HF-225

communications receiver

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HF-225

The demands made on a short wave receiver when used in the Western hemisphere, and particularly in Europe, are great indeed. Such a receiver has to be capable of resolving weak signals in a welter of almost unbelievably strong transmissions, and provide high sensitivity at the same time as high immunity to overload. Sadly, many short wave receivers, even those produced by well known companies in the domestic radio field, fail to survive in this demanding application.

The HF-225 has been designed specifically to give the dedicated short wave listener a receiver which fulfils all his requirements, whilst doing it within an attractive price. The performance of the HF-225 approaches that of professional receivers costing up to ten times its price, and the simple appearance of the HF-225 hides a very comprehensive specification.

The HF-225 short wave receiver was conceived, designed and is "Made in Britain" for the DX enthusiast. Its ability to perform on a crowded band with strong adjacent stations was a major consideration in its design. The HF-225 is also easy to use, the controls being simple and sensible. Essential bandwidth filters which are often options on other equipment are fitted as standard. Unnecessary frills are not included and their omission is deliberate. The result is an affordable high performance receiver.

The HF-225 has continuous coverage from 30 kHz to 30 MHz. Operating modes are AM, USB, LSB and CW. An optional board (D-225) adds FM and synchronous AM. Unlike other receivers, the HF-225 comes complete with a comprehensive range of bandwidths, a 2.2 kHz filter for SSB transmissions or for resolving an AM station using SSB mode and ECSS technique (exalted carrier, selectable side band), a 4 kHz, 7 kHz or 10 kHz filter for AM reception, the width chosen dependant on the signal and band conditions, and for the CW enthusiast a 200 Hz audio filter is included as standard.

Operating the HF-225 is refreshingly simple. The receiver is switched on by a combined on/off volume knob and displays the last frequency used on a large backlit liquid crystal display.

Two buttons, one marked up, the other down, select the correct megahertz and you tune to the required frequency using a large heavy knob with a thoughtfully provided finger recess. The tuning rates relate to a simple design concept of two stations per knob revolution on each mode. Tuning on SSB and CW is on 8 Hz steps. This allows extremely accurate resolution of SSB signals and ECSS reception of AM. On AM and FM the tuning step is increased to provide comfortable station selection. As well as providing the optimum tuning rate whilst you are carefully looking for a weak signal, the HF-225 automatically increases its stepping increment as the knob rotation speed increases. The result is an extra rapid frequency shift to a new part of the band. There is also an optional keypad controller (K-225) for even quicker frequency selection by direct numerical entry.

Mode selection is by a front panel switch. Initial filter selection is automatic and dependant on mode. AM switches in the 7 kHz filter and SSB/CW the 2.2 kHz filter. Checking the filter in use is easy, a momentary press of the FILTER

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SELECT button and the frequency display changes to indicate the current filter width, another press of the button identifies the next filter on the display and at the same time switches to it. Repeated pressing of the button switches in the other filters in turn. After a period of 3 seconds or immediately the VFO knob is turned, the display reverts to the frequency. Filters available for use on AM and SSB are 2.2, 4, 7 and 10 kHz and on CW, 2.2 kHz and 200 Hz. If the D-225 optional board is fitted and synchronous AM is selected the receiver automatically switches to the previously selected AM filter. Again this choice can be overridden. On FM, filter width is fixed at 12 Hz, the filter select button now switching the squelch in or out. The squelch level control is found on the rear panel.

To further enhance reception other facilities are included. A noise blanker is permanently in circuit to deal with vehicle ignition interference, 20 dB of R.F. attenuation can be switched in when required and a HF or LF cut tone control can be applied to the audio output.

The HF-225 has 30 memories which store receiver frequency settings. There are four memory functions; "preview" where by pressing the MEMORY SELECT button, the memory channel number is shown on the display, followed by the frequency held in that channel. The memory channels can be previewed in sequence by rotating the main tuning knob. During memory preview, the receiver remains tuned to the original VFO frequency. Pressing RECALL transfers memory frequency to VFO, and the receiver can be tuned away from the recalled frequency if required. Pressing CHANNEL is similar to the preview function except that in CHANNEL mode, the receiver tunes directly to each memory frequency as it is selected by the main tuning control. The store buttons transfer a frequency from VFO to the selected memory channel.

