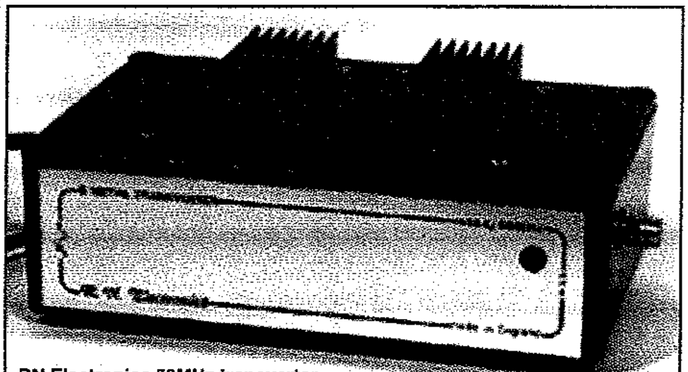
WORLD of VHF

Getting The Best Out of Your VHF Station

by **David Butler**, G4ASR*

ONE OF THE GREAT attractions of operating on the VHF bands is that there are so many different aspects of the hobby that can be utilised at these frequencies. Interested in voice communications? You can use the VHF bands for both local and international contacts. Perhaps your interest lies in digital communications. Well you can join the growing band of enthusiasts that use packet radio (AX25) to access mailboxes or the DX Cluster. A new aspect of this technology is the automatic packet reporting system (APRS) which allows real-time tracking of mobile (or fixed) stations. Image communications such as slow scan television (SSTV) is also popular, especially now that most of the processing is achieved by a computer and sound card. And don't forget Morse! This 'digital' mode is still very much used on the VHF bands by the DX community. Once you get hooked on working DX you'll then discover exotic propagation modes such as trans-equatorial propagation (TEP), Sporadic-E (Sp-E), Aurora and meteor scatter (MS). And it doesn't have to be two-way terrestrial contacts. You can also make use of amateur satellites or even bounce your VHF signals off the moon to make world-wide contacts. You can operate from home, in the car or go out back-packing from the hill tops. Other activities include low power or high power, rag chews or contesting. The VHF bands really do have something for everyone.



RN Electronics 50MHz transverter.

PRIME MOVER

THE ONE PIECE of equipment that determines exactly what facilities you can ultimately use on the VHF bands is the station transceiver. This will either be a single-mode or multi-mode base station, mobile unit or portable hand-held radio. The term 'mode' incidentally indicates the type of modulation used, for example - frequency modulation (FM), amplitude modulation (AM) or single side-band (SSB). Most single-mode transceivers available today are mobile units (often pressed into service for home use) and portable handhelds. These are designed to operate exclusively on FM and are very popular, as they can be used for short-range telephony (either direct or via a repeater) and for data communications such as packet radio. Single-mode FM transceivers can be obtained from amateur radio retailers, but that's not the only source of this type of equipment.

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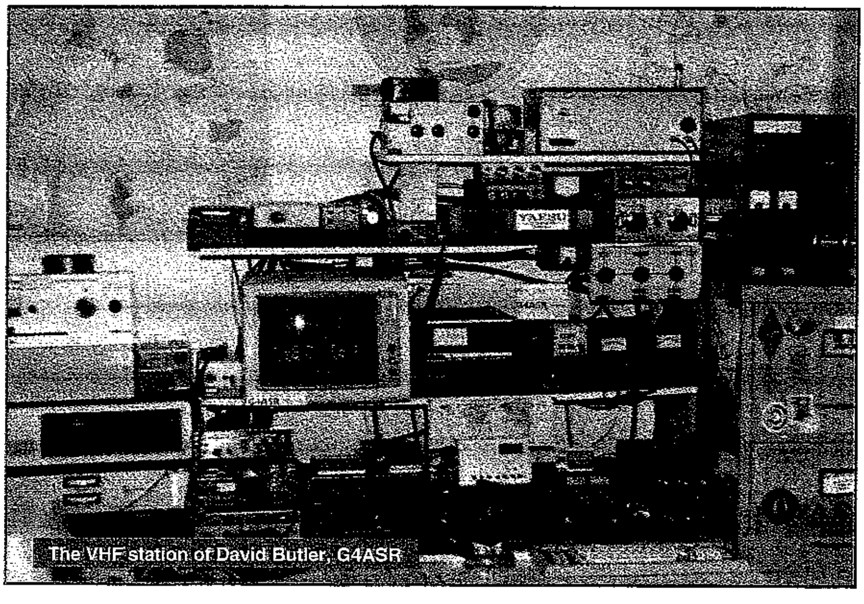
Commercial operators regularly upgrade their private mobile radio (PMR) equipment, and this can be obtained from traders who specialise in electronic surplus. It will get you operational on the VHF bands very quickly and at a price that will suit most pockets. Indeed, for many fixed station applications, I would recommend that you use dedicated PMR equipment as it does possess many advantages. It is designed to be used by a wide range of operators in varying environments. Because of this the equipment is normally of rugged construction. Drop it and it will probably keep working. The majority of PMR equipment has to be built to a high technical performance and reliability. Spectral purity of the transmitted signal is very good and the equipment is designed to run 24 hours a day without a break. Some amateur band allocations are very close to the commercial PMR bands. By looking around you should find equipment suitable for the 50MHz, 70MHz, 144MHz and 430MHz bands. Most equipment is relatively easy to modify and in some instances may not need any modification at all. However, before you hand over your money there are a few points to note. Is the equipment working on a frequency range close to an amateur band? What transmission mode does it use? Is it AM or FM? What is the bandwidth of the IF filters? Is it 50kHz, 25kHz or 12.5kHz? The latter two are preferable, whereas the 50kHz bandwidth would indicate that the equipment is many years old and may not be suitable for use on the VHF bands today.

