

Early EME operation using a Rhombic on 144 MHz

By Chris Skeer VK5MC

Recently I had the task of removing a piece of history from my landscape in the form of a 144 MHz EME rhombic antenna. It had stood the test of time and over the years provided a lot of interest to others and good memories for me. Although its removal was a sad occasion I decided to record its history and share it with others.

It all began as a result of the 1971 SERG (South East Radio Group) VHF field day weekend at Jones' Ridge, south east of Mt Gambier and just over the border into Victoria. From there we heard Ray VK3ATN working an American station on 2 metres. The thought went into my mind that it would be nice to do something like that, but how?

During the next few months I made a study of the Moonrise and Moonset times as published in the South Australian Advertiser. However the information was not very helpful, if you have ever tried to see the moon rise during the day you will realize why.

Ray VK3ATN obviously had a system that was working so it was decided to pay a visit to Birchip during March. Trevor VK5NC (VK5ZTN at the time) came with me and has been involved with this project ever since.

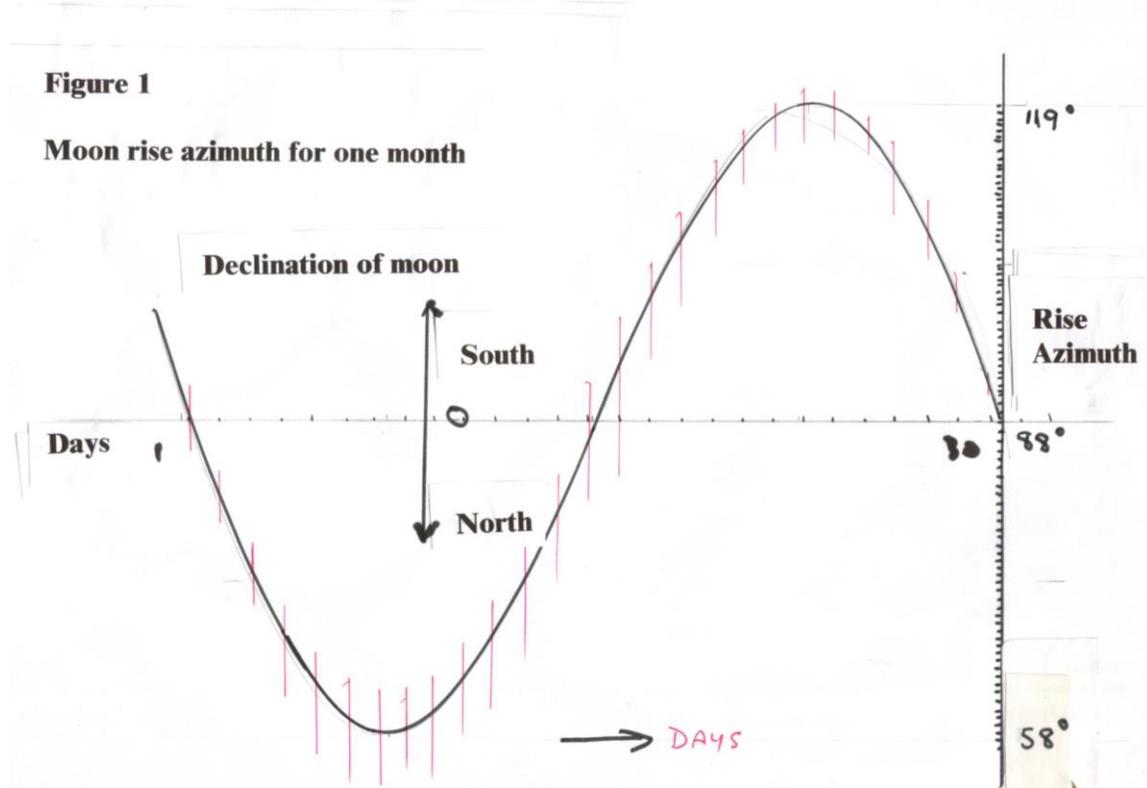
Ray was very helpful and gave us details of his rhombic; he showed us what equipment he was using, and a list of Ray's windows were noted. No doubt he has had many visitors over the years interested in EME, as I have also had, but not many take up the challenge.

