Derivation of Field Strengths

1. For the detection method peak measurements were taken.

2. Actual readings and corrections:

Frequency kHz	Peak Spectrum Analyser Reading dBuV V	Antenna Factor K	Field at 3 m E dBuV/m **Note 1**	Correction factor to convert from 3m to 300m **Note 2**	Corrected field strength for 300m 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 (dBuV/m) = V (dBuV) + K (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 –2x40 = -80dB

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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 Ω 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 μA/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.

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

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:

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

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: