



FIVE AND NINE PLUS

THE OFFICIAL NEWSLETTER OF THE APPLEDORE AND DISTRICT AMATEUR RADIO CLUB

Club Callsigns: G2FKO and GX2FKO
Web Site : www.adarc.co.uk

CLUB'S OFFICERS

President Terry Adams G4CHD
Chairman John Lovell G3JKL
Vice Chairman Mike Wogden G4KXQ
Secretary Alan Fisher 2E0EUZ secretary@adarc.co.uk
Treasurer Ray Hunter M0TLO

Committee Andrew Brook M0MFS
Keith Luxton G0AYM
Ben Louder 2E0FTZ
Graham Stephens M1GRA

QSL Manager John Lovell G3JKL
Web Master John Lovell G3JKL
Exam Secretary John Lovell G3JKL
Editor Terry Adams G4CHD terrywho35@gmail.com

May 2021

EDITORIAL

Welcome to another Club Newsletter.

As you can see in the table opposite, this month we have another fascinating talk from **Graham (M1GRA)** with a **visual history of Roberts radio** which is next **Monday - May 17th**.

Graham's talks are always very well researched and extremely entertaining and informative and hence well worth watching. Invites to the Zoom meeting should have already been sent by the time you read this Newsletter.



As we are now in the month of May, may I politely remind those who have not yet renewed their Club membership that this year's subs are only £10 - a bargain! So please make your Treasurer Ray a happy man!! Normally the end of May has been a deadline for membership renewal.

Not much more from me so hope to 'see' many of you at next Monday's Zoom Meeting.

Keep safe and keep healthy

Terry (G4CHD)

CLUB MEETINGS

Due to the present Covid 19 pandemic, **ALL** meetings scheduled to be held at the Appledore Football Social Club have been **CANCELLED** until further notice

Until Meetings are reinstated a programme of '**virtual Zoom Meetings**' has been arranged :-

Date	Topic
May 17 th	'A visual history of Roberts radio' by Graham (M1GRA)

APRIL MEETING

'Design of a 6m Delta Loop Antenna' by Terry (G4CHD)

There was a modest attendance for this Zoom talk which was the last one incorporating the NanoVNA. The talk should the process of simulating the design using the free version of EZNEC which proved adequate despite the restriction of 20 segments maximum.

The resultant design was built and tested using NanoVNA-Saver with the NanoVNA and the results compared with those predicted by EZNEC.

Finally, to improve the match, an LC matching circuit was designed using SimSmith which is a wonderful free program which made the whole process very simple without any deep knowledge of Smith Charts.



They say that the proof is in the pudding (or words to that effect!) and so an on air test qso with Mike G3PGA was the final part of the talk which hopefully confirmed the design. Hopefully those who attended enjoyed the talk and found its content informative and useful.

CROSSWORD

Many thanks to Stuart (M1FWD) for this month's Crossword.

The answers are in next month's Newsletter. Good luck !

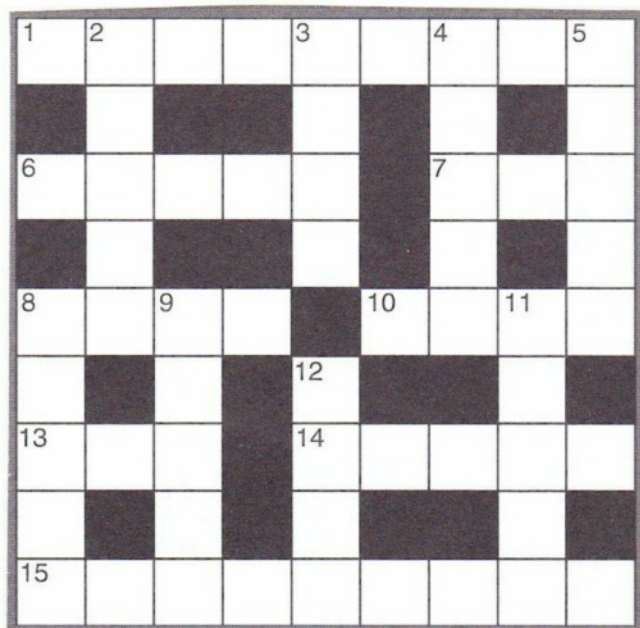


CLUES ACROSS

- 1) Instruments used to control a current by varying the resistance (9)
- 6) Sigmund ? (1856-1939), the founder of psychoanalysis (5)
- 7) An atom or molecule with a net electric charge due to the loss or gain of one or more electrons (3)
- 8) ? Of The Five Towns, 1902 novel by Arnold Bennett (4)
- 10) Southend in Essex has the longest one in the world (4).
- 13) Prefix relating to muscles (3)
- 14) Five Alpha (5A) land (5)
- 15) Electronic device used to control the volume of an audio signal (5,4)