Ray VK3ATN was the first to develop and utilise the rhombic antenna for EME use on 144MHz in Australia. His first contact was with K2MWA in 1966 closely followed by K6MYC.

After the trip to Birchip it was decided that rhombics were the way to go as I had a suitable area to do it and yagis at that time were not quite as refined as they are today. As the local TV station had recently started up it was decided to put an advert in the local papers to see if I could get some of the towers that were now obsolete. The phones ran hot for a week, many pipe, tubular steel and winch up towers were obtained, and with most people pleased to see them removed from their back yards.

During July 1972, 122 pounds of hard drawn copper wire was purchased at a cost of \$81-19 and some six-inch long strain insulators were obtained from America. From the information that Ray had given us I knew that his antenna was at 55 degrees from true north, but I was some two hundred kilometres to the West. As we only had a few degrees to play with how would we get our direction correct? On the sixth of July, Ray had a window so I got up at about 3 am at moon rise and put in two star droppers in line with the Moon. I now knew exactly where to point the rhombic.

Ray VK3ATN had carefully selected his antenna position to catch the moon on its northerly peak in declination, to allow for a couple of days of operation together each month. Figure 1 gives a plot of the azimuth moon rise over a month.

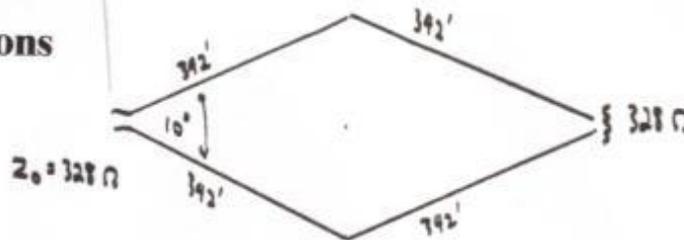


The first rhombic to be put up for moon rise was 342 feet per leg, making it 680 feet long with a feed angle of ten degrees. It was a four-layer antenna, each layer stacked six feet apart and used about a mile of copper wire. The rhombic crossed a country road with three of the towers in an adjoining paddock, the main feed tower was as close to the house as I could fit, but still had 150 feet of home made open wire feed back to the shack near the

house. The mind boggles at trying to get permission from the local council to put up such a structure these days. Figure 2 gives the dimensions of the antenna using feet as the measurement, as it was in those days.

