Vintage Radio

by PETER LANKSHEAR

Shortwave adaptors and converters

In the hunt for early equipment, the vintage radio enthusiast may come across a chassis, perhaps with a cabinet, that appears to be an incomplete receiver. Closer examination may reveal a tuning capacitor and RF coils, perhaps a power supply, but no audio section or loudspeaker. If so, the chances are that a shortwave adaptor or converter has been unearthed...

Shortwave adaptors or converters enabled standard broadcast radios to receive shortwave signals, and converters were often quite efficient. Some were made by receiver manufacturers during the early 1930's, but many more were assembled at home — often from kitsets. Radio magazines regularly published descriptions and construction information for them.

But what made converters so popular? Interest in shortwave listening grew alongside early broadcasting, but its origins go back to an International Telecommunications Conference held some 80 years ago. By 1912, the situation had become rather chaotic, and with the growing importance of radio for marine safety and revenue-earning commercial traffic, greater control was necessary.

Amateurs were fortunate not to be banned altogether, but rather their transmitting power was limited and they were banished to the region above 1.5MHz — where the restricted range of transmission was expected to render them 'harmless'.

There were valid engineering reasons for this decision. It was known that reception conditions varied with time of day and seasonally, but the characteristics of the ionosphere were not understood, and all signal propagation was assumed to be by ground waves whose attenuation was considered to be proportional to the number of wavelengths traversed.

For a given radiated power and distance, the attenuation at 15kHz with a wavelength of 20 kilometres is only 1% that of a 200 metre, 1.5MHz transmission. With this sort of limitation, the assumption was that amateurs could play happily in their own immediate vicinities and not annoy the neighbours.

Unexpected 'DX'

World War I put a stop to all amateur activity, but provided the stimulus for considerable communications research and development. With the end of the war and the resumption of amateur transmitting, and now with access to valves, hams were confounding the experts by communicating over unexpectedly long distances.

As described in last April's column, by 1921 American amateur signals had crossed the Atlantic, to be received in Scotland by Paul Godley using a Beverage aerial. The ultimate low powered DX was achieved in October 1924 when, transmitting with a few watts, Frank Bell of New Zealand's North Otago held a

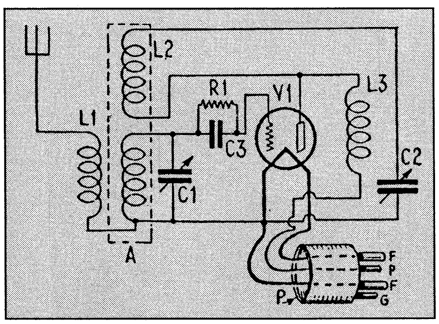
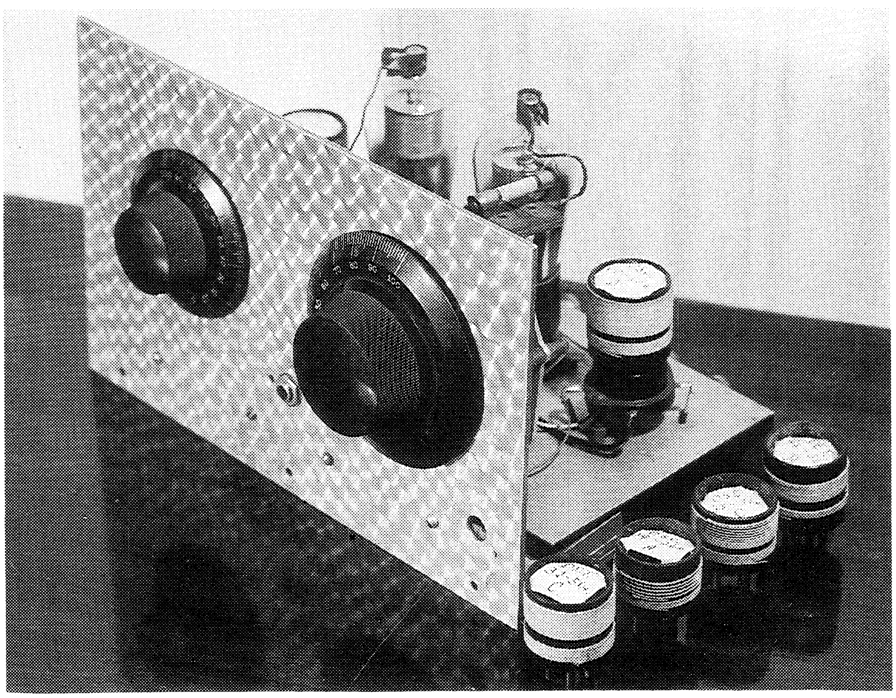
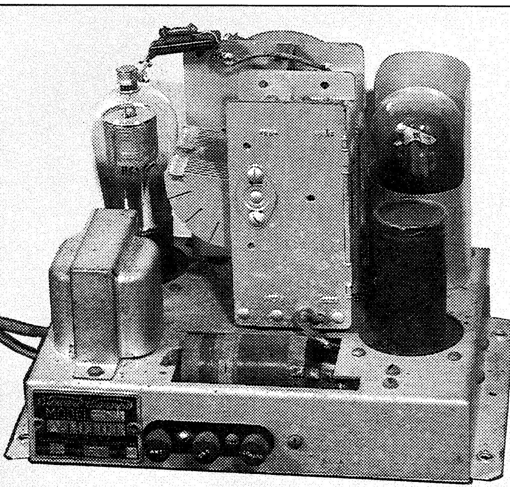


