The Peter Hart Review

DRAKE R8E

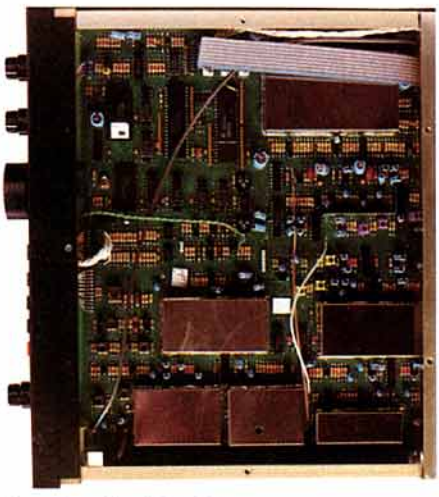
We welcome the Drake Company back to amateur radio with our review of the latest communications receiver.

THE R L DRAKE COMPANY of Miamisburg, Ohio, has been manufacturing HF communications equipment for the amateur since the early 1950s. Over the years Drake has achieved a reputation for excellence in RF performance and many of the top DXers have relied on Drake to give them a competitive edge. The R4C receiver dating from the mid 1970s, probably the finest receiver of its era, mixes valves and transistors to achieve an LF dynamic range virtually unsurpassed even today. The TR7 transceiver introduced in 1978 was one of the first to employ up-conversion with broadband frequency coverage. Unfortunately, during the early 80s, with increasing competition from Japanese set-makers, Drake withdrew from the amateur radio market to concentrate on the growing satellite TV business sector.

However, Drake has now returned with the launch of a new HF communications receiver, the R8, which was first unveiled in the UK at last October's Leicester Exhibition. The R8E is the version specifically intended for Europe, meeting the European safety specifications.

PRINCIPAL FEATURES

THE R8E IS A multimode HF communications receiver covering the frequency range 150kHz to 30MHz and can be powered either from the AC mains or from a 12V nominal DC supply. The modes covered are USB, LSB, CW, RTTY, FM and AM with either normal demodulation or synchronous demodulation on AM. Synchronous demodulation can give much reduced distortion when selective fading is experienced.



The underside of the R8E.

Tuning is via a 40mm diameter spin-wheel knob which tunes at a rate proportional to the speed of rotation. At low speeds, tuning step sizes are 10Hz (fine) or 100Hz (course) per step giving 1.27 or 12.7kHz per revolution of the knob. These increase by a factor of up to ten at high tuning speeds and by lesser amounts at intermediate tuning speeds. The fine or coarse step size is selected by context according to the resolution of the display which may be selected to be 1kHz (coarse steps), 100Hz or 10Hz (fine steps) and this applies to all modes. The last used display resolution is stored against each mode.

Apart from the rotary tuning knob, the frequency may be stepped up or down in increments of 100kHz or entered directly from a numeric keypad on the front panel. Twin VFOs are incorporated plus 100 memories. Each VFO or memory location stores eight separate parameters - frequency, mode, bandwidth, AGC setting, RF front-end setting, antenna, notch filter and noise blanker setting. Memories may be selected from the rotary tuning knob, up-down keys or directly from the numeric keypad. The usual memory operations may be performed. Memory locations may be locked against accidental erasure but there is no preview facility or direct VFO from a memory location.

Some very comprehensive scanning modes are included. Apart from scanning all memory locations, the memory is partitioned into blocks of ten locations (eg 10-19, 40-49 etc) and it is possible to scan any number of blocks in any order. Another mode is scanning from VFO A to VFO B in different selectable step sizes which includes 9kHz for the medium wave broadcast band. The scan rate seems quite fast and the scan criteria is programmable to stop on carrier, dwell for 5s on carrier or dwell until carrier drops for 5s.

