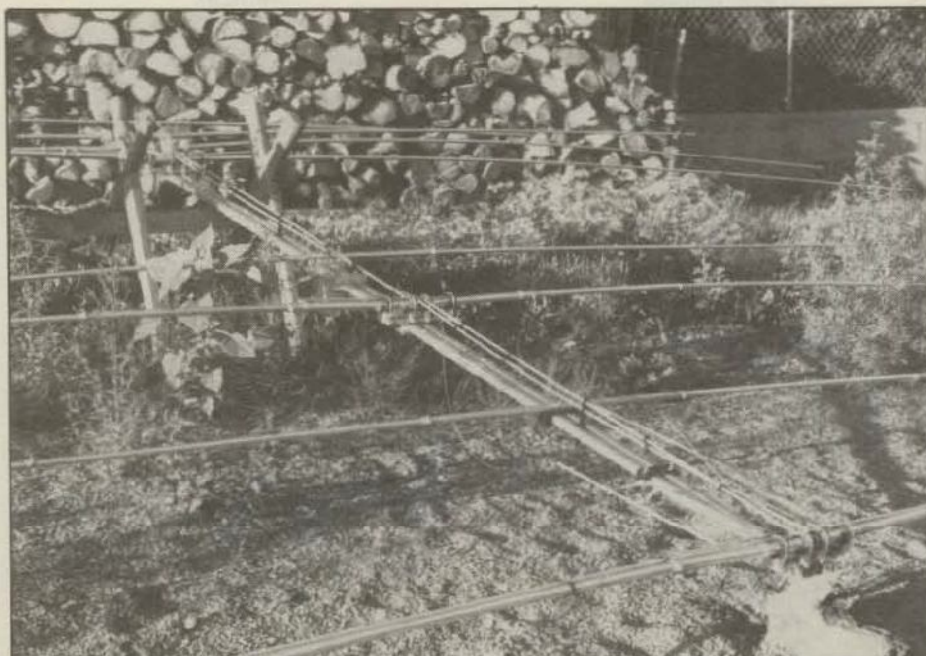
CQ REVIEWS:

The Sommer Trapless Multiband Beam

BY LEW McCOY*, W1ICP

As many readers know, I have spent the majority of my amateur career writing about antennas, making antennas, building Transmatches and Monimatches, and lecturing in this field. In fact, I am coming up on 40 years on the subject. I have to add that my interest in the subject of antennas has never lessened. During my career I have built Rhombics, Sterbas curtains, countless beams, and devised new antenna systems. More important, I have worked with some famous people and studied the works of others, including people like George Grammar, By Goodman, Tilton, Jascyk, and certainly not least, Dr. Yagi. By Goodman once said he was going to claim me as an IRS deduction because he devoted so much time and money to my training! For those readers who don't associate the name By Goodman, W1DX, with antennas, let me say that he organized and edited the first ARRL *Antenna Manual*. Enough said?



One doesn't get much level area to work on when you live in the mountains of New Mexico. In any case, here is the DJ2UT beam completely assembled prior to erection.

Some Multiband Antenna Background

So what has all this to do with a product review in *CQ*? Very simple! This review has to take us all a long way back in antenna design to what works and what doesn't. Anyone who has studied the literature on beams knows that Yagi and Uda wrote some very basic information about parasitically excited elements in antenna configurations. Prior to this time, completely driven arrays were in vogue. (Remember the 8JK?) The parasitic array consists of the feedline going to one element of the array (driven element) and then parasitically exciting other elements—usually directors and a reflector. The 8JK, on the other hand, consisted of two elements, both driven, and it could be used on more than one band, while the Yagi was designed for single-band operation.

The logical extension of the Yagi beam was an idea that was put forth by Ed Buchanan, W3DZZ, back in 1953 in *QST*, when he came up with the idea of tribanding a Yagi to cover 20, 15, and 10 meters. Let's be very honest. It is well nigh impossible to build a trap antenna (Buchanan's concept) without introducing appreciable losses because of traps. Additional losses take place because of compromises in element lengths and spacing to achieve a match for 50 ohm feed and broadbanding.

