EDGES MEMO #149

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To: EDGES Group

From: Alan E.E. Rogers

Subject: Preliminary results from 2014 deployment

A new version of EDGES-2 high band was deployed in October 2014. This version included a built-in S11 measurement system designed by Raul Monsalve of ASU and an extended ground plane designed by Tom Mozdzen of ASU. It also included a new earth pipe air circulation system for removing the heat from the hot plate of the electronics thermal element assembly described in memo #147. In this deployment the electronics box was located below the antenna ground plane in a manner similar to that suggested in memos 2 and 108 using heat exchange with the ground described in memos 119 and 147. In order to avoid locating a fan under the antenna air was circulated by an air pump located 100 m away in the equipment hut.

Calibration of the electronics was done at ASU prior to shipping. The results of this calibration is shown in Figure 1 which shows the hot load spectrum as a "cross-check" on the calibration constants which are then used to calculate the corrected spectrum of the hot load. The spectral data used were:

Cold_load.2014_273_04.acq

Hot_load_2014_275_00.acq

Open_cable_2014_276_00.acq

Shorted_cable_2014_277_00.acq

the S11 data was from calibration_S11.txt.

Temperatures of 396.7 and 296.9 were assumed for the hot and cold loads respectively. The loss for the hot load was derived from a cable model for the hot load. This model is for a 50 ohm semi-rigid cable 9 cm long with brass inner conductor, stainless out conductor, dielectric 2.05 and 1 mm diameter inner conductor. The actual loss depends on the measured S11 and is calculated using the formulae in memo #132. It was noted that the hot load spectrum had some RFI which is shown in more detail in figure 2. As a result it was decided to take more hot load data at the MRO using another hot load which was sent from Haystack to the MRO. The calibrated spectrum is shown in figure 3. This shows that the RFI in the hot load spectrum taken at ASU was not from the EDGES electronics but since no S11 data was taken on this hot load the curvature in the residual spectrum is probably the result of using the ASU hot load S11 data which is not valid for the Haystack hot load.

A "check" of the calibration was made by observing an open cable at the MRO. The result of this test is shown in Figure 4. Given the high reflection coefficient the rms residuals to the calibrated spectrum are not unreasonable.

Follow the installation sky noise spectra were taken. Figure 5 shows the residuals to a 2 parameter fit to the calibrated sky noise spectrum for short 0.1 hour integrations at Galactic hour angles 10 thru 10.5 hrs in which digital TV channels 6,7 and 8 are visible. Figure 6 shows spectra for days 303 thru 306 for 1 hour integrations for the Galactic hour angle range at night. A first order correction for the antenna beam pattern was made to the data following the calibration. The effect on this correction, which assumed a N-S orientation of the antenna, a spectral index of 2.5 below 20 degrees galactic latitude, a spectral index of 2.45 above 20 degrees and a value of gamma equal to -0.12 made a small improvement in the smoothness above 160 MHz at GHA values of 3 and 4 hours. It had little effect at other values of GHA. The source of the "bump" at 160 MHz is still unknown and the effect which was not seen in the previous deployment is under intense study. Figure 7 shows some longer integrations made by averaging the spectra from days 303 thru 306 and plotting the residuals to a 5 parameter fit on a finer scale. In this case the rms residual for each plot is about 40 mK.