Five IF bandwidth settings are included - 6.0, 4.0, 2.3, 1.8 and 0.5kHz. The last used bandwidth in each mode is automatically stored for initial recall. A notch filter is provided, as is a passband offset on all modes except FM. This shifts the IF filter across the passband of the signal and is also known as 'IF shift' in other radios. The AGC time constant may be switched between slow, fast and off and the front end with/without preamp or a 10dB input attenuator. The fitted noise blanker is switchable for wide or narrow pulses (woodpecker or ignition) and two different antennas may be selected from the front panel. Other functions include S-meter, tone control, front panel lock and all-mode squelch. A number of default settings are selectable at power-on such as beep tones, broadcast band scan step size etc.

> **'An interesting receiver... plenty of features'**

The display comprises an LCD panel with adjustable back lighting and has good visibility if viewed at the correct angle. A host of information is displayed including the frequency, memory number, mode, bandwidth, AGC and front-end status etc. Six push-buttons under the display perform dual selection functions according to the legend given on the display. The primary functions are

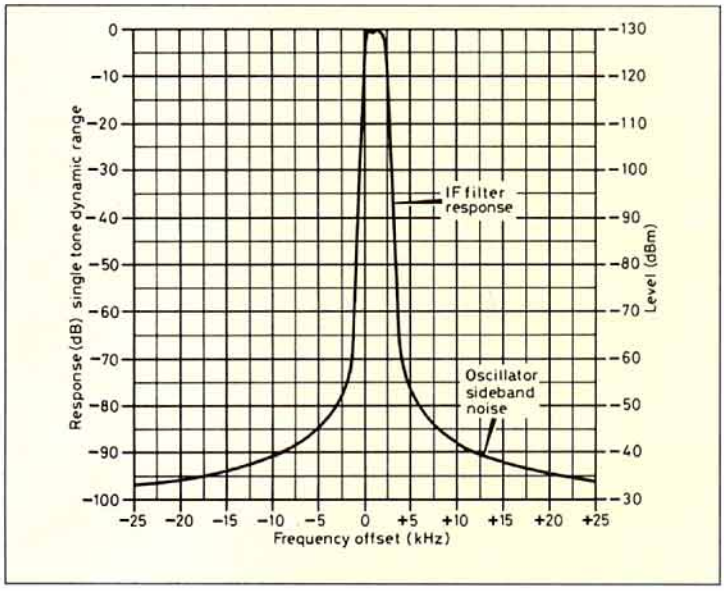
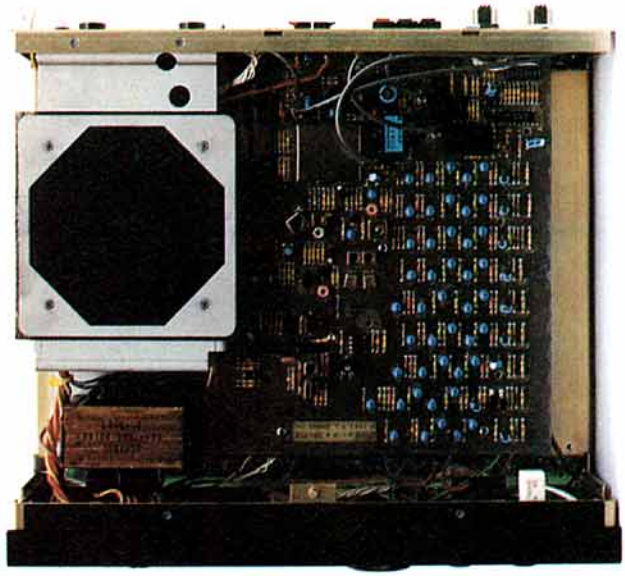


Fig 1: Effective selectivity curve.



Top view of the R8E. A 10cm speaker faces upwards.

normally enabled, with the secondary functions selected with the function key. Access to the secondary functions times out three seconds after the last key press and defaults back to the primary functions.

Clock and timer circuits are built-in. The clock allows for two time zones and the timer has one on and one off period. The timer may be used to switch on the radio and, via contacts on the rear panel, a cassette recorder or similar item. When the radio is switched off, the last accessed clock is continuously displayed as long as the power remains connected to the unit. Note that the clock and timer circuits are not battery backed and timing information will be lost if the power is removed for more than a few minutes.