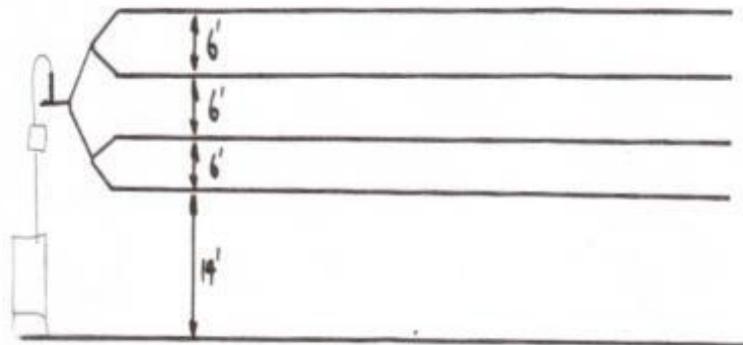
Figure 2

Antenna Dimensions

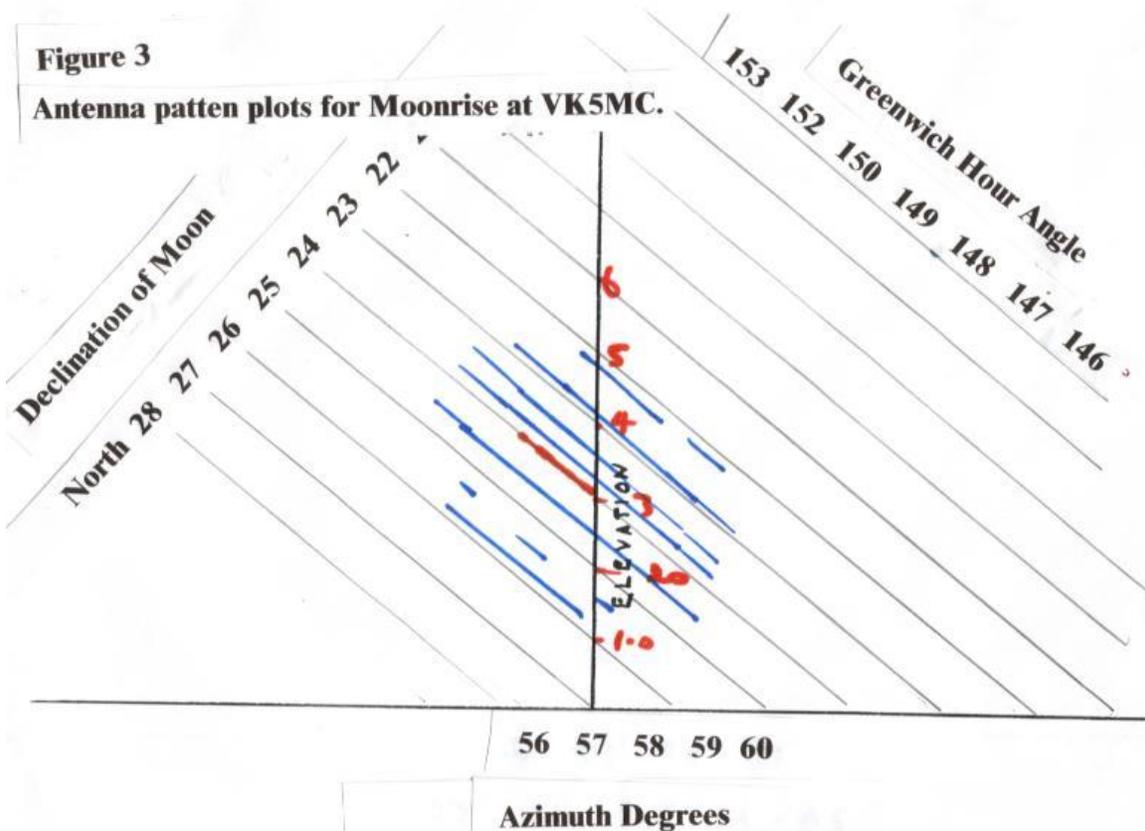


50 λ PER LEG.