CLUES DOWN

- 2) Large wading bird of the family Ardeidae (5)
- 3) ? lime, a mixture of calcium oxide and sodium hydroxide (4)
- 4) TV channel on Sky 132 (5)
- 5) Use of sound waves to 'see' in the water (5)
- 8) Capital city of Juliet Yankee (JY) land (5)
- 9) ? Campbell (born 1970), British model, actress and businesswoman (5)
- 11) Sierra Uniform (SU) land (5)
- 12) ? tooth, a standard for the short-range wireless interconnection of mobile phones, computers and other electronic devices (4)



Last month's answers :-

ANSWERS ACROSS: 1) anode 3) odd 6) ill 7) spool 9) Oman 11) item 13) occur 14) nil 15) out 16) Papua

ANSWERS DOWN: 1) amigo 4) diode 5) Spain 8) snout 10) Macau 12) Malta

LOCAL REPEATERS

2m Stibb Cross Repeater (GB3DN)

<http://www.g0rql.co.uk/gb3dn.htm>

User: Listen 145.6375 MHz - Transmit 145.0375 MHz.

Access 1750 Hz Tone or 77 Hz CTCSS

Repeater keeper is Tony (G1BHM)

Fusion/C4FM/WiresX Gateway (MB6DT)

Frequency 144.8125 MHz.

Keeper Darren (2E0LVC)

Fusion/C4FM/WiresX Gateway (MB6DN)

Frequency 144.825 MHz.

Keeper Drew (M0MFS)

LOCAL NETS

Weekday Zepp FM Net: Mon/Tues/Thurs/Fri :
145.450MHz - 4pm - 5pm
Wed via GB3DN - 4pm - 5pm
Net Control : Len (M0SXY)

2m Elevesens FM Net: Mon/Tues/Thurs :
11 - 12.00 noon 145.475MHz
Wed/Fri :
11 - 12.00 noon via GB3DN
Net Control ; Mike (G3PGA)

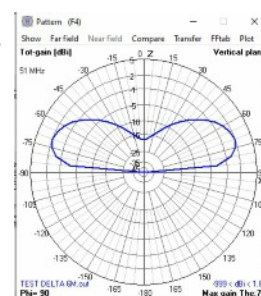
Friday Night 2m Net: Friday : 145.450 FM, 8 - 9pm

Sunday Top Band Net: Sunday 1.860 MHz
9.30 - 10.15am
(LSB - 32W pep max)
2m SSB Nets: Wed: 8 - 9pm 144.260MHz
USB SSB (Vertical polarised)
Sun: approx 10.30am (follows Top Band Net) 144.260MHz
USB SSB (Vertical polarised)

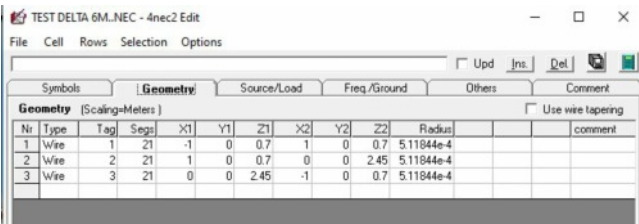
Sunday FM Net: Sunday: 11 to noon via GB3DN
Net Control ; Chris (G0FJY)