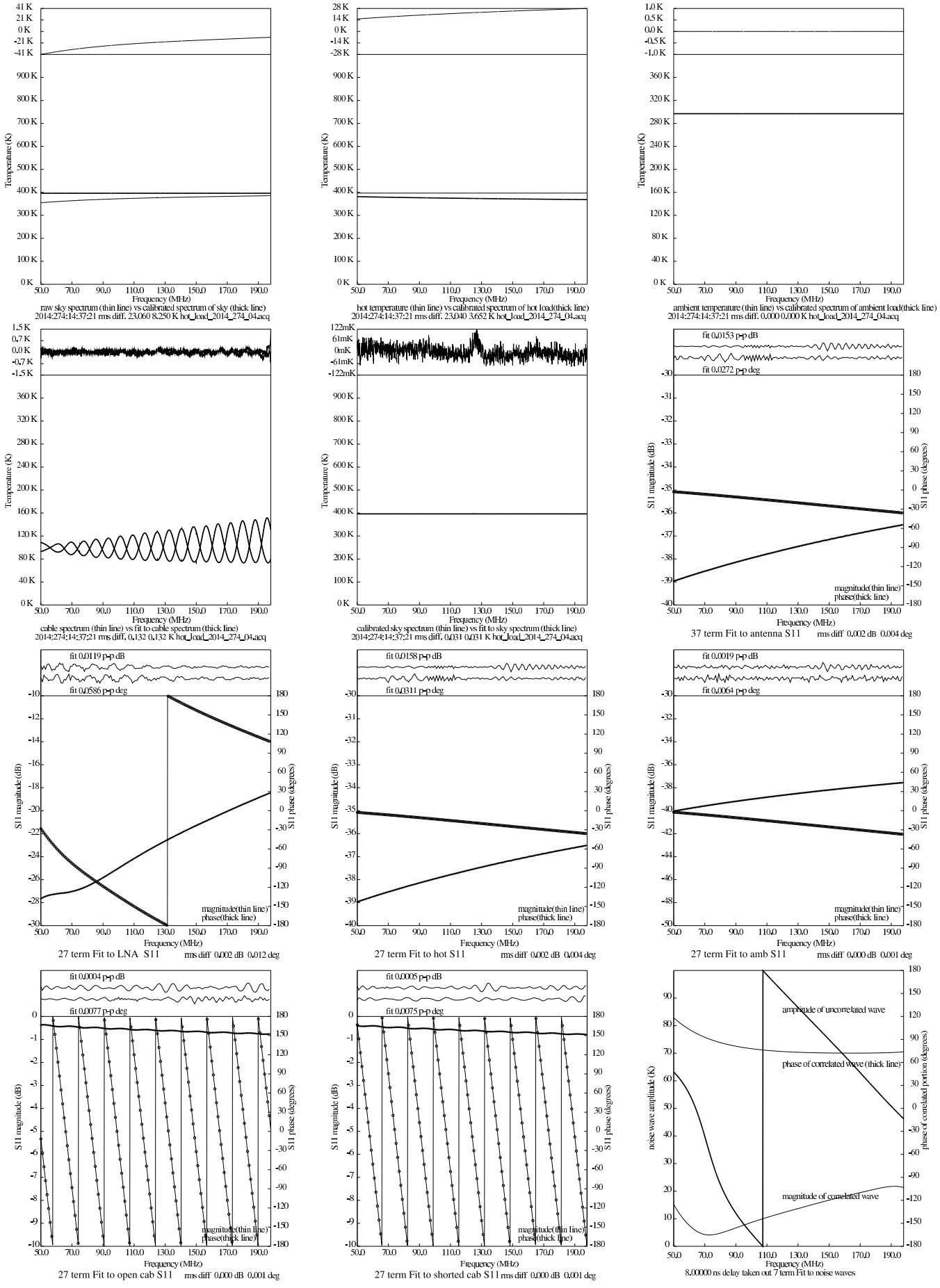
