~ "DL-Special DX" Antenna ~

Two delta loops in phase (collinear)

ON6WG / F5VIF

Foreword

The purpose of this article is to propose an antenna with a high gain, a high efficiency, a very low price and that is easy to build for any frequency (however there is one restriction as we will see farther in the text). Only wire, a few isolators and one connector will be required.

But at first, flashback to the nineties! We are in 1992 and a DXpedition eagerly awaited by numerous amateur radio enthusiasts is announced. This is the FOØCI expedition and its activity will be from Clipperton Island situated in the Pacific Ocean **(Fig 1)**.

Fig 1 (courtesy : C.Jost)

At that time there was a lack of directional antennas with gain at the ON6WG station and the competition to contact this DXpedition promised to be very arduous. So I had to find an antenna simple to build, quick to achieve and giving a substantial gain.

The library of the ON6WG station contains some standard reference works as regards antennas. The idea to build this antenna came to me when consulting the inevitable book, “Low Band Dxing” written by ON4UN and also another one “The Radio Amateur Antenna Handbook” written by W6SAI and W2LX. References of these works are in the heading titled “Appendix and Bibliography” at the end of these pages.
The result was equal to my expectations as it simply took me three calls through an indescribable pile up to contact FOØCI.
Subsequently a number of other DX expeditions were contacted, again with the same ease. That confirmed the excellence of the antenna.

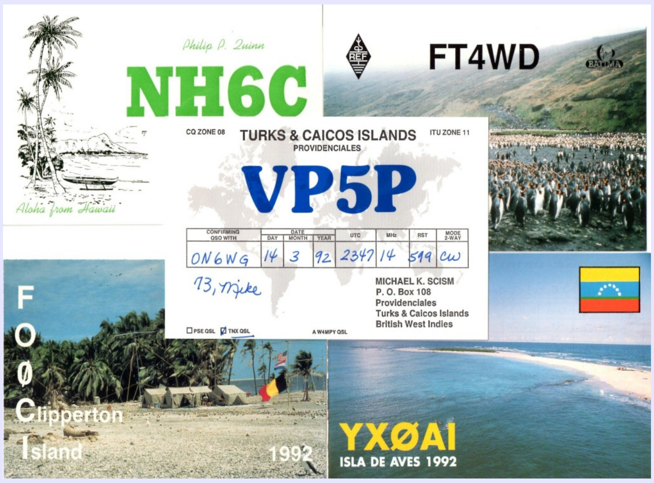


Fig 2

Fig 2 shows some of the DX stations or expeditions contacted with the *DL-Special DX* antenna. A VHF model was built to assess its performance before to build this antenna in different sizes to work on several HF bands. A description of the VHF model antenna was made at that time in the “Gigazette”, a magazine published by the Radio Club of Waterloo (Belgium). Following this article I had very positive feedback. I still continue to use the *DL-Special DX* antenna from time to time and it never ceases to amaze me with the results I get. However, only recently I decided to deliver a more detailed description in an article.

Introduction

The antenna presented here is consisting of two delta-loops placed one corner downward (like a double V) and connected together in the same vertical plane (it is a phased array antenna). This scheme was chosen primarily for its ease of implementation and its ease of coupling to the transmitter. Indeed, the *DL-Special DX* antenna has a radiation resistance close to 50 ohms and so, does not require an antenna coupler. If the antenna is made correctly the SWR will be close to 1. However there is a restriction, it is a **single-band** antenna.
This antenna made of wire can be achieved at a low cost price. On VHF bands or higher, its small dimensions make it possible to build it on a frame (see **Fig 3**). One can even imagine to stick it on a glass window or on a bay window. When this antenna is built on a frame placed on a mast, it can be oriented to different directions. On HF bands, even placed at a low height the lift-off angle of the wave is low enough to favor DX.

Concerning the gain of the *DL-Special DX* antenna it is similar to that of a four elements Yagi beam. **Fig 3** shows the VHF version of the *DL-Special DX* antenna in use at F5VIF.