4NEC2 - A FREE AND POWERFUL ANTENNA SIMULATION PROGRAM

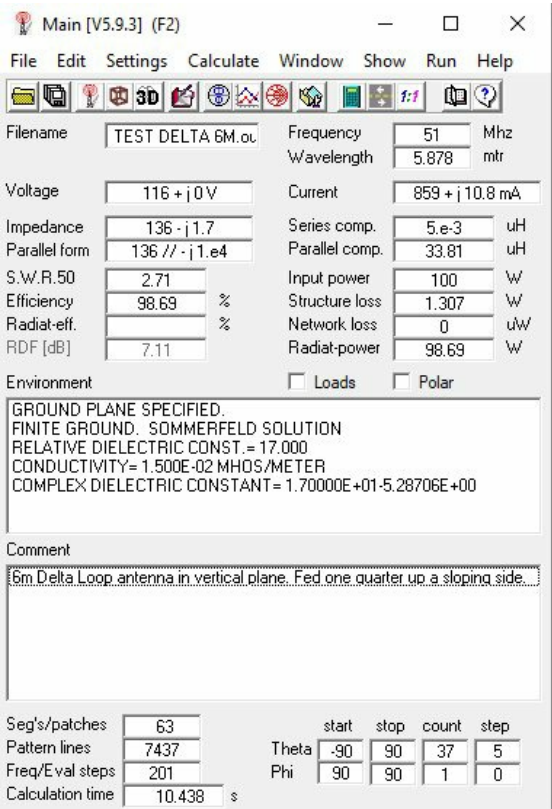
I have previously sung the praises of MMANA-GAL and EZNEC but both have their drawbacks. MMANA-GAL is very easy to use and has a powerful optimisation routine but cannot cope with different parts of the antenna being constructed with different materials. For example, if you have a vertical loop



antenna made of copper wire supported from an aluminium pole.



EZNEC does cope with this but the free version restricts you to a maximum of only 20 segments which is adequate for simple antennas but even a Delta Loop is near its limit. As a result, I did more digging on the web and came up with 4nec2 which I remember plying with many years ago. The program is completely free and has no segment restrictions (apart from computer computing capacity) and it can cope with most things. It isn't perfect eg you can include transmission lines but there doesn't appear to be any way of introducing frequency dependent losses. Also you need to compute the electrical length of coax you intend you use knowing the velocity factor.



Despite this I must say that I have been quite impressed and found the struggle to get to grips with it quite rewarding. Like most things, once you've sussed it out - it then is very easy to use.

For any masochists out there I have included at the end of this Newsletter my latest attempt to describe its use (I find this useful as I find after a few weeks I have forgotten most of what I've learned!).

If any one does read it and needs the .nec file that I produced in the Article, I'm happy to send it - just contact me.

Terry (G4CHD)

SUDOKU PUZZLE

The aim is to enter a number into each cell so that any column, or any row, or any block of cells contain all the numbers from 1 to 9

	2				5	3	1	
		1	9	6				2
		3		1	8			
						9	5	
				3				
	4	5						
			6	8		5		
8				9	2	7		
	1	9	4				8	

Terry (G4CHD)

So that's it for this month

Terry (G4CHD)

STEP BY STEP INSTRUCTIONS TO USE 4NEC2/4NEC2X PROGRAM

by Terry G4CHD

DOWNLOAD PROGRAM

Go to <https://www.qsl.net/4nec2/> and download the latest 4nec2 version and install.

NEC2/NEC4 ENGINES

According to the following Wikipedia entry '*The Numerical Electromagnetics Code, or NEC, is a popular antenna modelling system for wire and surface antennas. It was originally written in FORTRAN in the 1970s by Gerald Burke and Andrew Poggio of the Lawrence Livermore National Laboratory. The code was made publicly available for general use and has subsequently been distributed for many computer platforms from mainframes to PCs*'.

By far the most common version is NEC-2, the last to be released in fully public form. There is a wide and varied market of applications that embed the NEC-2 code within frameworks to simplify or automate common tasks. Later versions, NEC-3 and NEC-4, are available after signing a license agreement. These have not been nearly as popular. Versions using the same underlying methods but based on entirely new code are also available, including MININEC'.

Consequently, because of its historical development, the input data which was then loaded as a sequence of punched cards is now a text Input File *.nec and which when run using the Calculate button produces an Output File *.out which is displayed graphically in various windows.

Hence the use of a simple text Editor such as Notepad, or via the more user friendly use of either a Spreadsheet or GUI (Graphical User Interface) to enter the Input data to describe the antenna ending up with the *.nec text input file.

