EDGES MEMO #022

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To: EDGES Group

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Subject: Estimate of ripple due to common mode reflections on cable to LNA.

When used in the "EoR" mode the EDGES LNA is connected directly to the antenna. In this mode the LNA is then connected to the AC240 spectrometer via a long cable. Common mode reflections on this cable produce ripple in the spectrum. The level of the ripple depends on the following:

1] Unbalance in the balun

2] Connection to ground plane

3] Isolation of ferrite filters on cable

1] Unbalance in the balun

Unbalance produces currents in the cable. The edges balun, which uses a 240-2245-ND ferrite has a common mode current of about 10% of the differential mode.

2] Connection to the ground plane.

Most of the common mode current from the balun unbalance sinks into the ground plane. But since the ground plane is finite some fraction of the current will continue into the shield of the cable to the spectrometer. Using EZNEC simulation I find this fraction to be about 5% at 100 MHz dropping to under 1% at 200 MHz.

3] Isolation of ferrite filters on cable

The common mode current on the cable can be reduced by adding ferrite snap-on filters to increase the common mode inductance. Sherwood 28A0593-0A2 (Digikey 240-2246-ND) clamp-on split ferrite cores have an impendence of about 471 ohms at 100 MHz increasing to 575 ohms at 300 MHz. Placing these filters every meter reduces the current on the cable by more than a factor of 100 according to a simulation using EZNEC.

4] Overall limit

An upper limit of the ripple is estimated to be about 50ppm from the combination of the effects balun, unbalance, ground plane deficiency and cable filters. In addition, I attempted a full simulation in EZNEC and obtained a similar result.