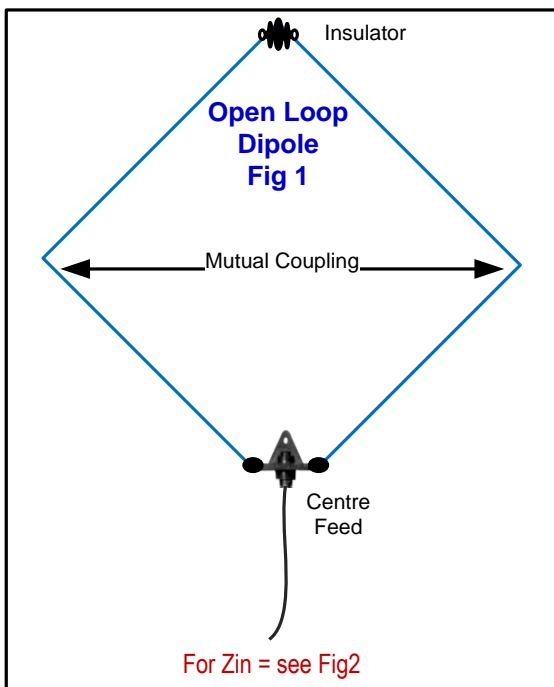


# STUDY - OPEN LOOP DIPOLE ANTENNA – G8ODE

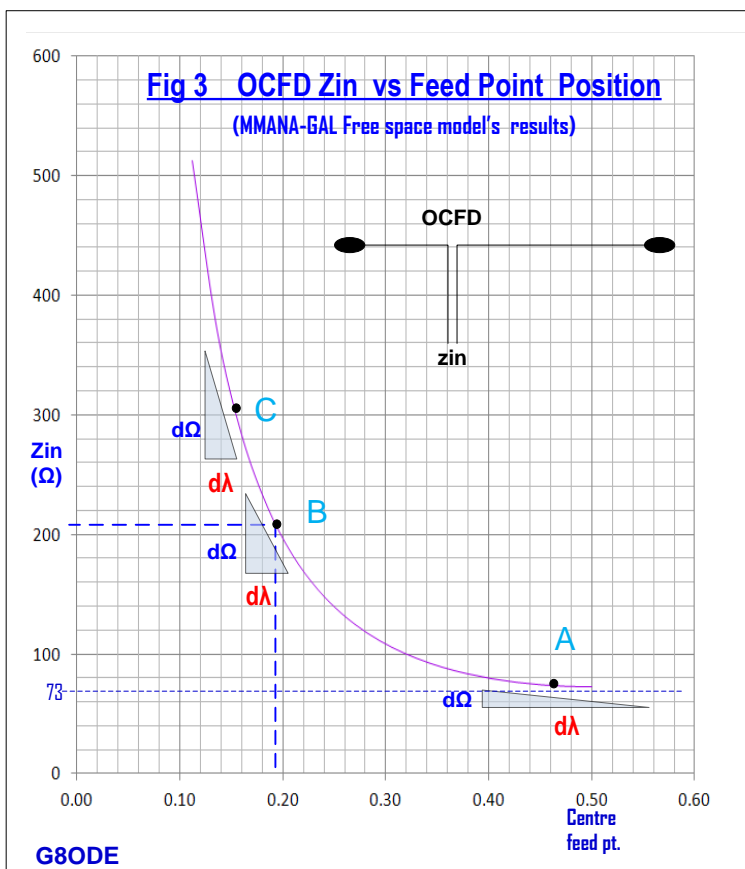
Using MMANA-GAL Freeware Antenna Modelling software



- This study used Freeware MMANA-GAL software V.3.0.0.31. The first model was approx 2.5m square optimised for 20m as shown in Fig1. The horizontal antenna was modelled a quarter wave ( 5m) above real average ground; dielectric =13 with average ground conductivity = 5mS/m.
- Using the MMANA-GAL “wire Scale” on the 20m antenna model, smaller copies were made for the 17m & 15m bands, but keeping the antenna height constant at 5m above real ground. The results for the three antennas are shown in fig 2.
- These show that the impedance of all the antennas is in the order of 9-13 Ohms. These values are the result of the increased mutual coupling of fields in the arms of the dipole i.e. they face each other unlike a conventional dipole where the arms are far apart and the coupling is thus minimised.

