

*The  
Peter Hart  
Review*

# FT-890

## Yaesu HF Transceiver

**T**HERE CERTAINLY SEEMS to be no shortage of new HF transceiver models around at the moment. The latest offering from Yaesu is the FT-890. This is a budget priced radio but with plenty of features. It is 12V operated and very small in size, which makes it ideal for mobile and portable as well as home operation.

### PRINCIPAL FEATURES

THE FT-890 PROVIDES the usual combination of general coverage receiver with 100W transmitter. The receiver tunes 100kHz to 30MHz and transmit operation is limited to sectors around the amateur allocations. LSB, USB, CW, AM and FM modes of operation are provided. Data modes are covered using SSB or FM with audio tones (AFSK).

UP/DOWN keys select between amateur bands in HAM mode or in 100kHz/1MHz steps in GEN mode with band stores returning the last used frequency, mode and filter setting on each band. Tuning is in 10Hz steps on SSB and CW at 5kHz or 10kHz per revolution of the tuning knob, and in 100Hz steps on AM and FM at 50kHz or 100kHz per revolution of the tuning knob. A FAST key increases all the step sizes and tuning rates by a factor of 10. The usual twin A/B VFOs are provided with split operation and a clarifier (IRT) tuning +/-10kHz in 10Hz steps on all modes including FM and AM.

Thirty general purpose memories are provided plus two which store scanning or tuning frequency limits. Each memory position allows independent storing of two frequencies corresponding to separate A and B VFOs, modes, wide/narrow IF filters where fitted, clarifier settings and split frequency status. It is possible to tune directly from any memory position, change mode, clarifier etc and then either cancel or store the new settings. Full



VFO/memory transfer operations are provided and the memory contents may be previewed whilst remaining tuned to normal VFO mode to allow for selection and checking of contents.

Scanning is provided between two preset frequency limits or across the memories and memory positions may be tagged to be skipped in the scanning process. Scanning pauses on any signal strong enough to open the squelch and resumes either when the signal disappears or after five seconds (user selectable). Several features are provided for operation with HF FM repeaters. The repeater offset, normally 100kHz, is programmable between 0 and +/-200kHz and a CTCSS access tone generator is built-in covering 88.5Hz and 32 other tones between 67Hz and 250.3Hz.

The standard FT-890 comes with a ceramic SSB IF filter which is also used on CW. A higher grade crystal SSB filter may be optionally fitted and also a narrow CW filter with 250 or 500Hz bandwidth. The FT-890 also includes a notch filter and IF shift. Other receiver features include a switchable RF preamplifier and 12dB input attenuator, adjustable noise blanker, two speed AGC and all mode squelch.

The transmitter includes an RF based speech processor with adjustable passband shift from -300 to +500Hz (+/-3kHz on AM). This functions in much the same way as the receiver IF shift and enables the transmitted audio signal to be tailored to suit requirements. LSB, USB and AM offsets may be set independently. For CW operation, semi break-in and full QSK are provided together with a built-in electronic keyer. The keyer covers the speed range from less than 12WPM up to 40WPM and has two weighting settings to give either 3:1 or 4.5:1 dash/dot ratio. Other transmit features include variable power output down to a few watts, VOX, thermostatic fan and metering of ALC, power output or antenna VSWR.

The FT-890 has an orange vacuum fluorescent display which gives excellent brightness and legibility. The frequency is indicated

to 10Hz or 100Hz resolution with the 10Hz digit being smaller and slightly divorced from the other digits. The display also indicates memory number, clarifier offset and has a variety of status indicators. A HI VSWR indicator shows when the antenna match is poor.

Two auto ATUs are available as optional extras. The ATU-2 is mounted internally and the FC-800 is mounted remotely at the antenna feed. Both ATUs are controlled from the front panel and have 31 memories which automatically store the most recent antenna matching settings for rapid retuning when changing frequency.

The rear panel carries the usual interface connections for power, audio and data I/O, linear control, PTT and key. Four dedicated multipin connectors interface to the DVS-2 digital voice system, FC-800 ATU, band data for auto ATU and QSK linears, and computer interface. The CAT computer interface operates at TTL levels at 4800 baud. There are 26 commands controlling a host of functions including digitised meter output. The VOX controls and CW delay are also located on the rear panel.

To suit individual preferences, a variety of functions may be customised at power-up or

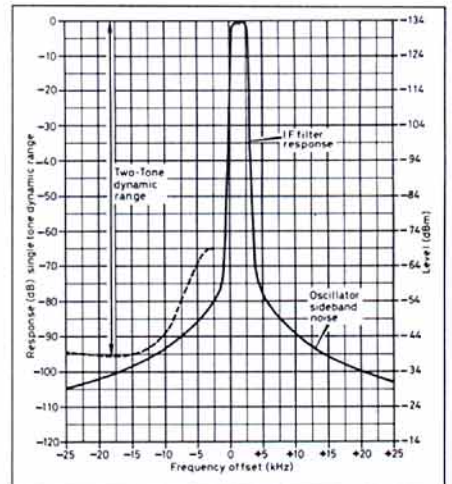
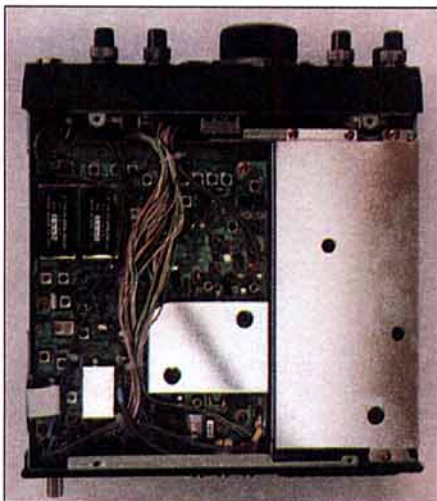


Fig 1: FT-890 effective selectivity curve (SSB).



