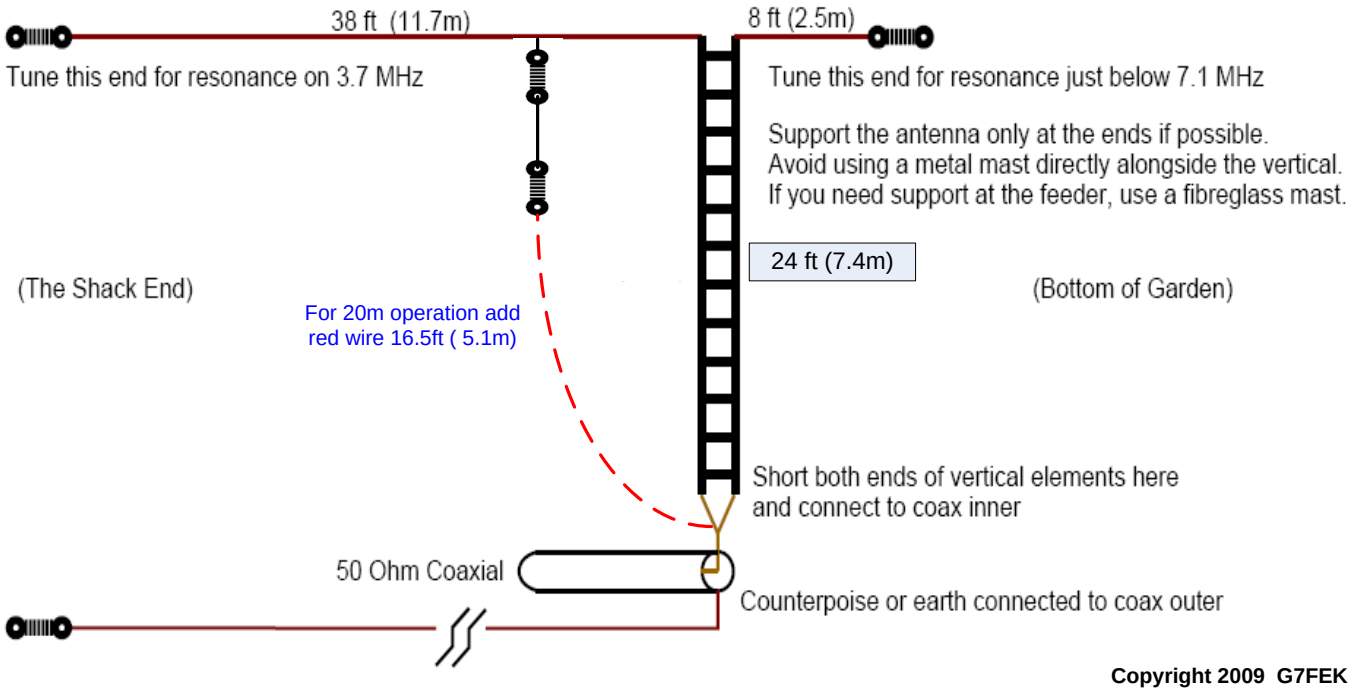
# G7FEK LIMITED SPACE ANTENNA

( Nested Marconi Antenna)

*80, 40, 30, 17, 15 , 12 m  see text for 20 & 10m operation*






During the 1980s **Mike, G7FEK**, described a limited space antenna suitable for most of the HF bands.

Link for the original G7FEK antenna article http://www.g7fek.co.uk/software/G7FEK%20antenna.pdf

Although 20m and 10m are difficult to match he also described a modification to allow operations on these bands. For all other bands two "Inverted L" antennas are connected in parallel and fed with a single feeder. This form of multi-banding has been used with multiple dipoles, often called "stacking" or "nesting", where only one half wave dipole presents a low impedance to the feeder, the others being reactive with high impedances. This also applies to antennas at odd multiples of a half-wave and it is well known that a 40m dipole will present a relatively low impedance on 15m

In a similar manner, the 80m Inverted L will present a high impedance to RF on 40m and vice versa, a type of automatic antenna selection. With higher operating frequencies both antennas contribute to the radiation. This can be seen in the **MMANA-GAL** Analysis and it also clear that as the radiation resistance changes, it will be necessary to consider additional matching techniques. Both of the "Inverted L" radiators are even multiples of a half wave on 20m and consequently the very high radiation resistance will be difficult to match. If 20m operation is required a quarter-wave wire radiator needs to be added to the feed-point  as shown above.

The horizontal (H) to vertical (V) proportions of the inverted “L” antennas can be changed to fit the available space in a garden as long as

**V+H = Quarter wavelength**

*Note:-  Jouko OH5RM read this article and suggested an improvement for 30m operation.* *See page 11*

## MMANA-GAL – G7FEK MODEL RESULTS

| No. | F (MHz) | R (Ohm) | jX (Ohm) | SWR 50 | Gh dBd | Ga dBi | F/B dB | Elev. | Ground | Add H. | Polar. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 3.75 | 28.51 | -3.582 | 1.77 | --- | -0.38 | -0.71 | 29.2 | Real | 0.0 | vert. |
| 5 | 7.05 | 50.55 | -3.572 | 1.07 | --- | 0.38 | -0.09 | 35.0 | Real | 0.0 | vert. |
| 4 | 10.12 | 252.2 | -488.9 | 24.2 | --- | 5.01 | -0.19 | 66.3 | Real | 0.0 | vert. |
| 3 | 14.05 | 742.4 | -612.5 | 25.0 | --- | 3.61 | -0.01 | 34.5 | Real | 0.0 | hori. |
| 2 | 18.12 | 47.41 | -155.1 | 12.1 | --- | 4.99 | -1.33 | 32.5 | Real | 0.0 | hori. |
| 1 | 21.2 | 50.83 | 65.6 | 3.4 | --- | 5.34 | --- | 32.0 | Real | 0.0 | hori. |

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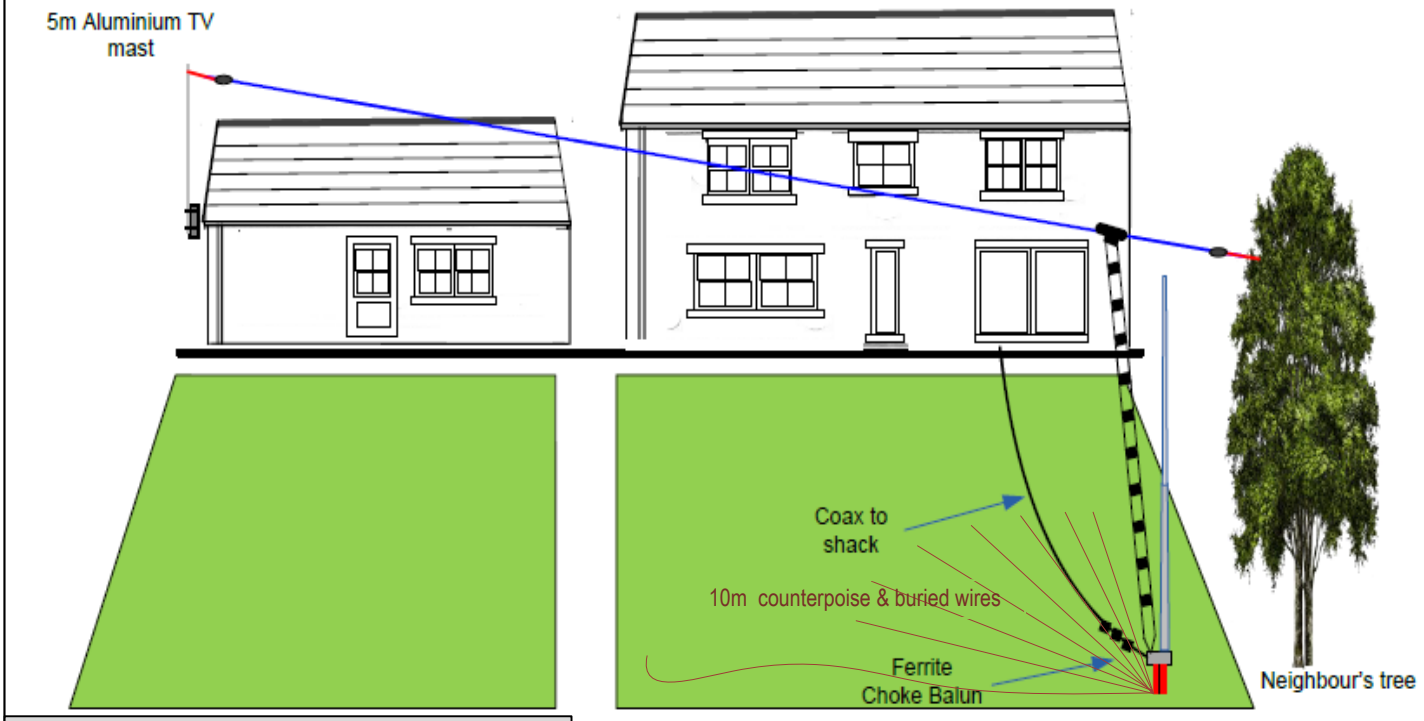


