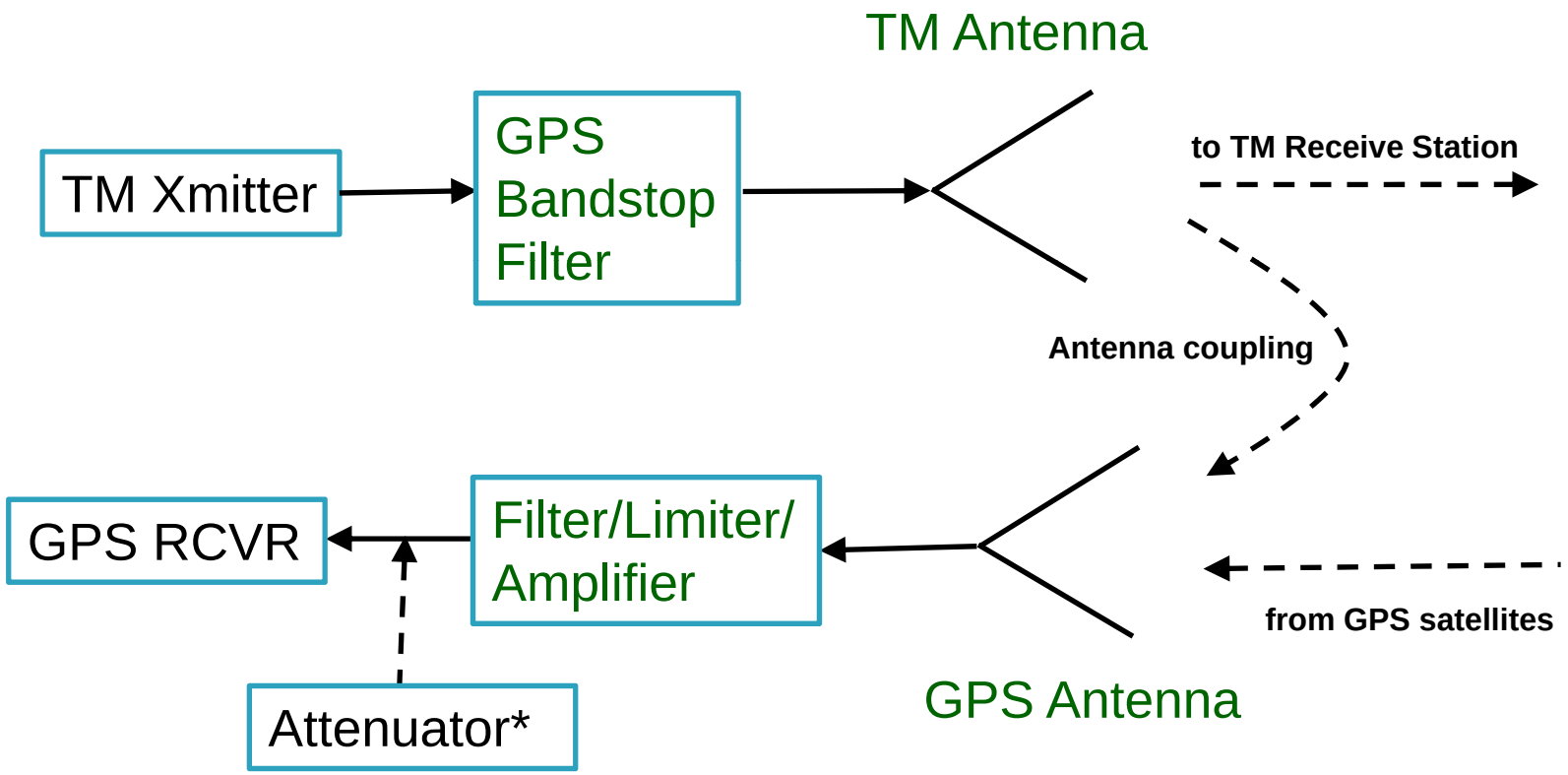
  P_{min} = -137 dBm - 35 dB - 10 dB = -182 dBm

- **Next using the measured data for GPS Additive Noise (-125 dB) and the Coupling between antenna system (25 dB)**

  P_{min} = -125 dB - 25 dB - Filter Attenuation

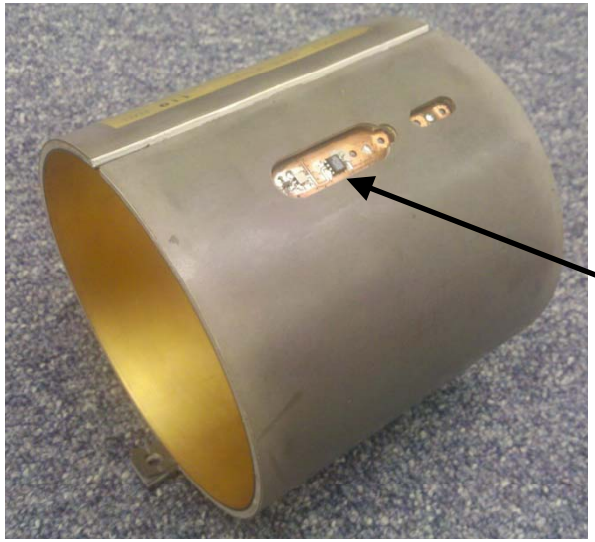
  Thus the Bandstop Filter on the TM transmitter output needed to filter out the spurious emissions is 32 dB.

Final Configuration



* Attenuator may be needed to prevent GPS Receiver from being swamped out by excessive gain of the Low Noise Amplifier

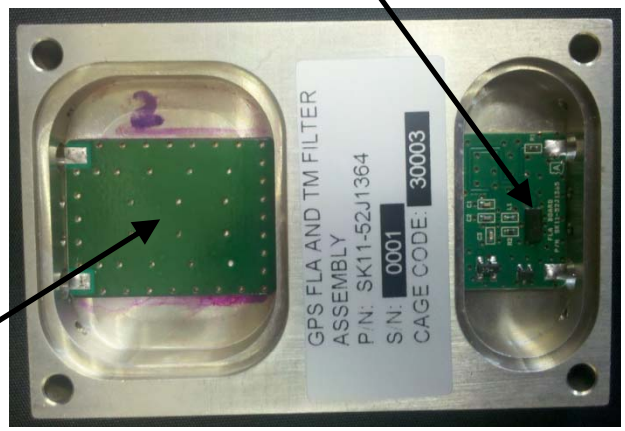
Filter/Limiter/Amplifier (FLA) Options



FLA integrated into conformal wraparound antenna

Low noise amplifier

External FLA Box



GPS Bandstop filter

Summary

- **All instrumentation system designers should use this process to prevent RF interference between GPS and Telemetry systems**

- **All that is needed are the following:**
  - **GPS Receiver specification information**
  - **Measurement data**
    - Transmitter GPS Additive Noise
    - Antenna Coupling between systems

Would like to acknowledge Kip Temple (Edwards AFB) for his support with the GPS Additive Noise Transmitter Testing.