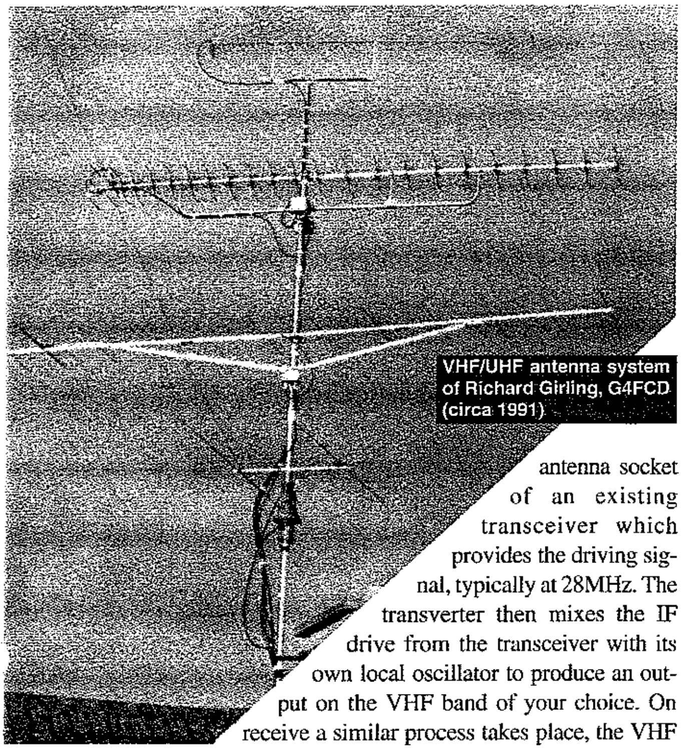
LONG DISTANCE

AS I'VE JUST mentioned, the use of FM equipment is for short-range communication links. If you want to broaden your horizons and contact stations much further away then you'll need to procure a multi-mode rig which in addition to FM includes CW and SSB transmission modes. Unfortunately you won't be able to find surplus PMR equipment that can be pressed into service as a multi-mode rig, so it really is a case of digging deep into your pockets and buying a suitable transceiver. However there is one option you may wish to consider if you already possess a multi-mode HF transceiver and that is the use of a transverter.

A transverter is actually a transmitting converter, a receiving converter and a local oscillator source all combined into one unit. It connects to the



The VHF station of David Butler, G4ASR



VHF/UHF antenna system of Richard Girling, G4FCD (circa 1991)

antenna socket of an existing transceiver which provides the driving signal, typically at 28MHz. The transverter then mixes the IF drive from the transceiver with its own local oscillator to produce an output on the VHF band of your choice. On receive a similar process takes place, the VHF signals being down-converted to provide an output signal in the 28MHz band. In practice transverters are available for all VHF bands and for a variety of IF drive frequencies. Although the majority will be at 28MHz you'll also find models that will accept drive at 144MHz. So if you already have a transceiver on this VHF band you should have no problem finding a transverter that will allow you to operate on the 50MHz band. The advantage of using a transverter is that it allows all the functions and performance of the driving transceiver to be used on the VHF band of your choice. More on this topic later.

