RADCOM TECHNICAL FEATURE

More on G3FDW Log Periodic Yagis

By Mike Gibbings, G3FDW*

THIS article describes two Log Periodic Yagi designs developed to overcome the problems of antenna survival in the severe weather at this northern QTH. Long boom Yagis tended to shed elements or even break up due to metal fatigue. Both of these LPY antennas are shown in the photograph.

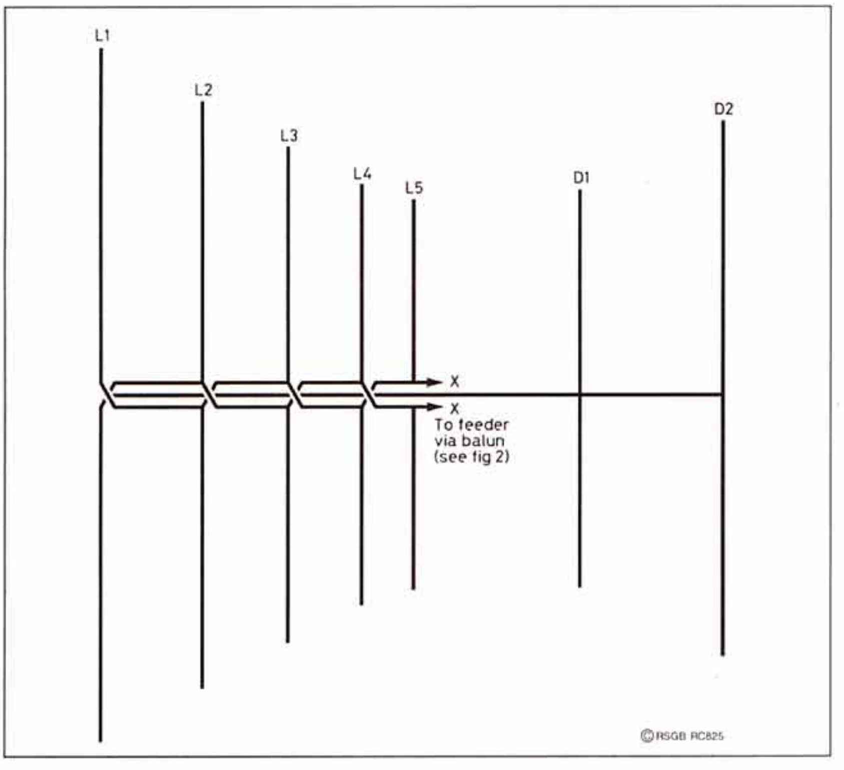


Fig 1: The Multiband Log Periodic Yagi.

VHF MULTI-BAND LOG PERIODIC YAGI

THE SEVERE weather survival strategy employed here is to lower the mast during predicted winds speeds in excess of Force 8 (severe gale, 45MPH with gusts to 60MPH). As you can guess from my call sign this solution was becoming more hazardous by the day. Weather conditions are much worse in the winter and the mast was down more often than it was up. In an effort to reduce the wind loading on my 23ft mast I took to using a single antenna at a time but this was, to say the least, very restrictive.

The mast wear and tear was increased to an unacceptable level for a contest man working on four bands.

A single 'winter' antenna was needed, even if this meant restricting the number of bands that I could work.

I decided to try a wideband log periodic cell that would give moderate gain on 6 and 4 metres, and to use parasitic directors to give increased gain on these two bands. The aim was a gain similar to that produced by a good three or four element yagi with a good match to 50Ω coax on a six foot indestructible one inch square boom.

CONSTRUCTION

Several weeks, half a tree and two calculator batteries later a design was produced, and with only minor adjustments of the feed cell open wire feeder spacing, worked right off the drawing board.

As part of the experiment it was hoped to try out the 'log periodic' theory devised by K4EWG[1]. This, put simply, means that if a log periodic is made to cover two bands then by making two of the component dipoles resonate on the two required frequencies, the other parameters such as feed impedance would come out equal in value. Sounded good, so it was hoped it would work in practice.

The final design, **Fig 1,** uses five elements in the log periodic cell and I consoled myself during the construction that the symmetrical layout looked like two 3-element beams in series. A single director is used for each band.