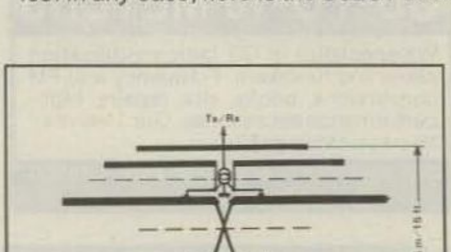


Fig. 1– This drawing shows the electrical layout of the XP507.

Also many years ago, it was established that excellent gain could be obtained with very short spacing of elements on a three-element, monoband beam. With spacings on the order of 0.1 wavelength, the theoretical gain of 7 dB plus could easily be obtained with an outstanding front-to-back ratio. However, and this was disastrous, the radiation resistance (useful power factor of the antenna) dropped to a very low value—10 ohms or less. The bandwidth of such an antenna was very narrow. In fact, such systems wouldn't work with modern transmitter design unless a Transmatch were used. Sure, one could use matching devices to get the impedance up higher, but when you started to think in terms of tribanding—or more—it was very discouraging.

About ten years ago a German amateur named Sommer, DJ2UT, concluded that there had to be a better method of building

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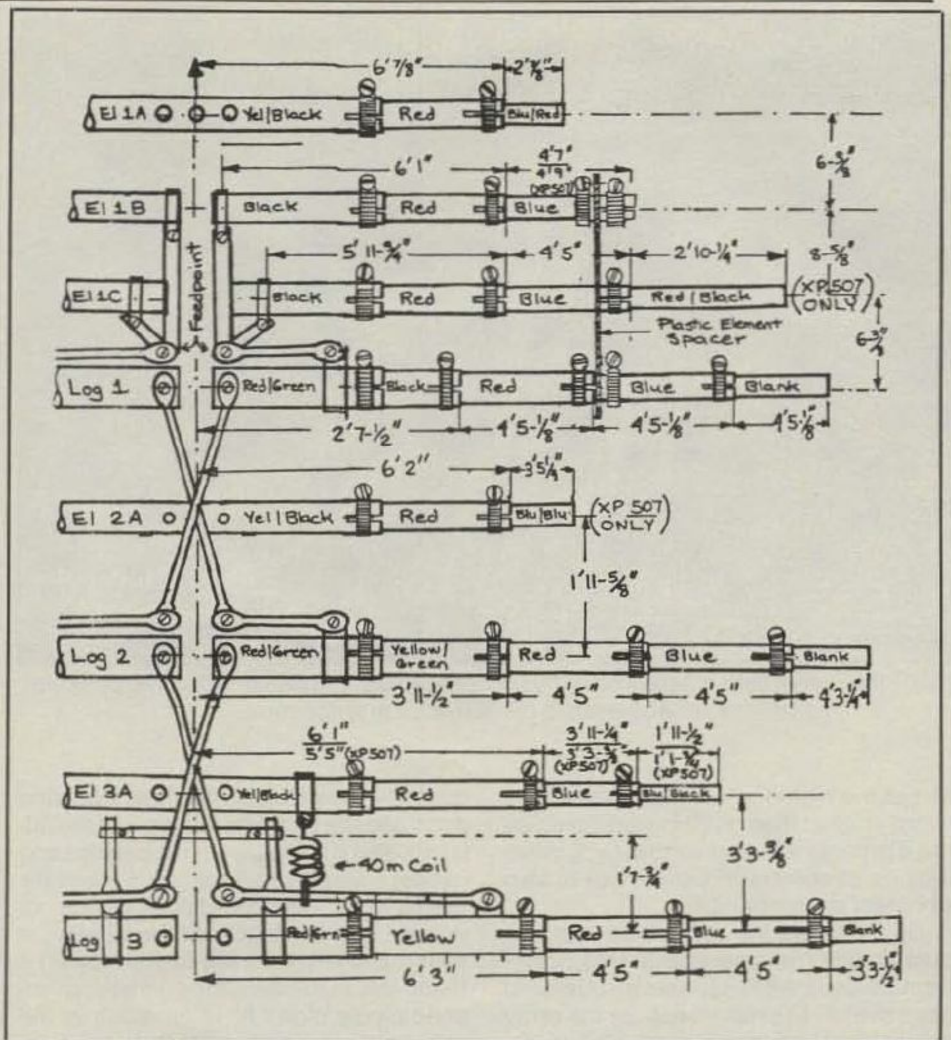