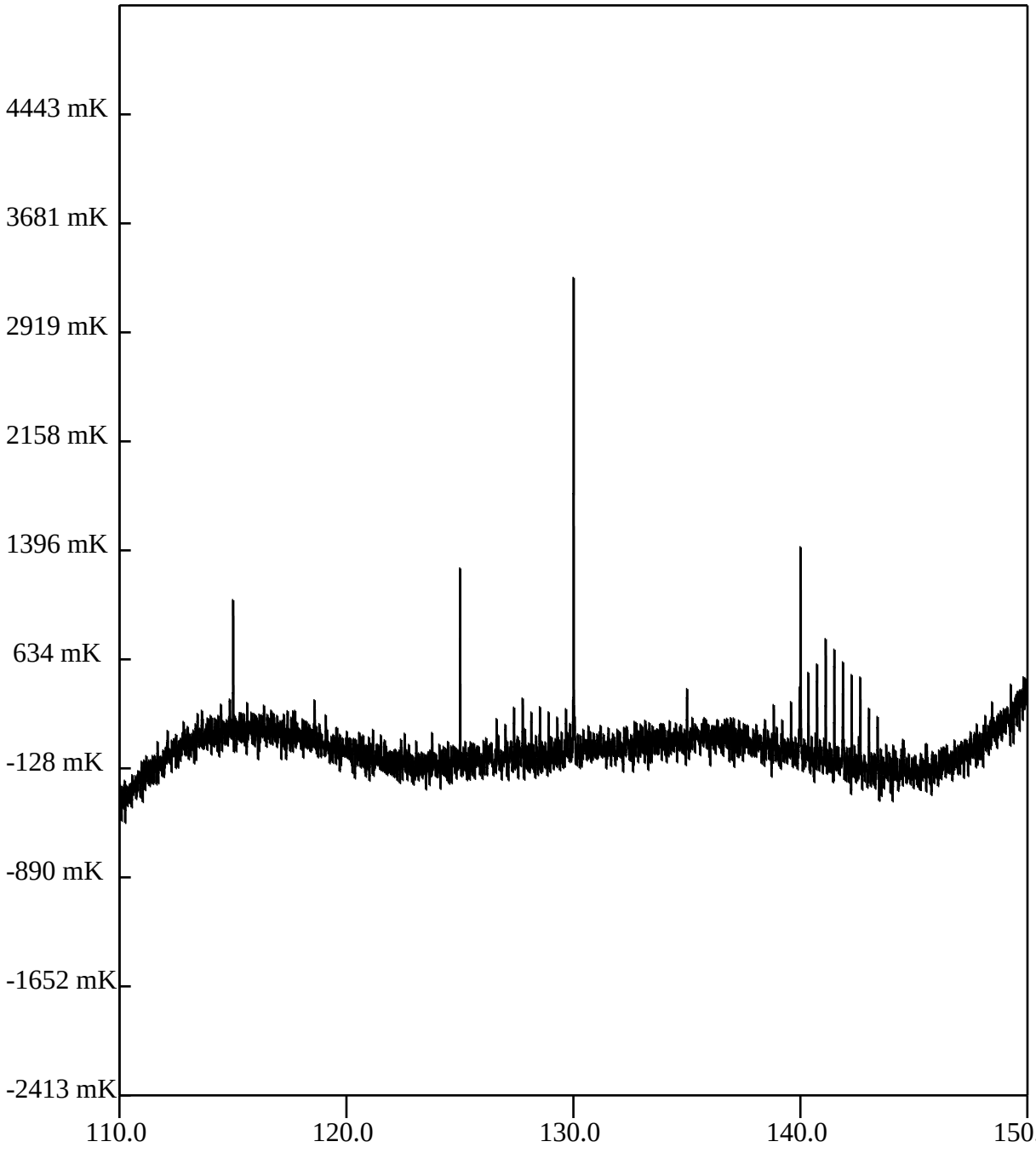