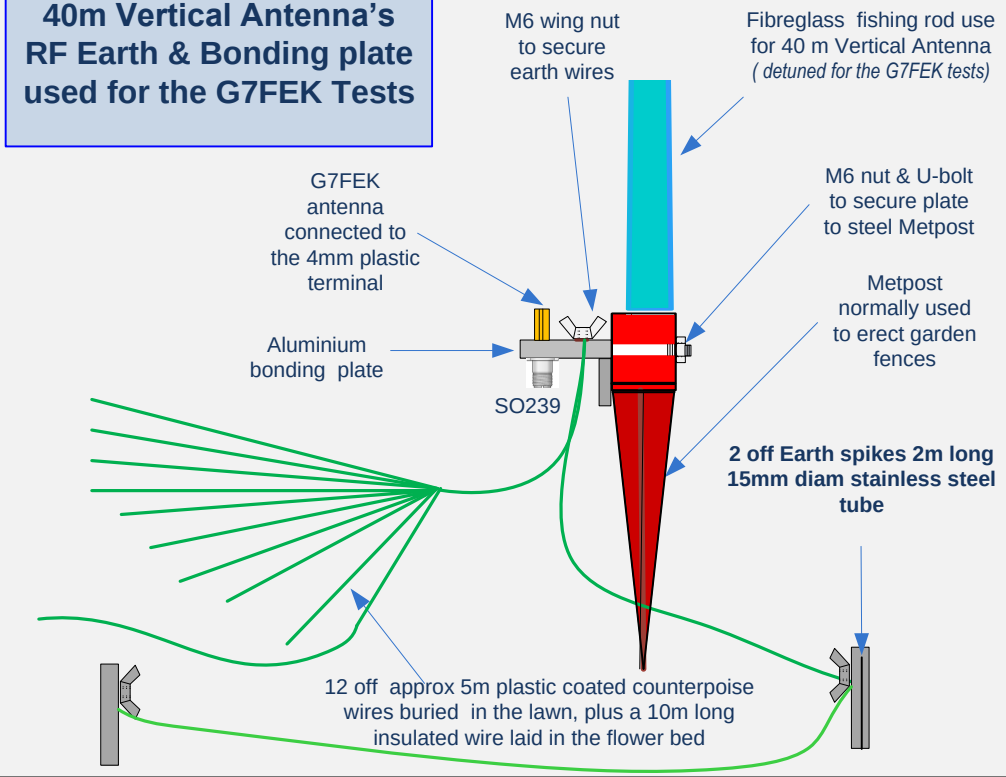

G8ODE Test Set-up for the G7FEK Antenna

*# See note below ref RF earth system*

The test setup utilising a kind neighbour's tree as one of the supports. The other end is attached to an extended "TV" mast secured to the side of the garage. The G7FEK used the connection plate and RF earth of the disconnected 40m vertical antenna in the corner of the garden.

*N.B. For the G7FEK tests the 40m & 160m wire antennas used at the QTH were de-tuned by removing about 2m of wire from each.*

## 40m Vertical Antenna's RF Earth & Bonding plate used for the G7FEK Tests




## Tuning and Performance

The tests carried out using the AUTEK VA1 antenna analyser suggest that the RF Earth is reasonably adequate. The SWR on 80m (3.53MHz)was 1.19:1 and on 40m (6.98MHz) was 1.04:1

Over several weeks various test-QSOs were carried out on 80m and 40m

These consistently gave 5/9 reports across the UK and Europe.

On 80m the G7FEK performed better than the G5RV at a height of 8-9m.

On 40m the received signals from across Europe were approximately the same.

Graphics by G8ODE Aug 2009 iss 1.3

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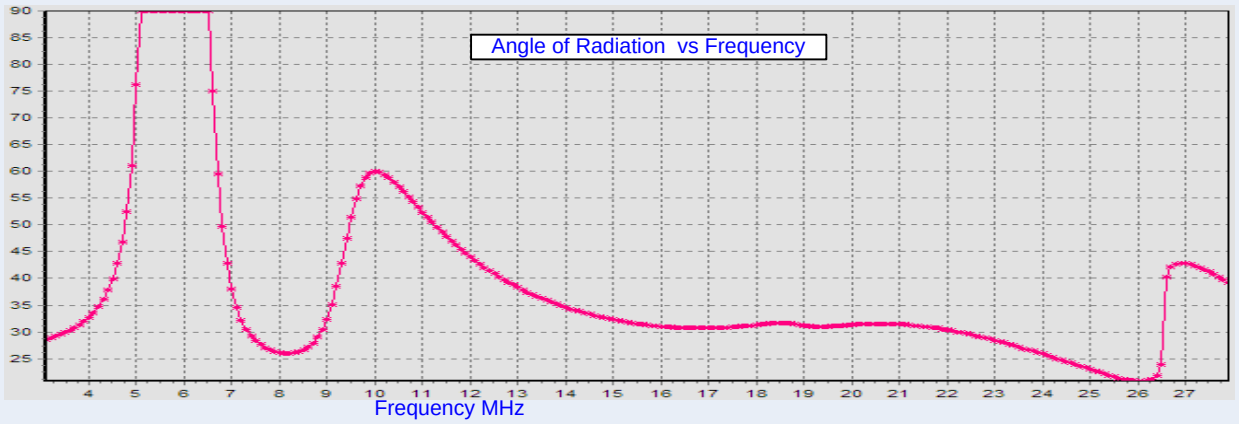
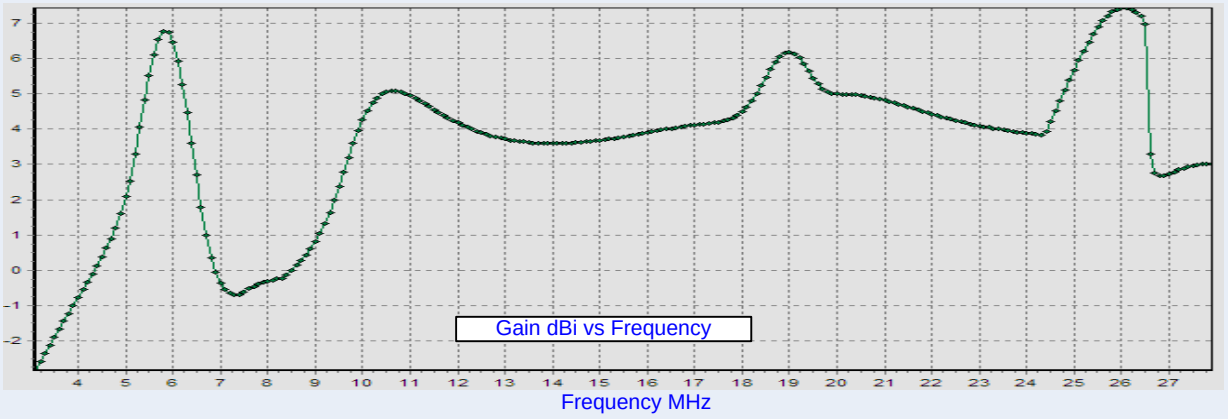
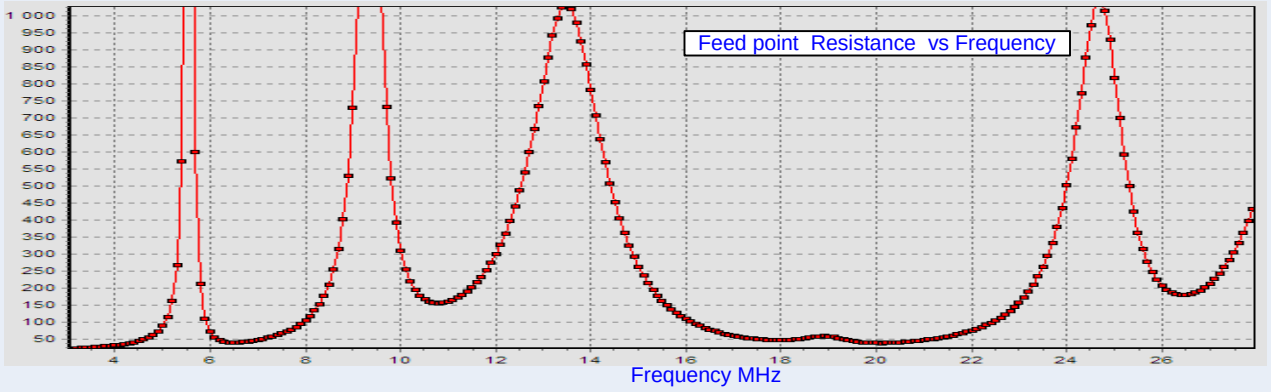
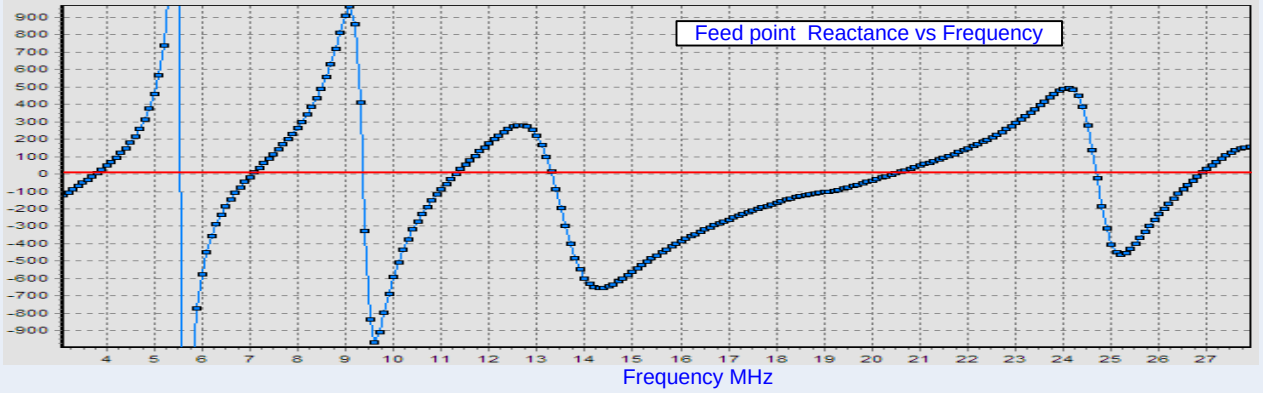
These additional graphs were provided by DL2KQ who is one of the MMANA-GAL program developers using another program and,  were plotted using the MMANA-GAL program G7FEK data file, because the MMANA-GAL program is very limited in the number of points it can plot for graphs and therefore was unable to show the detail below.

