



GPS Patch Antenna Considerations



Advanced Material On TECHNOLOGY

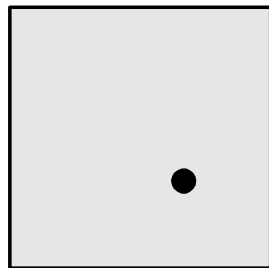


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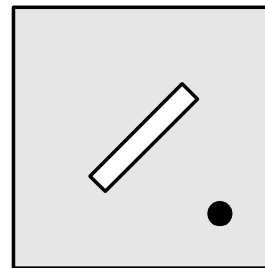
- n Antenna Element
- n Impedance and Resonant Frequency
- n Axial Ratio
- n Voltage Standing Wave Ratio (VSWR)
- n Bandwidth
- n Result of Measurement

Antenna Element

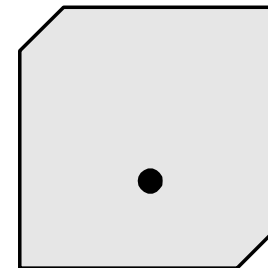
- n The antenna's size and shape
 - n compact size using ceramic material
 - n RHCP(Right Hand Circular Polarization) patch



Offset fed
rectangular patch



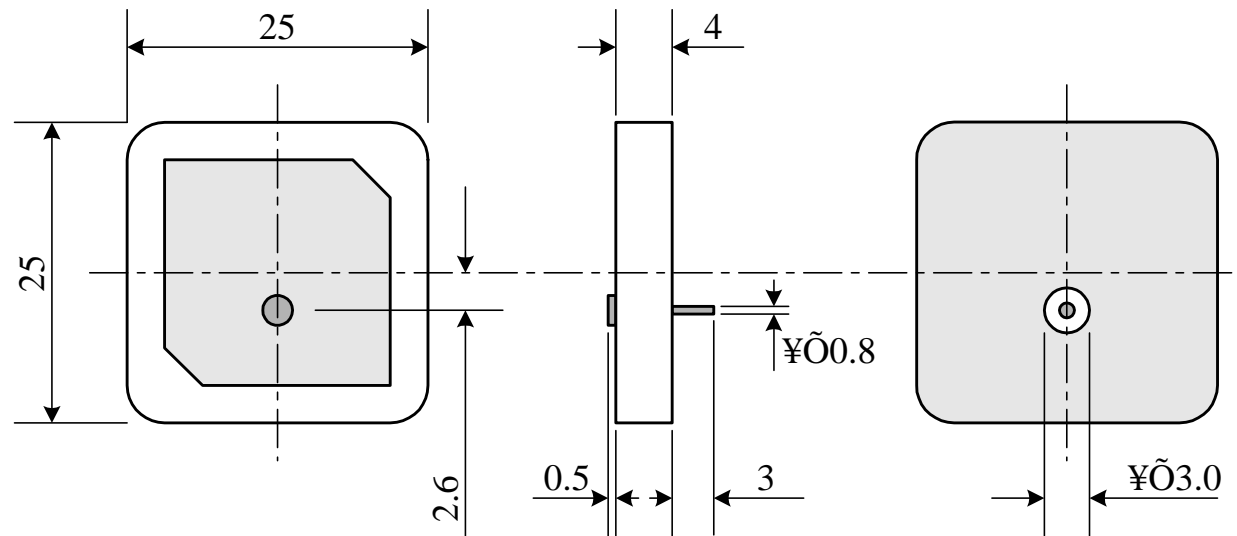
Slotted square
patch



Truncated corner
square patch

Antenna Element

n AMOTECH - GPS Patch Antenna



- n compact size : 25mm × 25mm × 4mm
- n excellent temperature stability
- n (silver plated) truncated corner square patch



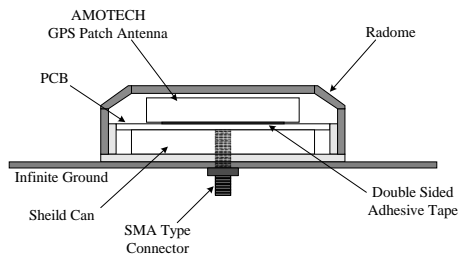
Impedance and Resonant Frequency

- n An antenna's impedance depends on many factors :
 - n how it is constructed,
 - n how it is fed,
 - n and to some degree, the surrounding environment
- n A microstrip patch antenna placed in a plastic enclosure (radome), for example, can have its resonant frequency shifted downward by several MHz, depending on
 - n the thickness of the radome
 - n its dielectric constant
 - n and the distance between the antenna face and inner radome.