Once the feed cell was constructed it was tested by measuring the feed impedance over the design bandwidth of 50 to 70MHz. Over this frequency range the feed impedance was substantially flat with a value of 90 ± 25Ω. The cell showed a typical bandpass characteristic with large changes in feed impedance outside the band.

Two directors were then fitted. The SWR was then measured with the beam supported on the pole a short distance from the ground and beamed vertically. The SWR improved and was then optimised by adjusting the spacing of the feeders. The feeder spacing between L1 - L2 and L2 - L3 effects the 6 metre feed impedance while the feeder spacing L3 - L4 and L5 - L6 determines the 4 metre feed impedance. The SWR measurements are tabulated in **Table 1.**

Frequency	50.1	50.3	50.5	51	52
SWR	1.2:1	1.2:1	1.2:1	1.5:1	1.3:1
Frequency	7.1	70.5	70.45		
SWR	1.2:1	1.3:1	1.5:1		
Frequency	144.0	144.5	145.0	145.5	146.0
SWR	1.4:1	1.4:1	1.25:1	1.15:1	1.1:1

Table 1: SWR measurements of the multiband VHF LPY.

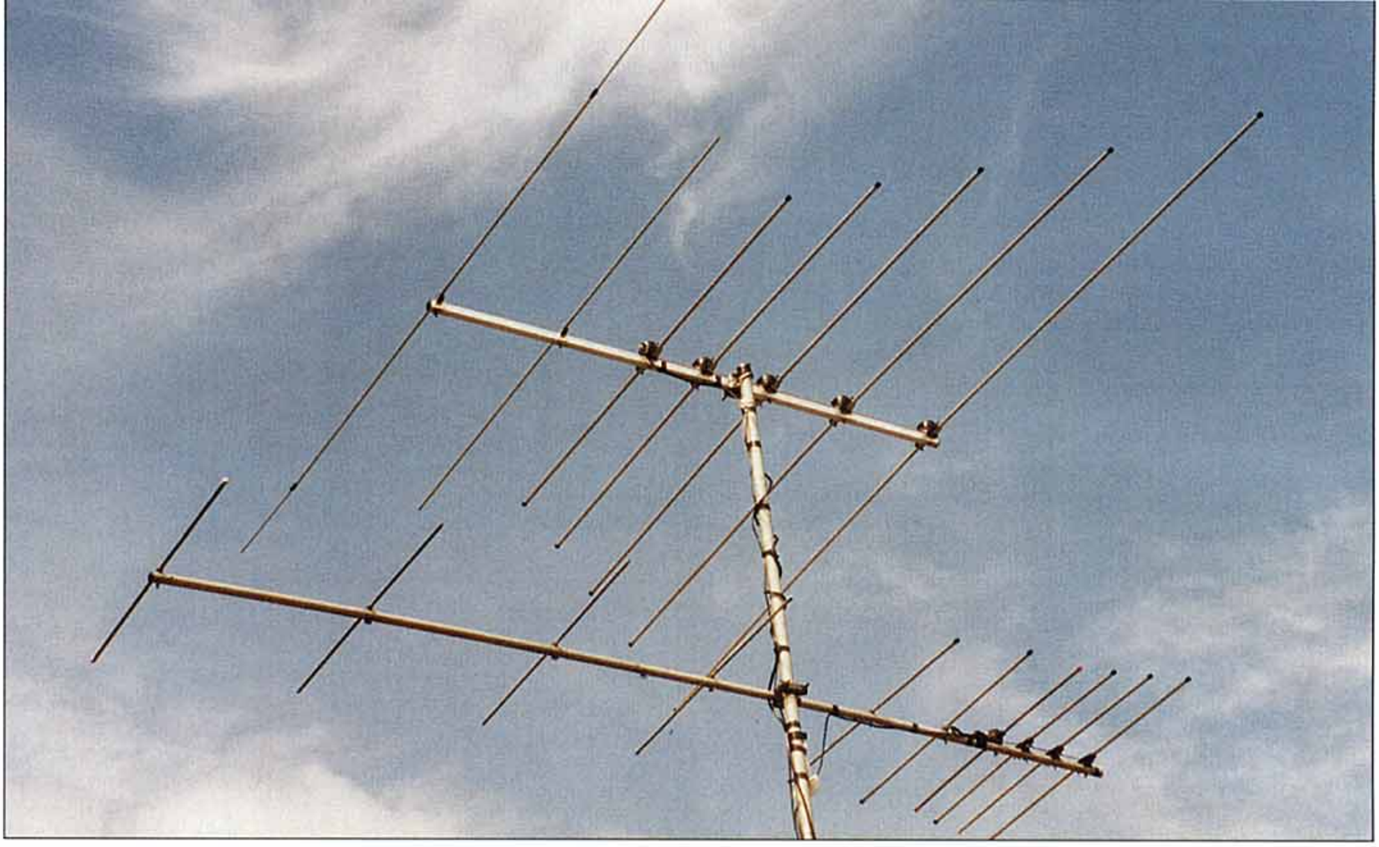
OPERATION ON 144 - 146MHz

I was surprised to find that the antenna is usable between 144 and 146MHz with a low SWR across the band, see Table 1. This is because the ½in diameter six metre elements of the cell are three half-wavelengths long, and present a low impedance when fed in the centre.

Unfortunately this arrangement produces two narrow forward lobes at an angle of approximately 40° either side of the centre line of the boom. The beam splitting could be corrected by angling the log cell elements to align the two lobes to produce a single main lobe. This would give an additional 3dB gain compared with a log cell with halfwavelength elements. Such an arrangement can be considered as a series of V-beams fed out of phase. Work by W4EWG[2] would indicate a gain for this array to be in the region of 10dB.

Although I did much experimental work

* 5 Meadowbank Lane, Grange Over Sands, Cumbria, LA11 6AT.



Showing both the multi-band G3FDW beam and the 10 element LPY.

with angled elements I did not use them in the final design. The main reason is that such a configuration is mechanically weak and would need bracing. This would defeat the original objective of a strong multi-band 'winter' beam.