ANALYSIS OF PORTABLE 6m DELTA LOOP ANTENNA SUPPORTED BY FIBRE GLASS POLE

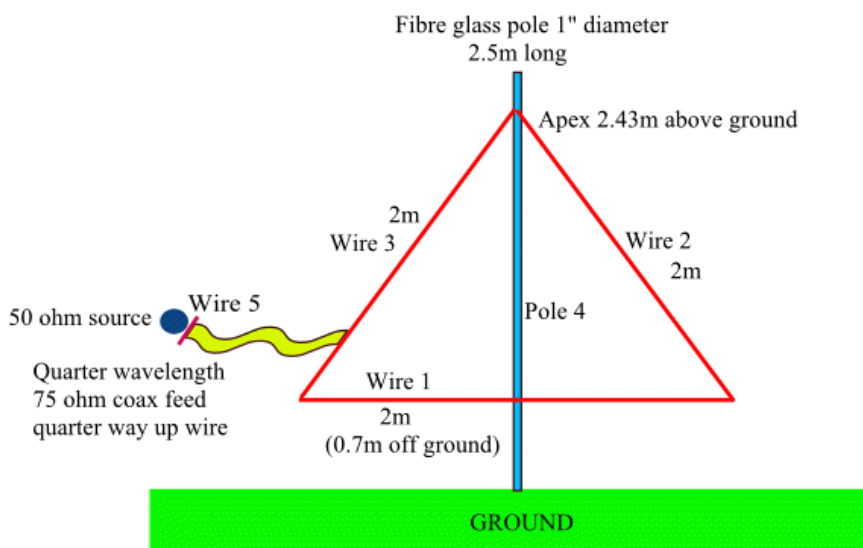
This antenna is designed to be supported by a single 2.5m long fibre glass mast.

Theoretically, a full wave loop antenna should use $300/51 = 5.88\text{m}$ of wire, ie approx 2m per side.

The antenna is fed via a quarter wave of 75 ohm coax to match to 50 ohms.

A short 'wire' (wire 5) is required to terminate the coax.

The resultant dimensions are shown in the diagram opposite:-



SEGMENT NUMBERS

Minimum number of segments should be **no less** than 10 per half wavelength - suggest 30 per half wavelength (ie 60 per wavelength) be adopted. Choosing more will place a heavier burden on computer memory and computing.

Hence for a Delta Loop with each wire one third of a wavelength long, each wire should have a minimum of 20 segments - therefore suggest 21 (prefer odd number) be adopted.

When the program is run, 2 windows will open :-

- Main (F2) - which is Read Only and summarises your design
- Geometry (F3) - which displays your design

INITIAL SETTINGS

Before starting the design, it is useful to make check/change some settings as per the following suggestions :-

In the **Main window**, click on the Settings Tab and make the following suggested changes :-

Auto Segmentation - enter 30 as the segments per half wavelength - auto segmentation is now active

Input Power - set to 100W

Char Impedance - set to 50 ohms

Length unit - set to metres

Radius unit - set to mm

I found that I needed to change the NEC Engine to Nec2DXS*.exe for the Calculate function to work.

Finally, the **preferred Editor** for entering Antenna details should be selected - my preference is to use the **Geometry Editor** which is graphical and therefore quite easy to use. However, it will also be useful to switch to the **NEC Editor (new)** which makes certain entries easier and can be selected by closing the Geometry Editor window and clicking on **Cntl F4** for the **NEC Editor (new)** to open.

ENTRY OF ANTENNA DETAILS INTO 4NEC2

4nec2 does not provide an easy way to start a new project *.nec input file. It is suggested that one either opens an existing *.nec file, renames it and then erases its contents or use a text Editor such as Notepad, to create a new empty text file and save it or rename it as *.nec.

Run 4nec2 and close all windows except the **Main** window. Select **File/Open 4nec2 input/output file** - and open your new *.nec file previously created. Now click on the **6th icon** in the Main window - **edit nec-input file** - and the preferred Editor window eg **Geometry Edit** will open.

Entry involves selecting to **Add** either a **Wire, Source, Load, Transmission Line, Comment, Frequency, or Ground** by clicking on the appropriate **buttons** at the top of the **Geometry Edit** window.

Since our antenna has $Y = 0$ at all points, then select the **XZ** view by clicking on the **XZ** button at the top.

First we **must** set the **Frequency** :-

Click the **Frequency** icon (2nd from right end) and in the right hand side (RHS) panel, edit value to 51 MHz and click on **File/Save**.

Now **draw the antenna** roughly and then edit the details to more exact values :-

Click the **Wire Geometry** button to select it, then the **Add** button which should turn green. Note the pointer changes to +.

Ensure **Wire-no, Ends, and Snap to Wire** are ticked.

Move pointer onto the graph (do **NOT** press left mouse button yet) and observe **X Y Z** values in the RHS panel.

Move pointer to the position where $X = -1, Z = 1$ and holding down left mouse button, move to the right to a position where $X = +1, Z = 1$ and then release the mouse button. **Wire 1** is now entered.

As this is your first wire, a new window will request the **wire radius**. Enter #17, then OK (or 0.575mm).