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# G7FEK LIMITED SPACE ANTENNA

( Nested Marconi Antenna)

*80, 40, 30, 17, 15 , 12 m  see text for 20 & 10m operation*

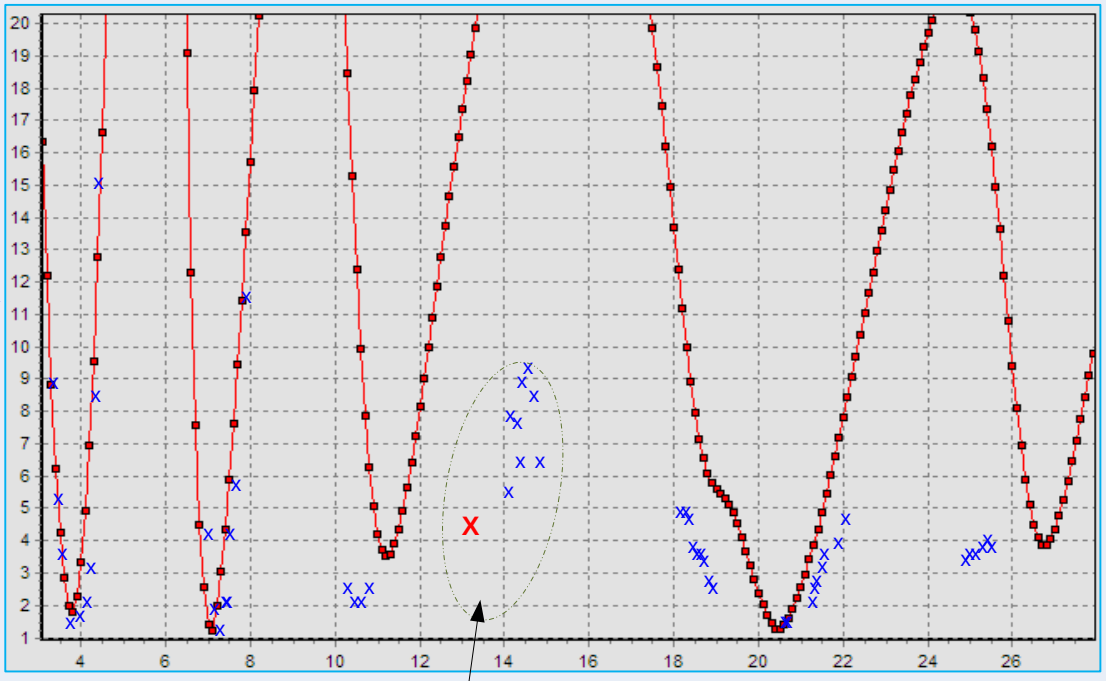
*Wide spectrum graphs provided by DL2KQ for the MMANA-GAL "G7FEK-mma-2" model that was the used to analyse the antenna*

11/7/2009

**Comparing the G7FEK antenna model with the G8ODE version deployed approx 6-7m above the lawn**

**Wide Spectrum MMANA-GAL SWR**

***Plot Provided by DL2KQ***




X= Autek SWR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Autek VA1 Results | Freq | 3.53MHz | 6.985 MHz | 10.14 MHz | | 20.24 MHz | 27.91MHz |
| | SWR | 1.19:1 | 1.04:1 | 2.05:1 | | 1.16:1 | 3.04:1 |
| Autek VA1 Results | Freq | | | | 13.28 MHz | | |
| | SWR | | | | 4.5:1 | | |

Suspect that this anomaly due to insulated counterpoise earths resonating. Theoretically the antenna should be a high impedance on 20m

## Notes on the Antenna Test Set-Up

**##** *The test -G7FEK antenna differs slightly from the original design shown on page one. The antenna was tuned to the CW end of the 80 and 40m bands so that it could be used with a QRP FT-817 transceiver without a tuner. The minimum SWR coincides with the two frequencies 3.53MHz and 6.985MHz.*

*The counterpoise was also omitted and replaced with the RF earth system shown on page 2.*

1. The Autek VA1 shows the antenna also has a min SWR 4.5:1 at 13.28MHz

2. The antenna measurements were taken in the shack at the end of a 10m RG213 coax with a 1.1m section of Mini-8 coax. An 8 turns coiled-coaxial choke (RG58 5m) was provided at the feed-point.

3 The RF earth comprises of 2 earth 1.2m & 1.9m rods separated by a distance of 2m . There are also 12 insulated 2.5mm diam wires all about approx 5m buried in the lawn 15cm down, and fanned out in a 90 degree sector of the lawn. An additional 8m wire was laid on the surface of the flower bed.

4. Lawn is laid on a predominantly sandy soil and the conditions during the tests – wet after some overnight rain.

5. **Conclusions about the model :-**
The measured results for 80, 40 and 15m bands show a close correlation with the MMANA-GAL model's results. The 20m results have the greatest errors. The 17 and15m readings follow the trend of the model but have a less sharp profile.

Even though the MMANA-GAL model used assumed values for the electrical properties of the ground, and cannot show the effects of nearby trees and bushes, the model's SWR values generally agree with the measured results. The model may also provide a good indication of how the antenna operates on the design frequencies or bands.

G8ODE

# G7FEK LIMITED SPACE ANTENNA

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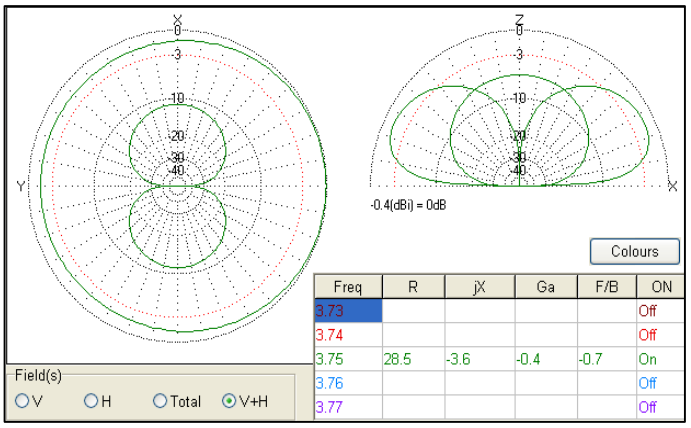
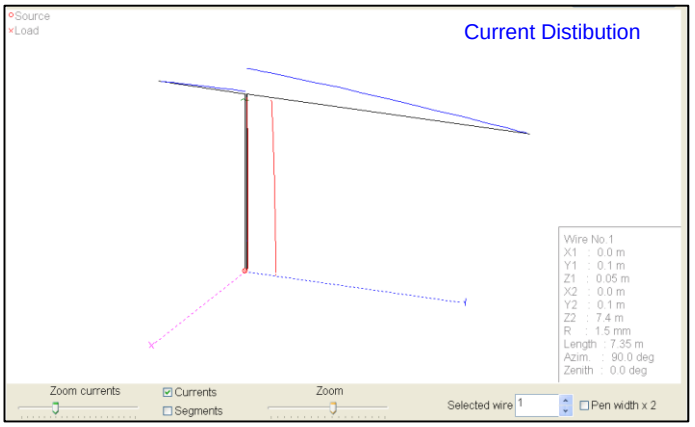
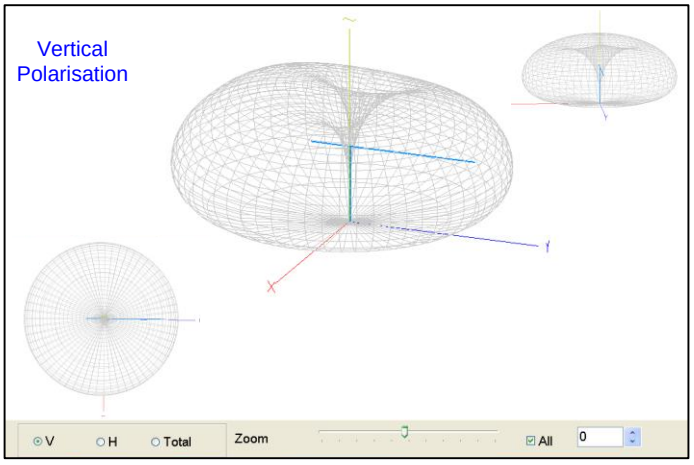
The antenna radiation patterns were produced using MMANA-GAL and a model of the G7FEK antenna supplied by Igor DL2KQ. The simulation had a RF ground comprising 12 x1.5mm radials with additional 15 ohms of loses, a dielectric of 13.0 and ground conductivity of 5mS/m. The model's vertical section was 7.4m and the two horizontal sections 12.4 and 3.8m respectively

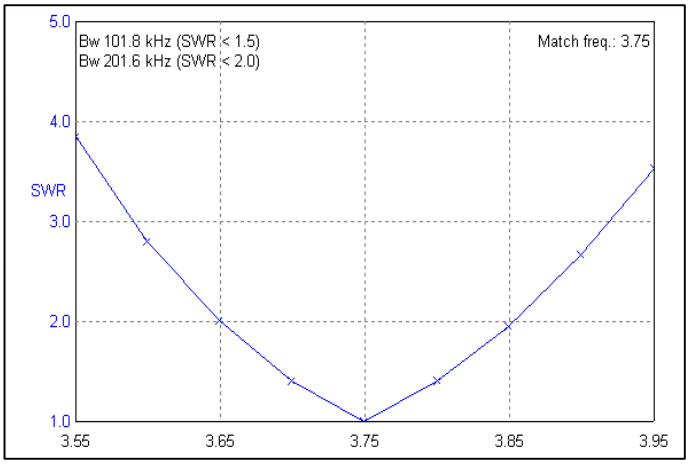
## 3.75 MHz Radiation Patterns

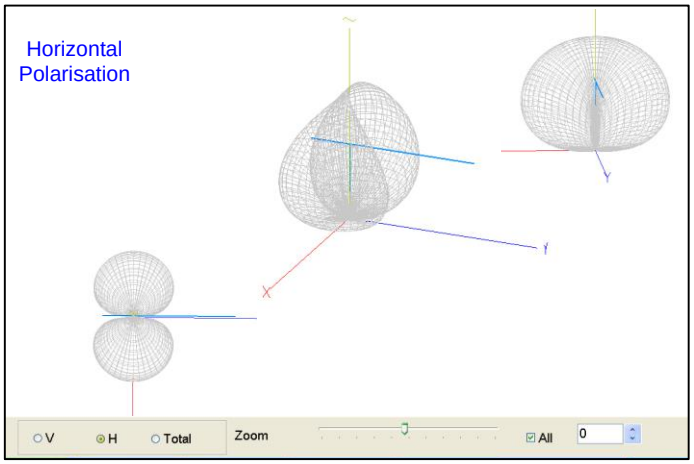


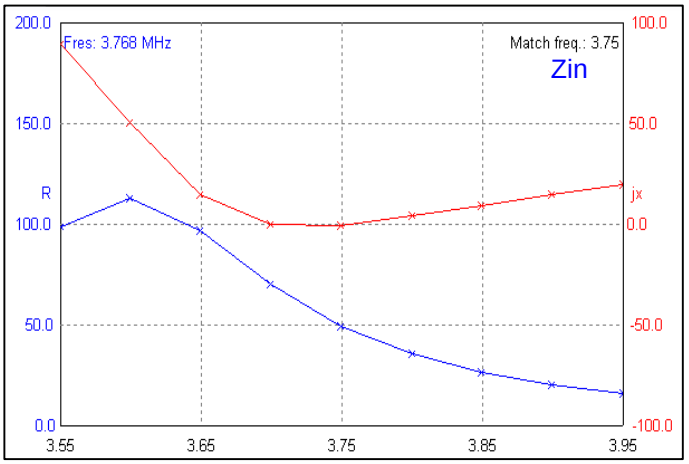

| Freq | R | jX | Ga | F/B | ON |
|---|---|---|---|---|---|
| 3.73 | | | | | Off |
| 3.74 | | | | | Off |
| 3.75 | 28.5 | -3.6 | -0.4 | -0.7 | On |
| 3.76 | | | | | Off |
| 3.77 | | | | | Off |




