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To: EDGES Group

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Subject: Detection of changes in receiver calibration

The occasional observations of the LNA connected to an "open" instead of the antenna can be used to detect changes in the receiver in the field. This is important, as the current S11 measurement system in the receiver is only capable of measuring the antenna S11 so that the accuracy of calibrated spectra relies on the calibration of the receiver in the field. While a complete check on the stability of the calibration can be made by returning the receiver to the laboratory for a "recalibration" a method of checking in the field can provide a higher degree of confidence than relying on the repeatability of antenna spectra alone. The ability to connect the 3-position switch input to an open is simply achieved by setting the S11 switch to a position which opens the path to antenna which occurs when measuring the antenna S11. To prevent leakage of the VNA signal into the LNA the VNA power is turned off.

Figure 1 shows the calibrated spectra from the "open" from data 4posSwitchOpen_with_SimAnt2_25c_2017 days 58, 59 and 60.

The top plot is residual to a 4 term polynomial fit using calibration from 2016. The middle plot uses calibration from 2017 while the bottom plot is the difference. The "open" spectra is treated as a lossless antenna with arbitrary reflection coefficient 0.99 and zero phase. This is done because we can only use the "open" spectra for detecting changes.

Figure 2 shows the simulated effect of a change in the "open" spectra for a change in LNA S11 of 0.5 dB.