THE VHF BANDS

BEFORE DESCRIBING the technical aspects of VHF systems it's worthwhile briefly considering the different characteristics of the three UK amateur bands, 50MHz, 70MHz and 144MHz, that lie within the VHF spectrum.

50MHz

Positioned at the lower end of the VHF spectrum, the 50MHz band exhibits propagation modes appropriate to both HF and VHF wavelengths. Because of this the band has, in general terms, been regarded as only suitable for DX working. This is far from the truth, as the allocated band is sufficient to support many popular transmission modes that are normally to be found on higher frequencies. Nevertheless the majority of operators prefer to use the band for its DX capabilities, using CW and SSB communications.

During the summer months contacts can be made via Sp-E propagation. Signals are very strong and it is possible to work considerable distances with simple antenna systems.

During the peak of the sunspot cycle, world-wide communication will be possible via F2-layer propagation.

Although you may be able to work some good DX with a small antenna, it is preferable to use some form of beam to make these type of long-distance contacts.

70MHz

Moving up now to the 70MHz band. This band, because of its limited access by other countries, has proved to be ideal for local rag-chewing. You'll find all modes in use and it's the only VHF band that has retained an AM calling frequency! This is the band where surplus PMR equipment can usefully be employed. Having said that though, there is good support for SSB and CW modes, especially during contests and other activity periods.

144MHz

Finally a brief look at the 144MHz band. This really is a band of two halves. Many operators are quite content to use the band for local communications, running low power FM into small vertical antennas. However, some exciting propagation modes effect the band and although world-wide communication is not possible (except for moonbounce) many CW and SSB contacts up to 2000 kilometres and more are regularly made via propagation modes previously mentioned. Stations interested in working long distances tend to run high power and often possess large antenna arrays.

OPTIMISATION

NOW IT'S TIME to take a look at what a VHF station comprises and how you can make simple improvements. No matter what VHF band or transmission mode you wish to use, the basic system will always be the same. It's a transceiver feeding an antenna via a length of coaxial cable. Sounds simple doesn't it, but why do some stations consistently perform better than others? One of the most important factors is the site on which the VHF station is located. Ideally, a hill-top location is best, but good results can be obtained in low lying areas that are clear of local obstructions. Results depend very much on the band used, obstructions having considerably less effect at 50MHz than at 144MHz. OK we can't all live at 700ft ASL with a clear take-off (like I do!), so you need to pay special attention to the most significant item in your station. And that, of course, is the antenna.

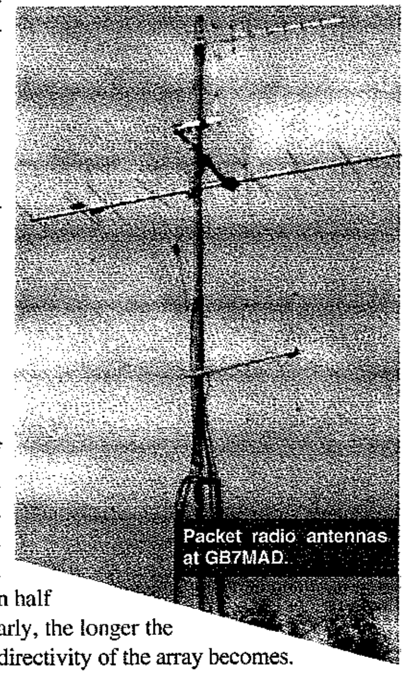
FM OPERATION

Convention dictates that for FM operation, both telephony and digital communications, an antenna with vertical polarisation is required. If you want to make local contacts then you'll probably need omni-directional coverage. Simple non-directive half-wave or quarter-wave vertical antennas are very popular for this type of general transmission.

If you run packet radio you will require a similar vertical antenna, although you might consider using a small 4 or 5-element beam for this type of fixed link. The design need not be critical and it will allow you to use less transmit power and concentrate your RF in the right direction.

ANTENNAS FOR DX

For serious VHF DX work, using CW or SSB, a horizontally polarised directional Yagi is recommended. There are many types of beam antennas available, some very good and some, well, not so good. But if you were to look at the claimed gains of antennas, for example those of between 9 to 18-elements, the difference between the poorest design to that of the very best may only amount to 4dB or so.