The current distribution clearly shows the dominant 80m side of the G7FEK antenna. The antenna appears to have good omni-directional properties, which have been borne out in practice and, because it is deployed at a height less that an 1/8 wavelength above the ground will provide  NVIS and a 200Khz bandwidth between the 2:1 SWR points

Graphics  by G8ODE Aug 2009  iss 1.3

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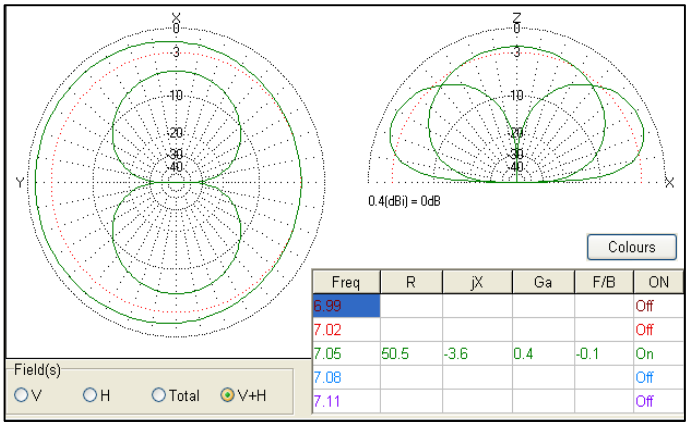
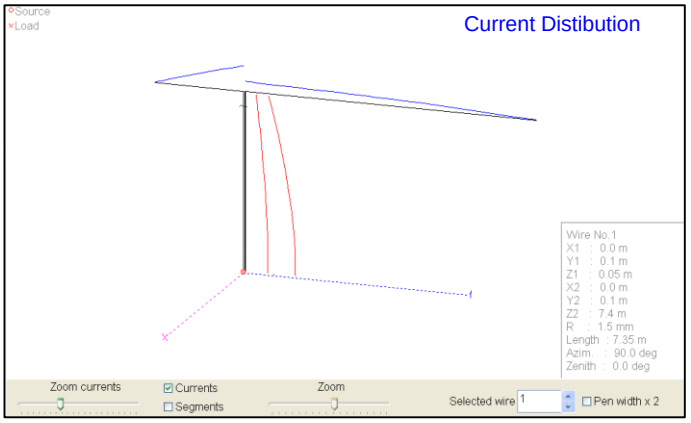
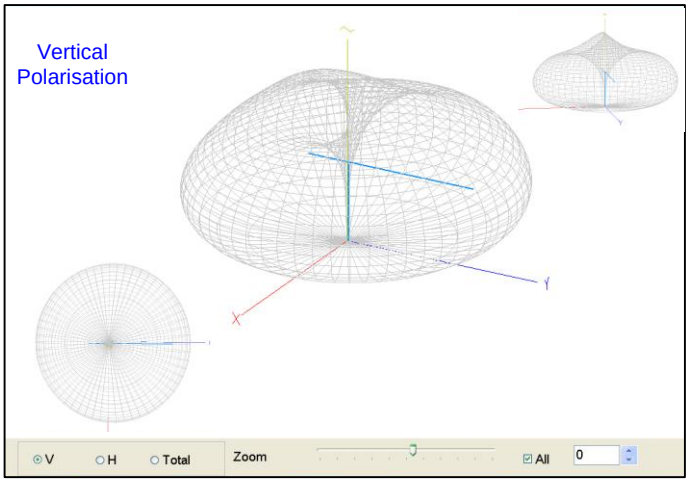
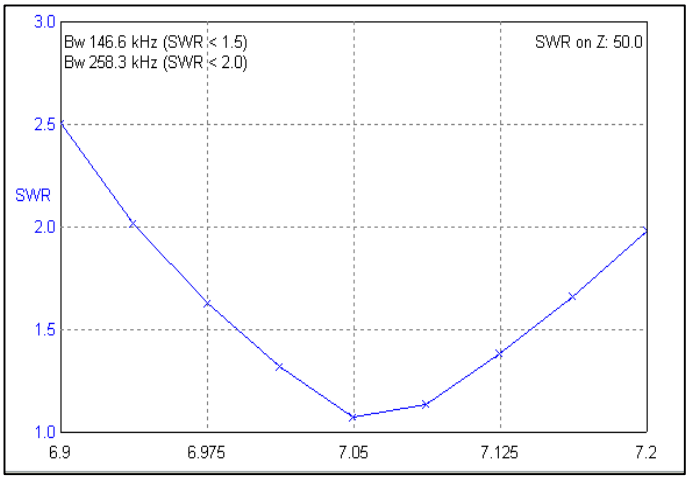
## 7.05 MHz Radiation Patterns

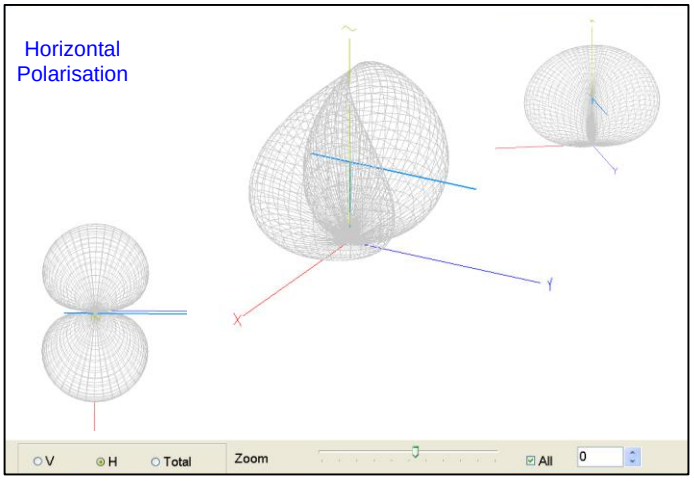


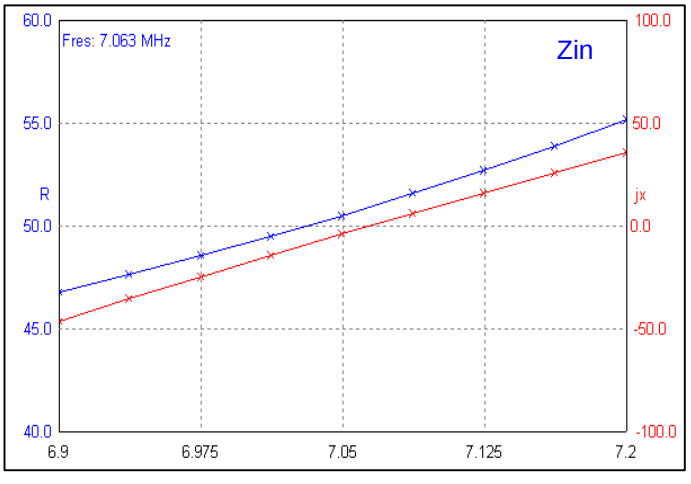

| Freq | R | jX | Ga | F/B | ON |
|---|---|---|---|---|---|
| 6.99 | | | | | Off |
| 7.02 | | | | | Off |
| 7.05 | 50.5 | -3.6 | 0.4 | -0.1 | On |
| 7.08 | | | | | Off |
| 7.11 | | | | | Off |




The current distribution shows the dominant side of the G7FEK  to be the 40m side as one would expect, but the 80m antenna also contributes some energy to the overall  radiation pattern. The antenna model indicates that the G7FEK is omni-directional on this band with a 250KHz bandwidth between the 2:1 SWR points