Having now found the optimum reception the outstanding performance of the HF-225 is revealed. Typical values for frequencies greater than 2 MHz are an SSB sensitivity of 0.3 μV for 10 dB S/N and on AM, 0.6 μV for 10 dB S/N at 70% modulation. For the technically minded, the intermodulation free dynamic range is >93 dB at 50 kHz spacing, and reciprocal mixing is >90 dB at 10 kHz in the SSB mode. All image and spurious responses have greater than 80 dB rejection.

Connections are included for both 50 and 600 ohm impedance aerials (SO-239 and a terminal block).The receiver has a 6mm jack socket for headphones on the front panel and two 3.5mm sockets on the rear panel, one for an external loudspeaker and the other for tape recording.
The HF-225 operates from 12 volts DC and is therefore suitable for use from an external battery whilst caravanning or boating. For home use an AC mains adaptor is supplied with the receiver. For truly portable listening, in the garden or on a hilltop, an internal rechargeable battery pack is available (B-225). A high quality carrying case (C-225) will afford complete protection for the HF-225 when used as a portable, and to complete the system, an active whip aerial is available (W_225). The active aerial may equally be used at home if required. Operation on a fully charged Nicad pack is around 8 hours.

Compact and light weight, the HF-225 is 255mm wide, 100mm high and 200mm deep, a portable high performance short wave receiver.

HF - 225 SPECIFICATIONS

Frequency coverage — 30 kHz to 30 MHz continuous coverage.
150 kHz to 26.1 MHz.

Reception modes — AM, LSB, USB, CW, Narrow band FM*, synchronous AM (AMS)*.

Receiver system — Microprocessor controlled PLL tuning, dual-conversion superheterodyne receiver.
First intermediate frequency 44.999 MHz to 45.000 MHz.
Second intermediate frequency 455 kHz.

Displays — 5-digit backlit LCD showing receiver frequency to the nearest kilohertz.
Additional indicators show memory mode and AMS detector lock.
Analogue signal strength meter, calibrated S1 to S9, +10dB, +30dB and +50dB.

Tuning — Dy spin wheel, MHz band buttons and Direct keypad frequency entry*.
Tuning rates CW, SSB, and AMS modes - 8 Hz steps, 1.6 kHz per revolution.
AM mode - 50 Hz steps, 9 kHz per revolution.
FM mode - 125 Hz steps, 25 kHz per revolution.
Tuning step size increases with rapid spin-wheel rotation.
Keypad frequency entry is to 1 kHz resolution.

Memories — 30 frequency memories selected with tuning spin-wheel.
Data held with lithium battery back-up for >5 years.
Memories 1 to 10 can be selected from the keypad*.
Memory functions: Store, Recall, Preview and Channel.
Two tuneable frequency stores, A and B.
Current tuned frequency is saved when the receiver is switched off.

IF Filters — SSB and AM : Operator selectable 2.2, 4, 7 and 10 kHz.
AMS : Operator selectable 2.2, 4, 7 and 12 kHz.
CW : 2.2 kHz.
FM : 12 kHz. (750 μs audio de-emphasis)

Audio Filters — 200 Hz wide audio peak filter centred on 800 Hz, selectable in CW mode.

RF Attenuator — Operator selectable 20 dB attenuator.

Controls — Power on/off and volume control.
Tone control (high pass/low pass).
Mode switch - CW, LSB, USB, AM, AMS, FM.
Memory mode select button.
RF attenuator/Memory CHANNEL button.
Filter select/Memory RECALL button.
MHz Down/Memory STORE button.
MHz Up/Memory STORE button.
Tuning/Memory select spin-wheel.

* Indicates facility available if appropriate option fitted.

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Aerial select switch (on rear panel)
PM squelch level (on rear panel).*

Aerial inputs — 50 Ω input via SO-239 socket.
600 Ω input and Earth connection on spring terminals.
High-impedance active aerial input for whip antenna via SO-239 socket*

Audio outputs — Record output at approx 350 mV (3.5 mm jack socket)
External loudspeaker (3.5 mm jack socket)
Headphone output (mono or stereo headphones) (6 mm jack). The internal loudspeaker is disconnected when headphones or an external loudspeaker are plugged in.