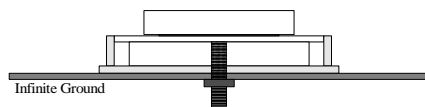
Impedance and Resonant Frequency

n Radome effect on resonant frequency

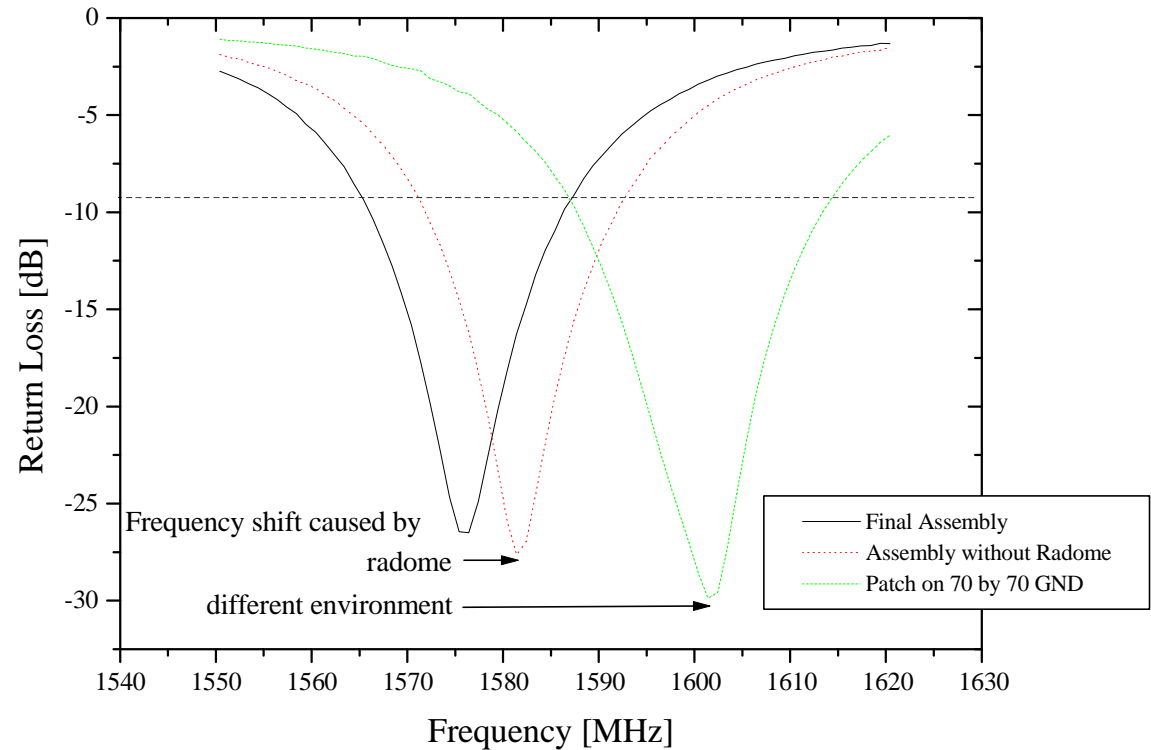
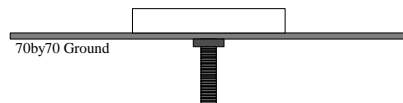
n Final Assembly



n Assembly without radome



n Patch on 70 by 70 ground



The final assembly obtains optimized operation over $1575.42\text{MHz} \pm 3\text{MHz}$



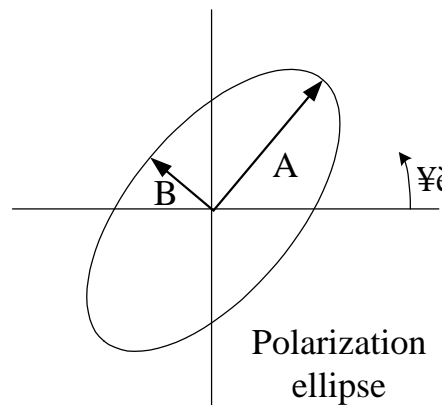
Axial Ratio

n General description

- n To be maximally sensitive to GPS signals, the ideal GPS antenna should be perfectly RHCP
- n The more elliptically polarized it is, the lower its RHCP sensitivity
- n The degree of ellipticity is given by the antenna's axial ratio
- n Good GPS antennas have an axial ratio in the zenith direction of 3dB or better.
- n A measurement of the VSWR alone does not guarantee the antenna's axial ratio performance.