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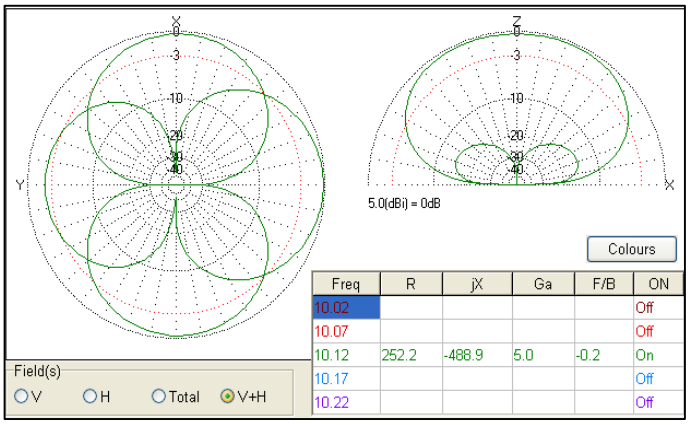
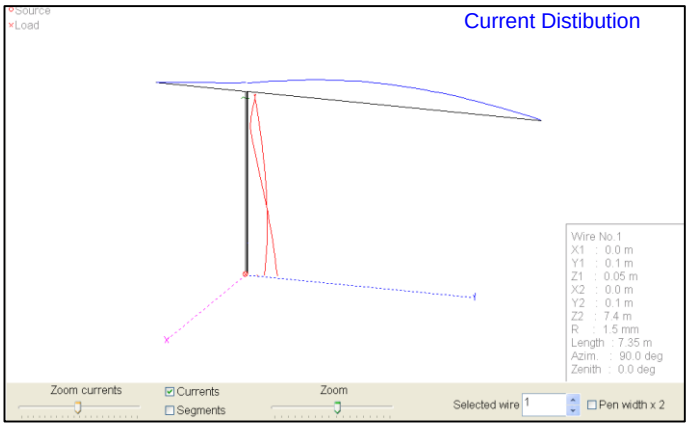
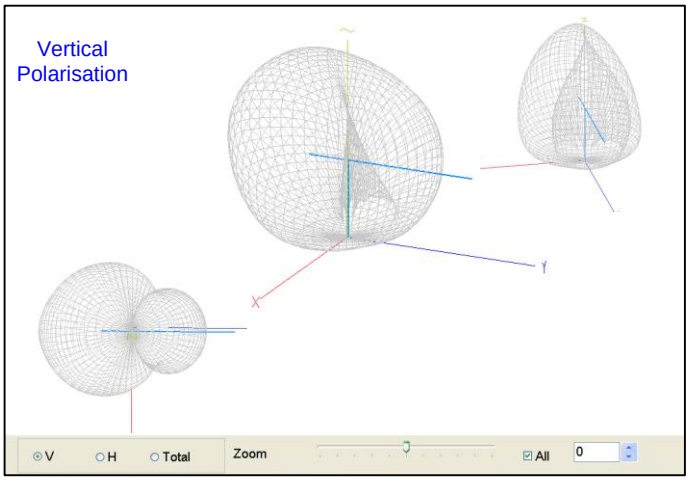
The antenna radiation patterns were produced using MMANA-GAL and a model of the G7FEK antenna supplied by Igor DL2KQ. The simulation had a RF ground comprising 12 x1.5mm radials with additional 15 ohms of loses, a dielectric of 13.0 and ground conductivity of 5mS/m. The model's vertical section was 7.4m and the two horizontal sections 12.4 and 3.8m respectively

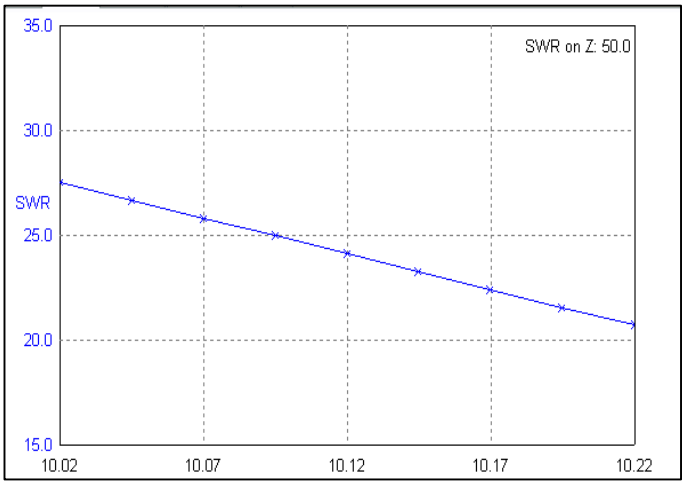
## 10.12 MHz Radiation Patterns

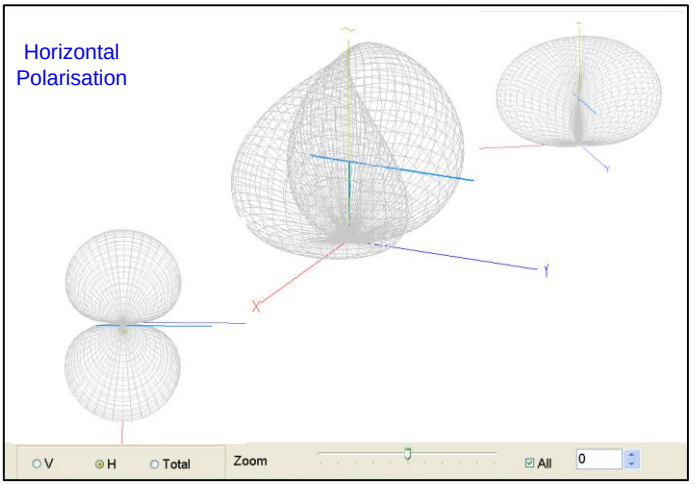


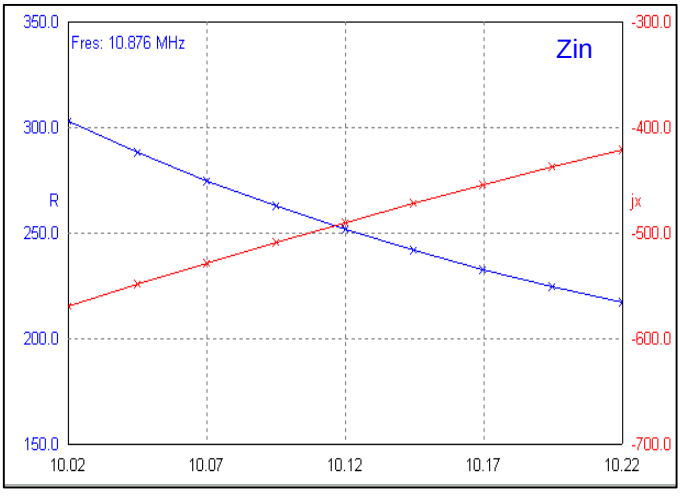

| Freq | R | jX | Ga | F/B | ON |
|---|---|---|---|---|---|
| 10.02 | | | | | Off |
| 10.07 | | | | | Off |
| 10.12 | 252.2 | -488.9 | 5.0 | -0.2 | On |
| 10.17 | | | | | Off |
| 10.22 | | | | | Off |




The MMANA MODELS SWR and Impedance graphs  show that the G7FEK  has a high input impedance on the 30m band – with the SWR = 24.2:1 , but it was found that it could still be tuned using an "T" match tuner since the Autek VA1 measured the SWR = 2.5:1. The antenna appears to be omni-directional.

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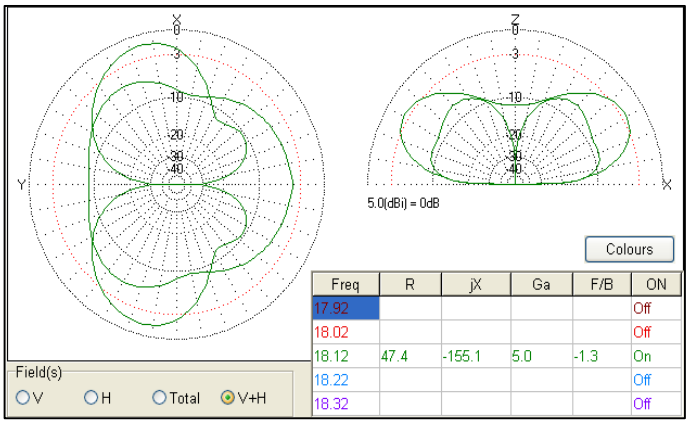
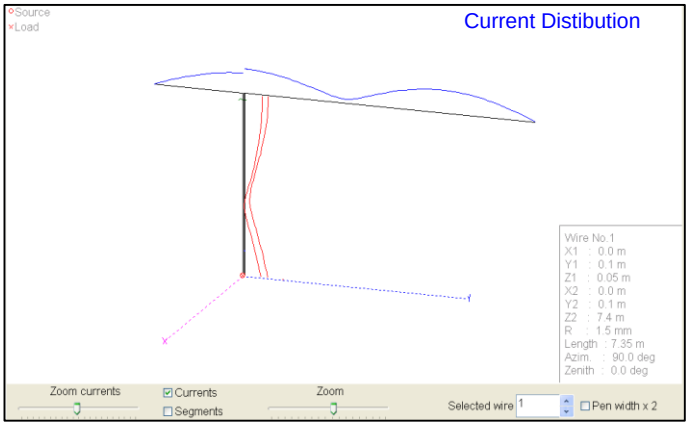
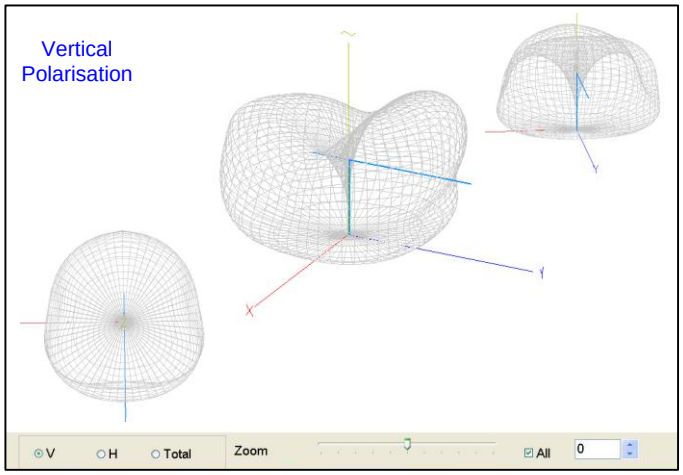
The antenna radiation patterns were produced using MMANA-GAL and a model of the G7FEK antenna supplied by Igor DL2KQ. The simulation had a RF ground comprising 12 x1.5mm radials with additional 15 ohms of loses, a dielectric of 13.0 and ground conductivity of 5mS/m. The model's vertical section was 7.4m and the two horizontal sections 12.4 and 3.8m respectively