If you can live with a 2-metre antenna whose two main lobes are 40° out of alignment with the rotator setting then the best way to regard it is as a 'free' 2-metre antenna with useful gain. I have had many QSOs at distances of over 100 miles using only 2.5 watts from an IC202.

The construction of the beam is the same as described in [3]. The design data and dimensions are given in **Table 2**.

Note: that for ½in diameter elements, L2 and L4 are resonant at 50.2MHz and 70.2MHz respectively.

It should be stressed that this is not a high gain DX antenna but was designed to provide a dual band device that would stand up to severe weather conditions. To date it has weathered wind gusts of up to 70MPH on no less than three occasions in the winter of 1994-5. With a performance as good as most 4-element beams on two bands it turns in a good dB per dollar. Additionally it only requires one length of low-loss coax and the antenna can be placed at the top of the mast.

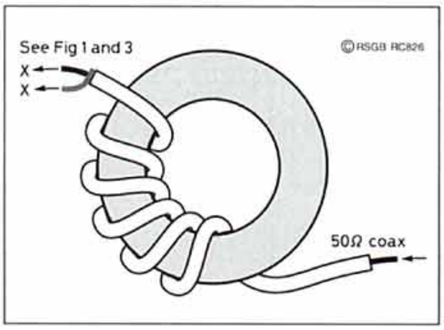


Fig 2: Coaxial balun.

RESULTS

In the first few months of use on six metres since Dec 1994, 30 countries have been worked, the best DX being CN8 and EH8. On four metres QSOs in excess of 200km have been made on several occasions. From observations on 4 metres this antenna is judged to be 1½ 'S' points down on the 8 element LPY described in [3].

BALUN

This consists of seven turns of UR43, 50Ω coax wound on an RSGB ferrite ring (see **Fig 2**).

TEN ELEMENT LPY FOR TWO METRES

WHEN THE SMALL 7-element two-metre LPY antenna was first used by the Westmorland VHF group it was greeted with much comment, and observation that it was too small to be taken seriously. Nonetheless, it has helped us to win the low power section of VHF NFD. This proved the LPY's performance by the well known 'proof of the

CONTINUED ON PAGE 59

Boom	=	72in (1in square)
L1	=	133.49in
L2	=	111.73in
L3	=	93.53in
L4	=	78.27in
L5	=	65.51in
d1-2	=	13.35in
d2-3	=	11.17in
d3-4	=	9.35in
d4-4	=	7.83in
D1	=	77in
D2	=	109.25in
s1	=	12.25in
s2	=	16.25in

τ = 0.873, σ = 0.5. Bandwidth of log cell = 50-70MHz. The gain of the array on 6 and 4 metres is estimated to be 7-8dBd. Back to front ratio is observed to be between 10 and 12dB.