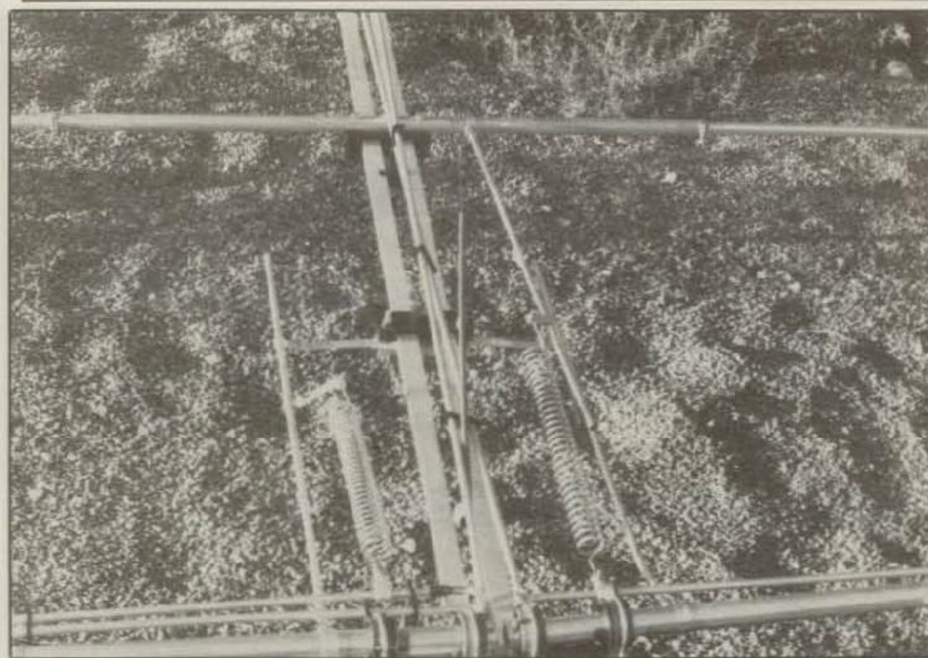
Fig. 2– One construction drawing from the manual showing one side of the array.

multiband beams. He realized that the gain and excellent front-to-back was possible with close spacings, and he was determined to overcome the feed problem (which was really the only tough one). After much experimentation, he achieved the multiband antenna we are discussing in this review. He incorporated some of the ideas from the Hans Rucker, VK2AOU, article (*Ham Radio* magazine, May 1979 issue) plus many of his own innovations. At the Dayton Hamvention in 1984 Sommer displayed his antenna, and there is no doubt that his beam was one of the main points of interest at the show. I told Sommer that *CQ* was very interested in doing a product review, and he was more than receptive to the idea. I was shipped the antenna that was designated the XP506, which is a beam that has 7 bands (10, 12, 15, 17, 20, 30, and 40 meters). And this is all done on a 15 foot boom! To say I was skeptical about such an antenna was putting it very mildly.

A Better Mouse Trap

We all know the cliche "Build a better mouse trap, etc.," but how about catching the mice without any traps, if you'll forgive the pun? First we must consider the bandwidth of the antenna on the various bands. When I did SWR curves for each of the bands, I found that mine, in most instances, were better than those shown in the manufacturer's advertising literature. My XP506 was installed at 55 feet above an almost perfect ground. (I might add that my location is 6300 feet above sea level, almost smack on the continental divide. More important, my earth conductivity is excellent, being an old gold, silver, copper, and manganese mining claim.)

The SWR curve for 20 is less than 1.3 to 1 across the entire band. The manufacturer rates the gain at slightly over 7 dB for most of the 20 meter band. Theoretically, it should have that gain, so I see no reason to question the figure. Also, all the gain figures are measured over a half-wave dipole, not some mythical, make-it-look-good reference. (Keep in mind—no trap losses!) Front-to-back is rated at over 25 dB. In my on-the-air tests, I actually had signals S9 or more off the front, and I couldn't hear them off the back so I know the antenna is not over-rated on that score. On 15 the SWR curve was slightly over 2 to 1 at the low end, dropping quickly about 50 kHz into the band to 1 to 1, and staying flat out to 21.3 and then slowly going up to 1.4



This is the rear of the antenna and on the right the 40 meter loading coil for the back element. At the left is the 30 meter arrangement.

