

THE YAESU VR-5000 RECEIVER

Reviewed by Chris Lorek, G4HCL*

AROUND 20 years ago Yaesu launched its first VHF / UHF all-mode wide-coverage base scanner receiver, the FRG-9600. Over the years, after-market modifications to give even greater extended coverage to this including an HF add-on have been very popular. Now Yaesu (or more correctly its new name of Vertex Standard, though Yaesu is still a marketing name) has launched the VR-5000, with all this included and plenty more.

It covers from 100kHz right up to 2600MHz, with modes of LSB, USB, CW, AM with selectable narrow, normal and wide bandwidths, FM and Wideband FM. To try to make life a little easier, an 'auto' mode can also be switched in where the receiver automatically selects a mode for you depending on the frequency you're tuned to. If you'd like to keep an ear open on another frequency as well, Yaesu has thought about that also. A built-in sub-receiver which operates on AM and FM can be used to tune to within 20MHz of the main receiver frequency. This gives you simultaneous dual-frequency reception, each receiver having its own separate volume control. A front panel keypad lets you enter frequencies directly and the large rubber-covered 'soft click-step' knob acts as a VFO tuning knob, with further up / down buttons for faster tuning steps.

Wide-band receivers sometimes suffer from out-of-band strong signals due to their necessarily wide-band front-end circuitry. In an effort to overcome this, the VR-5000 has a built-in RF tune preselection bandpass filter in the 1.8 - 1000MHz tuning range. This can be manually fine tuned to get the best results. If you need greater rejection, an RF attenuator can be switched in, and there's a switchable IF noise blanker fitted to reduce impulse noise such as that from car ignition systems.

FEATURES

THE SUB-RECEIVER facility can also be used to give you a 'real-time' spectrum scope, with a graphical display of signal activity above and below your tuned fre-



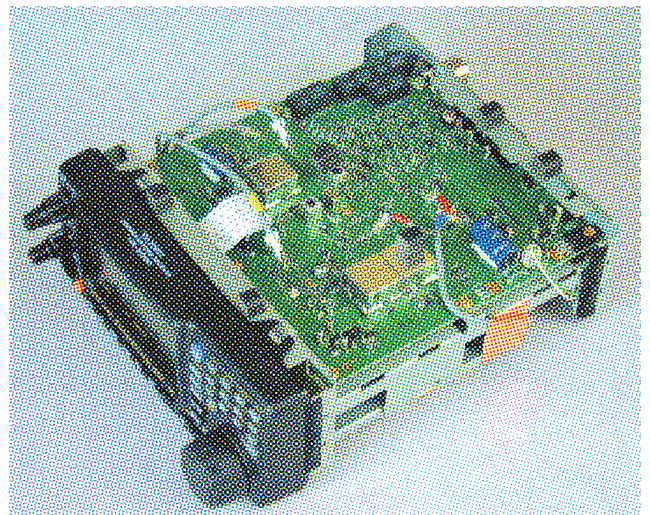
quency. The spectrum scope will sweep the band and display the relative strengths of received signals in the lower half of the set's large dot-matrix display. You can also switch the display to give you an audio oscilloscope display of the received signal.

A plug-in audio-based DSP (Digital Signal Processing) option is available, which adds an SSB/FM/AM digital bandpass filter with variable low and high cut frequencies, a CW narrow bandwidth audio peaking filter with 25, 100, 200 and 400Hz bandwidths, a CW tone pitch control, a notch filter which automatically notches out beat signals, and switchable noise reduction.