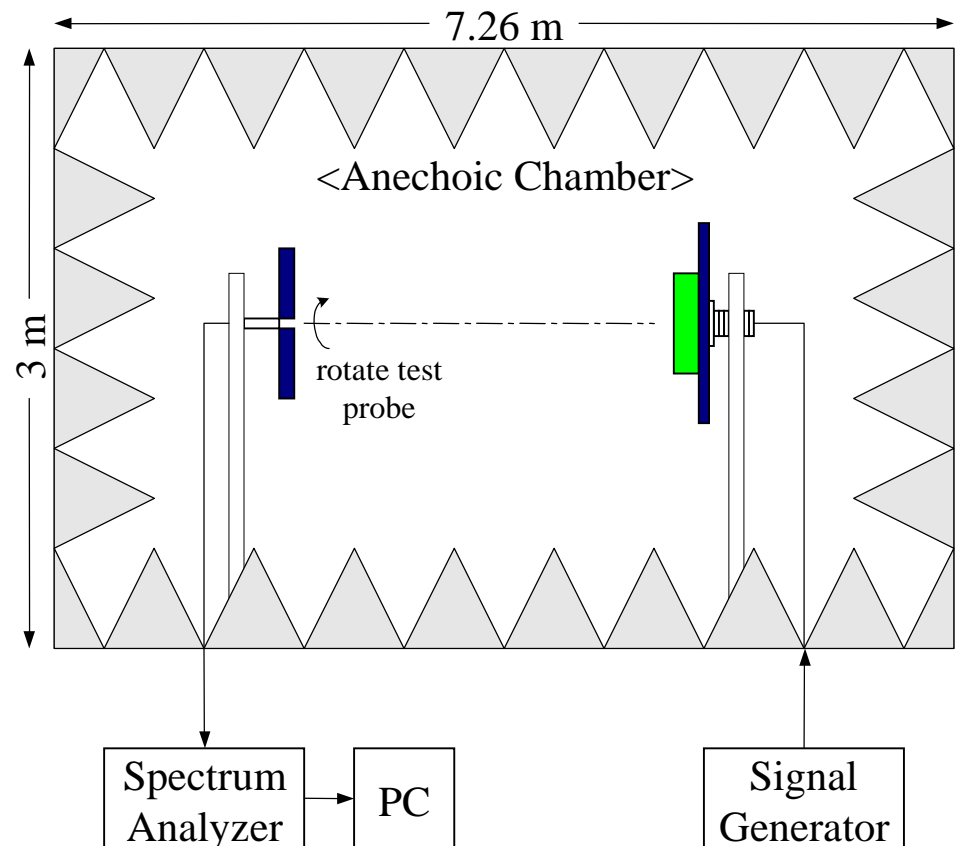
Axial Ratio

- n Measure the Axial Ratio
 - n The GPS Patch antenna transmits at the desired frequency.
 - n Rotates the linear polarization probe
 - n $AR = A - B$, in dB



AMOTECH

- n Measuring system in AMOTECH





Voltage Standing Wave Ratio

- n An important consideration is the antenna-receiver connection. This is achieved with a transmission line, usually a coaxial cable.
- n To maximize signal transfer from the antenna to the receiver, we must minimize power loss.
- n Power may be lost if the coupling between the antenna and the cable is imperfect and also within the cable itself.
- n To prevent power loss at the interface between the cable and the antenna, the impedance of the cable and the antenna must be the same.
- n The formula for relating mismatch loss to VSWR is:

$$\text{Mismatch_Loss(dB)}=10\log\left(1-\left(\frac{\text{VSWR}-1}{\text{VSWR}+1}\right)^2\right)$$



Bandwidth

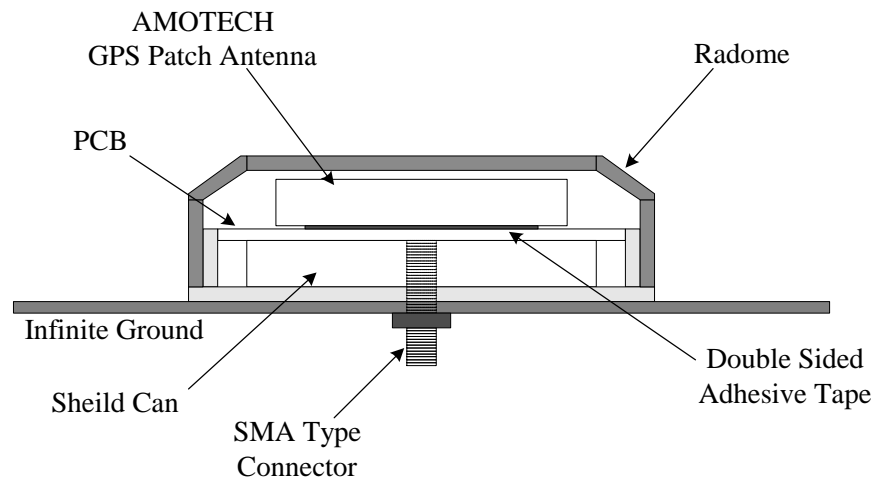
- n Operating bandwidth is defined as frequency range satisfied following:
 - n VSWR (< 2.0) or Return loss (< 10 dB)
 - n Axial ratio (< 3.0 dB)

- n GPS patch antenna designed by AMOTECH satisfies all criteria over the operating frequency range of $1575.42 \text{ MHz} \pm 3 \text{ MHz}$.