Fig 3

Design and calculation

The antenna consists of two equilateral triangles placed one corner downward. The triangles are arranged in the same vertical plane and connected together in phase by the two top facing corners. This is also the connection point of the coaxial cable. So the feed system is very simple. The diagram is shown in **Fig 4**. At resonance, the delta-loop length is **1.06 λ**.
The wavelength **λ in feet** is calculated from the following formula :

$$\lambda \text{ (feet)} = 1005 / f \text{ (MHz)}$$

The wavelength **λ in meters** is calculated from the following formula :

$$\lambda \text{ (meters)} = 300 / f \text{ (MHz)}$$

When building the antenna, cut the wire to **1.06 λ.** The dimensions given above are valid for one delta loop, obviously we have to multiply the result by two to make the *DL-Special DX* antenna. Keep the wire in one length. It is not necessary to cut the wire in the middle of the antenna to connect the coaxial cable (see **Fig 4**). Then check the frequency which is obtained at the minimum SWR (this is the resonant frequency). Adjust the length if necessary.

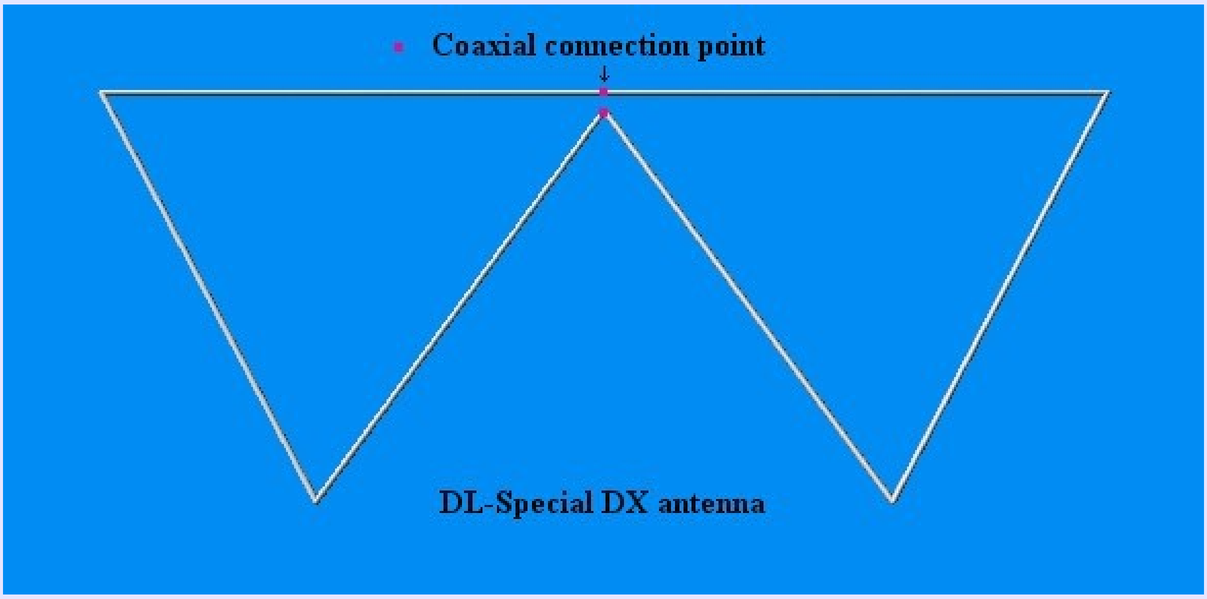


Fig 4

Feeding the antenna

This antenna design is symmetrical and normally the feed point requires a balun of 1/1 ratio. In this case, as the impedance is close to 50 ohms a 1/1 ratio choke balun can be added by placing ferrite sleeves on the coaxial cable near the point of connection to the antenna (for more informations a paragraph is devoted to “Beads Baluns” in the “ARRL Antenna Book” 21st and 22nd edition). This kind of balun, ready to use, can be bought also in any store specialized in radio amateur material.

Gain and radiation angle

Fig 5 shows the gain and the radiation pattern of the 145 MHz *DL-Special DX* model antenna placed at one quarter wavelength above a soil of perfect conductivity. The values were obtained by modeling using the “4nec2” program. The take off angle of the wave is at its lowest and therefore favors long distance communications (DX). As it is shown in the diagram, the gain produced is substantial and as discussed further in comparative tests, the antenna can stand comparison with a four elements Yagi.