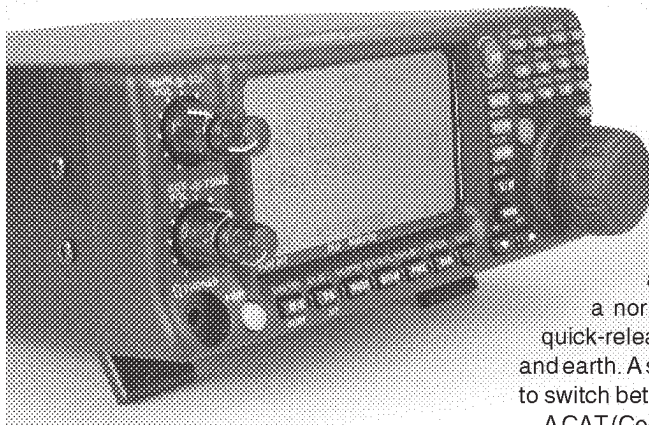
The receiver has 2000 available memory channels, with 100 memory groups into which to organise your channels. To help in identification, you can give a short alphanumeric name to each of the memories and groups. Besides storing the receive frequency and associated name, each memory can also store noise blanker status and DSP informa-

tion. Five further quick-access preset memories are also fitted, which give you instant selection of your favourite pre-stored frequencies. Once you've recalled the memory channel you want, you can easily tune away from it using the front panel rotary tuning knob. After tuning, you can either leave the memory channel on its original frequency, or replace it with your current tuned frequency with a single button push.

You can scan through the memory channels, either all of them or just those within a selected memory group. A VFO scan can



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and a sleep timer can turn the receiver off after 30, 60, 90 or 120 minutes of listening.

REAR PANEL

TWO ANTENNA connections are fitted, an SO239 socket for a normal coax feed, and a pair of quick-release connectors for a long wire and earth. A small rear panel switch is fitted to switch between the two.

A CAT (Computer Aided Transceiver) port is also present in the form of a standard 9-way D-type RS-232 connector, for direct linking to a PC for remote control. This connector also lets you clone the frequency and memory details directly from one VR-5000 to another.

A mute input lets you use the receiver together with a transmitter, and an external speaker plus a fixed-level 'Rec' audio output for tape recording or data terminal connection are fitted. There's a low-current 8V output for powering accessories, and a 10.7MHz IF (Intermediate Frequency) output for you to use with an external spectrum monitor or even specialised DF (Direction Finding) equipment.

POWER

THE VR-5000 operates from an external 13.8V DC supply, requiring 0.7A at its rated audio output of 1W. A suitable plug-in AC wall adapter is supplied, plus a fused DC lead for you to use with a different power supply or when operating mobile (you'll have to make your own mobile bracket though!)

The VR-5000 measures 180W x 70H x 203Dmm and weighs 1.9kg. As well as the AC adapter and DC cable it comes supplied with a plug-in telescopic whip antenna and a 60 page user instruction manual.

OPTIONAL ACCESSORIES

BESIDES THE DSP unit, an optional digital voice memory unit is also available. This was supplied for test with the review model, and can record received signal for a maximum of 16 seconds, for subsequent playback through the set's speaker. If the recording time is eight seconds or less, a further eight seconds of recording time on a second channel automatically becomes available. For visually-impaired users a plug-

in voice synthesizer option is also available which gives an audible announcement of the main band's operating frequency.

IN USE

CONNECTING UP, switching on, and tuning around was very simple, and I appreciated the wide coverage which even went up to and above the amateur 13cm band. On HF SSB, I was pleased to find that 20Hz steps could be selected, which allowed me to tune correctly not only to SSB speech signals but also to demodulate correctly plenty of utility data stations with the receiver's 'Rec' output connected to my PC's sound card input, with the PC running appropriate multi-mode decoding software. I soon realised the pre-stored 'auto tune' steps were geared to non-UK use, for example 5kHz steps in the 144-148MHz segment and 10kHz steps on medium wave, so I always selected the non-auto mode for tuning around. In fact I preferred this, as the narrow/normal/wide AM modes were very useful for MW and SW broadcast reception. The SSB/CW bandwidth I found a bit on the wide side with a defined peak in the audio bandwidth and high-audio frequency 'splitting'. But then the VR-5000 hasn't really been launched or marketed to be in the league of a dedicated HF receiver, such as the FRG-100, which works really well here.