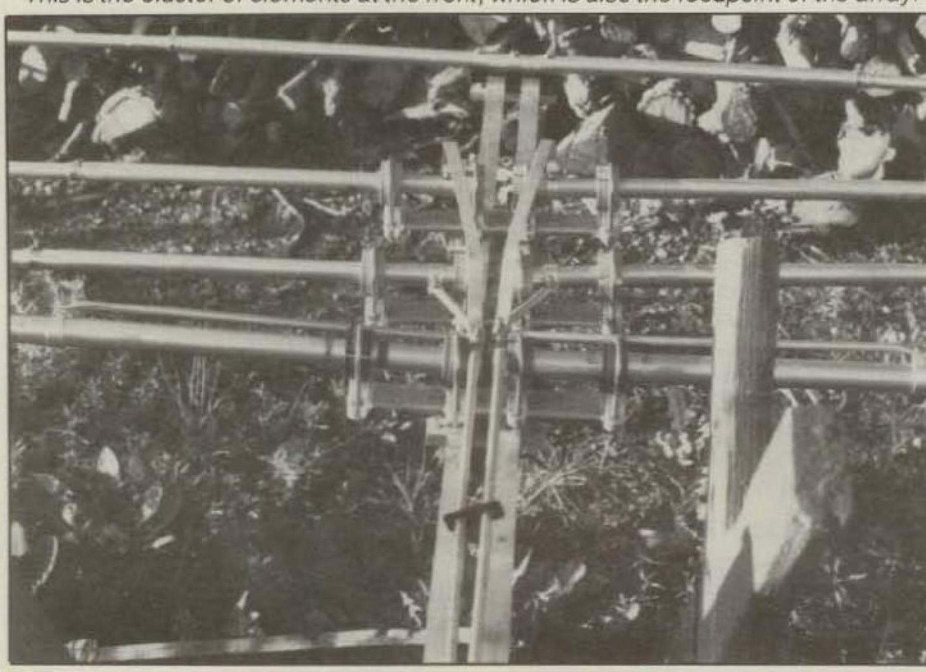
to 1 at the high end. Gain on this band is slightly higher than on 20 meters because the elements are approximately ¾ wave long on 15 meters. Front-to-back is also excellent on this band.

On 10 meters the SWR curve was also outstanding, running less than 1.5 to 1 from 28.2 to 29.6 MHz. Gain on this band goes over 8 dB simply because the array on this band becomes full-wavelength elements—truly a case of bigger is better. Front-to-back is rated at more than 20 dB here.

Of course that is only three bands, and the antenna I tested was actually seven bands. The longest element, at the rear of the beam, 36 feet 8 inches, is used as a quarter-wave dipole on 40 meters, utilizing a coil and the stray capacitance of the adjacent element to achieve reasonance and cancel capacitive reactance. Essentially we have a rotatable dipole (which, of course, is in the best possible location in your station—at the top of your tower). I found that in my case the 40 meter shortened dipole didn't have as much of the common figure-eight pattern as it should. There was directivity of front-to-side, but not as much as I have experienced with previous rotatable dipoles. However, I did get nice reports on 40, so maybe I was being too critical.

As expected, the SWR curve was much sharper on this band, going from 2.5 to 1 at

This is the cluster of elements at the front, which is also the feedpoint of the array.