Fig 6 shows the radiation pattern in the horizontal plane.

When the antenna is made to work on lower bands, **Fig 7** and **Fig 8** show similar radiation patterns to the previous one (and here the antenna is also at a height of one quarter wavelength above a perfect ground). In this example it is the 28 MHz band which was selected. The radiation pattern is similar for all other HF bands.

145 MHz

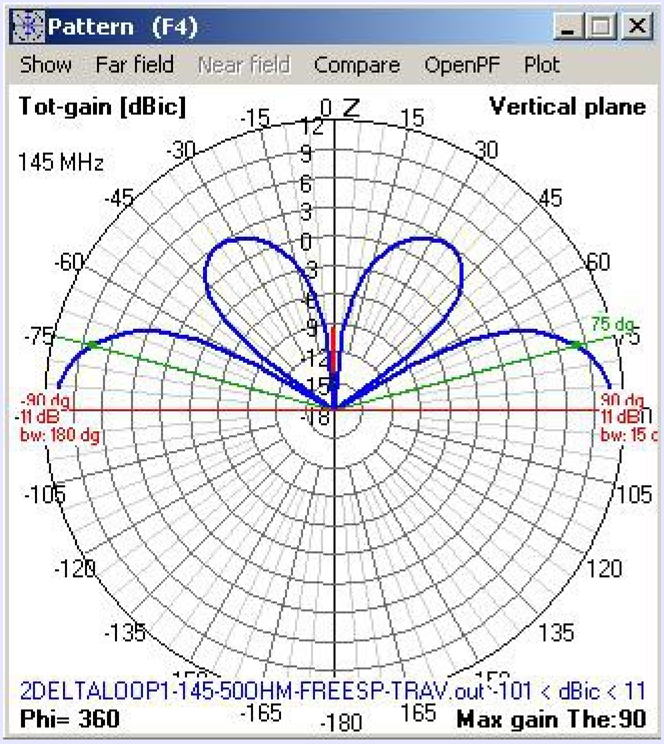


Fig 5

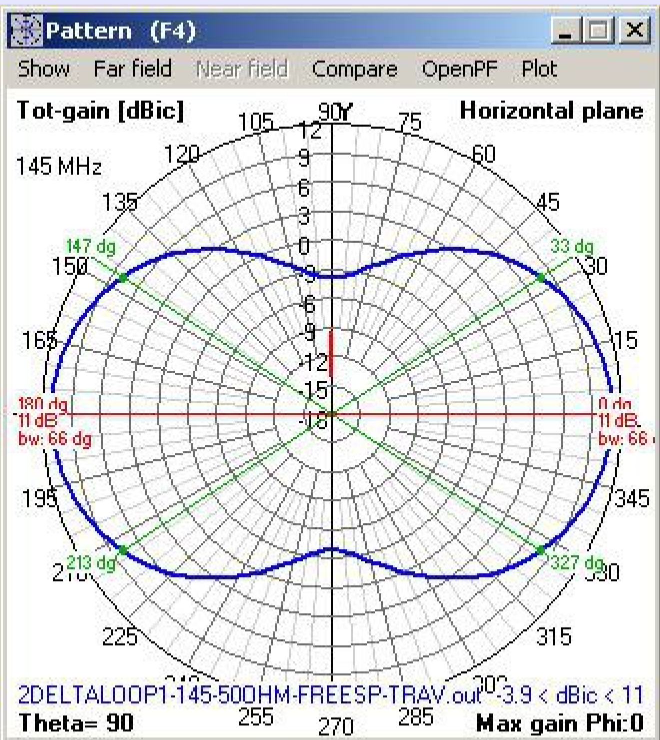


Fig 6

28 MHz

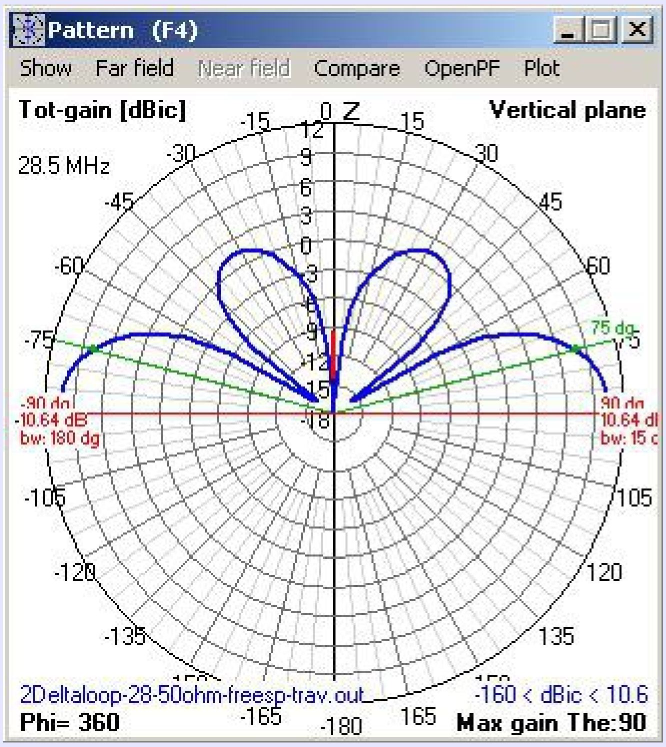


Fig 7 *DL-Special DX* **0.25 λ above the ground**

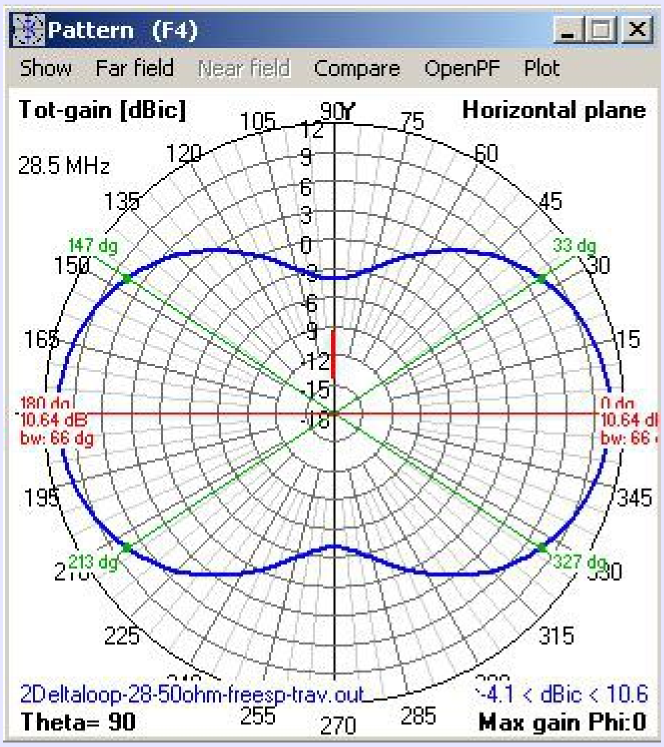


Fig 8

Raising the height of the antenna over the ground will cause a change in the pattern radiation as shown below in **Fig 9** and **Fig 10**.