The variable preselector was really useful, particularly on VHF and UHF to get rid of strong unwanted high-power pager transmitters. Although some manual tuning was needed, the end result was readable signals when other receivers I've tried just keel over. The receiver was reasonably sensitive, though not quite up to that of, for example, a dedicated 2m or 70cm base rig on these bands.

Likewise adjacent channel rejection and the like was to the standard of a typical scanner rather than a high-performance (with associated high price!) base monitor. I must say that I found many of the 'day to day' operating keystrokes a pain to use and these kept me constantly referring to the user instruction book.

I gave up on the programmed memory search facility after several attempts, and with other attempted entries I often had to just switch the receiver off and then on again

to try to clear incorrect keystrokes. Even setting the receiver's clock display to the correct time which must be done each time the power is disconnected from the radio for a short while (it hasn't an internal back-up battery to keep the clock running) needed 18 button and dial operations plus another four to enter the time itself. After a while I didn't bother setting it!

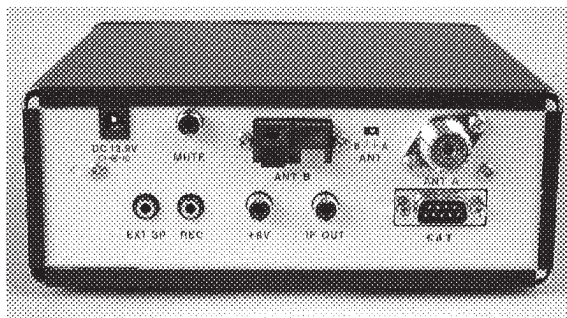
sweep the entire tuning range of the receiver looking for activity, or between any two pre-set frequencies with 100 band-limit channels being available, in effect giving you 50 search ranges. A 'Smart Search' can automatically program up to 100 memory channels with frequencies when it finds activity for you. Other scanning modes include a two-channel scan which switches between the main and sub band frequencies, and a priority watch where the set receives on one channel while it periodically checks another for activity, pausing on the priority channel when it finds activity there.

A programmable memory readout display mode is (possibly) a unique feature. This shows a 'chessboard' pattern of up to 50 channels, with active channels in black and those not active in white, quickly displaying activity. A similar search and display mode is also available with pre-programmed radio control channels for various countries. So, for example, you could turn up at a radio control model meeting and instantly see which channels are free for your own model's use. You can switch between Surface, Aircraft, and 27MHz radio control bands.

A further specialised display can show you the current relative field strength of a signal in bargraph form next to a bargraph reference. This could be useful for checking the signal level of distant beacons or repeaters as a guide to conditions, or as a health check if you're the one who maintains a local radio system.

The VR-5000 comes pre-programmed with 22 banks of frequencies, each bank containing frequencies of a particular short-wave radio broadcaster. These include European favourites like Deutsche Welle, Radio Sweden, the BBC, Swiss Radio International, Radio France Internationale, Radio Netherlands and so on, and you can change the pre-stored frequencies if you wish.

A built-in world clock displays the local time zone anywhere in the world, with a programme timer that you can set to remind you of 'skeds' or timed broadcasts while you're listening to something else. It'll even switch the VR-5000 to your programmed frequency at the time you've selected. An alarm timer can be set to wake you up by switching the receiver on at a pre-set time,

