COMPARISON of 6m LONG NON-RESONANT VERTICAL WITH 3-BAND DIPOLE

WHY THE TEST?

In the past several years there has been a shocking trend to neglect proven antenna theory and deploy a non-resonant antenna, usually vertical, fed with a (4:1) balun. The user depends on an in-shack matchbox to match the antenna to the transmitter and simply lives with whatever loss is in the feedline.

Although this antenna should best be deployed with 16 or more radials, the people selling these antennas claim they work well with a single (non-resonant) radial or even with a simple ground stake.

Obviously you can work QSOs using anything metal as an antenna, as long as it is matched to the transmitter. The question is not "if" this antenna will work, but rather how well it will work. To find that out, it was decided to test it with a known antenna – a dipole.

THE "STANDARD" ANTENNA USED FOR THE TEST:

I currently only have a 3-band trap dipole for 80/40/20m installed at this QTH. It is elevated 10m at the feedpoint and about 7 or 8 meters at its ends. For the purpose of this test (receive-only), it was determined that the 40m portion could be used for 15m (3/2 λ) and the 80m portion could be used on 10m (5/2 λ). For comparison tests on the WARC bands, the dipole (inverted-vee) was used without a tuner, so no real conclusion may be drawn on these bands. The antenna is a Kelemen trap dipole using traps made of Teflon coax. It is approximately 100 ft. in total length.

DESCRIPTION OF THE TEST ANTENNA:

The antenna is based on a 6m long telescoping fiberglass pole. It was strapped to a wooden stake with its base about 1m off the ground. The radiator itself is a wire 7m long, so its lower 1m of wire which connects to the balun was pretty much horizontal. It was kept insulated from the ground. The single radial which connects to the other terminal on the balanced side of the balun was strung elevated through the bushes, about 50cm off the ground.

Initial SWR measurements were erratic, and sensitive to touching the MFJ-259B. A coaxial RF choke (Toroids slipped over the coax) was deployed about 50cm from the balun. After that, a clean SWR reading could be taken.

The antenna was not resonant on any band, except for 6m where it had approximately 1.6:1 across the band. 6m was not tested in this test, since the use of vertical antennas on 6m is not permitted in Germany. Typical SWR was about 4:1 or 5:1 on the ham bands.

With 25 ft. of coax running to the antenna, using the built-in ATU in the transceiver, I was able to obtain a good match (for what that is worth) on all bands. The ATU in the transceiver I used has a broader matching range than many of the common transceivers on the market.

METHODOLOGY:

A TEN-TEC Eagle transceiver was used for the test. It has a fairly accurate S-meter with 6-dB per S-unit. For the record, the S-meter reading remains the same on the Eagle, regardless of the setting of the pre-

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amp or attenuator. Tests were made by switching between the antennas and comparing the S-meter reading. Each station was measured several times to be sure the results were not skewed by QSB. During the tests, the vertical antenna was matched using an external MFJ-986 Differential-T matchbox, and a perfect SWR (for what it's worth) was achieved on all bands. No attempt was made to match the Dipole on its non-resonant bands. Its SWR was under 3:1 across the bands it was designed for, and about 1.5:1 or better at resonance on each of these bands. I realize this was not an optimum antenna for a 7-band test, but it is the only antenna I had available at the time.

At the beginning of the test period, the noise level for each band with each antenna was recorded in bold print in S-units. Noise was sometimes a significant factor in the ability to copy stations.

THE TEST WEEKEND:

All tests were conducted on Saturday/Sunday, October 8/9, the weekend of the Scandinavian Activity Contest. 40m was tested during the day on Saturday and Sunday, as well as Saturday evening/night and early Sunday morning. I wanted to be sure and see how the antenna behaves on this band during different propagation conditions.

BAND BY BAND TEST RESULTS:

40m:

I have been a 40m fanatic for almost 50 years. I have always had various verticals and dipoles for that band during those years and am very familiar with how they behave at different times of the day.

This vertical is about 30% shorter than full size quarter wavelength vertical for this band, but that is not as critical as the fact that it has just one radial. It is obvious that every vertical will be several S-units down during daytime propagation. The big question here was will its vertical polarization be useful for long-haul DX? Unfortunately the conditions were not conducive to determining this during the contest weekend. Very few stations outside Europe were even heard.