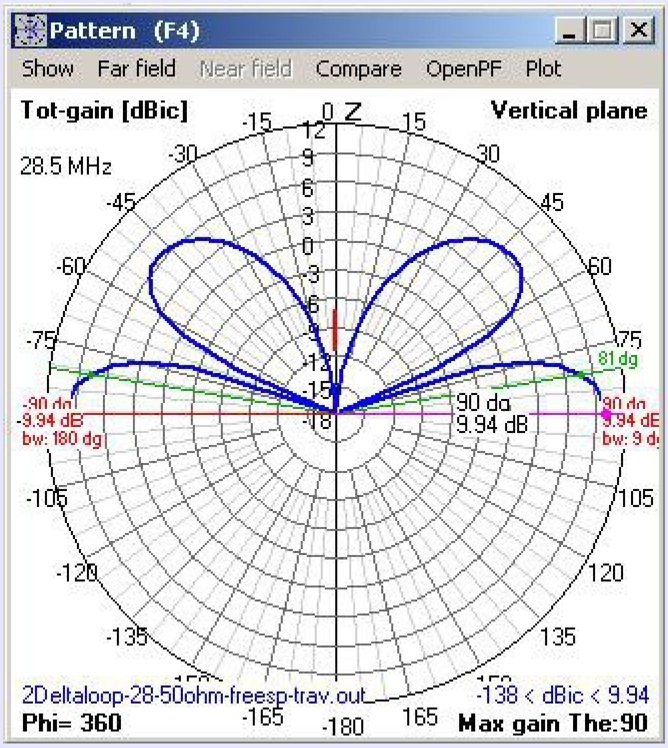


Fig 9 ***DL-Special DX*** **0.5 λ above the ground**

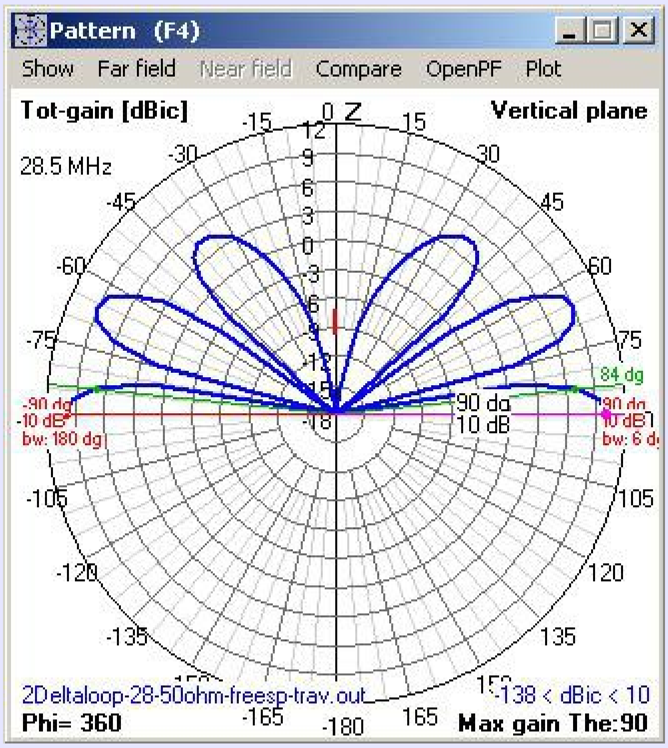


Fig 10 ***DL-Special DX*** **1 λ above the ground**

Fig 11 shows the impedance of the antenna at the resonant frequency and on a selected frequency range between 28 MHz and 29 MHz. The point of resonance is at the intersection of the resulting red line and the dashed line equal to 0.

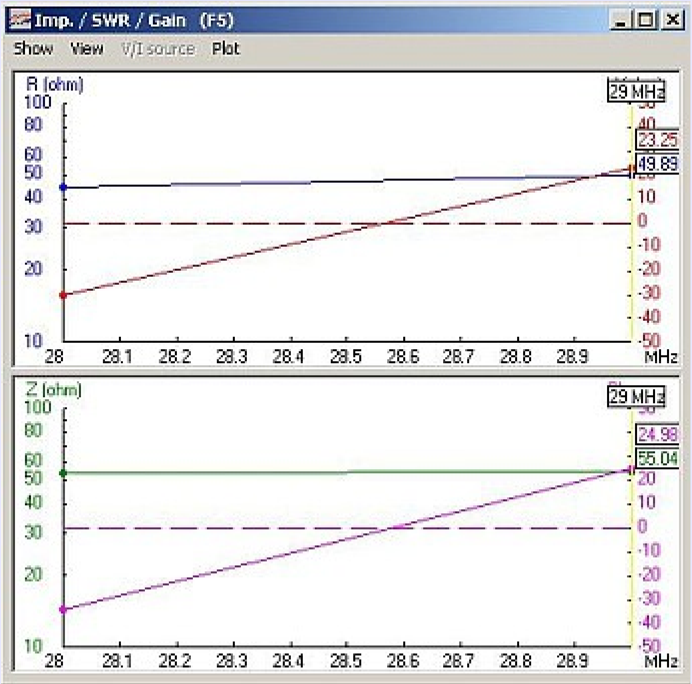


Fig 11

Fig 12 shows the SWR on the *DL-Special DX* model antenna. The bandwidth is wide so the antenna can be used easily on the HF bands. A very low SWR can be obtained over the entire band.