| No. | F (MHz) | R (Ohm) | jX (Ohm) | SWR 50 | Gh dBd | Ga dBi | F/B dB | Elev. | Ground | Add H. | Polar. |
|-----|---------|---------|----------|--------|--------|--------|--------|-------|--------|--------|--------|
| 3   | 14.15   | 8.938   | 0.818    | 5.6    | ---    | 4.03   | -1.04  | 88.0  | Real   | 5.0    | hori.  |
| 2   | 18.12   | 5.458   | 0.4542   | 9.16   | ---    | 3.66   | -1.12  | 48.0  | Real   | 5.0    | hori.  |
| 1   | 21.2    | 13.05   | -0.336   | 3.83   | ---    | 4.22   | -1.64  | 40.0  | Real   | 5.0    | hori.  |

Fig 2 Results for OLCFD 20, 17 & 15m antennas at a height of 5m above real average ground



## Open Loop Dipole Antenna 50 Ohms Feed Point

- For a conventional Off Centre Fed Dipole (OCFD) the feed point's impedance increases as it is moved away from the centre of the dipole towards on of the ends- See Fig3.
- This fact can be used to improve the Open Loop's low value feed point's impedance. However, the increase is exponential in nature, so at point B the rate of change is sharper than point A on the curve.
- The MMANA-GAL results in Fig2 model show the OL's impedance is reduced by 4 to 6 times from the ideal 50 ohms.
- Therefore, to improve this situation, the new feed point must be moved to a region of 200-350 ohms – region between point B & C, on the OCFD graph to increase Zin closer to ideal 50 ohms. - e.g. 200/4 or 300/6.
- The steep slope of the graph in the region also indicates that careful adjustments will be necessary. This particularly applies to the 17m Open Loop as the slope becomes even steeper at point C.



## THE OPEN LOOP ANTENNA'S CHARACTERISTICS

- Figures 4-7 show the characteristics of the 20m Open Loop Centre Fed Dipole.
- The Open Loop is omni-directional when deployed horizontally.
- The model also shows that the reactance is fairly low  $\pm j20$  Ohms over this range.