144 MHz RHOMBIC ANTENNA.

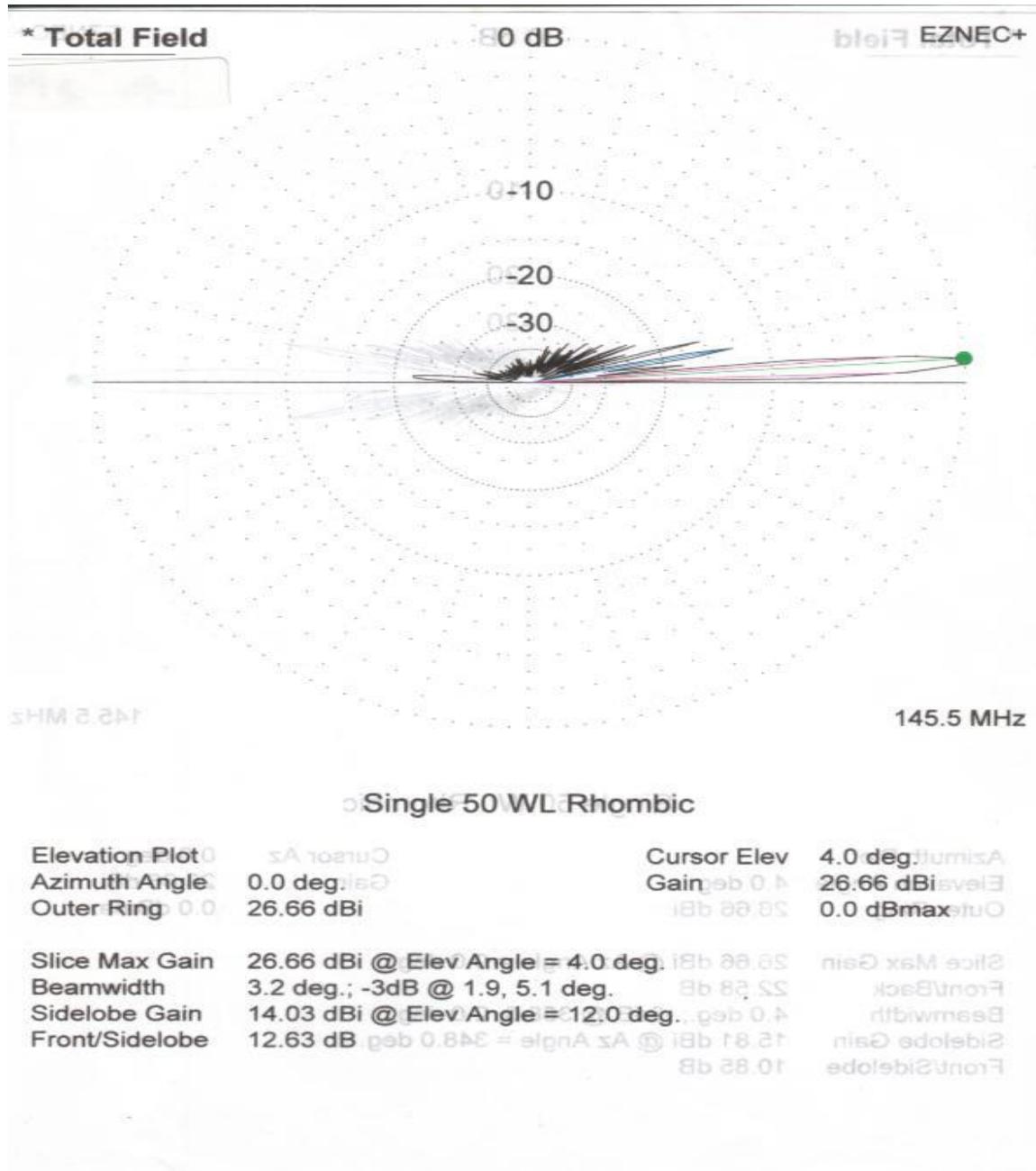


I can always vividly remember the first time I tried for an echo off the moon. When I lifted the Morse key after zero beating the receiver, “Bingo !!!” it was there. I heard echoes for seven and half minutes before they disappeared as I had actually started in the middle of the window of usable time. Over the next few months a plot of the antenna was made to see where I could actually hear echoes, and to determine where it was pointing in the sky. A rhombic such as this has a maximum gain not on the horizon but at a point where the sky wave and ground wave combine, in this case about three and a half degrees above. Figure 3 gives an indication of the antenna pattern and was built up using the times that echo’s were heard.



Once it was established where it was pointing in Greenwich Hour Angle and Declination, the only way of predicting when the moon was to be in the correct place was to purchase a Nautical almanac. This contained daily charts of the moon, sun and stars giving their Declination and Greenwich Hour Angle for each and every hour of the year. I would go through the days looking at the declination when this was acceptable, look at the GHA and calculate the centre time of the window. These normally occurred close together on a couple of days per month as Ray had carefully positioned his antenna at a position where the declination reaches a peak. If you plot the declination of the moon over a period of a month it will look like a sine wave, the antenna is positioned to be near the peak of the wave pattern, giving two or sometimes four consecutive days of useable window. When calculating the windows one has to be aware of the position of the sun, if it is too close nobody will be heard. On one occasion, when the sun was rising through the antenna, sun noise was measured at 18 dB over residual noise.

Later it was found that the calculated antenna gain for a four layer rhombic over good ground was 32.5 dBi according to an article, "The design of an optimum rhombic Antenna", by R.P.Decker. From the Collins radio Company. Information supplied to me recently by VK3AUU gives a computer plot of a single 50 wavelength rhombic.