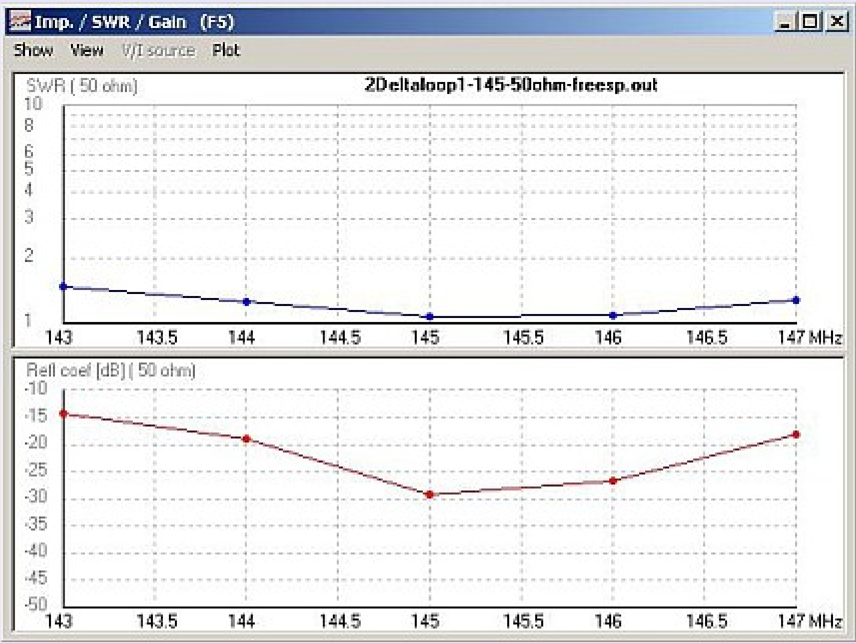


Fig 12

Note on the radiation pattern and the current distribution

Normally when using an equilateral triangle the feeder must be connected at a distance of 0.25 λ of one of the corners in order to have an equal distribution of the currents through the delta loop and therefore a symmetrical radiation pattern. It is clear that in this design, this target cannot be reached. As an indication, **Fig 13** exhibits this slight distortion in the radiation pattern when the feeder is connected directly to the corner of the delta loop.

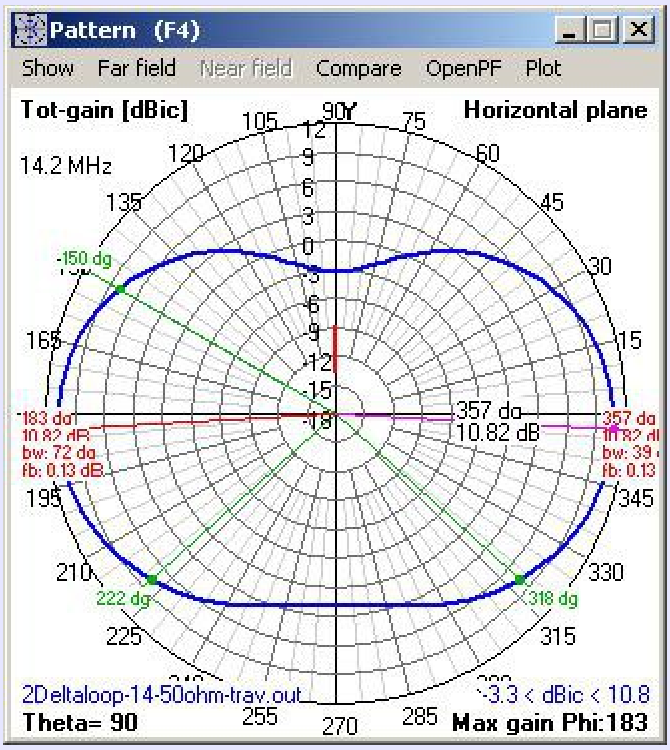


Fig 13

Referring to page 4, if you look closely at the pattern of the antenna in **Fig 4** we see that the triangles are not equilateral. The length of the perimeter of the triangles has not been modified but the lower corners of the triangles are offset outwardly. However, even if we are in the case of **Fig 13**, the aperture angle of the antenna is very wide and on the HF bands the slight shift of maximum radiation will have little impact. Indeed it is a matter to gain S points in a specific direction rather than in a specific part of the world. Note that this phenomenon is present on the VHF prototype.