Table 2: Multiband log periodic yagi design parameters and dimensions.

MATERIALS

MULTIBAND LOG PERIODIC YAGI

Boom	1in square section 6ft
L1 to 5	½in seamless tube
5 insulated dipole fittings	½in to 1in square
D1, D2	3/8in seamless tube
2 mounting clips	3/8in to 1in square
1.6mm enamelled wire	as required

10 ELEMENT LOG YAGI

Boom	1in diameter aluminium tube, overall length 10ft 6in
Elements	all 3/8in diameter seamless tube
4 Dipole fittings	
Metal element fittings	3/8in to 1in diameter required

Note. Director length corrections need to be applied if the fittings are different from the those specified.

All parts are available from Sandpiper Communications, telephone: 01685 870425.

CONTINUED FROM P56

pudding is in the eating' theorem beloved by all true amateurs.

I decided to try an increased boom length and additional director elements. I hoped to be able to increase the gain without running into the problems of 'plan view of a hedgehog' polar diagrams and low feed impedances that can happen with yagis which employ more than a couple of directors.

Starting with the original seven element LPY [3] as the basis for the new design I doubled the length of the boom and added three additional directors.

Unfortunately, no combination of director spacings allowed the antenna, using the 4 to 1 balun in the original design, to be matched to a 50Ω coaxial cable. In order to measure the feed impedance of the new beam the balun was disconnected, and to my surprise the measurement showed 45Ω with very little reactive component. A small repositioning of director 3 (D3) produced the required 50Ω impedance. The overall dimensions of the antenna are shown in **Fig 3**. When the antenna was connected to the feeder with an untuned balun, as shown in Fig 2, a very good match was achieved with no sign of polar diagram distortion or squint, over the DX portion of the 2-metre band.

The first tests were carried out at about 10ft above the ground and were done to measure the relative currents in the 10 individual elements. The current is measured by placing a loop current detector near to the elements. This test is always carried out as it seems to be a good indication that each of the elements is working. The results are shown in **Table 3**.

Element	L1	L2	L3	L4	D1	D2	D3	D4	D5	D6
Relative current	1	3	3	3.5	6	10	6	10	6	9.5

Table 3: 10 element log yagi currents.

The antenna was installed on a mast at 23ft. Tests with other stations who were able to give some estimation of the polar diagram. Data collected over a period of time suggests a front-to-back-ratio of around 15 to 20dB with all minor lobes better than 25dB down.

REFERENCES

[1] 'The K4EWG Log Periodic Array', Peter D Rhodes, *The ARRL Antenna Compenduim*, Vol 3, P118.

[2] 'Log Periodic-Yagi Arrays', *ARRL Antenna Handbook, 1988 Edition,* P10-20.

[3] 'The VHF Log Periodic Yagi', Mike Gibbings, G3FDW, *Radio Communication*, July 1994. ♦

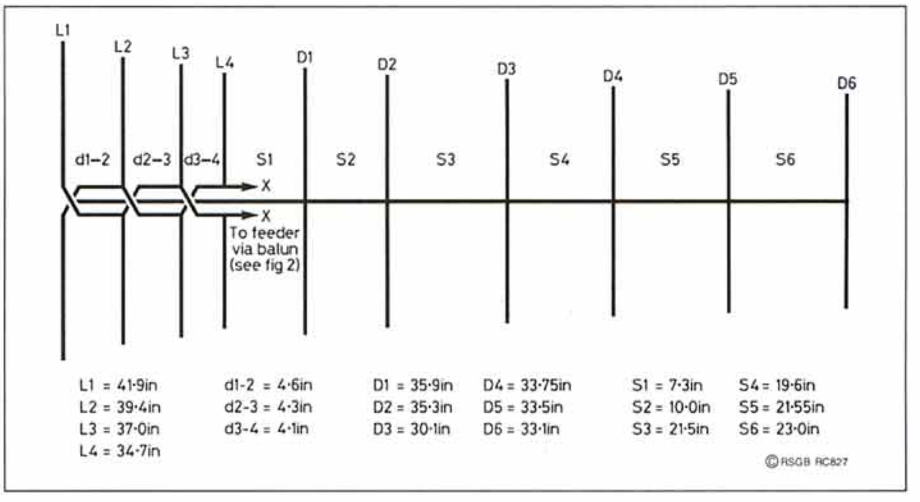


Fig 3 : 10 element 2 metre log periodic yagi.