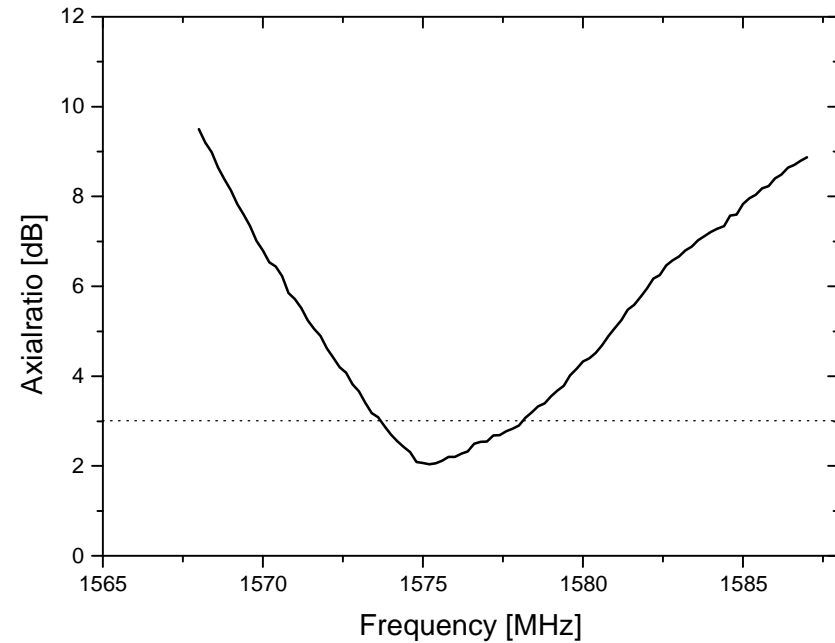
Result of Measurement

n GPS Antenna installed on Infinite Ground

Geometry of final assembly



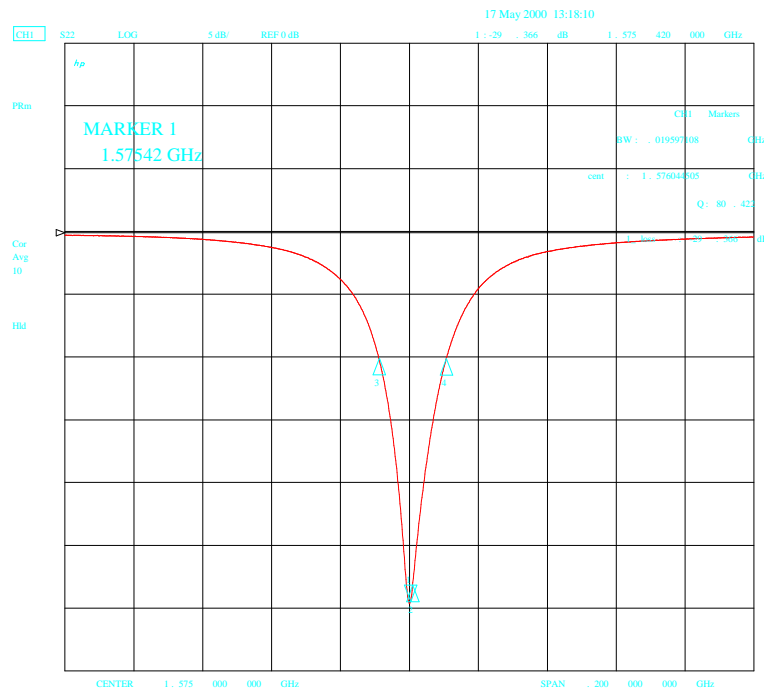
Axial Ratio



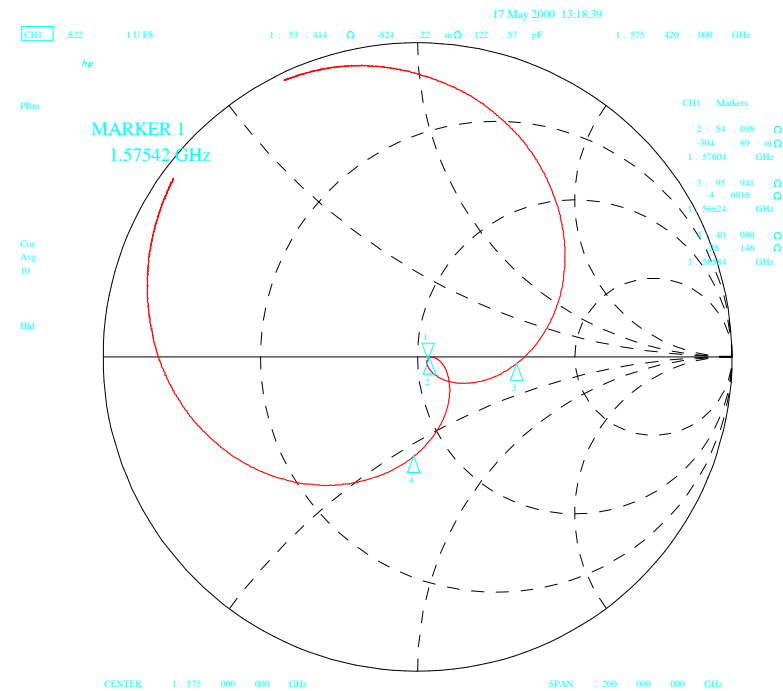
Result of Measurement

n GPS Antenna installed on Infinite Ground

Return Loss



