Measurement of Antenna (Aluminum Base)

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July 11, 2013
The main aspects of the measurements are:

- No shield
- Aluminum base
- Short cable between antenna and switch
- Antenna covered by foam box
- Measurement is 35-hour long
Figure: Results for the magnitude. Comments on the next page.
(Top): The air temperature reached 48°C. Regions 1 and 2 are limited by 37°. For lower temperatures the antenna seems significantly more stable.

(Middle): The variations are with respect to the initial trace. Regions 1 and 2 are fairly stable independently. The high-temperature region evidences the pattern due to a hot copper plate, pivoting at \( \sim 160 \text{ MHz} \). Important jumps occur at 16.7 hours (it quickly returns to normal) and 18 hours (no return). Ripples in frequency, of \( \sim 10 \text{ MHz} \), are present throughout the measurement.

(Bottom): Spectra of the magnitude. The amplitude is in dB. The plot is normalized to the peak value in the data set. The \( y \)-axis corresponds to the period of each component in MHz. In general, low frequency oscillations are larger. An 8-MHz component is significant all along, but more evident in region 2.
Figure: Results for the phase. Comments on the next page.
(Top): Air temperature.

(Middle): The variations are with respect to the initial trace. Regions 1 and 2 are fairly stable independently, especially region 2. The jumps at 16.7 hours and 18 hours are also evident.

(Bottom): Spectra of the phase. The amplitude is in dB. The plot is normalized to the peak value in the data set. The y-axis corresponds to the period of each component in MHz. In general, low frequency oscillations are larger.
Figure: (Top) All data in magnitude and phase. (Bottom) Peak-to-peak scatter for different sections. The stability for regions 1 and 2 is of order 0.05 dB and 0.4° C in magnitude and phase respectively.
Figure: Average spectra of magnitude (top) and phase (bottom) for Region 2. An offset has been added so the amplitude is above zero. Long-period oscillations are dominant. A relevant component in magnitude is 8 MHz. In phase, the amplitude decreases in a smoother way.
Figure: Jumps at 16.7 hours (top), and at 18 hours (bottom) during the high-temperature period. The Delta corresponds to After-minus-Before. The difference takes some minutes to establish. For the jump at the top, the antenna went back to its initial state very soon, as the figure on page 3 shows. The patterns fit very well the scenario of a varying top plate. In both cases, the After state corresponds to a case were the distance between the top plate and the panels increase.
Figure: Temperature coefficient of the magnitude (top) and phase (bottom). Fits were performed for data below and above 41°C, since there is a distinctive change in behavior as the plots in Appendices 3 and 4 show. Clearly, the behavior is smoother, more repeatable and less dependent on temperature for data below 41°C.
Conclusion

- The new aluminum base makes the antenna feel significantly stronger and more stable.
- Operation of the antenna under high temperatures seems to have helped to increase the preponderance of the top plate behavior. It is the dominant pattern for temperatures above 37°C.
- The jumps have been minimized, in particular for Regions 1 and 2. This is evidenced in the time streams shown in Appendices 1 and 2. In the high-temperature period, jumps still occur. The two largest occur at 16.7 and 18 hours, and their pattern in frequency indicates that it is due to changes in the top plate, specifically involving a decreasing capacitance. The overall reduction of jumps could be due to the stronger and more rigid aluminum base.
- An 8-MHz ripple in frequency is evident in the magnitude data. Clamp-on ferrites were used for the measurement. The most likely origin, as suggested by Alan, seems to be reflections from surrounding structures.
- Below 41°C, the data show smooth, linear variations with temperature (with few exceptions). For the magnitude, the temperature coefficient is ≤ 0.008 dB/°C in absolute value in the range 120-180 MHz. For the phase it is ≤ 0.07°/°C. For temperatures above 41°C, jumps still impact the data significantly, and therefore the temperature-coefficient values obtained from the fits are not very representative.
APPENDIX 1: Magnitude Time Streams for 120-180 MHz
APPENDIX 2: Phase Time Streams for 120-180 MHz
APPENDIX 3: Magnitude Temp. Coeff. for 120-180 MHz
147 MHz

148 MHz

149 MHz

150 MHz

151 MHz

152 MHz

153 MHz

154 MHz

155 MHz

Δ magnitude [dB]

temperature [°C]

147 MHz

148 MHz

149 MHz

150 MHz

151 MHz

152 MHz

153 MHz

154 MHz

155 MHz

Δ magnitude [dB]

temperature [°C]
Δ magnitude [dB]

temperature [°C]

174 MHz

175 MHz

176 MHz

177 MHz

178 MHz

179 MHz

180 MHz

181 MHz

182 MHz
APPENDIX 4: Phase Temp. Coeff. for 120-180 MHz
The images above show plots for different frequencies (156 MHz to 164 MHz) with respect to temperature (°C) and phase deviation (°). Each plot seems to display a trend line indicating a relationship between temperature and phase deviation. The data points are scattered, suggesting variability, while the trend lines suggest a consistent trend across different frequencies.