Figure 1. Calibration data taken at ASU.



fstart 110 fstop 150 pfit 5 smooth 0 resol 6 kHz rfi 0.0 int 1478 9446 sec
peakpwr 1.000e+99 pkpwrm 1.000e+99

Figure 2. RFI pick-up in hot load

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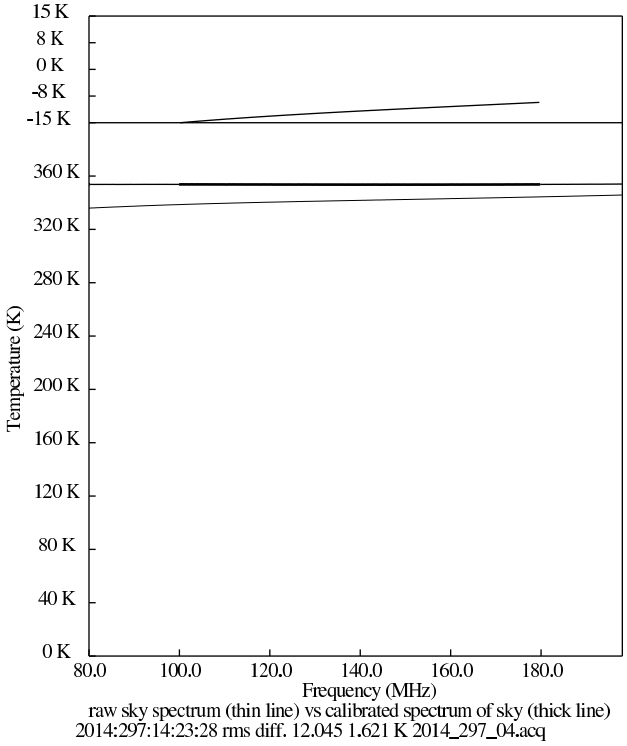
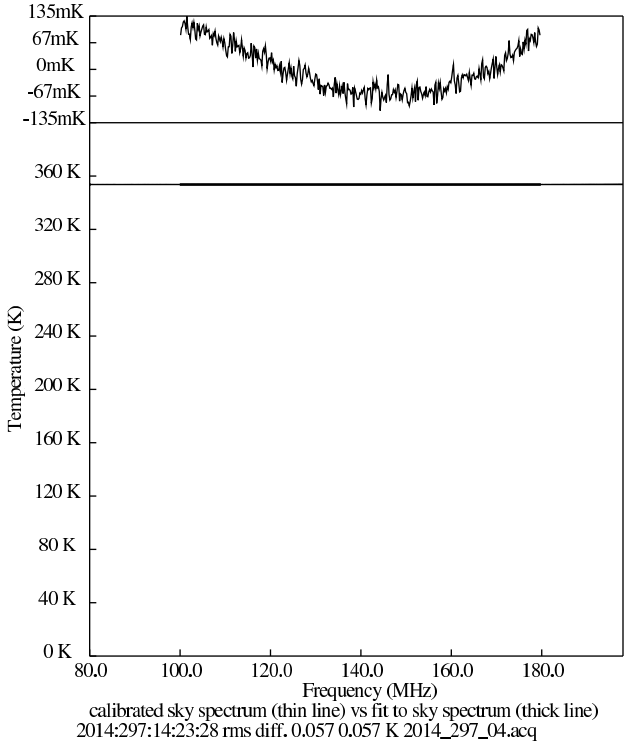