Polarization

The DL-Special DX antenna offers dual polarization. In this model the dual polarization is divided almost equally between horizontal and vertical polarization. This can prove to be a real asset to compensate for the fading on the HF bands. On the higher frequencies where horizontal or vertical polarization is specifically used it will allow to use one and the other without any handling. As an exemple, on the same frequency we can communicate via a relay using vertical polarization while being in contact at the same time with another station which is using horizontal polarization.

Performance

As noted above, the gain of 11dBi is equivalent to the gain of a four elements Yagi antenna. Tests between the *DL-Special DX* and a 9dBd four elements Yagi have been done on 144 MHz on numerous occasions to compare results obtained by diagrams with reports obtained during contacts. The antennas were placed at the same heigth on separate masts to avoid a possible coupling. In all cases with rare exception, during the tests in vertical or horizontal polarization, in transmission or reception, the reports are similar in both cases. **Fig 14** and **Fig 15** show the two antennas used for the tests (here during a portable activity).

Fig 14

Fig 15

Conclusion

The *DL-Special DX* is a directional and mono-band antenna. Wire, some insulators and here is a special DX antenna that can be build for any band with a small budget. This antenna may be placed at low heigth. The 50 ohms impedance is well adapted and a wide bandwidth with a SWR close to 1 almost across the band gives to it a real ease of use. A wide opening angle allows to cover large areas with a significant gain. The hollow in the radiation pattern at the ends of the antenna is much less pronounced than for a dipole. This may lead to contacts in these directions also. Its construction made of wire gives to it lightness and resistance to bad weather. It can also be easily folded or rolled and only takes up little space. It will also arouse the interest and curiosity of the stations who will contact you. So go off the beaten track and opt for its simplicity and originality. You will be amazed by the result !

3D Radiation Pattern

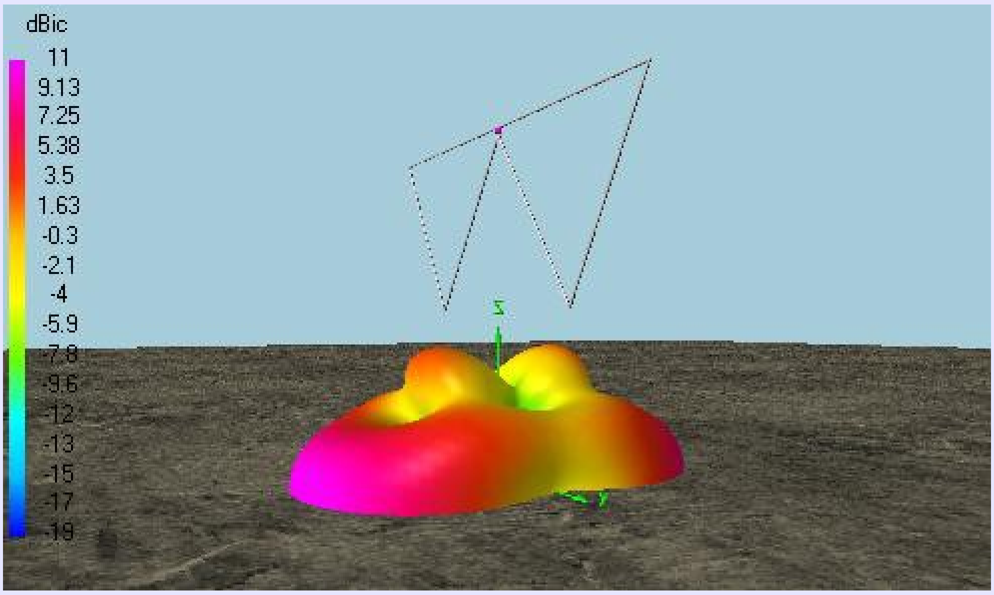


Fig 16

The 3D view of the radiation pattern of the *DL-Special DX* antenna here placed one quarter wavelength above the ground gives a more concrete vision of the lobes as well as gain at the different elevations.