Fig.1 (above): The earliest 'add ons' for shortwave reception were simple regenerative grid-leak detector units plugged into the detector socket of a broadcast receiver. In this 1929 design, C2 is the regeneration control and L3 an RF choke.

Fig.2 (right): Someone went to a lot of trouble building this neat little converter, found in a collection of early amateur equipment. The plug-in coils are wound on old valve bases.





Bandswitching is by means of an ingenious linking of toggle switches. For some reason, the type '24 grid-leak detector is connected as a triode. The converter has no IF transformer, and the main receiver can be tuned to any suitable frequency on the broadcast band. The variable grid inductance is to adjust tracking.

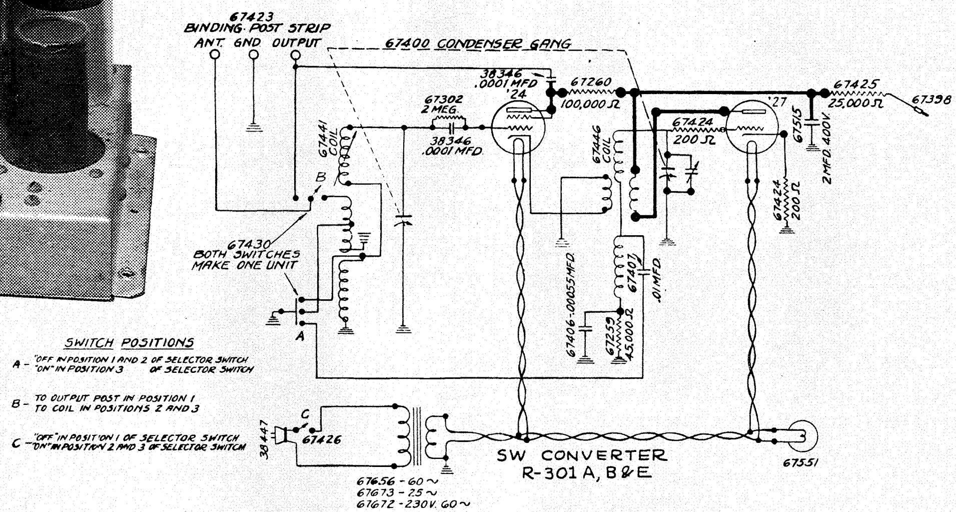


Fig.3: In 1931, Stewart Warner brought out its R301 converter, originally in a small pagoda-topped cabinet. The valve filaments are run from its own transformer.