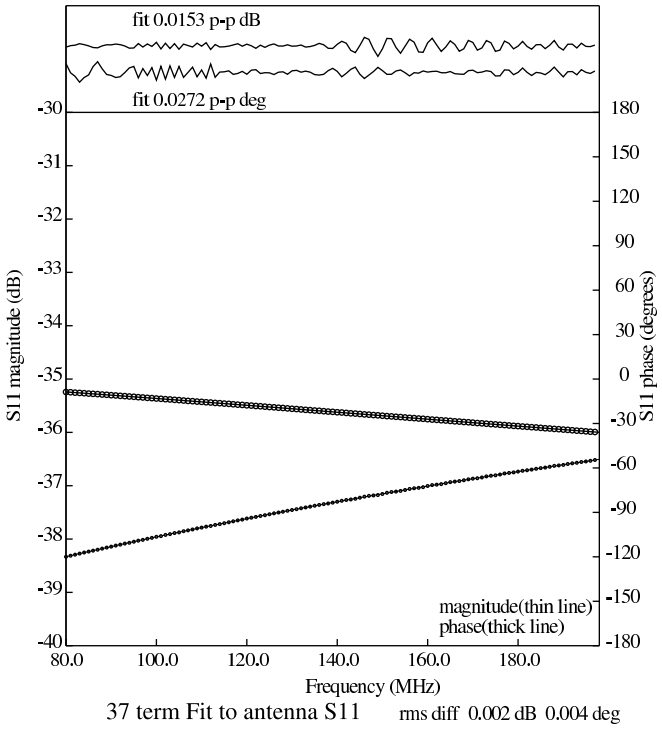
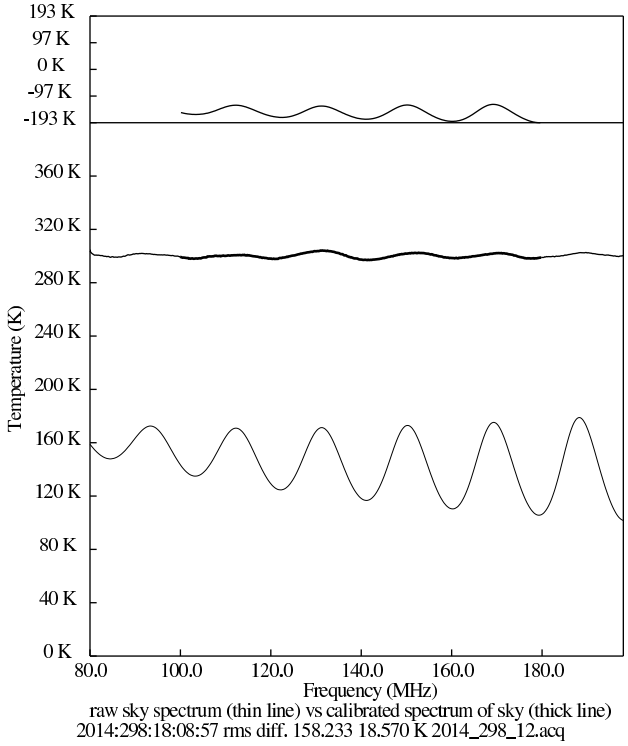
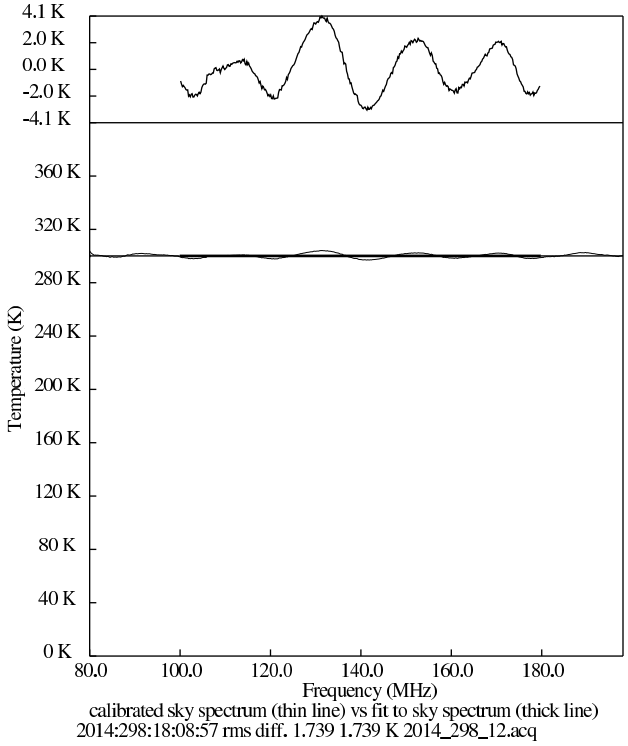


Figure 3. Hot load data teken at MRO.





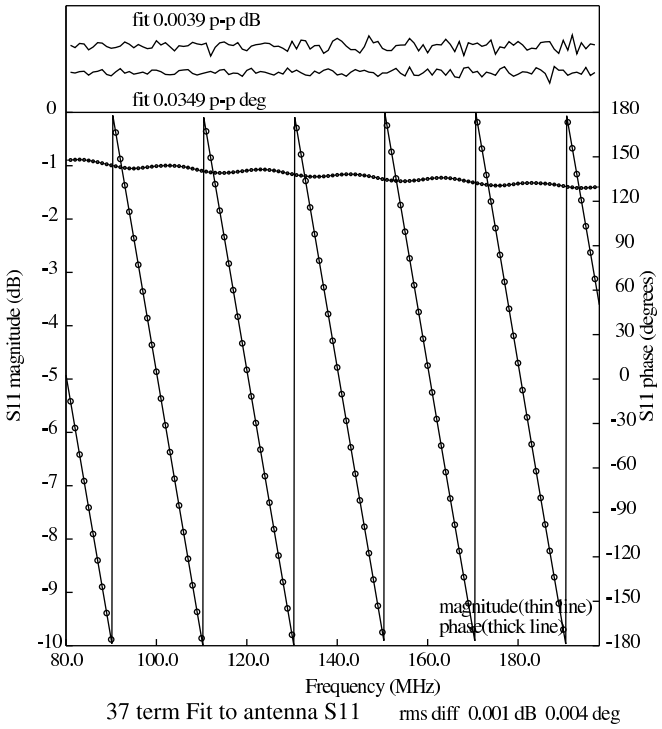


Figure 4. Check of calibration using a open cable.