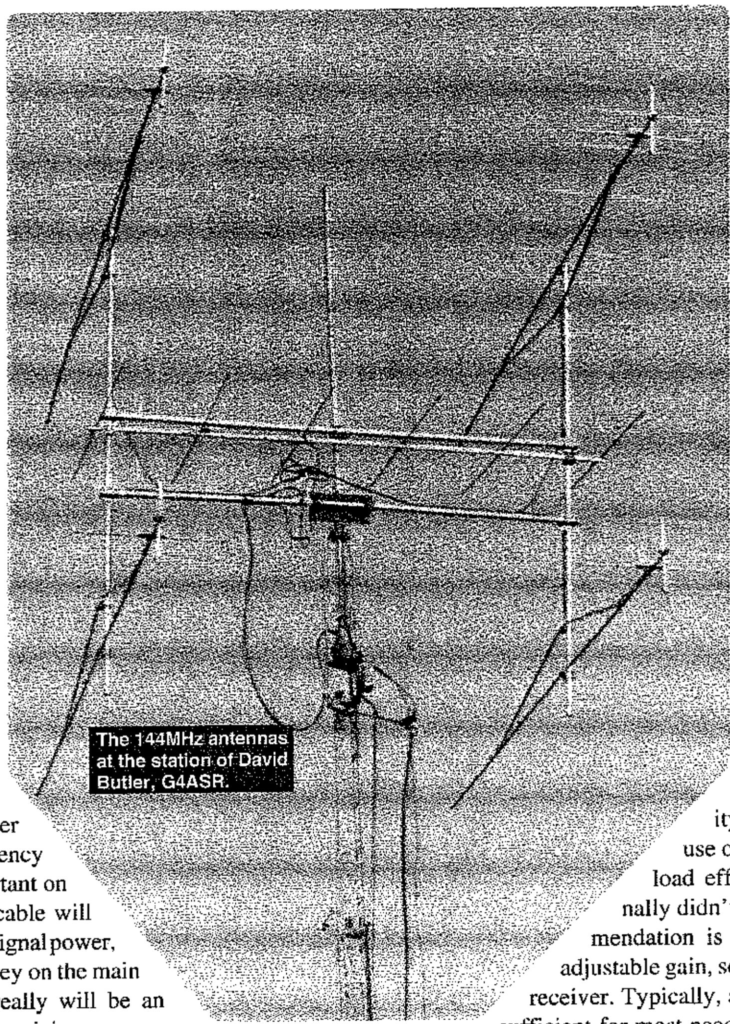
Packet radio antennas at GB7MAD.

The point here being that if you are only interested in working occasional DX when the band is open what 'real' difference does a few decibels make when propagation conditions can vary by many tens of dBs? So, unless you really want to eke out the very last vestige of antenna gain, I would suggest that the most important criteria is not ultimate gain but build quality. After all, a long boom antenna is no good if it folds in half during the winter gales. Similarly, the longer the antenna boom the sharper the directivity of the array becomes. The possibility of missing stations away from the main antenna lobe becomes increasingly likely. So you might consider trading off some gain for an increase in beamwidth.

Taking all these factors into account you might find that a pair of stacked 9-element Yagis (on the 144MHz band) might provide a more practical solution than using a single 18-element Yagi.

SITING & CABLING

The siting of an antenna is just as important as the type of antenna used. A ground-plane antenna located on a chimney top clear of any obstructions may give better results than a beam antenna located in the loft space. Unless you have restrictions imposed at your QTH, the best location for a VHF antenna is always outside in an uncluttered location. If possible mount it on a suitable pole, elevating it above the roof and away from nearby television aerials. The coaxial feeder connecting the antenna to the transceiver should have a low loss at the frequency in use and this is especially important on the VHF bands. A poor quality cable will lose valuable transmit and receive signal power, so be prepared to spend more money on the main feeder than on the antenna. It really will be an investment. I recommend that as a minimum you use 10.3mm diameter cable such as URM67 or RG213. If you really want to go for the very lowest loss then I suggest you choose a hardline cable such as Andrews Heliax. This can often be obtained on the surplus market and, provided it has been treated with respect by the previous owner, it will provide you with many years of further use. The connectors can be quite expensive though. Also, make sure you buy the right impedance cable. You'll want LDF4-50, not LDF4-75. It's an easy mistake to make when buying from a poorly lit Bring & Buy table! Finally, make sure that the connectors you use are of the highest quality. Although the use of N-type plugs and sockets is recommended they are not essential, especially on the lower VHF bands.