57

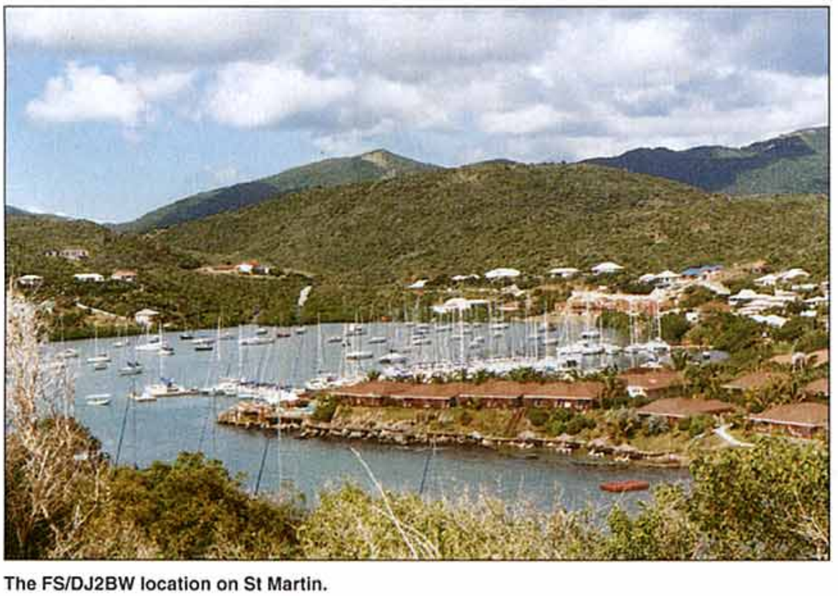
DXpedition consisted of two Kenwood TS-50 transceivers, KAM interfaces, laptop computers and ETM-9COG memory keyers. Operation on two bands at once could thus take place.

Hermann and the team really enjoyed their stay on this beautiful island abounding with palm trees and tropical vegetation, sandy beaches and small villages. They were fascinated by the great number of large crabs crawling over the beaches and the colourful birds.

St Martin

HERMANN'S MOST RECENT DXpedition was his trip to the Caribbean island of St Martin. Hermann, his wife Margot, DL2DK, and daughter Sabine arrived there on 29 October 1994 for a two-week stay. Approximately half of the island is French, and the other half Dutch, so that gave Hermann the unusual advantage of being able to use two callsigns - FS/DJ2BW and PJ7/DJ2BW - by operating from two locations.

The FS/DJ2BW shack was located in a pleasant modern bungalow, with 220V mains electricity supply, on the edge of a harbour backed by rolling hills. During the first week, operation took place from this location, resulting in 3100 QSOs. Activity was from the Dutch side of the island during the second week, when 1500 stations were worked as PJ7/DJ2BK. The bands used were 28, 24, 21, 18, 14, 10.1 and 7MHz. Operation on 3.5MHz was unfortunately not possible due to antenna limitations. Of the total of 4600 contacts for the two locations, 4300 were on CW, 100 on SSB and 200 on RTTY.



The FS/DJ2BW location on St Martin.

The equipment used consisted of a Kenwood TS-50 mobile transceiver, a KAM interface, a laptop computer, a small ASTU and an ETM-9COG memory keyer. The only antenna used was a fibreglass fishing rod 9m long, with a quarter-wave wire attached to it appropriate to the band in use.

To operate in PJ7, or elsewhere in the Netherlands Antilles, it is first necessary to obtain a reciprocal licence from the local authorities, supported by one's home licence. In French St Martin, in common with other French overseas territories, the home licence is sufficient, as France is a signatory to the CEPT T/R 61-01 recommendation permitting temporary operation abroad.

[Frank Watts, G5BM, is the UK agent for Samson electronic keyers - *Ed*] ♦