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To: EDGES Group

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Subject: Proposed design of low band antenna

Studies of the “blade” antenna indicate that it will offer better performance than the Fourpoint. Memo #154 shows the measured S11 of a high band prototype of the blade. The S11 is not quite as good as the Fourpoint but the antenna is much simpler. In addition the FEKO simulations of the frequency dependence of the beam indicate superior performance. Since the low band antenna is twice the size of the high band antenna it may be possible to locate the receiver under the antenna without degrading its performance. The table below shows the results of FEKO simulations done at the high band but should apply to the low band by scaling the design by a factor of 2.

| | rms (mK) | | | | | |
|---|---|---|---|---|---|---|
| Antenna | 3 | 4 | 5 | S11dB | Box L×W×H | Box volume |
| Dipole | 97 | 8 | 0.6 | | | |
| Fourpoint | 576 | 93 | 7.7 | -11.4 | | |
| Blade | 250 | 38 | 3.2 | -8.1 | None | |
| Blade | 270 | 43 | 5.9 | -8.0 | 9×9×8 | 648 |
| Blade | 263 | 42 | 5.2 | -8.1 | 8×8×8 | 512 |
| Blade | 257 | 40 | 4.5 | -8.3 | 8×8×6 | 384 |
| Blade | 253 | 40 | 3.9 | -8.5 | 8×8×4 | 256 |
| Blade | 255 | 40 | 4.0 | -8.3 | 6×6×8 | 288 |
| Blade | 253 | 39 | 3.8 | -8.3 | 6×6×6 | 216 |
| Blade | 252 | 38 | 3.6 | -8.2 | 6×6×4 | 144 |
| Blade | 251 | 38 | 3.3 | -8.3 | 4×4×4 | 64 |
| Blade | 251 | 39 | 3.5 | -8.5 | 4×4×8 | 128 |
| Blade | 250 | 37 | 3.3 | -8.6 | 5×2.5×9 | 112.5 |
| Blade | 251 | 38 | 3.4 | -8.2 | 8×4×4 | 128 |

Table 1. rms residuals to spectra 100-190 MHz antenna beam convolved with sky model after removal of a 3, 4 and 5 term polynomial.

A measure of the effect of the frequency dependence of the beam given in table 1 is the average rms residual over the full range of LST. Various receiver box sizes located symmetrically are considered. The S11 dB column indicates the S11 at 100 MHz.

The table is given for the high band. For the low band the box dimensions given in inches would double.

Table 1 shows that there is a loss of beam constancy by placing the box on the ground plane but the loss is insignificant if the receiver can be housed in a box with volume less than about 150 cubic inches at high or 1200 cubic inches for low band. From Table 1 the best dimension at low band are 10”×5” ×18”.

Other aspects of the design are basically a scaling of the components shown in Figure 3 of memo 154 by a factor of 2. For example the fiberglass supports go from 1.25” to 2.5” and the balun tubes go from 0.5” to 1.0” O.D. Nylon threaded rods will be replaced by PVC threaded rods.

FEKO simulations show that the most critical dimension is the gap between the panels. The uniformity of the gap should be better than 0.5% to avoid an increase in the frequency dependence of the beam. If the receiver box is placed above the base the balun shield is placed on top of the receiver box.