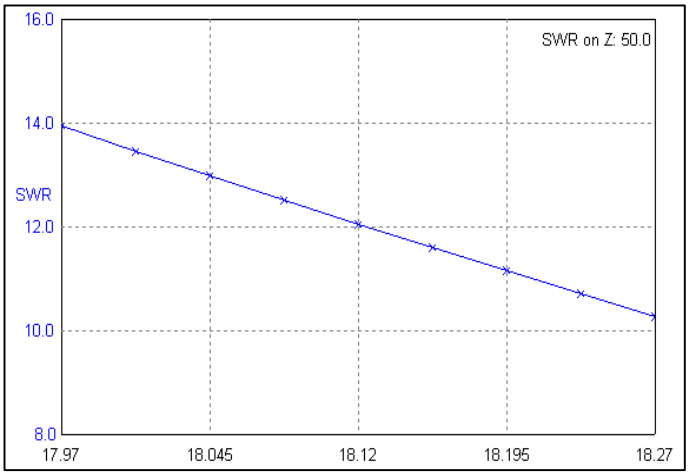
## 18.12 MHz Radiation Patterns

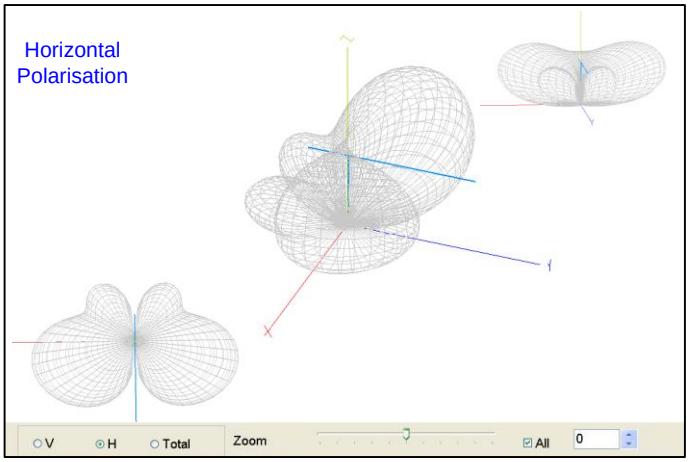


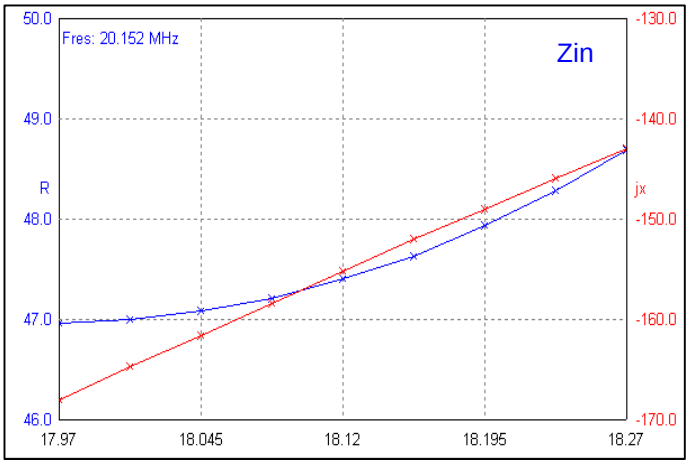

| Freq | R | jX | Ga | F/B | ON |
|---|---|---|---|---|---|
| 17.92 | | | | | Off |
| 18.02 | | | | | Off |
| 18.12 | 47.4 | -155.1 | 5.0 | -1.3 | On |
| 18.22 | | | | | Off |
| 18.32 | | | | | Off |




The SWR and Impedance graphs show that the G7FEK has an input impedance that is still relatively high on the 17 m band – with the SWR = 12.1:1 , but it was easily tuned using an "T" match tuner. The antenna produces a number of lobes on this band and is no longer omni-directional. Moreover both the 40m & 80m antennas appear to contribute fairly equally to the radiation pattern.

Graphics by G8ODE Aug 2009 iss 1.3

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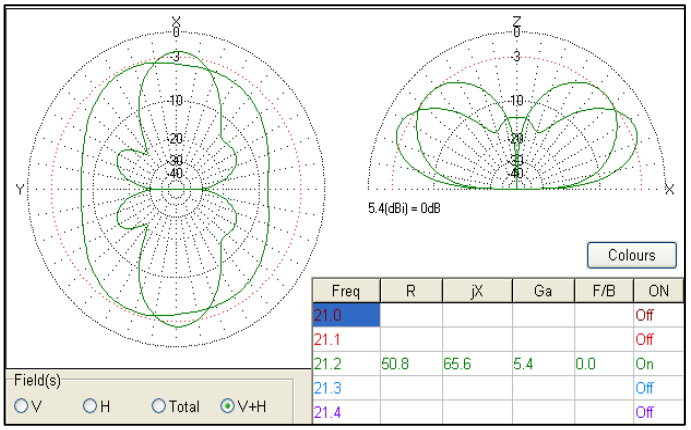
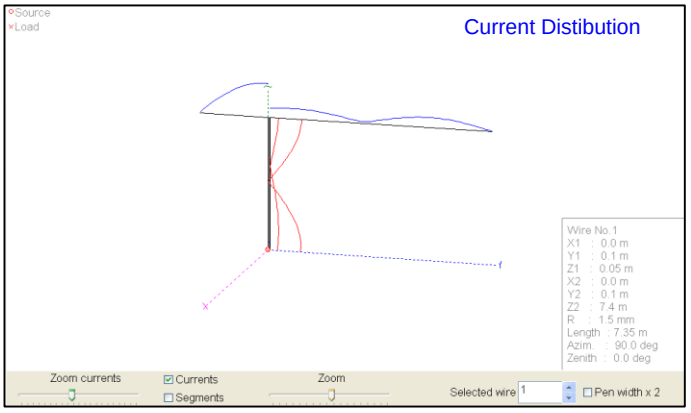
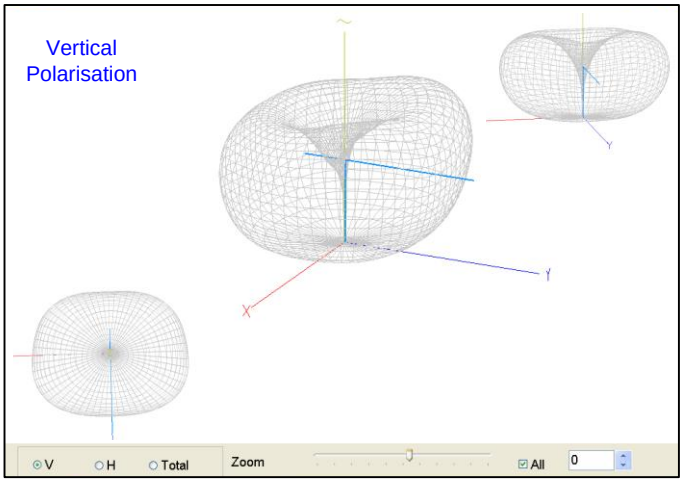
The antenna radiation patterns were produced using MMANA-GAL and a model of the G7FEK antenna supplied by Igor DL2KQ. The simulation had a RF ground comprising 12 x1.5mm radials with additional 15 ohms of loses, a dielectric of 13.0 and ground conductivity of 5mS/m. The model's vertical section was 7.4m and the two horizontal sections 12.4 and 3.8m respectively

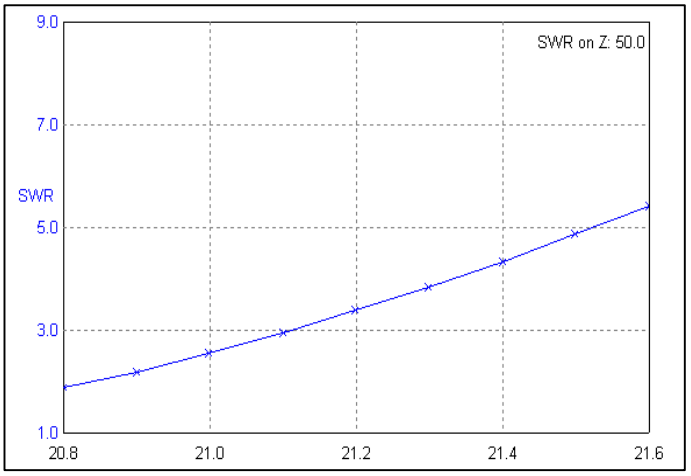
## 21.2 MHz Radiation Patterns

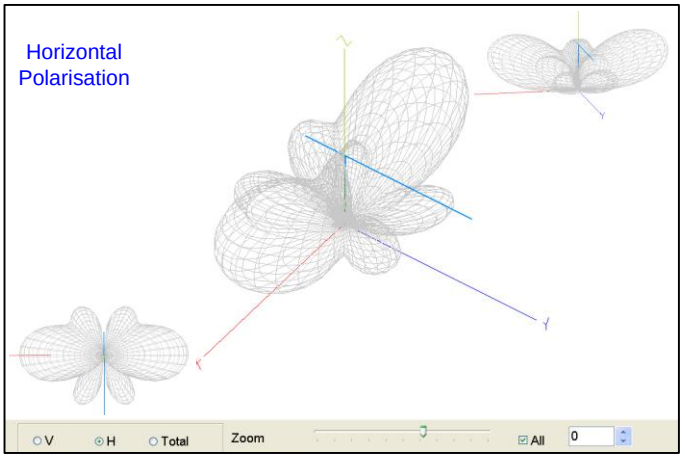


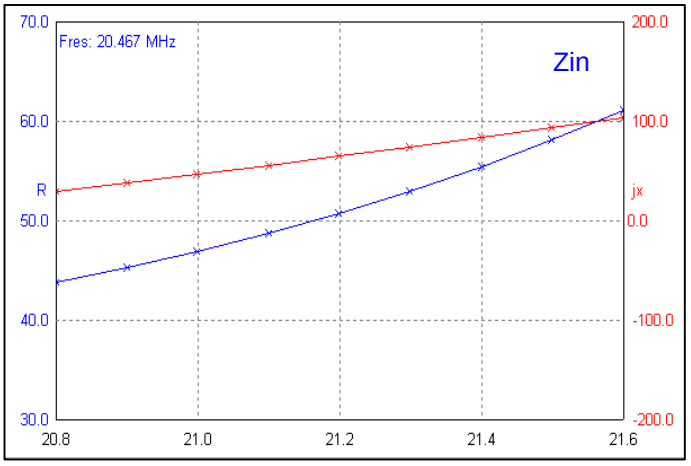

| Freq | R | jX | Ga | F/B | ON |
|---|---|---|---|---|---|
| 21.0 | | | | | Off |
| 21.1 | | | | | Off |
| 21.2 | 50.8 | 65.6 | 5.4 | 0.0 | On |
| 21.3 | | | | | Off |
| 21.4 | | | | | Off |




The SWR and Impedance graphs show that the G7FEK has an input impedance that is 150 ohms ( SWR 3:1 @ 20.7 MHz ) on the 15 m band, but it but was easily tuned using an "T" match tuner. The antenna produces a number of lobes, with two significant horizontally polarised ones broadside to the antenna. Both the 40m & 80m antennas contribute can be seen to the radiation pattern.