An optional VHF converter is available covering the frequency range 35-55MHz and 108-174MHz. This mounts inside the case, has a separate antenna input on the rear panel and is controlled from the front panel. Other rear panel connectors include twin HF antenna inputs, DC and AC mains power, timer control, external speaker and twin low level audio outputs to data terminals, tape recorders etc. A ground to mute input is provided for use with transmitters and an RS-232C computer interface. The computer interface operates at 9600 baud, faster than most other radios, and allows computer control of all non-analogue functions. This does not include digitised S-meter which is now commonplace in many Japanese rigs.

I can only hope that the 27-page manual included with the R8E is temporary. The operation of the equipment is adequately described but there is no technical, circuit or service information included. The manual is unprofessionally presented as stapled sheets of paper. *[Nevada have advised us that from January, production models will include a printed fully comprehensive service manual - Ed.]*

DESCRIPTION

THE R8E IS HOUSED in a black crackle case and measures 33.4 (W) by 13.4 (H) by 33.0cm (D). The weight is 5.9kg. Inside, the circuitry is contained on three large PC boards mounted on a conventional chassis and panel arrangement with a fourth board supporting the display behind the front panel. The speaker is a good size measuring 10cm square and facing upwards.

The R8E is a double conversion radio on all modes except FM with IFs of 45MHz and 50kHz. On FM, the radio is triple conversion with IFs of 45MHz, 10.7MHz and 455kHz. Nine diode switched filters provide input filtering and the first and second mixers are double balanced diode types. The main selectivity is achieved at 50kHz using an 8-pole electronically switched filter and appears to comprise a number of high-Q LC resonators using pot cores. The passband offset shifts the frequency of both the 45.05MHz 2nd local oscillator and 50kHz carrier insertion oscillator in sympathy effectively to shift the position of the filter passband without affecting the signal frequency.

The notch filter is implemented at audio. Audio notch filters can achieve a narrower notch but have the major disadvantage that the interfering carrier will capture the AGC and reduce sensitivity. IF notches remove interfering signals before the AGC circuitry. Notches at 455kHz and above tend to be too wide and impair the wanted signal and the main reason why top performance receivers have a final IF in the 50-100kHz region is to implement an effective notch filter. It seems surprising that Drake, having provided such a low IF, has not implemented the notch at this frequency.

Unlike most radios, the R8E stores all control settings and memory locations in non-volatile EEPROM (electronically erasable PROM) which has the major advantage over a battery-backed memory system that there is no battery which needs replacing in the future.

MEASUREMENTS

THE MEASUREMENTS are detailed in the table opposite with additional comments as follows:

SENSITIVITY

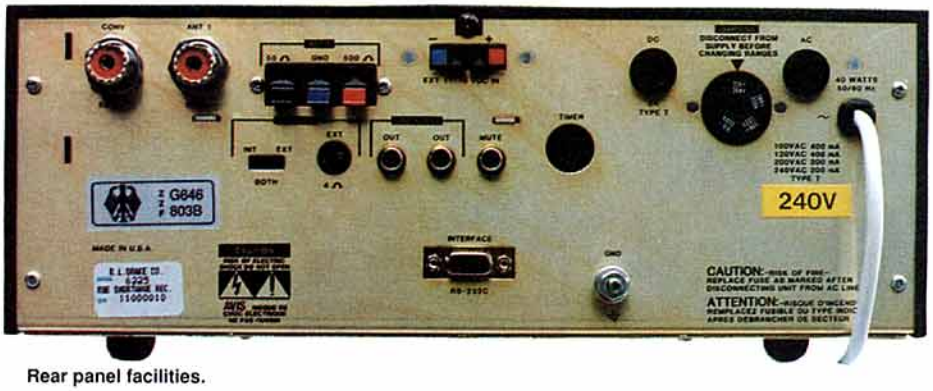
American HF receivers have invariably been slightly less sensitive than their Japanese counterparts but the measured sensitivity is entirely satisfactory.