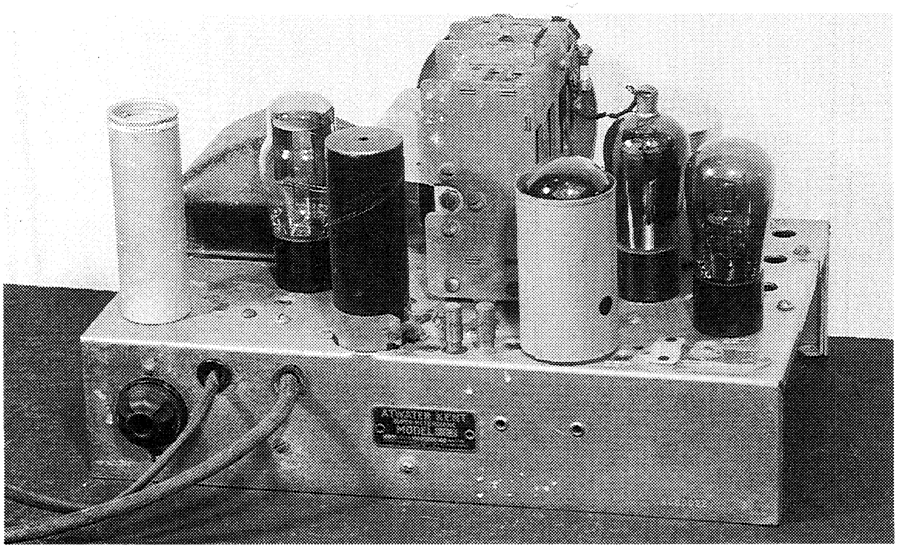
two-way 3.3MHz communication with Cecil Goyder in London.

Meanwhile, Marconi and his engineers had been doing their own research into shortwave transmissions. As has been related many times, one outcome of this was the abandonment of the proposal to build the enormously expensive long wave Imperial Wireless Scheme linking Britain with the Empire. Instead the much simpler and less costly shortwave Beam Wireless service was set up.

During the 1920's, all manner of interesting shortwave transmissions began to be heard. As well as increasing communications traffic, pioneer broadcast stations like America's KDKA were experimenting with using shortwave transmissions for linking. Others simultaneously transmitted their standard medium waveband programmes on shortwave, and by 1928, 3LO Melbourne and 2ME Sydney were broadcasting internationally on shortwave.

In a 1934 editorial in the American *Shortwave Craft* magazine, Hugo Gernsback commented on the already extensive use of shortwave radio by governments for propaganda broadcasting — which still occurs today, of course.

In the early days, the only practical shortwave receivers were the superheterodyne and the regenerative detector. The conventional TRF had insufficient selectivity and sensitivity. The selectivity of RF amplifiers is related to frequency, and a bandwidth of 1% would be a representative figure. At 1MHz this is 10kHz, typical for a domestic receiver.



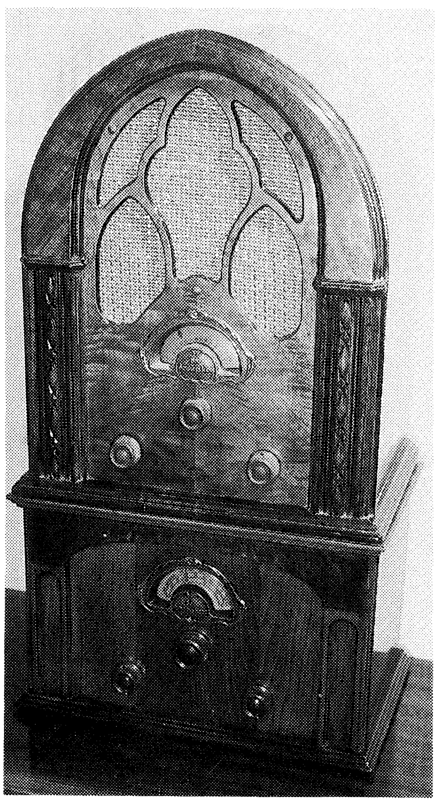


Fig.4: Far from being experimenter's inexpensive add-ons, some converters were very well made and intended to be integrated with the manufacturer's receivers. With its own power supply and an IF amplifier, and using the standard Atwater Kent nickel plated mantel receiver chassis, the self-contained four valve Atwater Kent 1932 three-band model 93 was as complex and cost as much as some complete receivers. It could be used as a stand for the model 567 (right).