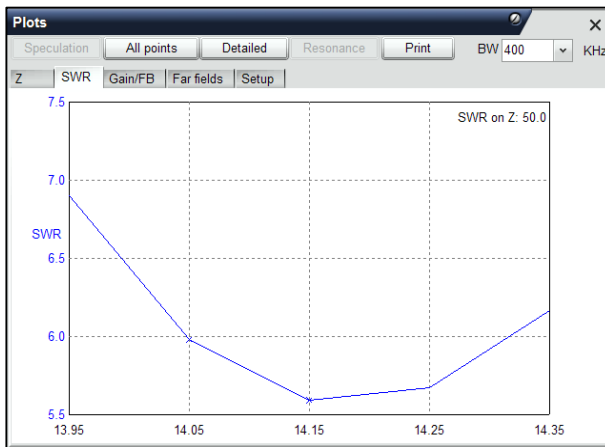


Fig4

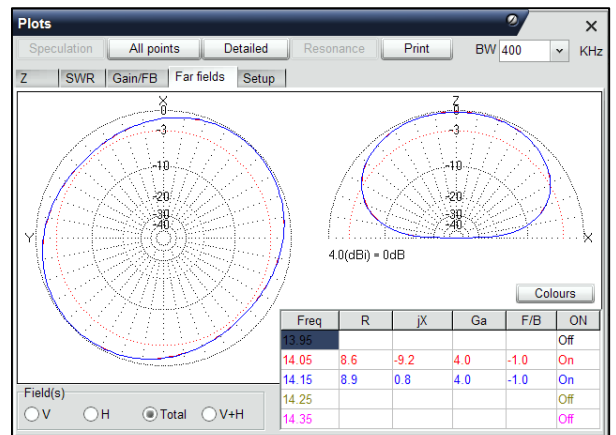


Fig5

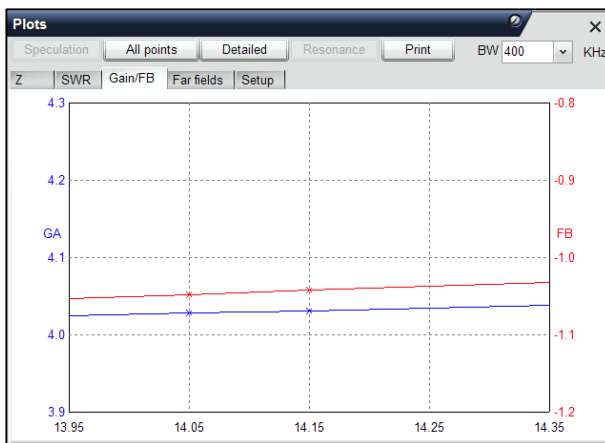


Fig6

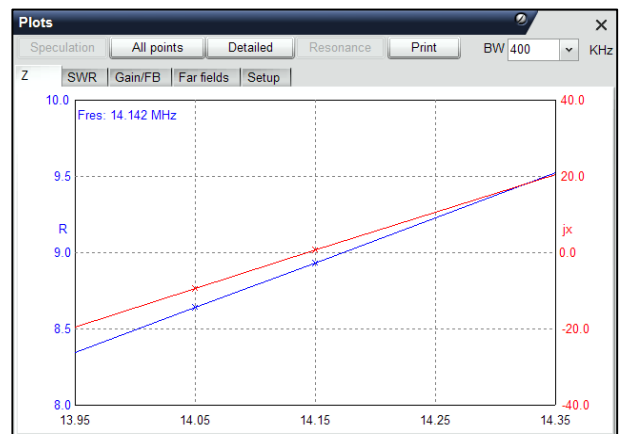


Fig7

## Open Loop Concentric OCFD Antenna (20-17-15m)

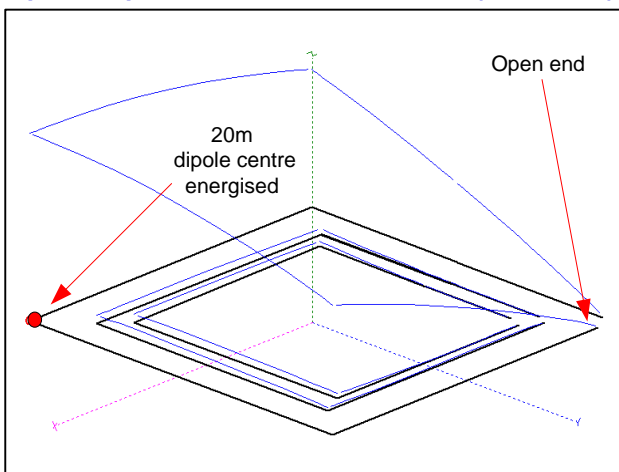


Fig8

- Fig 8 shows the distribution of magnitude of the current around the square Open Loop Centre Fed Dipole.
- Importantly there is little current in the 17m & 15 m dipoles i.e. the transmitter's power is effectively radiated by the 20m element of the concentric array.

# STUDY - OPEN LOOP DIPOLE ANTENNA – G8ODE

Using MMANA-GAL Freeware Antenna Modelling software



In the final Off Centre Fed Dipole (OCFD) model, the three elements were combined into a concentric array. However, the model showed that it is not possible to have a common feed point, because this lowered its impedance considerably, consequently the three elements have to be individually switched to the feeder at the masthead using relays.

## The OPEN LOOP OCFD Results with the antennas at 5m height above average ground

| No. | F (MHz) | R (Ohm) | $jX$ (Ohm) | SWR 50 | Gh dBd | Ga dBi | F/B dB | Elev. | Ground | Add H. | Polar. |
|-----|---------|---------|------------|--------|--------|--------|--------|-------|--------|--------|--------|
| 3   | 14.15   | 50.14   | 2.384      | 1.05   | ---    | 3.94   | -0.11  | 81.0  | Real   | 5.0    | hori.  |
| 2   | 18.12   | 49.99   | 2.218      | 1.05   | ---    | 3.69   | -1.22  | 48.0  | Real   | 5.0    | hori.  |
| 1   | 21.2    | 49.46   | -3.269     | 1.07   | ---    | 4.25   | -1.78  | 39.0  | Real   | 5.0    | hori.  |