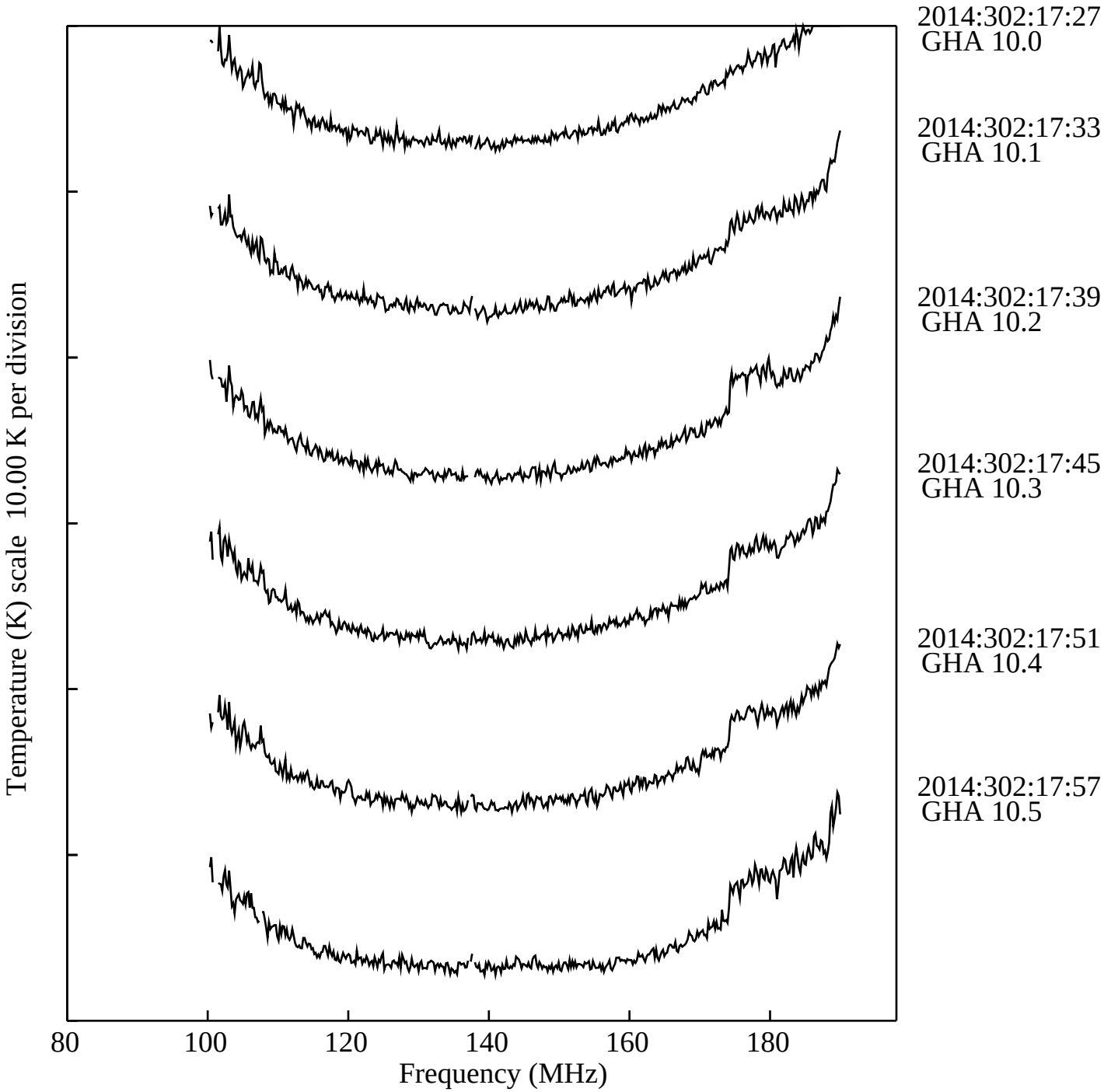


Figure 5. RFI from digital TV channels, 6, 7 & 8 on day 302.

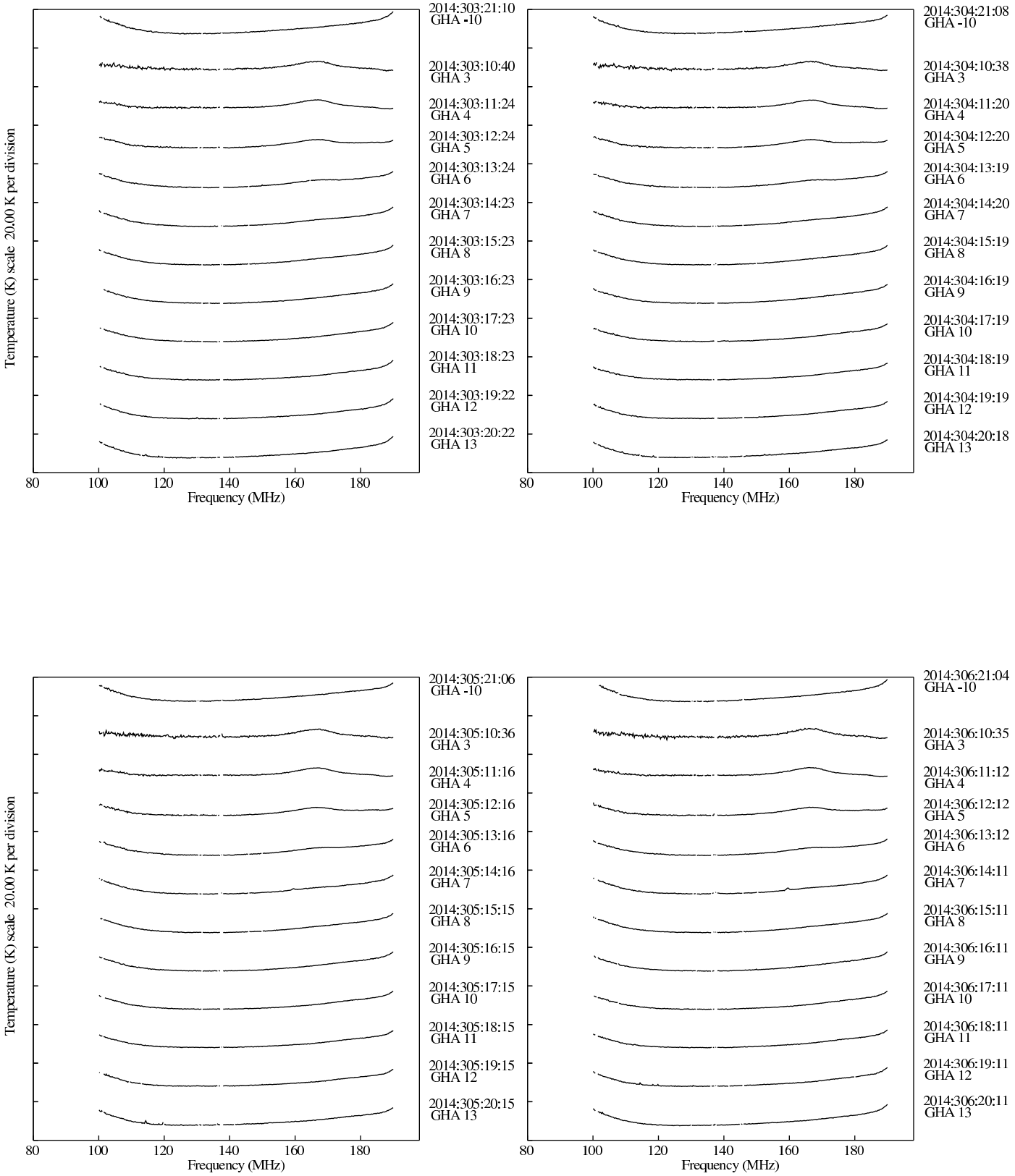


Figure 6. Residuals to calibrated spectra taken on day 303-306 after subtraction of 2 parameter fit.