Here is the log:

40m	Dipole	Vertical	dB
NOISE -->	**S1**	**S1**	
LN9Z	59	56	-18
IK3SCB	59	59	0
ITALIAN	59+20	59	-18
SK3W	59	56	-18
OH1F	59+10	57	-22
ITALIAN	59	55	-24
ITALIAN	59+10	58	-16
ITALIAN	59+20	57	-22
OH1F	59	56	-18
OK1KZ	59	56	-18

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DUSK / EVENING:		59		
LA9BM	59+15	59	-15	
LN9Z	59+10	57	-22	
OH9TH	59+30	59	-30	
SN7S	59+15	57	-27	
OH5Z	59+10	58	-18	
SM5F	59+30	59	-30	
S51CK	59+20	59	-20	
EARLY MORNING:	**S4**	**S7**		
SM5QU	59	56	-18	
OH5UQ	56	55	-6	
LZ1DM	57	54	-18	
OG6N	59	54	-30	
OH1WZ	58	56	-12	
EA3JE	59+25	59+5	-20	
NC1E	31	NIX		
SI9AM	57	56	-6	
ZM1A	579	559	-12	
ES7Q	589	549	-24	
YL3FT	599	579	-12	
W5TOC	569	549	-12	05:50z
SP8ZV	559	NIX		
DJ6ZM	58	54	-24	
UR5CR	54	NIX		
SJ6R	59+5	57	-17	
LA9BM	59+20	59	-20	
OH2BV	59	56	-18	
SE5E	59+5	56	-23	
YO3CZW	59+5	57	-17	
FRENCH	59	57	-12	
DM2BRF	58	55	-18	
ITALIAN	55	NIX		
OZ1ZD	59+10	58	-16	
LN9Z	57	56	-6	

(The periods of darkness are indicated with a dark background.)

The **daytime** results were as to be expected. A horizontal dipole generally outperforms any vertical antenna during this time of day. Almost all stations were 12 to 24 dB weaker on the vertical than on the dipole. No surprises here.

The **nighttime** results were disappointing. Generally during this time of the year, at about 4pm local time when the band conditions begin to extend enabling DX QSOs, a good vertical will begin to perform as well as the typical (low) dipole, and a few hours later, it generally is an S-unit or 2 stronger for most

stations. The exception would be with local stations within a couple hundred km. Not so with this vertical. As can be seen from the log, it exhibited the same typical 12 to 24 dB worse performance than the dipole even at night. The only real DX heard was ZM1A (New Zealand) and W5TOC, both about 05:50z (07:50 CEST) Sunday morning. By this time it was daytime outside. The vertical pulled within 12 dB of the dipole for these two DX stations. My experience has shown that a good vertical should have been 6 to 12 dB better. So we can speculate and say on this band, it was working about 18 to 24 dB worse than a good vertical.

The exception was LN9Z who was only one S-unit weaker on the vertical. Since he was nearly as strong on the vertical, I expected his QTH to be way up north near the North Pole, but oddly enough, he is located on the southern coast of Norway. This made no sense to me.

In the early morning hours the noise level had increased significantly, but it was 3 S-Units lower on the dipole than on the vertical. This made the dipole much better to use than the signal strength (S meter reading) alone would indicate.

Only one station, IK3SCB in central Italy, was the same on both antennas. Go figure!

30m:

This is a band where I have no personal experience. I did not have any expectations on this band when the test began. I did not find a lot of activity on this band.

Here is the log:

30m	Dipole	Vertical	dB
NOISE -->	**S1**	**S2**	
IW1DFU	569	579	6
OK1HAS	539	559	12
IK5TSZ	559	569	6
A45XP	549	569	12
G0GKH	539	559	12
EA4DT	559	579	12
IZ0FVD	579	599	12
NOISE -->	**S2**	**S3**	
GM4KGK	539	559	12
SP7LHV	549	579	18
HA5CW	539	579	24
IV3/S57X	529	549	12
IK3NWX	559	569	6

(The periods of darkness are indicated with a dark background.)

On this band the vertical was almost exactly a quarter wavelength long. With more radials it would probably make a pretty good antenna here. (Sorry, that was speculation!)

Again the vertical was noisier than the dipole, but only by 1 S-Unit. The vertical beat the dipole hands down for all contacts, averaging about 2 S-units more gain. Of course the dipole is not resonant so the comparison results are pretty meaningless for this band.