Power supply — External 12V DC supply (2.1mm power jack).
240V AC Mains power unit supplied as standard.
Internal Ni-Cd rechargeable batteries with charging circuit*.

Dimensions — Size 253 x 109 x 204 mm (WxHxD, overall)
Weight — approx 1.9 kg (2.6 kg with internal batteries)

Receiver Performance

Sensitivity — Signal levels are in micro-volts (μV) PD across the 50Ω aerial input.
AM and SSB sensitivity measured with 10 dB signal/noise ratio at the receiver output.
FM sensitivity measured for 12dB SINAD.
AM signal - modulated to 70% depth at 1 kHz.
FM signal - deviated by 3 kHz at 1 kHz.
SSB signal - unmodulated, resolved at 1 kHz.

Receiver Frequency — 60 kHz to 2 MHz:

AM < 1.2 μV	typically 0.8 μV
FM < 1.0 μV	typically 0.7 μV
SSB < 0.6 μV	typically 0.4 μV

2 MHz to 30 MHz

AM < 0.9 μV	typically 0.6 μV
FM < 0.9 μV	typically 0.6 μV
SSB < 0.5 μV	typically 0.3 μV

Selectivity

I F Filter	Bandwidth (kHz)		Shape factor 6:60 dB
2.2 kHz	2.3 at -6dB 5.5 at -80dB	3.4 at -60dB	1:1.5
4 kHz	5.9 at -6dB 10.7 at -80dB	9.8 at -60dB	1:1.7
7 kHz	8.8 at -6dB 14.6 at -80dB	12.9 at -60dB	1:1.5
10 kHz	10.5 at -6dB	21.3 at -60dB	1:1.2

200 Hz audio filter centred on 800 Hz.
Bandwidth 170 Hz at -6dB, 850 Hz at -20dB.
SSB carrier point attenuation (2.2 kHz filter) 20 dB.
CW mode filter position : (ref carrier frequency)
-6dB points at -0.8 kHz and +1.35 kHz.
Resolved audio 800 Hz at carrier frequency.

FM Adjacent channel selectivity

12.5 kHz channels	40 dB(1.5 kHz deviation)
25 kHz channels	65 dB(3.0 kHz deviation)
FM signal capture ratio	9 dB

Dynamic range — Reciprocal mixing effects : (2.2 kHz filter)
> 80 dB at 5 kHz from wanted signal.
> 90 dB at 10 kHz from wanted signal.
> 105 dB at > 100 kHz from wanted signal.
Intermodulation effects : (2.2 kHz filter)
At 10 kHz signal separation,
3rd order intercept point > +3 dBm
Intermodulation-free dynamic range > 85 dB
At > 50 kHz signal separation,
3rd order intercept point > +12 dBm
Intermodulation-free dynamic range > 93 dB

Spurious responses — Images : At +90 MHz >75 dB rejection
At +910 kHz > 90 dB rejection
Fixed responses : At 45 MHz >85 dB rejection
At 455 kHz >100 dB rejection
At 22.5 MHz >75 dB rejection

Frequency stability — (Typical performance only - not guaranteed spec)
At constant 20C : Drift < ± 30Hz in one hour.
Frequency error < ± 50 Hz.
-15C to +50C : Frequency error < ± 200 Hz.

Noise blanker — Audio blanking triggered by IF signal level.
Permanently enabled on all reception modes.
Blanking period 500 μs.
Threshold level 12 dB above normal carrier.

Audio output — 1.6 W into 8 Ω at 5% THD
(with 12V power supply unit).
2.0 W into 4 Ω at 5% THD
(with 12V power supply unit).
External loudspeaker output is suitable for loudspeakers with impedances of 4 Ω or greater.
Headphone output : up to 4 Volts from 220 Ω.
Record output : 350 to 400 mV from 5 kΩ.