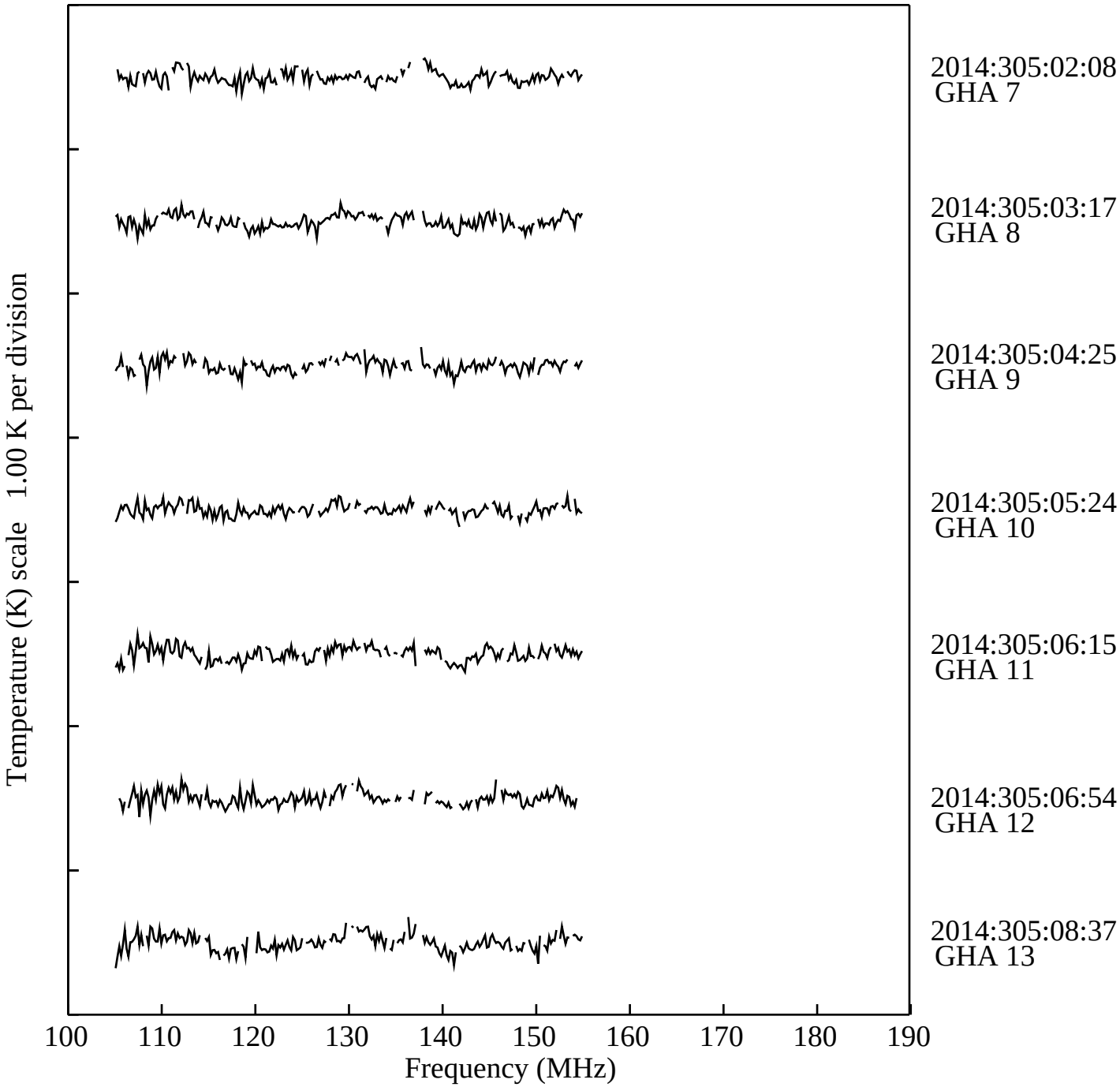


Figure 7. Longer integrations. Days 303, 304, 305, 306. Residuals to 5 parameter fit.