A sensitive test of the accuracy of calibration is discussed in memo 219. In this test a calibrated noise source spectrum is obtained with and without cable box between the noise source and the receiver. Ideally these spectra should be the same. Figure 3 shows the difference using the new calibration data taken in 2017_03_02 which uses the same spectra as for 2016_10_31 but has a revised LNA S11. The difference shown in Figure 3 is much smaller than the difference shown in Figure 2 of memo 219 which used the LNA S11 from 2016_10_31.
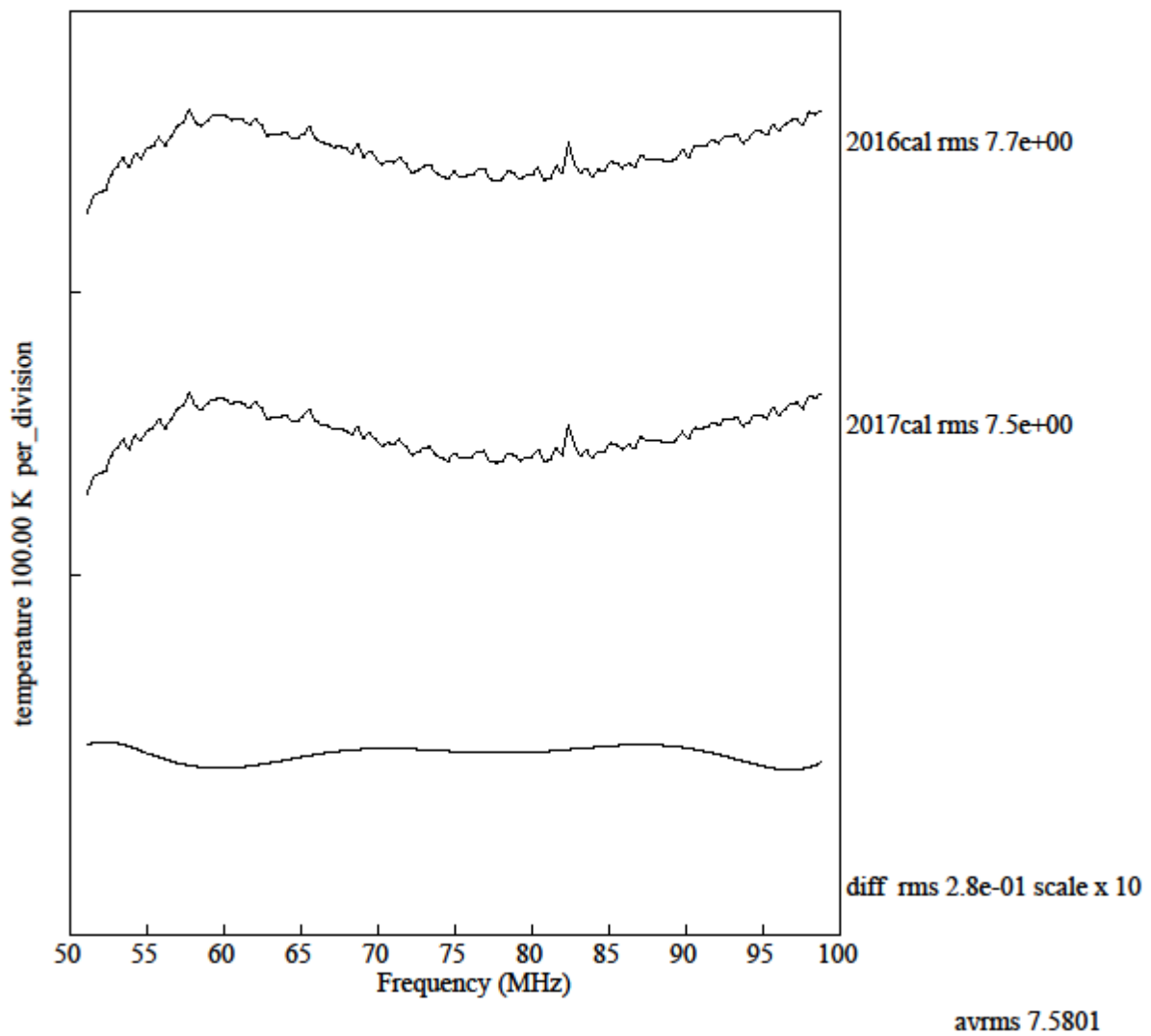
Figure 1. Calibrated "open" spectra residuals with 4 poly terms removed using 2016 and 2017 calibration along with the difference.
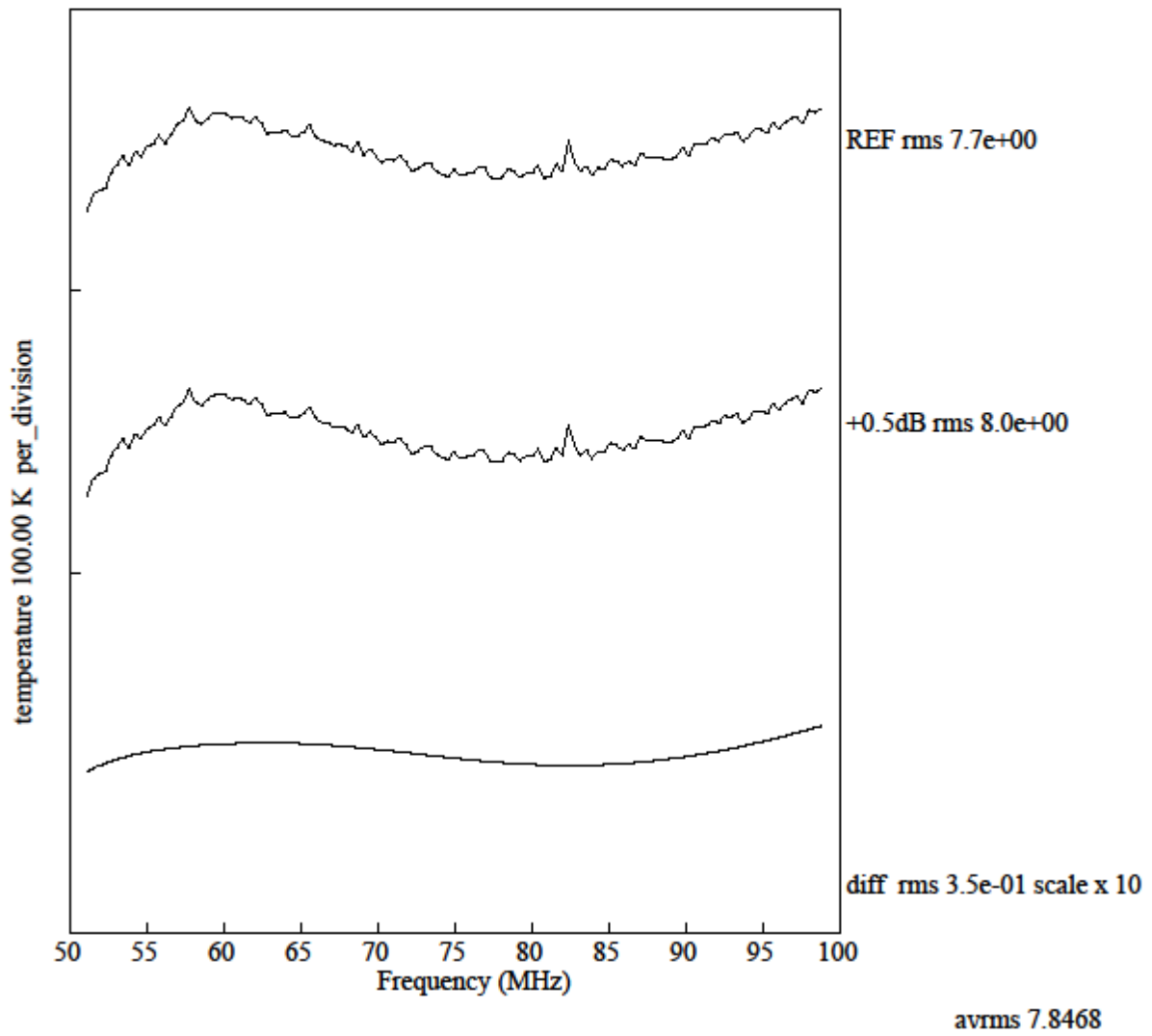
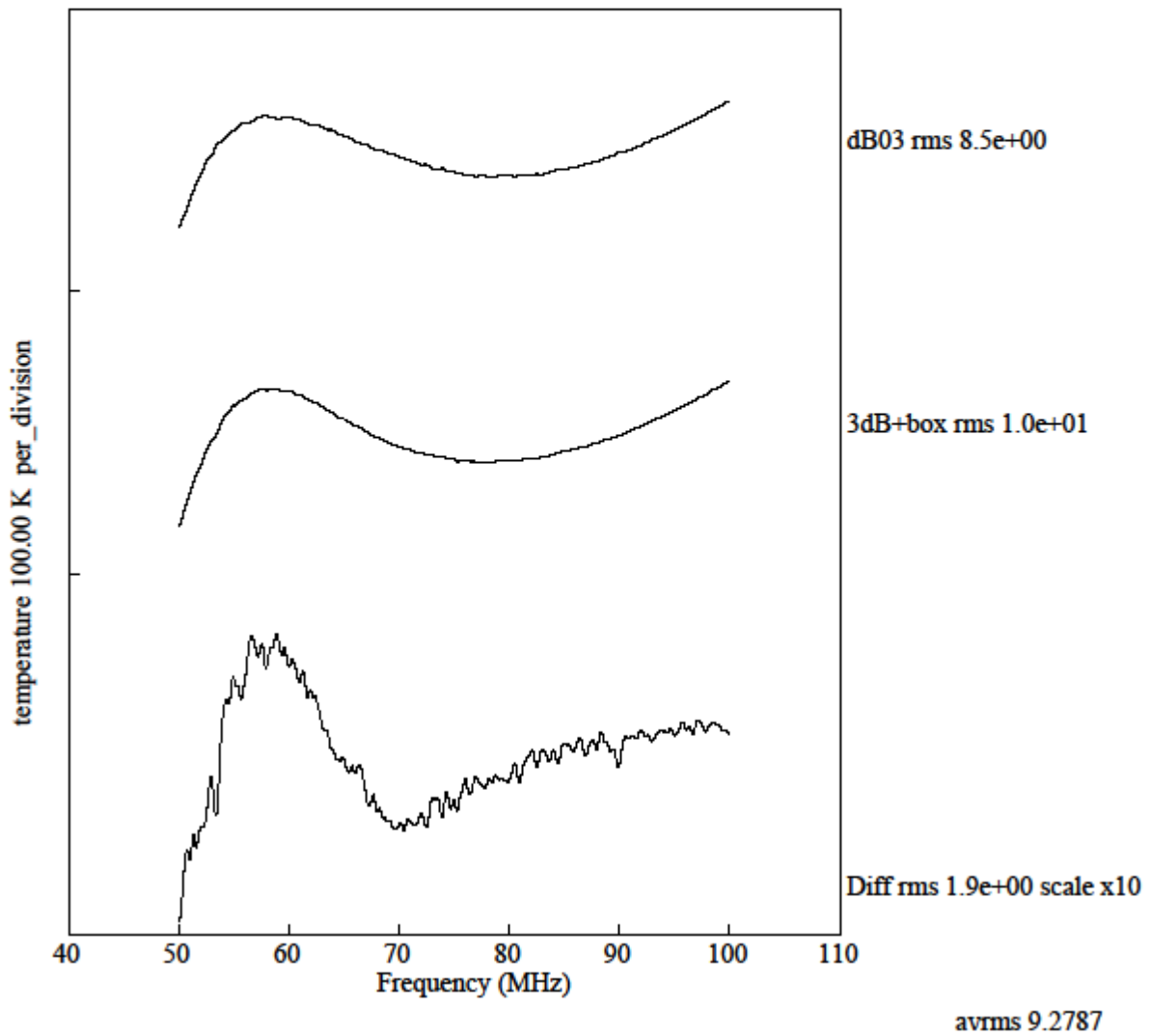Figure 2. Difference for 2016 calibration when LNA S11 is increased by 0.5 dB.

Figure 3. Noise source difference using 2017 calibration to be compared with Figure 2 of memo 219.