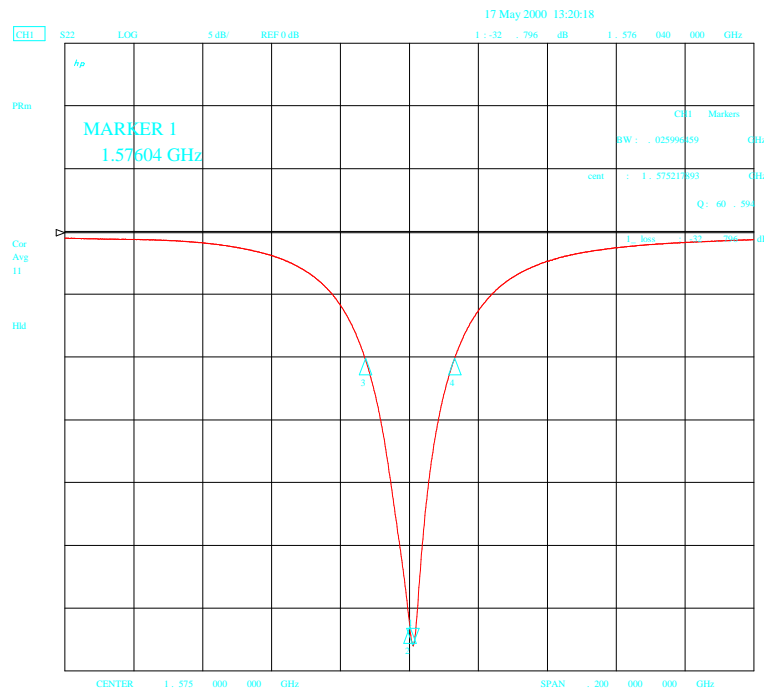
Smith chart



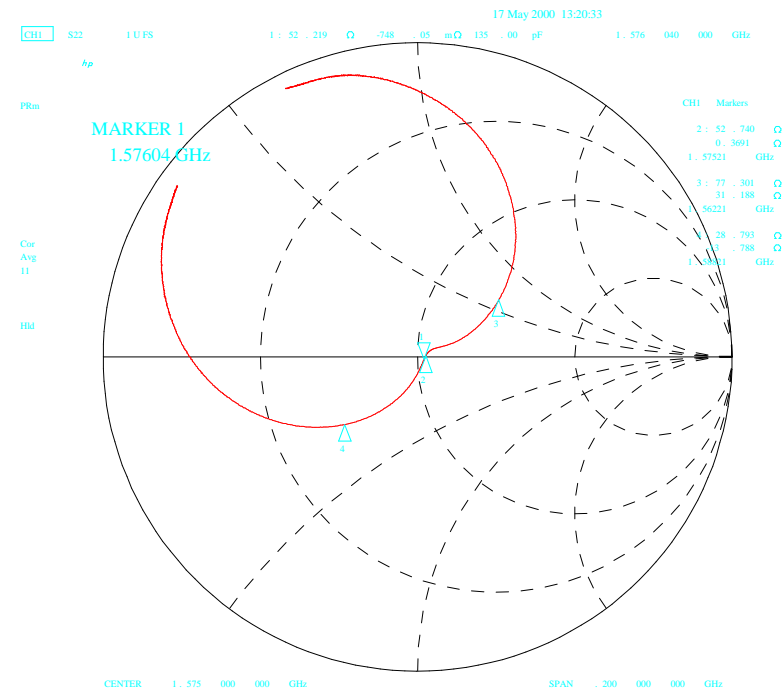
Result of Measurement

n GPS Antenna installed on 70mm×70mm Ground

Return Loss



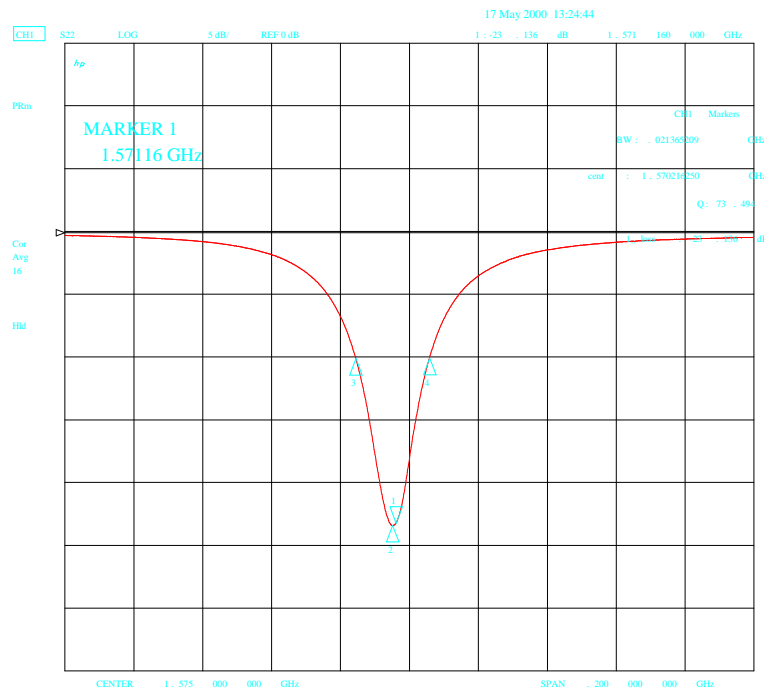
Smith chart



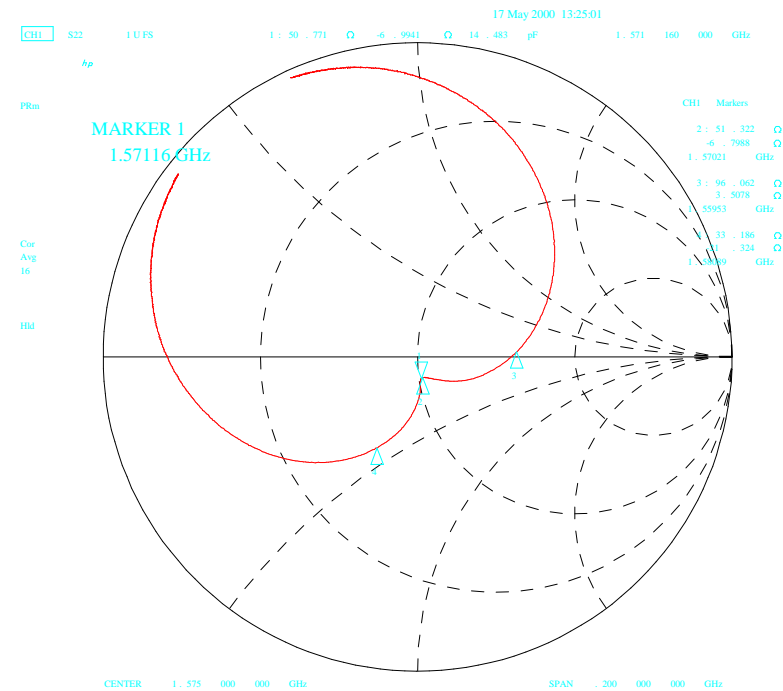
Result of Measurement

n GPS Antenna installed on 50mm×50mm Ground