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However, this same percentage at 10MHz becomes 100kHz, which is far too wide to eliminate adjacent signals.

In any event, until the advent of the screen grid RF tetrode in 1927, there was no practical shortwave RF amplifier for receivers. Although the superheterodyne was eventually to be the ultimate method of reception, before 1930 there were patent restrictions, making it very expensive. Also existing technology was not very successful at shortwave frequencies. With the low frequency and broadly tuned IF amplifiers then in use, strong nearby transmissions could 'pull' the local oscillator frequency off tune. Selectivity was poor and there were too many spurious responses and images.

Although it was far from perfect, the regenerative detector did not have these problems. When well constructed and used properly, this type of receiver, coupled to a simple audio amplifier, provided sensitivity and selectivity out of all proportion to its simplicity, and some impressive DX reception was achieved.

Prior to the advent of screen grid RF valves, commercially made broadcast band receivers combining the functions of broadcast band and shortwave reception were uncommon. Even then, multiband receivers were enthusiasts' instruments with plug-in coils — a landmark example being the Pilot Super Wasp, featured in January 1990.

By today's standards, radio equipment was extremely expensive. For example, in 1927, even after considerable factory automation, the manufacturing time for a receiving valve was 30 minutes. Naturally then, there was a strong motivation to adapt the family broadcast receiver for shortwave listening.

As use of the standard TRF receiver's RF section for shortwave was impractical, one common method was simply to use the broadcast receiver's audio amplifier and speaker, but to substitute a regenerative shortwave detector. Fig.1 shows how it was done very economically, by using an adaptor.

The receiver detector valve was transferred to the adaptor, and the connecting plug inserted into its original socket. This automatically powered the shortwave adaptor from the main receiver batteries and coupled it into the audio section — a practical, if inconvenient method of shortwave reception.

Frequency conversion

Experimenters soon found that, with an adaptor plugged instead into the socket of one of the receiver's RF amplifiers, another mode of operation became possible. By advancing the adaptor's regeneration control until there was continuous oscillation, it functioned as a rough and ready autodyne frequency converter. Oscillations and signals were mixed together, creating beat frequencies or heterodynes which could be amplified and detected by the broadcast receiver.

A combination of adaptor and a broadcast radio became in effect, a superheterodyne receiver with an IF operating somewhere between 550kHz and 1500kHz. There was, however, a major problem. The adaptor had only one tuned circuit and to provide the necessary beat frequency, this was tuned to the oscillation frequency, at least 550kHz removed from the signal frequency; the positive feedback necessary to maintain oscillations made the tuning very sharp and it tended to be seriously detuned by the received signal.

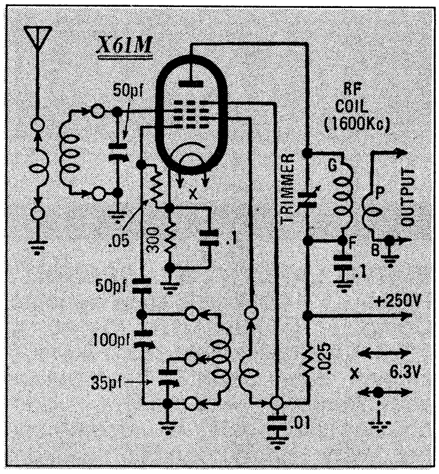

Fig.5: Frequency converter valves simplified shortwave converters considerably. This simple but popular design appeared in the July 1953 issue of 'Radio TV and Hobbies'.

This led to the development of a full scale frequency converter, incorporating an oscillator and mixer with an independently tuned non-regenerative detector and a separate oscillator valve. Connected ahead of a standard broadcast receiver, the combination created a true superheterodyne with a considerably improved performance over existing receiving methods.