NO FATAL ERROR(S)  
1.59 sec

Add height 5.00 m  
Material Cu wire

Fig 9

## The OPEN LOOP OCFD Results with the antennas at 6.5m height above average ground

| No. | F (MHz) | R (Ohm) | $jX$ (Ohm) | SWR 50 | Gh dBd | Ga dBi | F/B dB | Elev. | Ground | Add H. | Polar. |
|-----|---------|---------|------------|--------|--------|--------|--------|-------|--------|--------|--------|
| 3   | 14.15   | 59.27   | -5.75      | 1.22   | ---    | 4.08   | -1.18  | 48.0  | Real   | 6.5    | hori.  |
| 2   | 18.12   | 50.73   | -6.31      | 1.13   | ---    | 4.2    | -1.55  | 35.0  | Real   | 6.5    | hori.  |
| 1   | 21.2    | 45.0    | -10.28     | 1.27   | ---    | 5.14   | -1.86  | 30.0  | Real   | 6.5    | hori.  |

NO FATAL ERROR(S)  
1.48 sec

Add height 6.5 m  
Material Cu wire

Fig 10

By energising only one element at a time i.e. simulating an antenna relay switch and using the MMANA-GAL "View" function, the currents in each of the elements can be inspected to see if there is any interaction with the other two elements. (See Figures 11-13).

20m Element currents

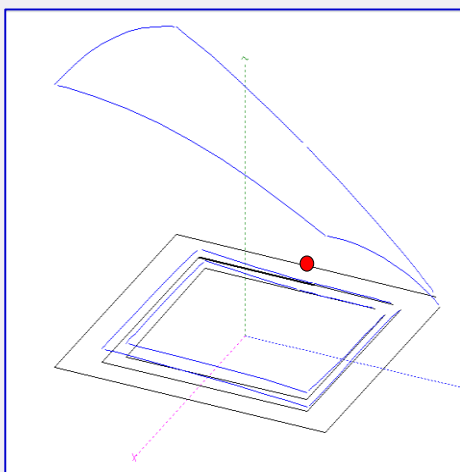


Fig 11

17m Element currents

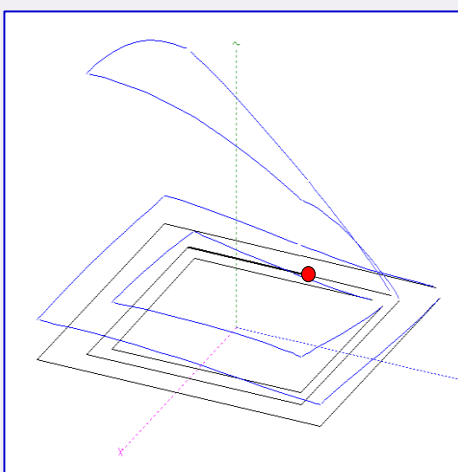


Fig 12

15m Element currents

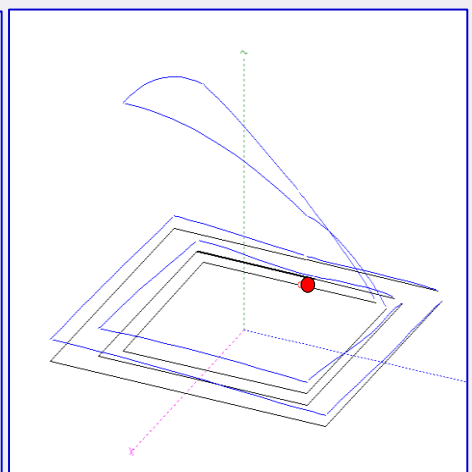


Fig13

● =Source

Figures 11-13 show that the majority of the Far Field radiation exists in the wire the source is connected to.