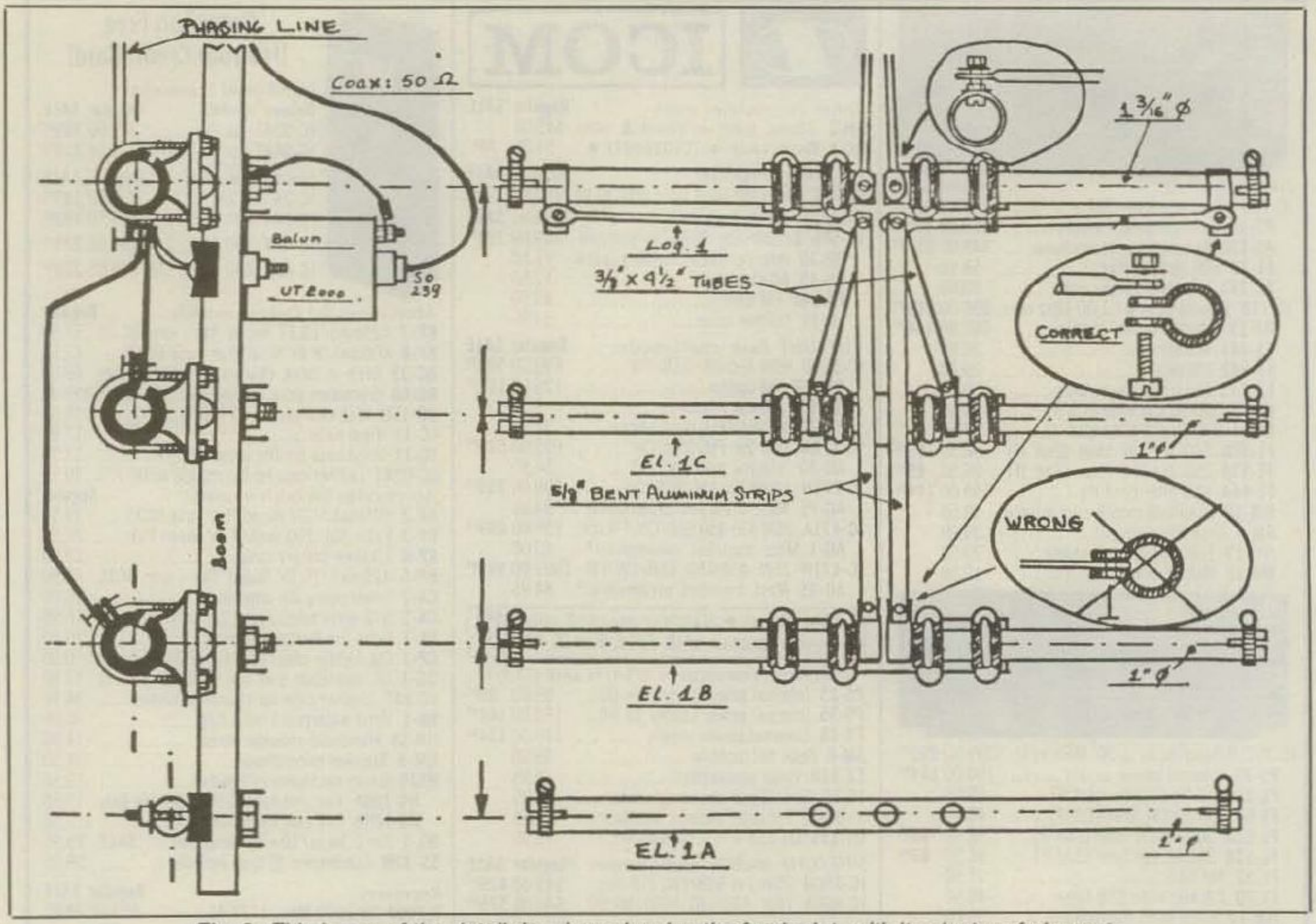


Fig. 3– This is one of the detail drawings showing the feedpoint with its cluster of elements.

the band edges, dropping to a good match at 7.2 MHz. I might add that instructions are given for moving the SWR curve either up or down in the band (CW or phone). However, "tweaking" the 40 meter dipole coil isn't easy unless you have a tilt-over tower such as I have. The SWR for 30 meters is low enough to cover the band adequately.

On 30 meters, 10 MHz, the same element is used as a rotatable dipole with a similar coil/capacitor loading system. However, there is a slight gain over a dipole on this band because the cluster of elements at the front of the array tends to work as a director. As I mentioned above, both 40 and 30 meters can be "tweaked" so that they are right on the nose for the desired operating frequency range. Keep in mind that the SWR is higher off resonance on these bands.

The two newer WARC bands are also in the system, which provides the "seven" bands. I didn't operate there, so I cannot give an evaluation except to say the antenna "listens" extremely well on these frequencies, while checks with a noise bridge also show a very low SWR on these bands.

The antenna is no lightweight, coming in at 66 pounds with a wind-load factor of 10 square feet. I have a Rohn Model 45 crank-over tower with a power-winch, and although I backed it up with another winch, the tower and existing winch handled the beam with ease.

Technical Details

Describing the technical details of an antenna like this is not easy, and some of the information is proprietary for patent reasons. However, let's go through it so you have a better idea of what is happening. (I'll only describe my model because there are others, but more about that in a moment.)