Return Loss



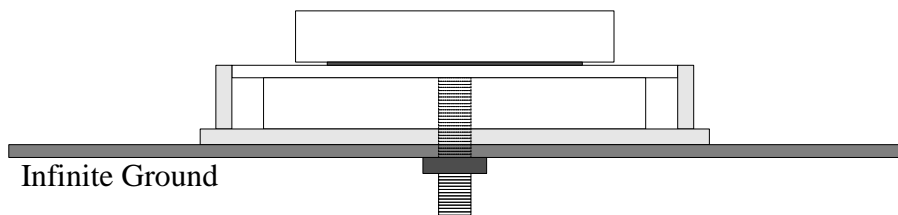
Smith chart



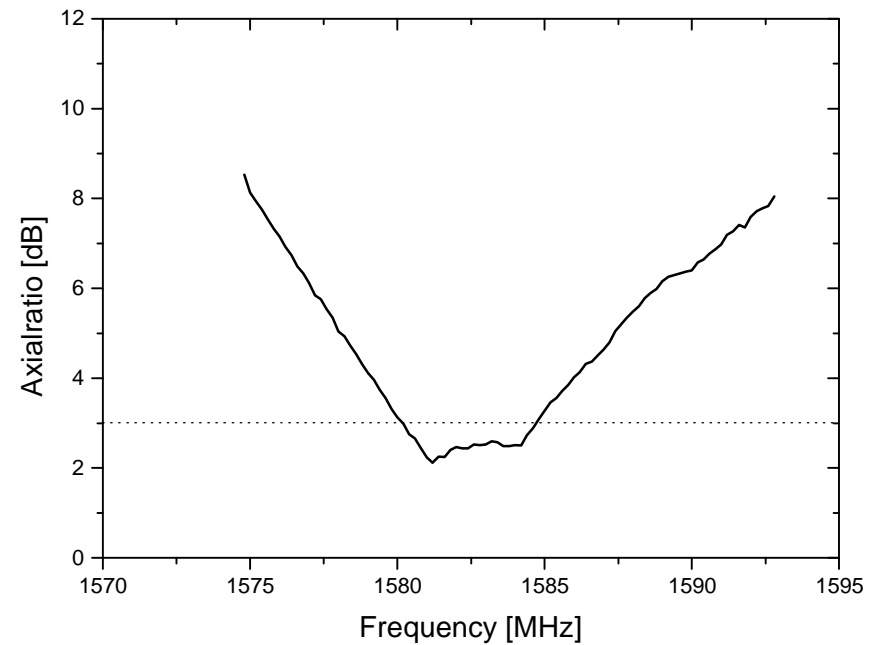
Result of Measurement

n GPS Antenna without Radome on Infinite Ground

Geometry of assembly without radome



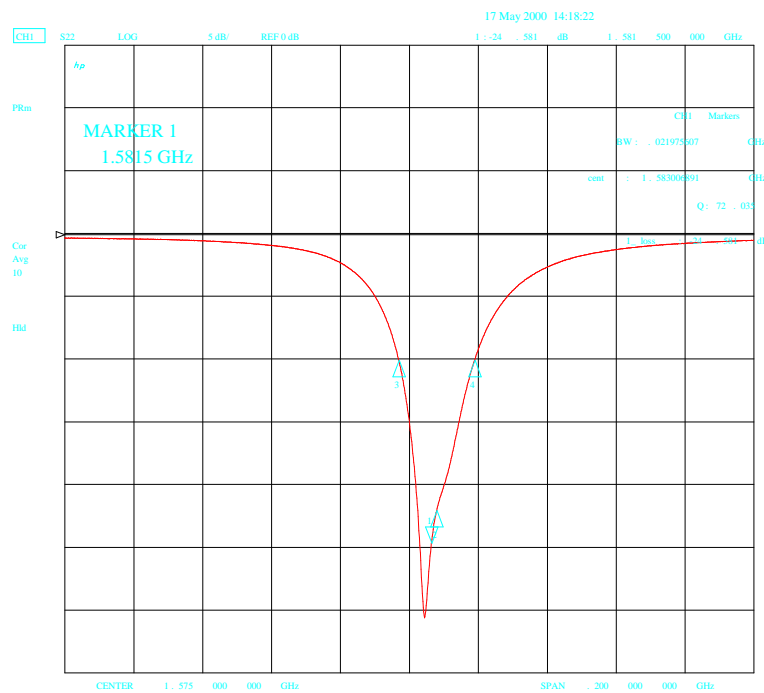
Axial Ratio



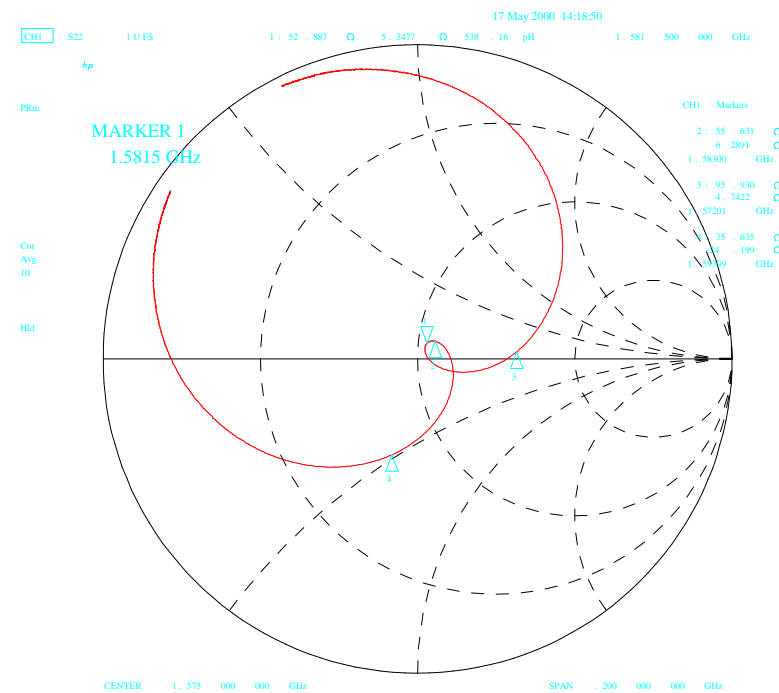