The first attempt at a CW contact was with Bob Sutherland W6PO; it must have been a Sunday afternoon as quite a gathering of SERG members was present. We could hear Bob quite well; he had a 1000 watt 8877 transmitter compared to our 4CX150A which gave around 100 watts out less the losses of 150 feet of open wire feed. Using the T M O reports used on EME (T= odd letters, M= most letters, O= all letters). His report received was "M" and no "Rogers", so it was not an official contact although we had heard him and he had heard us.

After several attempts I did have an "O" report contact with W6PO, on March 13 1973. Bob at that time was using a 160 element collinear antenna, a U-310 preamp and 8877 triode final amplifier.

A few months later, Lionel VE7BQH was heard with very good signals, "O" was sent to him but no report was received from him at all, very frustrated I took the tape recording to Trevor VK5NC. After listening to the tape he said "A good signal from him, but you were calling VE7BYH not VE7BQH that's why he did not give you a report". For those not familiar with Morse code a Q and a Y are a mirror image of each other and for an inexperienced operator as I was at that time it is easy under the pressure of the moment to get them wrong. Needless to say a month or so later I did correct my morse sending and had a contact with VE7BQH.

Almost all of the contacts that were made on 144 MHz EME were made on a random basis, all I did was publish a list of window times for the next six months, when the moon was in the correct place for me to use the moon. Whoever wished to make a contact with me could come up and call me. I would transmit on 144.012 and listen 144.000 to 144.010 for any calls. This would enable me to break way from the normal 2 minute transmit /receive periods if I thought signals were strong enough.

Early in the experimentation it became quite obvious that the only way to get a better signal up to the moon was to cut down the feed line loss. So a small shack was built at the feed end of the rhombic so that the transmitter could be as close to the antenna as possible, a preamplifier was also put at the antenna and the system was starting to work quite well.

Making skeds for a window six months in advance had its problems although I was working for myself and could take an hour off whenever I

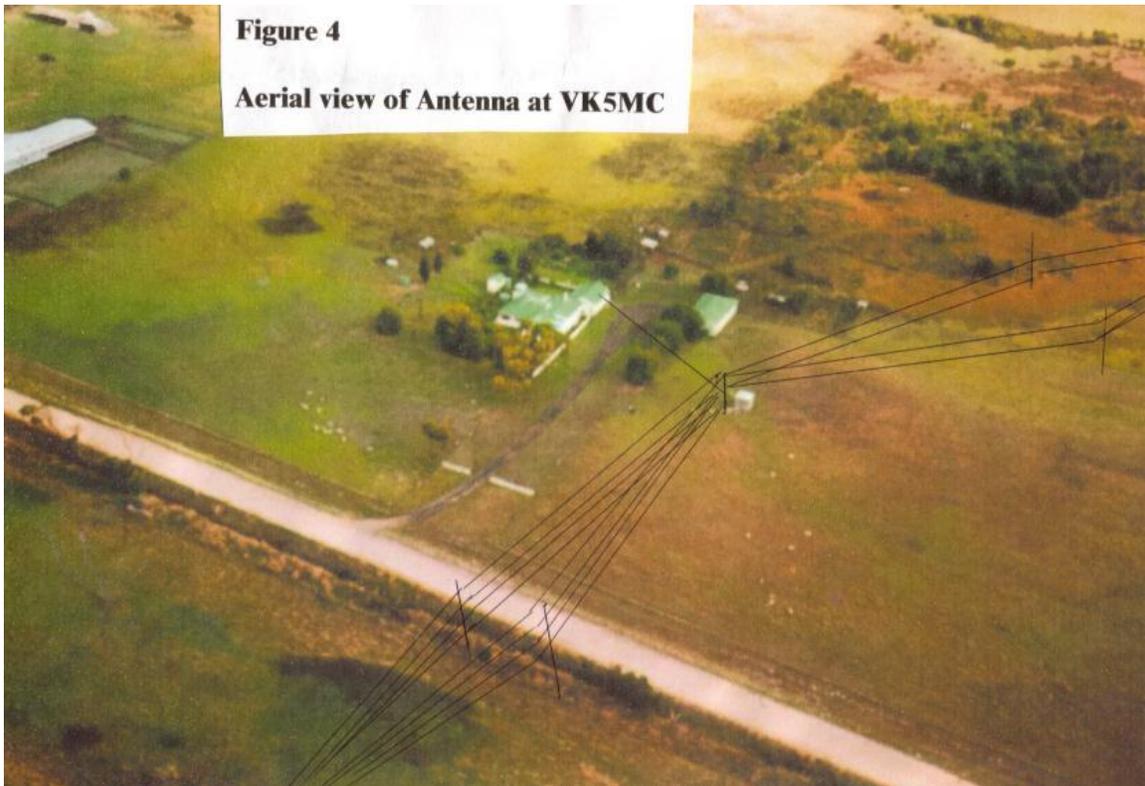
wished to although sometimes things clashed. One Saturday in March I was involved in a cricket final and could not be there for the window. After some instructions on how to turn on the tape recorder and tune the receiver, the XYL recorded the window for me and heard K8III, K2RTH and VE2DFO all calling me, to no reply as I was busy playing a cricket final.