Graphics by G8ODE Aug 2009 iss 1.3

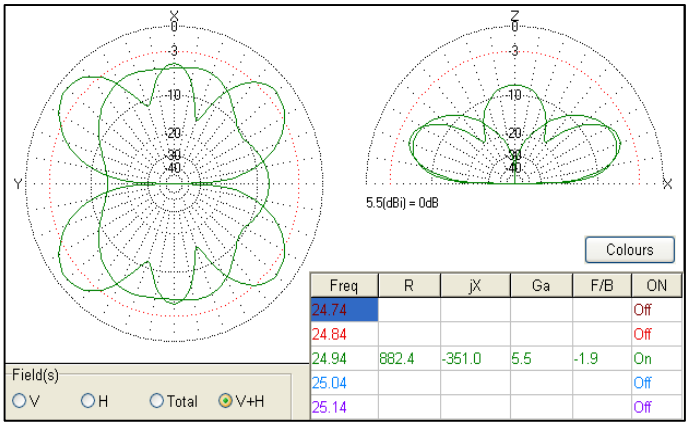
# G7FEK LIMITED SPACE ANTENNA

( Nested Marconi Antenna)

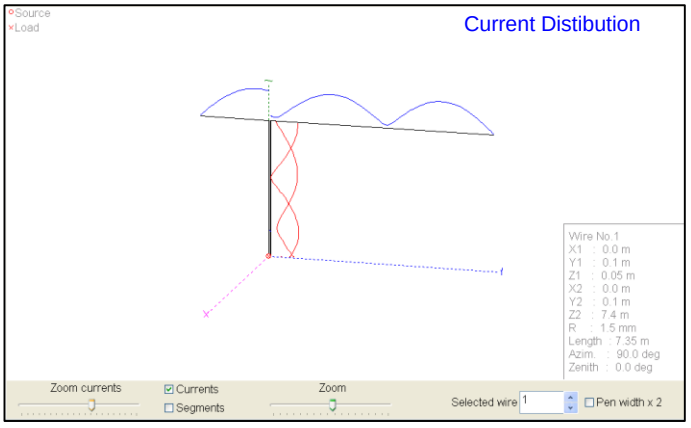
*80, 40, 30, 17, 15 , 12 m  see text for 20 & 10m operation*

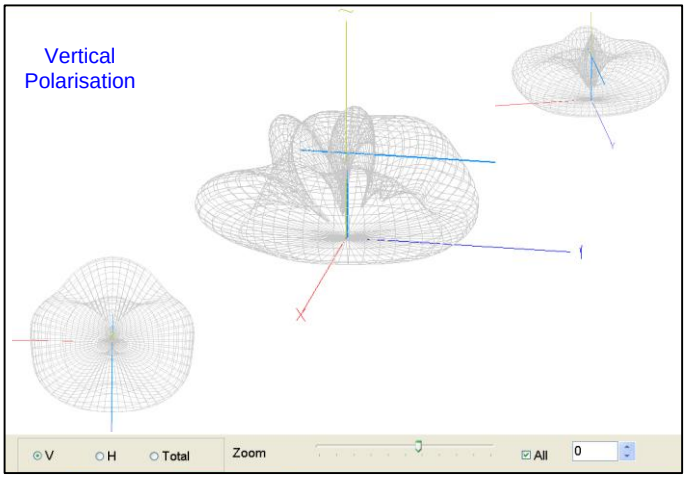
The antenna radiation patterns were produced using MMANA-GAL and a model of the G7FEK antenna supplied by Igor DL2KQ. The simulation had a RF ground comprising 12 x1.5mm radials with additional 15 ohms of loses, a dielectric of 13.0 and ground conductivity of 5mS/m. The model's vertical section was 7.4m and the two horizontal sections 12.4 and 3.8m respectively

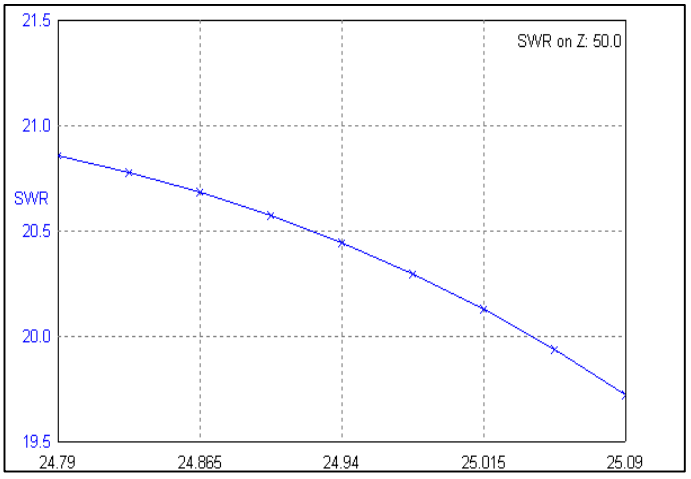
## 24.94 MHz Radiation Patterns

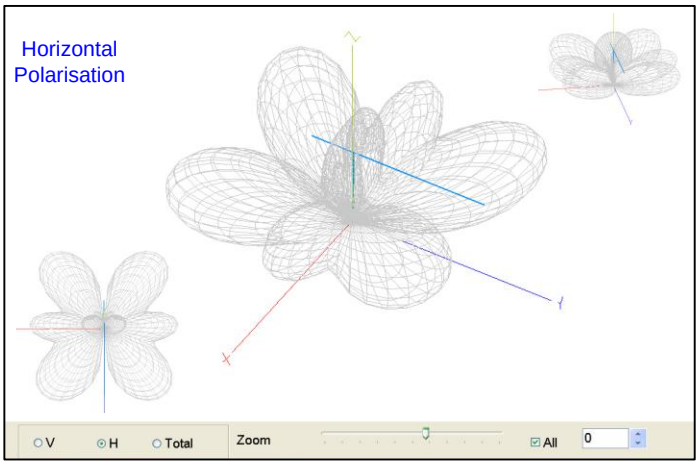


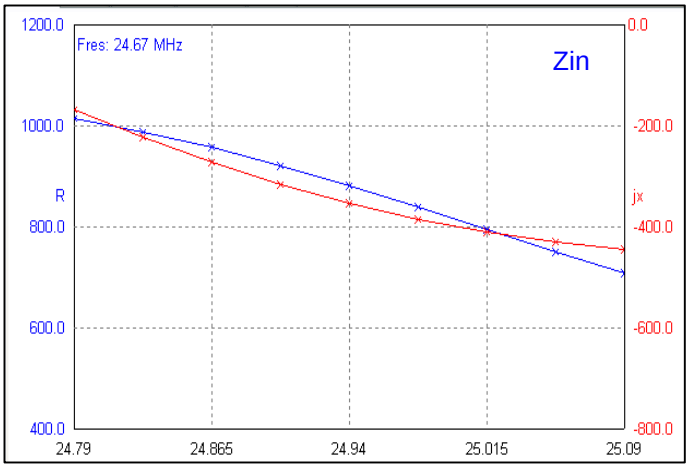

| Freq | R | jX | Ga | F/B | ON |
|---|---|---|---|---|---|
| 24.74 | | | | | Off |
| 24.84 | | | | | Off |
| 24.94 | 882.4 | -351.0 | 5.5 | -1.9 | On |
| 25.04 | | | | | Off |
| 25.14 | | | | | Off |




The SWR and Impedance graphs show that the G7FEK has a very high input impedance >1000 ohms ( SWR 20.4: @ 24.77 MHz ) on the 12 m band, but was still tuned using a Welz Antenna Matcher & MFJ 945E "T" match tuners. The antenna produces a clover leaf pattern of Horizontal lobes. Both the 40m & 80m antennas contribute can be seen to the radiation pattern.

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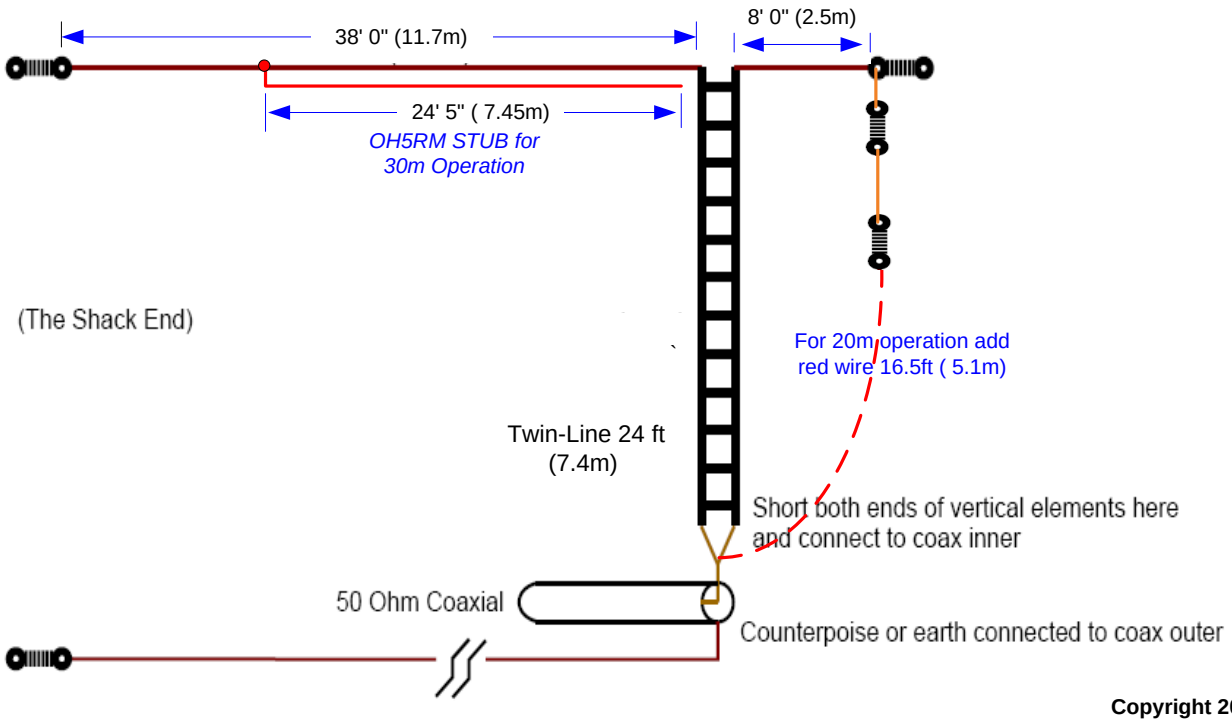
# G7FEK LIMITED SPACE ANTENNA
## Improved 30m Operation