The 144MHz antennas at the station of David Butler, G4ASR.

BACKGROUND NOISE

Having paid attention to the antenna and feeder, it's now time to look at the receiver. The background sky noise arriving at the antenna effectively limits the maximum receiver sensitivity required for normal communications. On the lower VHF bands of 50MHz and 70MHz, man-made noise often exceeds the background noise by 10dB or so. Consequently, receiver noise figures as high as 12dB and 10dB respectively are quite adequate for these bands. At 144MHz, however, the sky noise is much less and a receiver noise figure of around 2.5dB will be quite adequate for most types of terrestrial communication. Unfortunately you probably won't find out what the overall noise figure is of your commercially made transceiver because it's never given. Normally the specification is given in terms of so many µV for a signal:noise ratio of so many dB. For example, one 144MHz transceiver quotes "better than 0.5µV for 10dB s:n". Making the most favourable assumptions this translates to a noise figure of 11dB. Now you can see how little some manufacturers are really offering the VHF enthusiast. In my opinion, too much effort seems to be exerted in producing rigs with 100 memories, air-band receive facilities, computer control and displays that say 'Hello'! What is really required is a VHF transceiver with a low noise figure, a dynamic range in excess of 100dB, switchable filters, IF shift, notch filtering, adjustable noise blankers and full CW break-in. All these features can be found on a modern HF radio, which brings me nicely back to my original suggestion of using a VHF transverter with an HF transceiver. You really do get the best system performance by adopting this technique.

PRE-AMPS

ANOTHER WAY of overcoming the basic lack of sensitivity is to use an external pre-amplifier, and if this is mounted at the antenna it will also eliminate the effect of feeder loss in the receive direction. Unfortunately, the receive sensitivity is only improved if the pre-amplifier has sufficient gain, *but* this extra gain also decreases the strong-signal handling capability of the receiver. Therefore, the use of a pre-amplifier may show overload effects on some signals that originally didn't cause any problems. My recommendation is to use a pre-amplifier that has adjustable gain, so that you can adjust it to suit your receiver. Typically, a gain of between 6-15dB will be sufficient for most needs.

SUMMARY

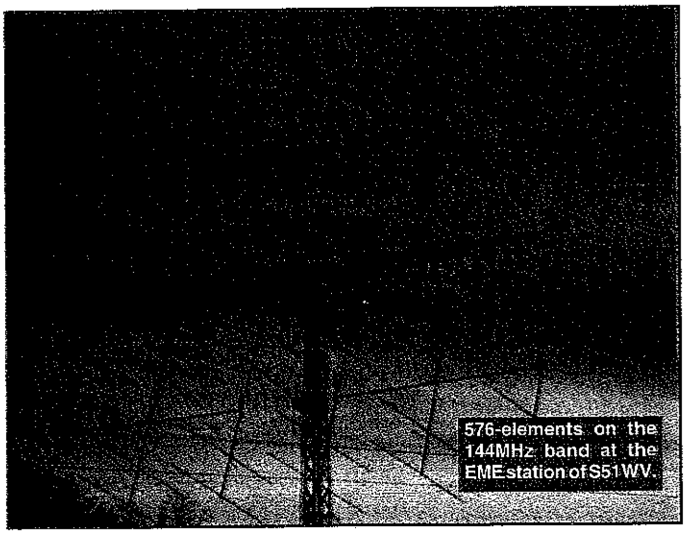
THE BIGGEST improvements to your VHF station always come first. Changes to the antenna system, coaxial feeder, making the receiver more sensitive and increasing your transmit power will easily improve your system performance. After that, it become a little bit more difficult. The rewards are still there, but each improvement will be less significant.

FURTHER READING

Surplus 2-Way Radio Conversion Handbook by Chris Lorek, G4HCL (ISBN 0-85242-946-0).

The VHF/UHF DX Book by Ian White, G3SEK (ISBN 0-9520468-0-6).

The VHF/UHF Manual edited by Dick Biddulph, G8DPS (ISBN 1-872309-42-9) ♦



576-elements on the 144MHz band at the EME station of S51WV.