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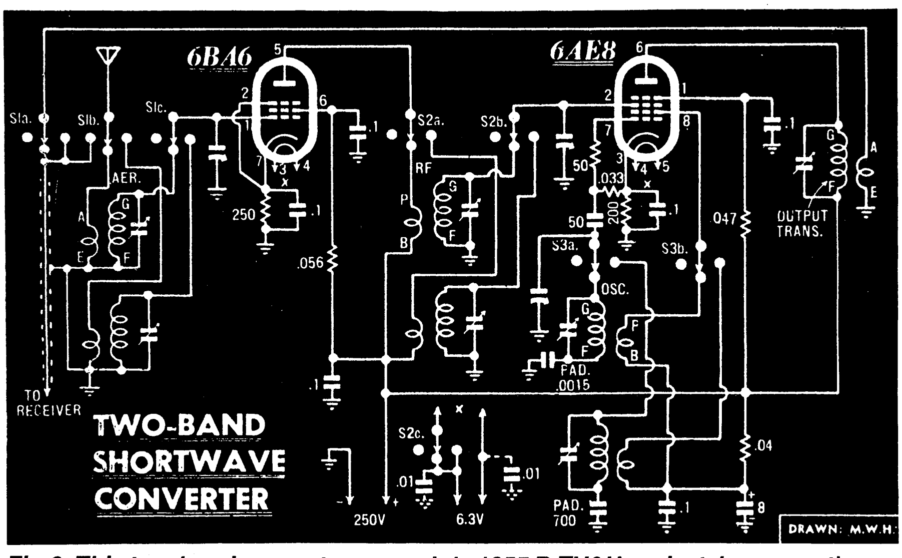

Fig.6: This two-band converter was a July 1955 R,TV&H project, incorporating an RF stage and high gain miniature valves. When coupled into a typical domestic receiver, performance would have been superior to anything short of a communications receiver. A connection of the receiver's AGC line to the grid circuit of the 6BA6 RF amplifier would have been a worthwhile refinement.

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Shortly after this, late in 1930, superheterodyne restrictions were lifted — leaving manufacturers free to make converters. Many did so, one of the earliest being Stewart Warner. Whereas most home-made converters used separate tuning capacitors for mixer and oscillator, commercial manufacturers ganged the controls and as a major convenience, used *switched* rather than the admittedly more efficient *plug-in* coils. Many models like Stewart Warner's had their own filament transformer, with the small HT demand supplied by the main receiver.

More elaborate models, the 1932 Atwater Kent model 93 being a typical example, had their own power supplies and controlled the mains and aerial switching to the main receiver. As can be seen from the photograph (Fig.4), this model was intended to be closely integrated with its parent receiver and it was but a short step to include both in the same cabinet, with the odd looking arrangement of two dials and sets of controls. However, this was a makeshift combination and was soon abandoned.

Band switching

In Britain and Europe, right from the earliest days of radio, there had been simple switching between long wave and broadcast band coils. With converter shortwave band switching now proven, the obvious move was next to combine sets of broadcast band and shortwave coils, creating the familiar 'all wave' receiver. Some of the precursor American models appeared late in 1932.

The next year, there was a significant superheterodyne development in the form of the American pentagrid mixer valve and in Britain, the heptode, eliminating the need for a separate oscillator valve and simplifying receiver design.

With the advent of the all wave receiver, the demand for commercially built converters diminished, but there were still plenty of enthusiasts who wished to build them. Magazines regularly published details, and kitsets were popular. For five guineas ($10.50), Australia's Lekmek provided a complete kit with a pre-wired coil unit for a four band, four valve converter designed by *Listener In*. This was somewhat like the Atwater Kent, but with pentode mixer and IF stages. For the less ambitious home builder, a one-valve converter could give quite acceptable results, and a typical triode-hexode circuit is in Fig.5.

By the mid 1930's, with an ever increasing number of shortwave transmissions, some shortcomings of all wave receivers, especially the need for better image rejection, were becoming apparent. This had been improved somewhat by raising the intermediate frequency to the 450 - 475kHz region, and better class receivers with an RF stage and one or perhaps two IF stages performed well. Not so effective was the standard small 4/5 valve receiver without an RF stage.

An economical solution for the serious shortwave enthusiast was to build an advanced converter, the *Radio TV & Hobbies* design (July 1955) in Fig.6 being a good example. The combination of a well built converter of this type and a standard domestic radio, tuned to around 1500kHz, created what was in effect a double conversion superheterodyne which could outperform practically anything short of a full communications receiver.

Today, solid state converters are still used to provide special coverage or superior performance, especially for VHF work. But these are hardly *vintage* yet! ❖