Let's start with 20 meters, because essentially the antenna is based on a 20 meter design. The XP506 has three full-size, 36 foot plus elements, spaced slightly less than 0.1 wavelength, all fed with phasing lines. Through a complex system of T-matches, the resulting feed impedance is 50 ohms. Keep in mind that there are no coils and capacitors in this system—in other words no traps—just a clean completely driven 20-element array (plus the use of full-size elements).

On 15 and 17 meters the 20 meter elements become ⅝-wavelength (approximately) radiators. The matching techniques devised by Sommer with the phasing lines and T-match, etc., plus a cluster of additional elements at the feedpoint, bring the impedance down to 50 ohms.

On 10 and 12 meters the 36 foot long elements become full-wavelength elements, and in this case they are fed via the phasing lines, which in effect make a colinear array, with the increased gain that results from using such a large colinear system on 10 meters. Using full-wavelength elements would result in a very high impedance, so careful attention is given to matching and bringing the feed impedance down to 50 ohms, which it is.

I have already mentioned the use of the rear element for 40 and 30 meters, so I won't go into additional details on those bands. There are two parasitic elements on the model I had—one at the front of the array for 10 meters (additional gain) and another near the rear for 12 meters.

There are two parasitic elements in the XP506—one at the very front for 10 meters and one near the rear for 12 meters. Just in front of the foremost 20 meter element are two additional driven elements that are part of the feed/broadbanding system. The actual feedpoint is here, through a 1 to 1 balun. The balun is made with a Teflon-insulated coax (which will easily handle 2 kw). The balun is encased in a plastic material enclosure. The SO-239 fitting on the balun is gold-plated!

The boom is made up of two lengths of square aluminum tubing in order to provide additional strength plus added flexibility. Having such a boom is a rather

I have a Rohn Model 45 crank-over, and it proved to be no easy job getting the beam on mast—in the upside-down position. However, with the help of some intrepid local amateurs, we got the job done.

radical departure from the customary aluminum tubing. However, Sommer has excellent basic engineering here in that the boom can flex and stretch, similar to a suspension bridge. The element supports are extremely rugged and really hold the two square sections of the boom together. As you can see from the photos, the element supports are large and are made from cast aluminum. A stay guy is used to give additional support, and it is made from stranded stainless steel.

The instruction manual provides detailed drawings. It took me about five hours to put together the antenna, with another amateur helping for about two hours of that five. The XP506 weighs 66 pounds and has a wind loading area of 10 feet. What to me was interesting is that the gain claims for these antennas are completely realistic. As I said earlier, the manufacturer rates his gain over a half-wave dipole. For example, the XP406 model which is on an 8 foot boom has a stated gain 5 to 6 dB on 20 meters, and this is certain to be just about what it is. There is no doubt in my mind that the Sommer beam is in a class by itself when it comes to multiband arrays.

The real test of any antenna system is how it works in your station, and I have to mention one experience with this antenna. I got the antenna up on a Saturday and used it during the ITU DX contest. I noted immediately on 20 meters that the front-to-back was superb. I heard an old friend, W6BNX, Tiff, and called him to get some reports. While working him I heard a break, so I stood by for the breaker. The voice came back and said, "This is T32AN, Phil, on Christmas Island, and I wanted to tell you how well you are coming in here!" Needless to say, that makes a believer out of any antenna user. It is also a pleasure to have a rotatable dipole on 40 meters on top of my tower. I was also constantly amazed as to how low the SWR was across 20, 15, and 10. If I sound enthusiastic about the XP506, I am, and I will really be surprised if this system doesn't revolutionize multiband beam systems.

Here are the introductory prices for the various models: the XP406 is $514, the XP506 is $642, and the XP706 is $778. I didn't mention the gain on the XP706, but it is rated at close to 9 dB on 20 meters (over a dipole reference).

The manufacturer is Sommer GmbH, DJ2UT, Kandelstrasse 35, D-7809 Denzlingen, West Germany, and the beams are distributed in this country by H.J. Theiler Corp., P.O. Box 5369, Spartansburg, SC 29304 (803-576-5566). CQ

This shows the antenna installed on top of the tower. The back of the beam is to the right. That's a 2 meter Swiss quad on the top of the mast, not part of the DJ2UT beam.