Result of Measurement

n GPS Antenna without Radome on Infinite Ground

Return Loss



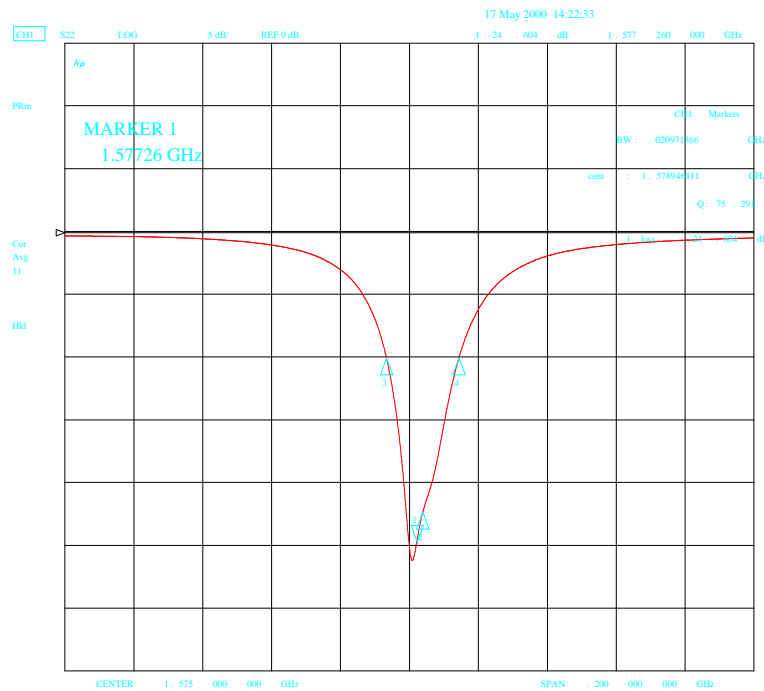
Smith chart



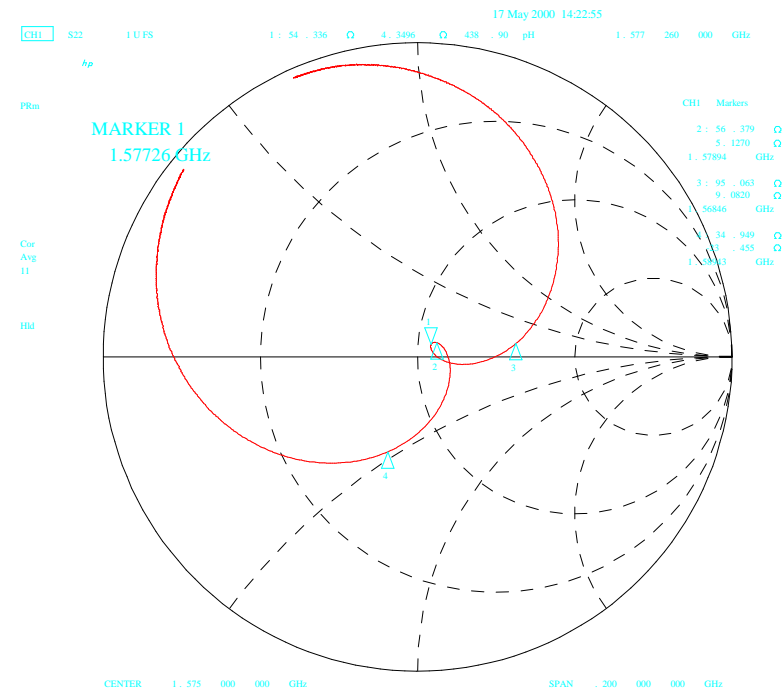
Result of Measurement

n GPS Antenna without double sided adhesive tape

Return Loss



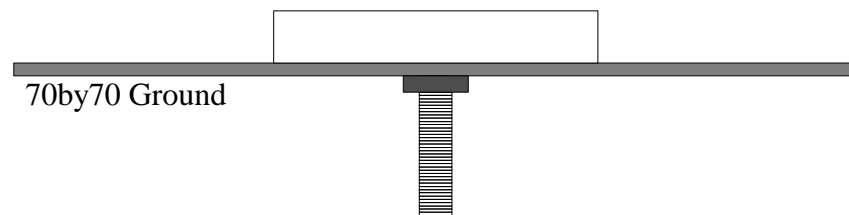