Repeat for **wire 2**, starting at the **right hand end of wire 1**, and holding down the left mouse button, move upwards and to the left until you reach $X = 0, Z = 2$ and release the button.

Repeat for **wire 3**, starting at the **top end of wire 2** and move down to $X = -1, Z = 1$.

Exit the “Add” mode by clicking on the “**Arrow**” button.

We must now **edit our basic antenna geometry to the exact requirements** (this is optional for a rough design). Ensure that the number of **Segments per wire can be entered manually**, by clicking **Options**, **No auto-segmentation** in the **Geometry Edit** window. Also ensure that **Keep Connected** is **unticked**.

Click on **wire 1** (changes **colour**) and edit its values at the bottom of the RHS panel for End-1, and End-2 to

End-1 :- -1, 0, 0.7 End-2 :- 1, 0, 0.7

and edit number of segments to eg **21**

Click on **wire 2** and edit its values to :- **End-1 :- 1, 0, 0.7 (done) End-2 :- 0, 0, 2.43**

and edit number of segments to eg **21**

Click on **wire 3** and edit its values to :- **End-1 :- 0, 0, 2.43(done) End-2 :- -1, 0, 0.7**

and edit number of segments to eg **21**

We must now change the wire **conductivity to that for Copper** :-

Click the **RLC Loading** button and then the **Add** button.

With the cursor off the antenna, hold down the left mouse button and slide the pointer onto any wire and release the button. A small square will appear on the wire.

In the RHS panel, edit **Par-RLC** to **Wire-Ld** in the drop down menu. Edit the **Spot Load** to **Whole Struct**.

Finally select **Copper** for the Material from the drop down menu.

It is useful to show this by clicking **Options, Show Struct/wire-loading** in the **Geometry Edit** window.

We now have the 3 wires correctly entered made of copper.

We must now add the **wire insulation** :-

Click the **RLC Loading** button and then the **Add** button.

With the cursor off the antenna, hold down the left mouse button and slide the pointer onto any wire and release the button. A small square will appear on the wire.

In the RHS panel, edit **Par-RLC** to **Coating** in the drop down menu. Edit the **Spot Load** to **Whole Struct**.

Select eg **PVC (soft)** for the Material from the drop down menu and set the radius to 1.3mm .

The 3 wires are now pvc insulated to a thickness of 0.725mm

Now need to **draw the fibre glass pole** roughly and then edit the details to more exact values:-

Change the view in Geometry Edit to **YZ** in order to position the pole 10cm ‘behind’ the antenna.

Move pointer on graph (do **NOT** press left mouse button yet) and observe **X Y Z** values in the RHS panel.

Move pointer to the position where **Y = 0.1, Z = 0** and holding down left mouse button, move upwards to position where **Y = 0.1, Z = 2.5** and then release the mouse button. Set the pole radius to 20mm.

The **pole** (element 4) is now entered.

We must now **edit the basic pole geometry to the exact requirements** :-

Click on the **pole** (changes **colour**) and edit its values at the bottom of the RHS panel to :-

End-1 :- 0, 0.1, 0 End-2 :- 0.1, 2.5

and edit number of segments to eg **21**

We must now change the pole **conductivity to that of Insulator** :-

Click the **RLC Loading** button and then the **Add** button.

With the cursor off the antenna, hold down the left mouse button and slide the pointer onto the pole and release the button. A small square will appear on the pole.

In the RHS panel, edit **Par-RLC** to **Wire-Ld** from the drop down menu. Edit the **Spot Load** to **Single Wire**

Finally select **Insulator** for the Material from its drop down menu.

We must now change from Free Space and introduce **Real Ground**.

Click on the **Ground params icon** (end right) and in the RHS panel, change from **Free Space** to **Real**

Ground from the drop down menu. Finally, select your **ground type** from the drop down menu eg **Average**

We will now insert a **Source 25% up along wire 3 in segment 17** :-

Click the **V/I Source** button and the **Add** button.

Again with the pointer off the antenna, press the mouse left button and slide the pointer to approx one quarter of the way up wire 3 and then release the mouse button. A small circle should appear on wire 3.

In the RHS panel, ensure that the **V/I Source** is **Voltage** and **Segm is 17**

Exit the “Add” mode by clicking the “**Arrow**” button.

We can now do a **SWR sweep** to check the resonant frequency of the antenna :-

In the **Geometry Edit** window, click the **green calculator** button in the RHS panel to open a new window.

Select **Frequency Sweep**, and set **Start to 40, Stop to 60, and Step to 0.5**. Click **Generate**.