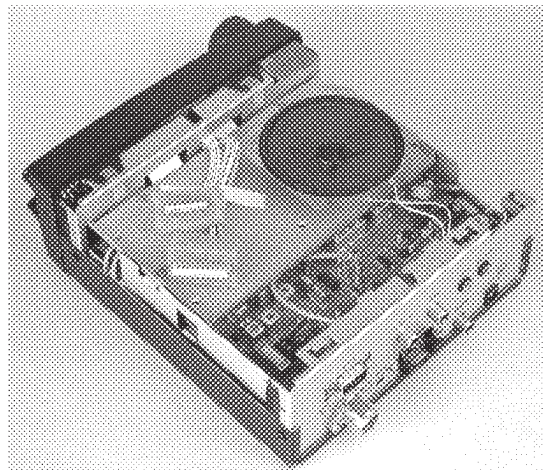


SUB-RECEIVER TUNING

THE SUB-RECEIVER could usefully automatically track the main VFO tuning. For example, if I set the main VFO to 433.200MHz (my local 70cm repeater's output frequency) and the sub VFO to 434.800MHz (the repeater input frequency), as I tuned in 25kHz steps the sub-VFO could follow suit, so I could listen to both input and output repeater frequencies simultaneously. It could track in 1, 5, 9, 10, 20, 25, 50, 100 and 500kHz steps but not in 6.25 or 12.5kHz steps. These are the most-used frequency increments and offsets in the UK in amateur and PMR (Private Mobile Radio) use. The sub-receiver also has no squelch facility, so you get just noise with no signal. Even so, I often found it handy to leave the main receiver where it was and use the sub-receiver to tune around either side of my centre frequency for alternative listening. The real-time spectrum scope was very handy, it was nice to be able to listen simultaneously to a centre frequency and see what's on either side - many receiver 'spectrum scopes' mute the received audio while they're searching due to a single receiver being used.

MEMORIES

ONCE THE memories etc had been alpha-tagged, I could command the receiver to search for a given 'string', and even automatically sort the channels into alphabetical order to make life that bit easier. The 'preset'



memories were particularly handy, I often used these as a quick 'store and recall' when tuning around. In scanning, the receiver could also be programmed as a 'voice scan', ie to stop only on channels with audio rather than blank carriers.

I missed the ability to be able to link banks together for scanning, and to be able automatically to skip pre-programmed unwanted channels in VFO scan modes. The 16-second audio memory activated after I'd told it to start recording, stopping after the allocated time. I'd have preferred this to have been a constantly recording type, ie always recording and just remembering the last 16 seconds of audio for 'missed idents' and the like.

CAT CONTROL

I RAN 'Scancat Gold' software to control the VR-5000 remotely, quickly making up an RS-232 lead with pins 2 and 3 (TXD and RXD) crossed over to link the VR-5000 to the RS-232 port of my PC.

I found this system very handy to store and recall frequencies, as an alternative to entering these manually into the VR-5000, also using the PC's hard disk for received audio storage. You can control the receiver's main VFO receive frequency, mode and channel step as well as receiving the squelch status and S-meter level from the receiver, but not the memory channel data. But with the power of a PC for storing this, it gave very easy operation.

CONCLUSION

A GREAT WIDE-BAND multi-mode receiver for the price, as long as you can get used to the often complicated keystrokes required for various operating functions. All in all, after using and testing the VR-5000, in my professional capacity I decided to choose this receiver for a government security monitoring specification which required a DSP-capable receiver operating under PC control as part of an overall system. What more can I say? ♦