Smith Chart



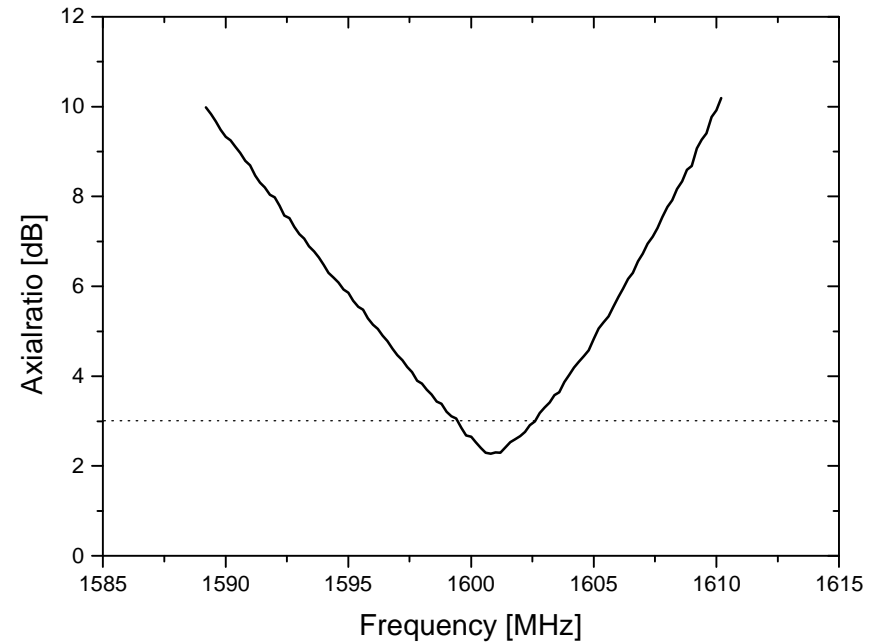
Result of Measurement

n GPS Patch Antenna on 70 by 70 AMOTECH Test Jig

Geometry of patch antenna



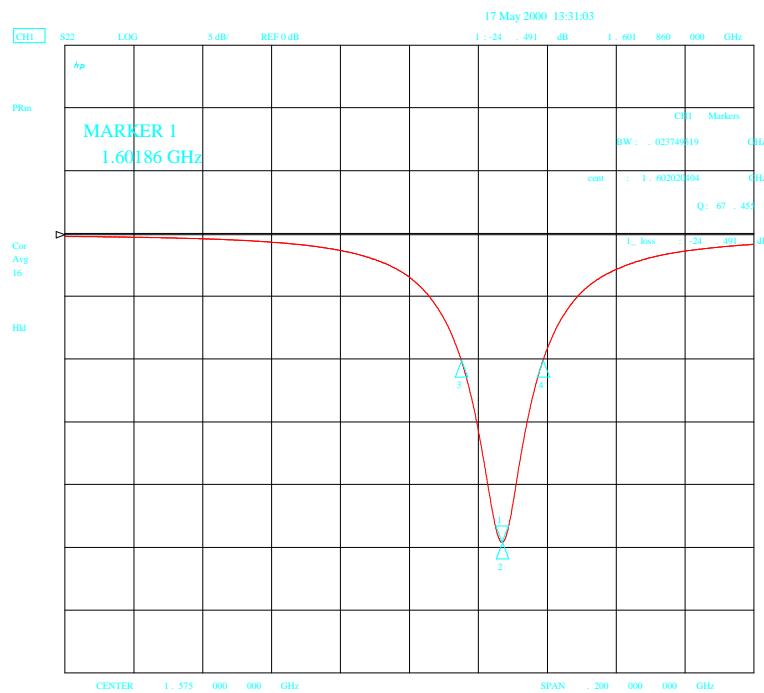
Axial Ratio



Result of Measurement

n GPS Patch Antenna on 70 by 70 AMOTECH Test Jig

Return Loss



Smith Chart