Balun

Again, this antenna is belonging to the family of symmetrical antennas. The use of a 1/1 ratio balun is therefore advisable (see page 4 § Feeding the antenna).

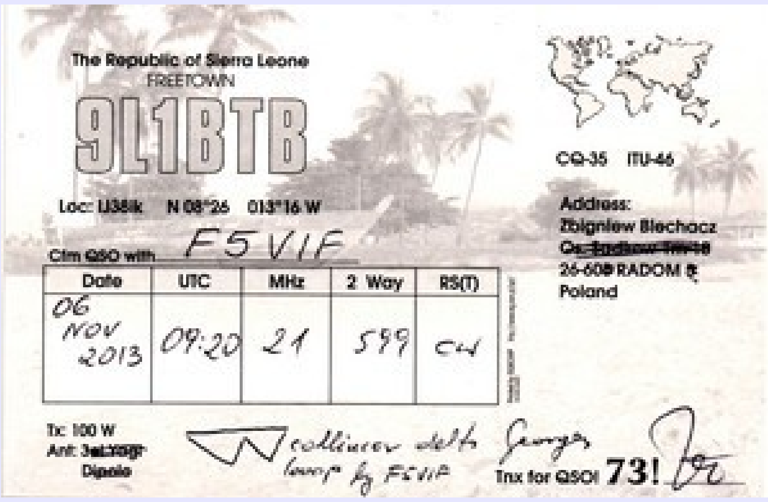
* * *

9L1BTB DXpedition

Here is a practical example on how to fit a large size "DL-Special DX" on one mast only

The "DL-Special DX" antenna was used on 15 meters with satisfactory results by Zbig, SP5BTB, during his Dxpedition to Sierra Leone with the callsign 9L1BTB from 25 of October till 11 of November 2013.
On his web page there is a very nice picture of the antenna. There is also a detailed and very interesting description on how to build it and an easy and inspired idea to tune it. Just click on the link below to reach the page.
Congratulations, Zbig, for this nice job !

Link to 9L1BTB web page : **…....... http://www.qsl.net/9l1btb**



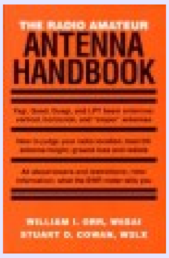
It is interesting to note the working conditions on my side during the QSO with 9L1BTB because this highlights the ability of the "DL-Special DX" in receiving signals. Thanks also to Zbig and his skill in copying signals in a pile up. My sigs were certainly not among the strongest. The power used was 90 watts and the antenna was a center loaded mobile whip 1.6 meters in length fitted on a balcony at a height of twenty meters.

Appendix

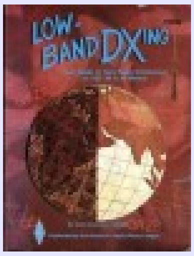
Note about the *DL-Special DX* antenna : (I had to give it a name so that it is easy to find it on the web) – means **Delta Loop-Special** (*Special* because this word is similar in many other languages and because we are facing a very special antenna, and ***DX*** because the very low take off angle of the wave favors long haul communications). That's all !

Bibliography

The works below are part of the ON6WG library and were helpful in preparing this article. They refer, among other things, to this type of antenna.



The radio Amateur Antenna Handbook
William I. Orr, W6SAI
Stuart D. Cowan, W2LX



Low Band Dxing
John Devoldere, ON4UN

Pictures and photographs Except for the image of **Fig 1**, all images are from the author.
Fig 1 image : courtesy C.Jost (web)

To design and create field pattern diagrams the following software was used :

4nec2 …..........by Arie Voors …........... *http://home.ict.nl/~arivoors/home.htm*

(Click on the blue link to reach the web page)

French translation of this article …. *http://on6wg.pagesperso-orange.fr/Page%2014.html*

ON6WG / F5VIF Web Site …........... *http://pagesperso-orange.fr/on6wg*