LABORATORY RESULTS

Sensitivity				
Input signal level in μV PD required to give 12dB SINAD				
Freq	CW / SSB	AM	FM	WFM
2MHz	0.33 μV PD	1.09 μV PD	0.52 μV PD	-
4MHz	0.25 μV PD	0.82 μV PD	0.36 μV PD	-
6MHz	0.44 μV PD	1.39 μV PD	0.63 μV PD	-
8MHz	0.32 μV PD	1.01 μV PD	0.48 μV PD	-
10MHz	0.30 μV PD	0.91 μV PD	0.41 μV PD	-
15MHz	0.17 μV PD	0.53 μV PD	0.24 μV PD	-
20MHz	0.16 μV PD	0.50 μV PD	0.23 μV PD	-
30MHz	0.13 μV PD	0.41 μV PD	0.20 μV PD	0.61 μV PD
50MHz	0.14 μV PD	0.34 μV PD	0.18 μV PD	0.60 μV PD
70MHz	0.18 μV PD	0.41 μV PD	0.23 μV PD	0.77 μV PD
100MHz	0.29 μV PD	0.71 μV PD	0.38 μV PD	1.34 μV PD
145MHz	0.17 μV PD	0.39 μV PD	0.23 μV PD	0.71 μV PD
170MHz	0.28 μV PD	0.67 μV PD	0.38 μV PD	1.27 μV PD
250MHz	0.46 μV PD	1.15 μV PD	0.64 μV PD	2.07 μV PD
350MHz	0.15 μV PD	0.69 μV PD	0.21 μV PD	0.67 μV PD
435MHz	0.17 μV PD	0.38 μV PD	0.23 μV PD	0.72 μV PD
450MHz	0.17 μV PD	0.37 μV PD	0.23 μV PD	0.73 μV PD
550MHz	0.45 μV PD	0.91 μV PD	0.56 μV PD	1.95 μV PD
750MHz	0.26 μV PD	0.58 μV PD	0.36 μV PD	0.92 μV PD
950MHz	0.38 μV PD	0.51 μV PD	0.38 μV PD	1.13 μV PD
1297MHz	0.39 μV PD	-	0.46 μV PD	1.52 μV PD
1500MHz	0.31 μV PD	-	0.37 μV PD	1.19 μV PD
1700MHz	0.40 μV PD	-	0.43 μV PD	1.41 μV PD
1900MHz	0.36 μV PD	-	0.32 μV PD	1.08 μV PD
2300MHz	0.38 μV PD	-	0.34 μV PD	1.15 μV PD

FM Adjacent Channel Selectivity	
Measured as increase in level of interfering signal, modulated with 400Hz at 1.5kHz deviation, above 12dB SINAD ref. level to cause 6dB degradation in 12dB on-channel signal.	
+12.5kHz	34.1dB
-12.5kHz	33.1dB
+25kHz	51.6dB
-25kHz	52.7dB

Intermodulation Rejection	
Measured as increase over 12dB SINAD level of two interfering signals giving identical 12dB SINAD on-channel 3rd order intermodulation product.	
25kHz spaced signals:	58.4dB
50kHz spaced signals:	57.5dB

Blocking	
Measured as increase over 12dB SINAD level of interfering signal modulated with 400Hz at 1.5kHz deviation to cause 6dB degradation in 12dB SINAD on-channel signal.	
+100kHz	60.4dB
+1MHz	84.5dB
+10MHz	88.4dB

Image Rejection	
Difference in level between unwanted and wanted IF image signal levels, each giving 12dB SINAD on-channel signals.	
1 st IF (640MHz) image:	>100dB
2 nd IF (45.775MHz) image:	>100dB
3 rd IF (10.7MHz) image:	71.6dB
4 th IF (455kHz) image:	>100dB

All measurements taken at 145.000MHz, NFM, main VFO, unless otherwise stated, using supplied external 13.8V power supply.

Maximum Audio Output	
Measured from external audio output socket, using 1kHz audio, at the onset of 10% distortion.	
1.27W RMS	

Squelch Sensitivity			
Level of signal required to raise receiver squelch			
Sq Level	AM	FM	WFM
Threshold:	0.82 μV PD (16dB SINAD)	0.32 μV PD (19dB SINAD)	4.62 μV PD (33dB SINAD)
Maximum:	1.78 μV PD (23dB SINAD)	1.08 μV PD (27dB SINAD)	69.8 μV PD (33dB SINAD)

Signal Selectivity				
Single signal selectivity				
	CW/SSB	AMN	AMW	
-3dB	0.14kHz	3.96kHz	8.45kHz	16.30kHz
-6dB	3.46kHz	4.16kHz	8.99kHz	17.75kHz
-10dB	4.06kHz	4.18kHz	9.44kHz	18.62kHz
-20dB	4.42kHz	4.48kHz	10.37kHz	19.98kHz
-40dB	5.02kHz	5.20kHz	12.11kHz	22.69kHz
-60dB	5.28kHz	5.33kHz	12.37kHz	23.91kHz