About the only conclusion I can draw here is that the vertical antenna is usable on this band. With signals averaging 569 to 579, I'm sure one would have no problem making QSOs with this antenna on 30m.

I won't speculate on how much better a resonant antenna with 8 to 16 radials would work. Nor will I speculate on how well a resonant dipole might have compared. I will just leave the results as shown and each person can draw his own conclusions.

20m:

Twenty is my second favorite band, next to 40. Again this is a band where I have a lot of experience with all types of antennas. Here I did have an expectation level going into the test. I expected the dipole to out-perform the vertical due to the marginal ground network it has.

20m is open most of the day and a resonant antenna for this band is of reasonable size. This vertical was 40% longer than a quarter wavelength on 20m. Since most of the contacts are made with dx stations on this band, and a resonant dipole on a typical city lot may be placed high enough to be effective, the performance difference between a good vertical (meaning good ground network/radials) and a typical dipole is normally not significant. It is common to find some stations better on the one antenna and others better on the other – and to see this reverse as the band conditions change. In other words, it should be a wash.

Here is the log:

20m	Dipole	Vertical	dB
NOISE -->	**S4**	**S4**	
OG6N	57	57	0
LA8OM	56	55	-6
ON1NDO	56	56	0
SE0X	58	56	-12
OH9VC	57	56	-6
UA6YN	58	58	0
SE6Y	57	57	0
SK6HD	58	58	0
OG6N	59	59	0
403A	59	57	-12
9A2AA	59	57	-12
SK4DM	58	58	0
OH2PQ	59	58	-6
SM2T	59	58	-6

SK2AZ	59+10	59	-10
UA6YN	57	59	12
YO4DW	59+10	59	-10
SPAIN	59	58	-6
OG7X	59+10	57	-22
TA1CQ	58	57	-6
OH8CW	56	56	0
YO5PJF	56	56	0
SV0IO	59+5	57	-17
EC1KR	59	57	-12
UZ4I	59	59	0
LA6KOA	55	53	-12
OH1O	58	57	-6
French	58	55	-18
SV1EMX	58	57	-6

(The periods of darkness are indicated with a dark background.)

This time the noise level was the same on both antennas when the test began. In the morning of the second day, it was one S-unit louder on the vertical.

It is difficult to draw a conclusion on this band. Often the vertical was 2 to 3 S-units worse on this band, but it was also often about the same. Only once was it better, and that was the second time I logged UA6YN. I purposely switched back and forth several times to be sure the results were not being skewed by QSB. He was louder on the vertical.

Even in cases where the vertical was 3 S-units down on the dipole, the signal strength was still 55 or 56, so clearly the antenna is very usable on this band.

Although this is the band which brought the best results for the vertical, my gut feeling is that it was about 6 to 12 db down on a good vertical. Lack of radials is the reason.

SPECULATION: If you can take the time to lay down 7 to 15 more radials, this would probably be a very useful antenna on this band.

17m:

Like 30m, 17 is a band where I have very little experience, so I entered the test here with curiosity.

Like 20m, this band should see similar performance from a typical (good) vertical and a typical dipole.

Here is the log:

17m	Dipole	Vertical	dB
NOISE -->	**S3**	**S5**	
UA3DCX	579_{BETTER}	579	0

JH1AJT	56_{BETTER}	57	6
C31CM(?)	34	NIX	
IT9BDW	56_{BETTER}	57	6

(Daytime tests, only.)

The vertical was slightly better than the dipole, but let's not forget that the dipole is not resonant on this band. The noise level was 2 S-units higher on the vertical so the results shown skew the performance a little bit. Even though signal levels were lower on the dipole, the noise was lower so most signals were clearer with the dipole. This band seemed pretty dead this weekend.

15m:

This is a very important band for me because during most of the past years, it has been the highest band where I could expect to easily work DX. Ten has been a disaster.

Here is the log:

15m	Dipole	Vertical	dB
NOISE -->	**S1**	**S5**	
SZ1A	59	59+10	10
SE2I	54	55	6
SM3EAE	55	56	6
YO3CZW	55	56	6
OH2F	54	55	6
OH9W	56	57	6
SI3A	55	55	0
OH1WZ	56	56	0
OH6RM	55	55	0
OH3UU	56	56	0
UR5MM	54	56	12
SV5DKL	55	56	6
OH6RM	55	56	6
OG6K	58	58	0
OH6AD	54	55	6
ALL STATIONS ABOVE WERE MUCH BETTER ON THE DIPOLE DUE TO NOISE.			