## Detailed plots of all three Open Loop OCFD concentric antennas

### 20m Open Loop Off-Centre Fed Antenna



Fig14

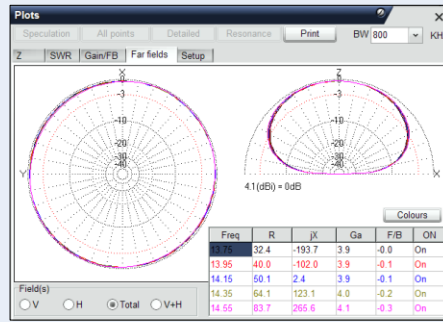


Fig15



Fig16

### 17m Open Loop Off-Centre Fed Antenna



Fig17

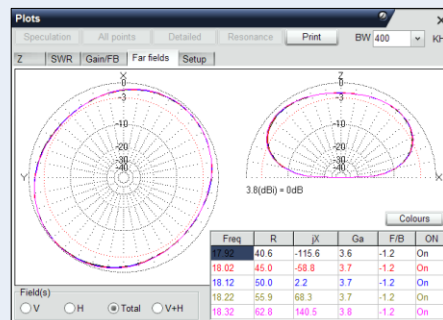


Fig18



Fig19

### 15m Open Loop Off-Centre Fed Antenna

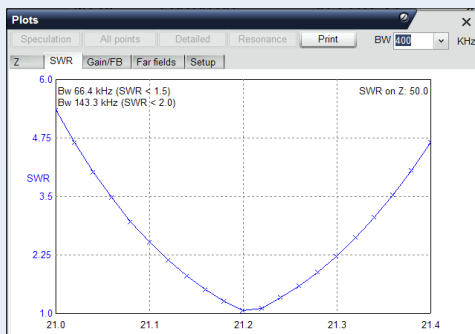


Fig 20

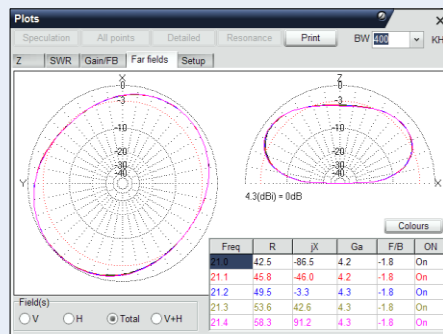


Fig 21

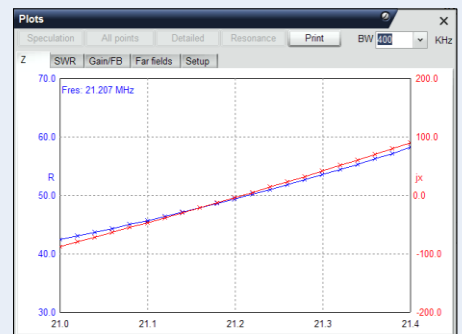


Fig 22

### 20m - 3D FAR FIELD PLOTS - the other bands are similar Fig15,18 & 21

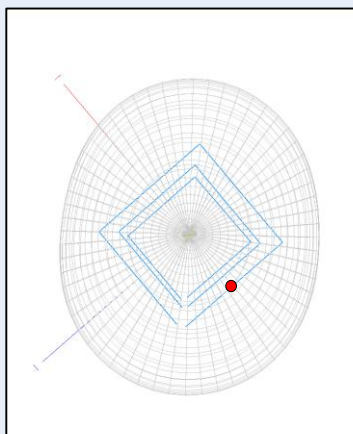


Fig23

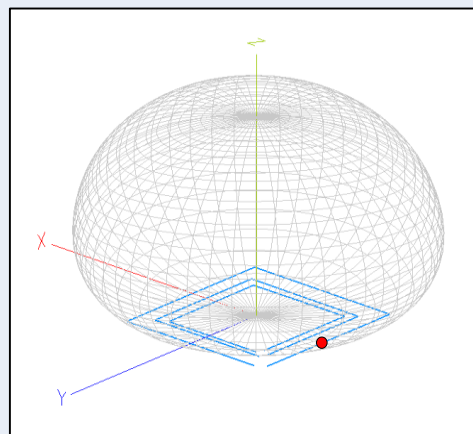


Fig24

● =Source

### CONCLUSIONS

- It is possible to have three concentric open loop antennas fed off-centre with a 50 ohm feed point, but this requires remote antenna switching using relays. *Note: Refer to other RSARS E-Library articles*
- The BW increases with frequency.
- Increasing the height from 5 to 6.5m increases the SWR on all three bands slightly. The OL-OCFD antenna may therefore be sensitive to changes in the water table height.