

## Derivation of Field Strengths

1. For the detection method peak measurements were taken.

2. Actual readings and corrections:

| Frequency<br>kHz | Peak<br>Spectrum<br>Analyser<br>Reading<br>dBuV<br>V | Antenna<br>Factor K | Field at 3<br>m<br>E dBuV/m<br><br><b>Note 1</b> | Correction<br>factor to<br>convert<br>from 3m to<br>300m<br><br><b>Note 2</b> | Corrected<br>field<br>strength<br>for 300m<br>dBuV/m |
|------------------|------------------------------------------------------|---------------------|--------------------------------------------------|-------------------------------------------------------------------------------|------------------------------------------------------|
| 133.502          | 87.00                                                | -41.3               | 97.2                                             | -80                                                                           | 17.2                                                 |
| 400.71           | 45.00                                                | -41.4               | 55.1                                             | -80                                                                           | -24.9                                                |
| 534              | 38                                                   | -41.5               | 48                                               | -80                                                                           | -32                                                  |
| 667              | 44                                                   | -41.5               | 54                                               | -80                                                                           | -26                                                  |
| 934              | 45                                                   | -41.5               | 55                                               | -80                                                                           | -25                                                  |
| 1068             | 42                                                   | -41.5               | 52                                               | -80                                                                           | -28                                                  |
| 1201             | 40                                                   | -41.5               | 50                                               | -80                                                                           | -30                                                  |

### Note 1:

Formula used to obtain field E at 3 m

$$E \text{ (dBuV/m)} = V \text{ (dBuV)} + K \text{ (dB S/m)} + 51.5$$

This formula is taken from the National Physical Laboratory calibration report for the antenna (copied on the following page).

### Note 2:

The correction factor of -80dB to convert from field measured at 3m to field at 300m is taken from 47 CFR 15.31 f (2) (page 661, 10-1-99 edition) which states that an inverse linear distance extrapolation factor of 40dB/decade can be used. There are 2 decades of distance from 3m to 300m, therefore the extrapolation factor is  $-2 \times 40 = -80\text{dB}$

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## MEASUREMENTS

The loop was positioned at the centre of a Crawford Type TEM Cell with the plane of the loop perpendicular to the magnetic field and parallel to the direction of propagation. The output from the loop was connected through a coaxial cable to a calibrated 50  $\Omega$  receiver. A tracking generator was used to set up a calculable, linearly polarised, electromagnetic field in the TEM cell, approximating to a plane wave of 13  $\mu\text{A}/\text{m}$  (5 mV/m).

At each frequency, the ratio of the applied TEM cell voltage to the terminated loop output voltage, was used to calculate the antenna factor according to the following definition.

$$H [\text{dB } (\mu\text{A}/\text{m})] = V [\text{dB } (\mu\text{V})] + K [\text{dB } (\text{S}/\text{m})]$$

where: H is the magnetic field strength

V is the correctly terminated output voltage from the loop

K is the magnetic antenna factor

The **free space equivalent** electric field strength can be calculated for linearly polarised plane wave conditions, and is given by:

$$E (\text{dB } \mu\text{V}/\text{m}) = V (\text{dB } \mu\text{V}) + K + 51.5$$

The reflection coefficients of the loop antenna was measured using a calibrated Hewlett Packard 8753 network analyser.

Reference: CEM/17/98/15/9

Checked by: *APW*