(Again all stations were logged during the day.)

On this band, the vertical is very close to being a half wavelength long. Theoretically this would make it the most difficult band to match, but the MFJ analyzer indicated about 4:1 SWR on that band, like all the other bands. The Eagle's built-in ATU had not trouble matching it.

From the chart you would think the vertical would be the antenna of choice. In reality, the 4 S-units of additional noise on this band made the vertical very unpleasant to use. Most stations were only one or

two S-units above the noise level on the vertical, whereas on the dipole they were 4 or 5 S-units above the noise.

When I began the tests, I began on 15 and thought the noise might be due to the vertical's close proximity to the house. However the dipole is only about 6m farther away from the house and I did not experience this amount of noise on the other bands. On the other hand, being that it is close to a half wavelength on 15m, that could be the reason that it is much more noisy on this band than on the other bands.

I have to say, this antenna at this QTH was a disappointment. Clearly a resonant dipole or especially a full-wave loop on a fiberglass pole would be a better solution here.

12m:

Another dead band.

Here is the log:

12m	Dipole	Vertical	dB
NOISE -->	**S1**	**S1**	
A61ZX	53	54	6
	S2	**S3**	
SV0XBZ/9	549	559	6
EA7AJR	569	569	0

(All tests were made by daylight.)

As can be seen, there is not much data to go on. I'll just say the antenna works on this band and leave it at that. This would need to be repeated when there are more signals on the band.

10m:

In the days leading up to the weekend, I had heard that 10m was wide open. Unfortunately I could not concur. It seemed pretty dead to me, which took the fun out of testing on this band.

Here is the log:

10m	Dipole	Vertical	dB
NOISE -->	**S0**	**S0**	
4Z5LA	57	55	-12
WC5NT	51	NIX	
UA9FFY	55	54	-6
NN4ZZ	53	51	-12
AN2??	54	53	-6

(Once again all tests were made by daylight.)

Again there is far too little data to draw any conclusion. However in each case it was one or two S-units weaker than a very poor dipole (on this band).

SUMMARY OF TEST RESULTS:

For the band conditions on the weekend of the test, the dipole was the clear antenna of choice. It was usually stronger and clearly had less noise than the vertical. If I had had a resonant dipole for 15 and 10m, as well as the WARC bands, I'm sure the results would have been even stronger in favor of the dipole.

WHAT ARE THE STRENGTHS OF THIS VERTICAL?

Clearly its strengths are cost, size, and land space required for installation. In addition, it is very low-profile. The only additional cost besides the coax was 3 EURO for a wooden stake to mount it to.

To be fair, the cost of this antenna was only 40 Pounds Sterling (U.K.), which is about 45 EURO or $65.

The total cost of the dipole was (in EURO) 79 for the pole, 10 for the extensions at the bottom, 10 for the guy ropes, and about 100 for the Kelemen 400w 80/40/20 trap dipole. Altogether it cost over 200 EUROS, or nearly $300. In addition it occupies about 30m (100') of horizontal space in length, as well as about 15 to 20m (70') space in width for the guy ropes. That totals 600 sq. m or 7000 sq. ft. of area for its installation. The vertical requires less than 1 sq. m (indeed, just 1 sq. ft.) plus a hidden wire running 7m along the ground.

Finally, when mounted behind the house, the vertical cannot even be seen from the front of the house. The mast of the dipole is 10m high and more difficult to hide behind the house. Its wires and ropes make it much more conspicuous to neighbors' eyes.

CONCLUSION:

This vertical as it is sold can only be seen as a practical multi-band, low profile antenna which can give fair performance on many bands. It can be installed or taken down in just a few minutes, and stores in a back-pack size package.

I believe it would be a fairer test to compare it with a ground mounted or car-mounted mobile antenna such at the Outbacker, rather than with the dipole I used for the test.

SPECULATION:

If you have the time and space to install 16 radials, each about 7m long, the performance would be significantly better.

In addition to the radials, if you would mount a remote ATU at the base of the antenna, such as an Icom AH-4 or SGC-230, this would be a very good antenna, showing only weakness with daytime operation on 40m.