On 12 December 1984 on a window when no other signals were being heard I was receiving some fairly strong echoes. It was decided to see how low a power could be detected. On that occasion a 10-watt button was put in the "Bird 43" wattmeter and echoes were detected 2db over the noise with 4 watts of power. Obviously on that occasion everything was working in favor and not against as they normally are when looking for echoes.

Over the years one could get a feel for the antenna. As it relied on ground reflection to help it perform, at the end of summer when the ground underneath the antenna was very dry the performance would not be as good as it was in the winter or spring. Faraday and libration fading were also noticeable, some times signals from other stations could be heard quite well but no echoes could be heard at all.

One very memorable contact on Dec 30th 1974, which is recorded on tape, occurred when the late Ron Wilkinson VK3AKC, a 1296 EME operator at that time and VK5NC were present in the shack. It was an evening moonrise and Kelly W8KPY was contacted on CW with 549 reports both ways, no O reports, as signals were fairly good. On his final 73s he requested that I go to SSB for a try, which we did. We heard him quite well and gave him "strength 5 readability 5" report. His report to us was 4x4 ; we received Rogers from him wishing us a good morning. Looking at the back of his QSL card Kelly noted that according to him it was the first ever SSB contact on 144 MHz from the United States to Australia.

It became fairly obvious during operation that I was hearing stations much better than they were hearing me. During 1975 a high power permit was applied for and obtained and the transmitter now was improved to a pair of 4CX250B with 600 watts output on 144 MHz.



During 1978 another rhombic was constructed, this time a dual purpose rhombic. Owing to the layout of the trees and hills in the area a beam heading was chosen that pointed on Albany across the Great Australian Bight to VK6 and to catch the moon at 3.5 degrees Declination. This gave me moon set from VK and access to stations in Europe and South Africa. This rhombic was a two-layer antenna as not enough copper wire was available at the time; it gave me a window one-day per month.

By this time personal computers were starting to become available and Trevor VK5TH converted a program to run on his Commodore Pet computer that could predict months in advance where the moon window would be. Later still I reworked this program to come up with a list of window start times for my two rhombics and this gave me the start time within a few minutes.

The 144MHz receive system to start with was a single gate 2N5245 (TIS88) JFET converter to 28 Mhz into a Yaesu FR100 receiver. This used a slug tuned neutralising circuit for the first stage, which was very unstable. Once the dual gate variety of MOSFETs became available, MPF121 and 3N140, they were put into use, with much better reliability and ease of tuning. It is

interesting to see the progression of the preamplifier over the years. Firstly a 2N5397, then the Magical U310 in a grounded gate configuration, these were meant to give me a noise figure of around one db. Then later on came the GaAs FET with its 0.5 db or lower noise figures. With my antenna looking at the ground, one was never sure if the later preamplifiers really made any difference on the signals received, but it made you feel better if the latest device was in use. The measurement of them is another story.