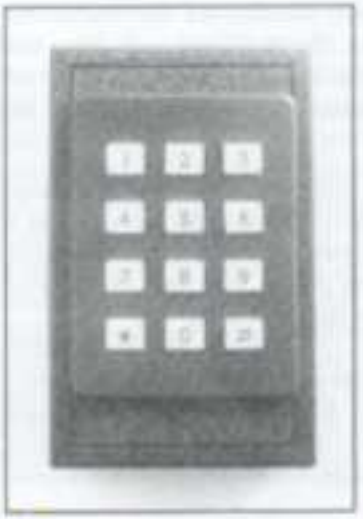
Frequency response — (Tone control in central position)
Tone control action — (7 kHz filter, AM mode)
Distortion — AM mode : 1 kHz signal modulated at 70% depth.
With standard AM detector : THD 1%
With synchronous detector : THD 0.6%
SSB mode : 1 kHz resolved signal : THD 0.2%
Two signal IM products > 35 dB below wanted signals,with signal separation > 100 Hz.

AMS Detector — Lock range: ± 100 Hz
Audio distortion under carrier fade conditions.
Signal modulated to 70% depth at full carrier level.
6 dB carrier reduction: 2.8% THD
(23% with conventional AM detector)
10 dB carrier reduction: 4.0% THD
(39% with conventional AM detector)
20 dB carrier reduction: 4.1% THD
(50% with conventional AM detector)

Power supply — DC supply 10 to 15 V (12 V nominal).
Quiescent current 200 mA (no options, no audio output)
Typical power consumption 250 to 300 mA

HF-225 options

B-225 — Internal Ni-Cd battery pack giving typically 8 hours operation from a full charge. The batteries charge from the standard 12V supply when the receiver is turned off.
C-225 — Carrying case with shoulder strap.
D-225 — Additional detector unit providing narrow-band FM and synchronous AM modes.



K-225 — Remote data entry keypad. (connected by wire).
S-225 — External high-quality loudspeaker, 8 Ω.
W-225 — Telescopic whip antenna (1.2m long) with internally fitted preamplifier and matching unit.

Specification subject to change without notice.

* Indicates facility available if appropriate option fitted.

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The Lowe Electronics HF-225 "Europa"

Background information

The HF-225 was designed to be as close to "all things to all men" as possible and the specification was carefully drawn to give a wide appeal, balancing features against retail price. The success of the HF-225 across a wide spectrum of users drew requests for special versions of the receiver for more dedicated applications, and amongst these requests was one from the DX club of Finland for a series of modifications to make the HF-225 fit their very specific needs. Although the modifications were quite costly, the new HF-225 "Finlandia" not only satisfied the members of the DX club, but also brought the "Finlandia" to the front in the European DX Council "Best DX receiver of the year" contest against the JRC NRD-535 and the ICOM R72E.

News of the award for "Best DX receiver of the year" spread around Europe and because of the widespread interest we decided to produce a "Special Edition" version of the HF-225 which we called the "Europa", drawing for its specification on the "Finlandia". So what are the differences between the standard HF-225 and the "Europa"?

1. The IF filter bank has been changed to include higher specification components around the filters than the original HF-225, including a new 3.3kHz filter (X3) following the second mixer. And we have replaced the original 10kHz filter with a 7kHz (X5).

2. The control software has been re-written to show the new tighter filter bandwidths and to select the filter configuration as follows:-

Bandwidth	Filters in use
2.2 kHz	X2 + X4 + X5
3.5 kHz	X3 + X4 + X5
4.5 kHz	X3 + X4 + X5
7.0 kHz	X3 + X5

3. To prevent unwanted leakage across the new filters, all filter select chokes are replaced by high quality magnetically shielded chokes.

4. All filter selection diodes are replaced by low capacitance switching diodes.

The overall effect of these changes is a noticeable improvement in skirt selectivity and residual noise performance of the receiver, and the new filter bank is rather like having a close ratio gearbox in a car. When winkling out the really weak stations, the closer selection of filter bandwidths allows the user to tailor the receiver bandwidth more closely to the transmitted signal and squeeze the last drop of information from it.

The complete "Europa" specification includes a factory fitted D-225 FM/synchronous AM detector option, and the famous KPAD 1 keypad frequency controller.

Remember ... The HF-225 in this format was voted a better DX receiver than the JRC NRD-535 and the ICOM R-72E.

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