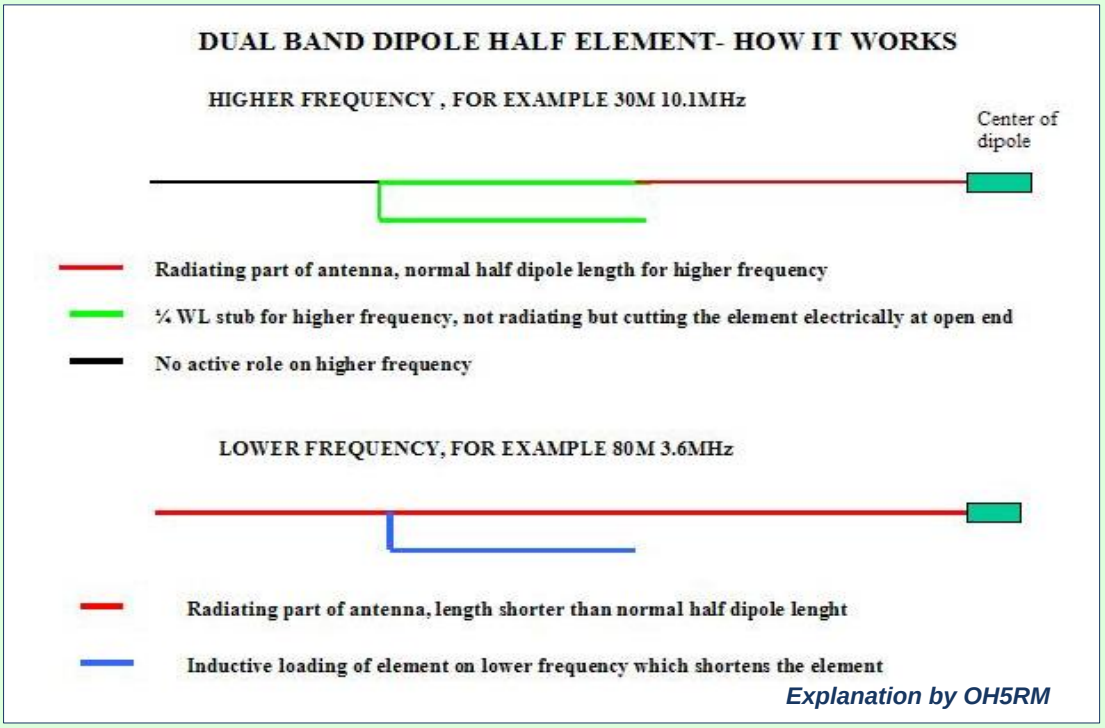
Jouko OH5RM read this article on the G7FEK and suggested this improvement for 30m operation.

This was modelled using the freeware program MMANA-GAL ...seems to work ok .






OH5RM shortened the 80m section slightly, and also suggests using BT Telephone copper-plated steel drop wire ) Zo approx 140 Ohms.
MMANA Modelled a 1.5mm dia wire spaced 11cm away 80m wire

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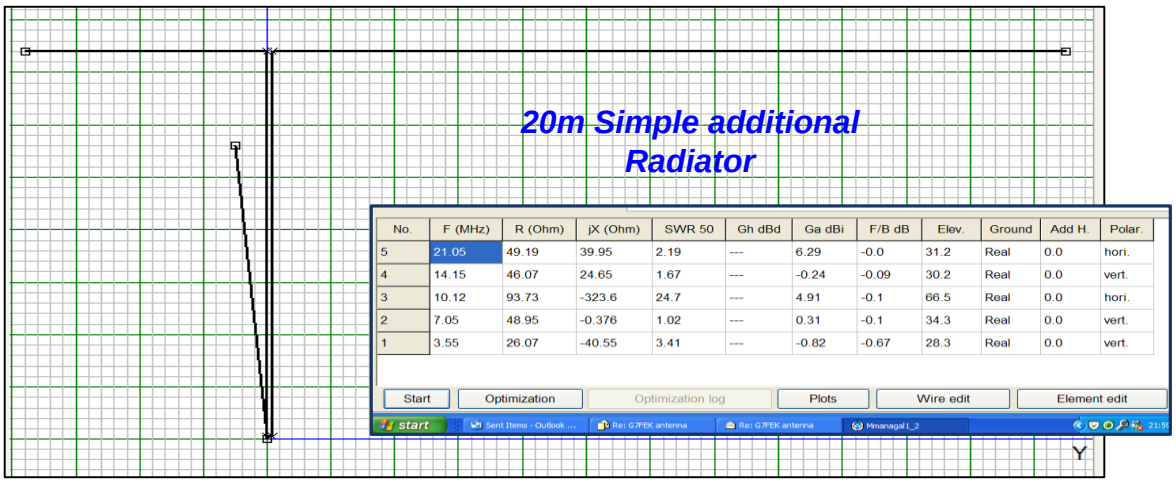
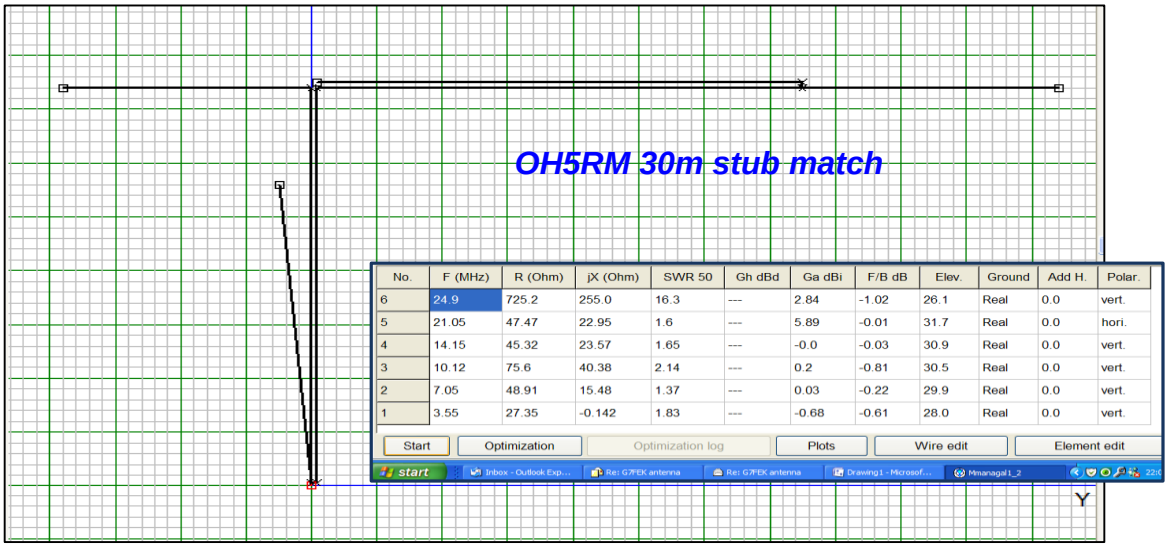
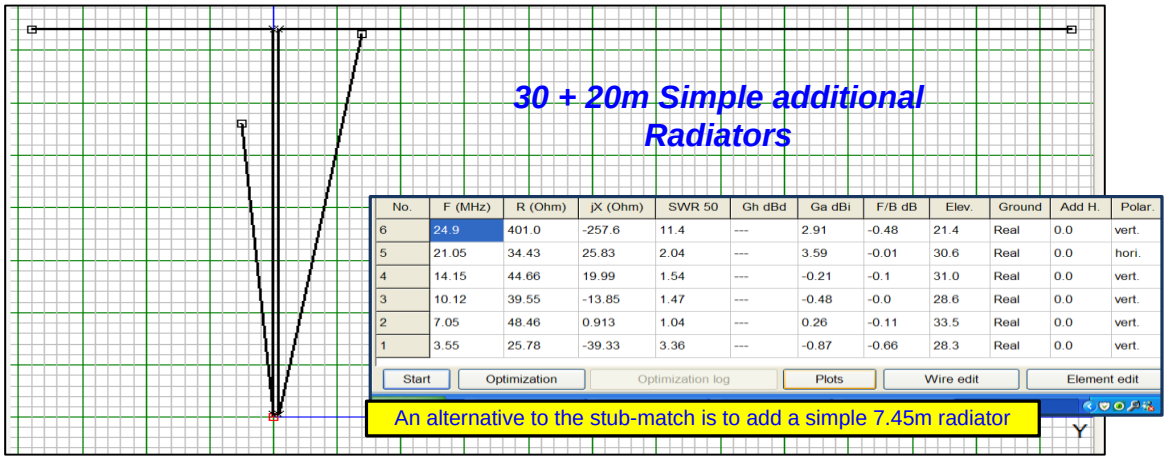
# G7FEK LIMITED SPACE ANTENNA
Improved 30m Operation

## G7FEK 20m & 30m Band Extensions




For further detailed G7FEK antenna analysis by Martin Ehrenfried – G8JNJ refer to:-
http://g8jnj.webs.com/G7FEK%20antenna%20revisited.pdf

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