S-METER CALIBRATION

SSB, CW, AM and RTTY gave the same results and the linearity was satisfactory. On FM, S2 to S9+60 represented 40dB which is poor but not as bad as some radios.

SPURIOUS REJECTION

Rejection of the 45MHz IF was around 90dB with the primary image rejection well over 100dB. The second mixer image occurs 100kHz below the on-tune frequency and rejection of this signal was close to 80dB on all bands. This is remarkably good, consider-



Rear panel facilities.

ing that the 45MHz filter is only two cascaded miniature monolithic dual filters as used in cellular telephones. The receiver was also remarkably clear of other responses and particularly good close-in where many rigs tend to show up problems. No other response was worse than about 100dB down.

AGC

The AGC started acting at a very low level.

STRONG SIGNAL PERFORMANCE

The third order intercept and dynamic range are reasonable and improve with the preamp out of circuit. The close-in dynamic range degrades but not as much as some other more expensive receivers and not until quite close-in. The reciprocal mixing performance is also reasonable. The limitation on all close-in measurements was the IF filter skirt selectivity. The inband linearity measured with 200Hz tone spacing was better with the slow AGC setting and improved markedly with the RF gain control turned down.

SELECTIVITY

The filter skirts are somewhat wider than can be achieved with higher frequency crystal filters. The passband offset control was slightly out of alignment: The optimum position was about "eleven o'clock" set by adjusting for similar tonal quality on background noise between lower and upper sidebands. The effective selectivity curve is shown in **Fig 1**.

DIAL CALIBRATION

Checking the display accuracy at the time of measurement, the receiver was 70Hz low in frequency on 28MHz reducing in proportion on the lower frequencies. On CW the indicated frequency is the zero-beat frequency. When set for the normal 700Hz beat frequency, the display will read 700Hz low.

DRAKE R8E MEASURED PERFORMANCE

FREQUENCY	SENSITIVITY SSB 10dB s+n:n		INPUT FOR S9	
	PREAMP IN	PREAMP OUT	PREAMP IN	PREAMP OUT
1.8 MHz	0.18µV (-122dBm)	0.28µV (-118dBm)	11µV	35µV
3.5 MHz	0.18µV (-122dBm)	0.28µV (-118dBm)	11µV	35µV
7 MHz	0.18µV (-122dBm)	0.28µV (-118dBm)	11µV	35µV
10 MHz	0.18µV (-122dBm)	0.28µV (-118dBm)	11µV	40µV
14 MHz	0.2µV (-121dBm)	0.32µV (-117dBm)	13µV	40µV
18 MHz	0.2µV (-121dBm)	0.32µV (-117dBm)	11µV	45µV
21 MHz	0.22µV (-120dBm)	0.35µV (-116dBm)	13µV	45µV
24 MHz	0.25µV (-119dBm)	0.35µV (-116dBm)	14µV	45µV
28 MHz	0.22µV (-120dBm)	0.32µV (-117dBm)	14µV	40µV

S-READING (14MHz)	INPUT LEVEL	
	PREAMP IN	PREAMP OUT
S2	0.3µV	1.1µV
S3	0.5µV	2µV
S5	1.3µV	4.5µV
S7	3.5µV	13µV
S9	13µV	45µV
S9+20	160µV	560µV
S9+40	2mV	6.3mV
S9+60	13mV	40mV

FILTER	BANDWIDTH	
	-6dB	-60dB
6kHz	6070Hz	10.8kHz
4kHz	4260Hz	7450Hz
2.3kHz	2510Hz	4860Hz
1.8kHz	1970Hz	3970Hz
500Hz	550Hz	1170Hz