Note the **minimum SWR** from the plot. A minimum SWR value of approx 4.5 appears to be **between 51 and 51.5 MHz** indicating that the antenna is very slightly too short and needs to be **lengthened by a factor of $51.25/51 = 1.005$**

We can now **rescale all antenna wires** by this factor :-

In the **Geometry Edit** window, click **Edit** and then holding down the Cntrl key, click on all 3 wires in turn.

Note how all wires change **colour in red**.

Now click **Edit** and then **Rescale Wires**. Accept that not all wires are selected.

In the **Rescale Wires** window, note that 3 wires are selected and alter the **Scaling factor to 1.005, OK**.

We can now do another **SWR sweep** to check the new resonant frequency of the antenna :-

In the **Geometry Edit** window, click the **green calculator** button in the RHS panel to open a new window.

Select **Frequency Sweep**, and leave **Start at 40, Stop at 60, and Step at 0.5**. Click **Generate**

Note the new **minimum SWR** now appears to be **51 MHz** as required.

However, the SWR is **approx 4.5** and if we click on Show/Imped/Phase in the SWR window, at 51 MHz the impedance is almost all resistive and equal to approx **221 ohms**.

We need to introduce an **electrical quarter wavelength of 75 ohm coax** to change 221 ohms to approx 50 ohms.

Transmission lines must have a wire segment to connect to at each of its ends. One end will be connected to segment 17 of wire 3. We thus need to introduce another **wire (5)** with 3 segments for its far end.

An electrical quarter wave at 51MHz is $(300/51) / 4 = 1.47\text{m}$ **which is the electrical length**. However, coax has a velocity factor of approx 0.7 and hence the physical length of the coax needs to be only approx **2.1m**.

We can draw the transmission line with any length as long as we use its **electrical length**.

(If we do not specify its electrical length, then the drawn length will be assumed to be its electrical length.)

Before we add wire 5, delete the existing source by selecting the source icon and click on the delete icon. In the **Wire Geometry** window, click the **Add** button. Note how pointer changes to +.

Move pointer on graph (do **NOT** press left mouse button yet) and observe **X Z** values in the RHS panel.

Move pointer to the position where **X = -2, Z = 0.2** and holding down left mouse button, move upwards to position where **X = -2, Z = 0.3** and then release the mouse button. **Wire 5** is now entered.

Edit wire 5 to have exactly : **End 1: -2, 0, 0.2 End 2 : -2, 0, 0.3** and set segments to **3**

Wire 5 is now 0.1m long.

We can now add the **transmission line** :-

Select the **transmission line icon** (ladder) and click **Add**. Holding down the left mouse button, draw a line from wire 3 to wire 5. In the RHS panel, ensure that each end is connected to segment 2 (central one) and edit the **Char-imp to 75**.

We must now re-insert the **Source half way along wire 5** :-

Click the **V/I Source** button and the **Add** button.

Again with the pointer off the antenna, press the mouse left button and slide the pointer to the middle of wire 6 and then release the mouse button. A small circle should appear at the centre of wire 6.

In the RHS panel, ensure that the **V/I Source** is **Voltage** and **Segm is 2** (centre of 3 segments)

Exit the “Add” mode by clicking the “**Arrow**” button.

We can now do another **SWR sweep** to check the new resonant frequency of the antenna :-

In the **Geometry Edit** window, click the **green calculator** button in the RHS panel to open a new window.

Select **Frequency Sweep**, and leave **Start at 40, Stop at 60, and Step at 0.5**. Click **Generate**

Note the new **minimum SWR** now appears to be **2** - a little high, but better than the original 4.5. It would be interesting to see if raising the antenna higher would improve the SWR. This was tried but had little effect.

We can now examine the **Radiated Signal Pattern** :-

In the **Geometry Edit** window, click the **green calculator** button and select **Far Field Pattern** and click **Generate**.

Now press **F9** key on the keyboard to open the **Viewer** window.

In the RHS panel, change **Structure** to **Currents** and **Hide Pattern** to **Pattern** using drop down menus.

The display can now be **rotated** by holding down the **left mouse** button or **enlarged/reduced** by holding down both the **left and right mouse** keys.

Note the almost omni directional nature of the radiated pattern. Also by changing Total to Vertical or Horizontal it can be seen that virtually all the radiated signal is vertically polarised.

Finally we can **save this final point in the analysis** thus :-

In the **Geometry Edit** window, click **File** and **Save As** and name your file.