I would normally have a spare preamplifier on hand, as one of the problems that I would have was that of static discharge blowing the field effect transistor from time to time. In the early days I would disconnect the connector during electrical storms and as it lay it on the floor, I can remember the discharge jumping an inch or so to a nail in the floor.

On another occasion when we planned to move the antenna nine degrees to catch up with the declination movement, Trevor VK5NC and myself had the antenna almost on the ground across the road ready to move the towers, when the council grader was seen coming along the road. A hasty lift of the cables avoided disaster.

Sadly the last recorded contacts were on Oct 17 1992 during an ARRL contest weekend when W5UN, N6DC and KB8RQ were contacted. This was an unusual situation as rarely did the rhombic windows coincide with ARRL contests.

A list of the initial contacts over the years were:

1973- W6PO, VE7BQH, KH6NS, VE2DFO.

1974- W8KPY, WA2BIT, W8KPY ssb.

1975- K1WHS, W4DFK, JA6DR, W7CNK.

1976- W4WNH, K8III, WA7BJU, K9HMB, WA4MVI.

1977- K7NII, W7FN, WA9DOT.

1978- JA9BOH, K5CM, WB0QMN, W0SD.

1978- K5BMG, K4PKV, GW4CQT, I2MBC, DK5LA, WB4EXW, SM7BAE, W0SD, W7FU, WB5LUA, WA1JXN.

1979- W5LUU, ZS5ZY, WB6ESQ, K1MNS, W1JR, W5UGM, WA3VSJ, WB5LBT.

1980- G3POI, DK4XI, KA0Y, WB6NMT, WA9KRT, OK1MBS.

1981- KR5F, UA1ZCL, Y22ME, K9XY, WA8ONQ, N4GJV, KI7D, WA4LYS, W7HAH, WB9PAT, W2CNS, N7WS, F6BSJ, OH7PI, KB8RQ, W4WD, WA8ZHE.

1982- WA2GSX, KG6DX, YU3USB, N6AMG, SM4IVE, KY4Z,
WA6MGZ, VE3EQQ, JA0JCJ, K1GVM, WA4NJP, DJ5DT.
1983- DL8DAT, OZ1ASL, HB9QQ, VE1UT, K9TI, K2OS, KB7Q,
SM4GVF.
1984- WA1JXN, W0VB, OZ5VHF, PA2VST, SM2ILF, PE1AGJ,
WB8ART, KD8SI, WB0DRL.
1985 – WA0TKJ, W7ID, WB7WW, K9MRI, N5BLZ, K6HXW, VE1ALQ,
W5SUS, KF0M, DJ7UD, HB9CRQ.
1986- SM5DGX, AF1T, WD9ACA, W7IUV, W0RT, HB9SV, W4ZD,
DK2PH, KI3W.
1987- Y23RD, I2FAK, JH0YSI, VK3AUU, W0HP, HG0HO, K5YY.
1988- WA1FSK, W8WVM, AA4FQ, K0IFL, KA5AIH, AF9Y, N1BUG.
1989- N7BNJ, SM2CEW, I1KTC, KB0HH, K2GAL, LA8YB, OK1MS,
W7VXW, KJ7F, WA6PEV, WA7TDU, YU1IQ.
1991- SP5EFO, W0RWH, OK2PZW, DL5MAE, JA9EYI, DK4TG.

This may not seem a lot of stations as some EME operators today would contact this many during a contest weekend, but you must remember that my antenna was fixed and had limited time. I had to wait for a station to want to contact me, and in the early days there were very few stations with the ability to work EME. I also had many repeat contacts with some stations.

The comments on some of the QSL cards and photos were interesting; there were a lot of first EME contacts between overseas countries and VK. One that I remember very clearly was a local operator in the USA who did not think I would be on as it was 3 am in VK. He believed he would be wasting his time, but was pleased to find that I was there with a good signal. To use the words of the late Ron Wilkinson VK3AKC, “Nothing great was ever achieved without enthusiasm.”

All of this was of course not achieved without some help, I wish to acknowledge the help that was given by Trevor VK5NC, Ray VK3ATN, Roger VK5NY, David VK5ZOO and many other amateurs for their interest and help over the years.