AM sensitivity (28MHz): 1.3µV for 10dB s+n:n at 30% mod depth

FM sensitivity (28MHz): 0.4µV for 12dB SINAD 3kHz pk deviation

AGC threshold: 0.25µV

100dB above AGC threshold for +2dB audio output

AGC attack time: 5ms or less for all speed settings

AGC decay time: 0.25-0.4s (fast), 2-3s (slow)

Max audio before clipping: 1.6W into 8Ω, 2.4W into 4Ω

Distortion at above levels: 1%

Inband intermodulation products: -26 to -32dB (see text)

	INTERMODULATION (50kHz TONE SPACING)			
	PREAMP IN		PREAMP OUT	
FRQUENCY	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE
1.8 MHz	-1dBm	87dB	+9dBm	91dB
3.5 MHz	-1dBm	87dB	+10dBm	92dB
7 MHz	+3dBm	90dB	+10dBm	92dB
14 MHz	-3dBm	85dB	+10dBm	91dB
21 MHz	-1dBm	86dB	+8dBm	89dB
28 MHz	-1dBm	86dB	+10dBm	91dB

TONE SPACING (28MHz BAND)	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE
4 kHz	-19dBm	74dB
5 kHz	-16dBm	76dB
10 kHz	-2dBm	85dB
15 kHz	-1dBm	86dB
>15kHz	-1dBm	86dB

FREQUENCY OFFSET	RECIPROCAL MIXING FOR 3dB NOISE	BLOCKING	
		PREAMP IN	PREAMP OUT
3 kHz	not meas	not meas	not meas
5 kHz	82dB	-18dBm	-9dBm
10 kHz	89dB	-6dBm	+4dBm
15 kHz	93dB	-6dBm	+4dBm
20 kHz	95dB	-6dBm	+4dBm
30 kHz	100dB	-6dBm	+4dBm
50 kHz	104dB	-6dBm	+4dBm
100 kHz	112dB	-6dBm	+4dBm
200 kHz	115dB	-6dBm	+4dBm

NOTE: All signal input voltages given as PD across antenna terminal. Unless stated otherwise, all measurements made on SSB with the receiver front-end preamp in circuit.

ON-THE-AIR PERFORMANCE

IN TERMS OF RF performance, the receiver functioned well in all situations and modes, and sounded very clean. There was adequate sensitivity for weak signals on the higher bands and the receiver coped well with evening operation on the lower bands, particularly with optimum use of the input attenuator. On CW, true single signal reception was always achieved with the 500Hz filter but with the 1.8kHz filter, the audio image could be detected on the opposite side of zerobeat for stronger signals. The AM performance was excellent and on signals suffering from selective fading, synchronous detection mode made a big improvement. On some signals, the synchro mode would take some time to lock on. However; once in lock, it remained in lock.

The frequency synthesiser was smooth in operation but gave a slight click every 1kHz. This was not noticeable on SSB but just noticeable on CW and AM and there was a slightly unsteady sound to the tuning characteristic.

I often have problems with interference from a neighbouring electric fence. The noise blanker in the narrow position was particularly effective at eliminating this problem.

The radio is generally easy to use and has some nice features. However, I have a few criticisms with some of the panel ergonomics. The push-buttons are rubber and lack a positive action unless pressed firmly and squarely. The mode and bandwidth settings scroll in one direction only. To transfer from USB to LSB requires five key presses whereas LSB to USB requires just one. Keypad frequency entry times out after three seconds. If you hesitate in the process, you are liable to end up on an unintended frequency. Similarly other functions are also liable to a three second timeout. Auto speed-up can be helpful in speeding up tuning but does give rise to an apparent backlash.

CONCLUSIONS

THE DRAKE R8E IS AN interesting receiver for all HF uses and has plenty of features. All modes and bandwidths are fitted as standard. It has a good RF performance, but some areas of user ergonomics could be improved. The current price is £965 inc VAT.

ACKNOWLEDGEMENTS

I WOULD LIKE TO THANK Nevada Communications of Portsmouth for the loan of the equipment.

Peter Hart, G3SJX