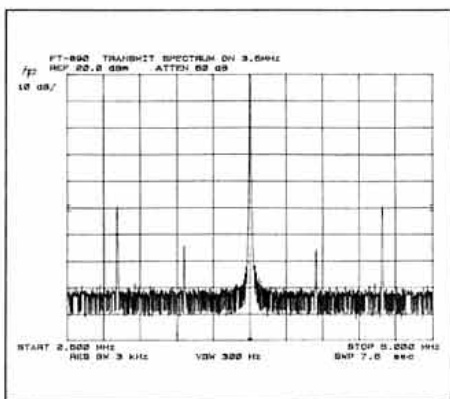


Fig 2: Transmit spectrum on 3.5MHz horizontal span 2.5 to 5MHz, vertical scale 10dB/div.

set as multiple key presses in conjunction with the FAST key. These include tuning rate, display items, TX offsets, CTCSS freq etc.

The radio is provided with a 42 page operating manual. In common with other recent Yaesu manuals, it is very comprehensive and well written as an operating and installation guide. Although a set of circuit diagrams are included, no other service or circuit details are provided.

**DESCRIPTION**

THE FT-890 IS A COMPACT radio measuring 238mm(W) by 93mm(H) by 243mm(D) and weighs 5.6kg. This is virtually identical in size to the FT757 and FT747 radios and is probably the smallest radio with a built-in ATU. The unit is modular in construction. The upper part of the case comprises a fan blown diecast heatsink containing the PA and output filters. The lower part of the case contains two main PCBs for the RF and local oscillator, and the auto ATU. Metal construction is used with a plastic overlay moulding for the front panel. The top of the case contains the 6.5cm diameter upward facing speaker and the keyer controls.

The receiver adopts a quadruple conversion architecture with three different IFs on SSB, CW and AM. The first IF is 70.455MHz and the second is 455kHz where all the channel selectivity is located. The notch filter is implemented as a fixed frequency crystal notch at 8.215MHz. It is possible to achieve a much better performance from a fixed frequency notch than from a variable frequency notch using crystal resonators. Tuning of the notch is implemented in the same way as passband tuning. The 455kHz IF is mixed up to 8.215MHz, passed through the notch, and then mixed back down to 455kHz using the same oscillator for both conversion proc-

esses. By varying the frequency of the oscillator, the effective notch frequency is altered. For operation on FM, the first two IFs only are used. The receiver uses a parallel pair of FETs for the RF amplifier and four FETs in an active double balanced configuration for the first mixer.

On transmit, SSB is generated at 455kHz and mixed through 70.455MHz to final frequency. The first local oscillator drive is provided by a single loop synthesiser in conjunction with a DDS (direct digital synthesiser) and magnetic rotary shaft encoder. One of four VCOs is used to give the required tuning range. A second DDS generates the 455kHz carrier oscillator and a total of five microprocessors are used for various control tasks within the radio. A lithium backup battery retains data in the 16 bit main processor and ATU processor when the power is off.

**MEASUREMENTS**

ALL THE MEASUREMENTS were made with the transceiver powered from a 13.55V PSU and the auto ATU switched out. Note that the receiver was fitted with the higher performance SSB filter and 500Hz narrow CW filter. The measured performance of the radio is summarised in the table with additional comments as follows.

**RECEIVER MEASUREMENTS**

**S-METER CALIBRATION**

The range and linearity were good and the calibration was similar on all modes. On FM, the S meter was 4dB more sensitive across the whole range.

**SPURIOUS REJECTION**

The rejection of the first mixer image was in excess of 84dB and rejection of all IFs in excess of 90dB. There was a slight response 100kHz above and below the on-tune frequency and a few weak internal spuri. However, the main problem is a spurious response 910kHz above the on-tune frequency at a level only 45-50dB down on the wanted signal. At this level, phantom signals will be heard. This spurious is due to the image response of the second mixer and is most likely due to insufficient skirts or leakage around the 70.455MHz IF filter.

**AGC**

Slight overshoot was observed in the attack characteristic.

**STRONG SIGNAL PERFORMANCE**

Considering that the FT-890 is a budget priced

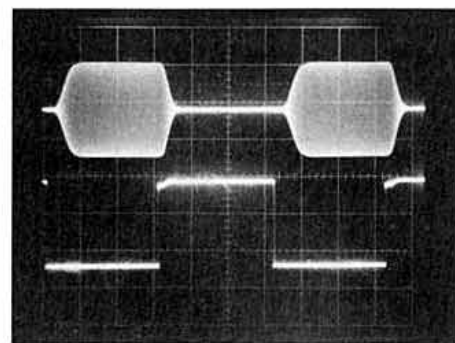


Fig 3: CW keying waveform; 40WPM semi break-in.

radio, some good figures were measured for the third order intercept, close-in dynamic range and reciprocal mixing performance. Indeed these figures are on a par with radios costing twice as much.

The inband intermodulation performance improved markedly with the RF gain control reduced.

Fig 1 shows the effective selectivity curve on USB (higher performance filter fitted).

**FREQUENCY CALIBRATION**

When measured at room temperature the receive and transmit frequencies were accurate to within 60Hz. The CW frequency reads correctly for a 700Hz beat note.

**TRANSMITTER MEASUREMENTS**

**POWER OUTPUT**

The figures given in the table were measured at maximum output but the power was variable smoothly down to about 2W. With the ATU in circuit, power levels were about 15% less. With a mismatched load, 70-100W was produced into a 2:1 VSWR and 30-35W into a 3:1 VSWR. Into these mismatches, the ATU restored the power to about 80-95W output. The power output reading on the front panel meter was remarkably accurate, within 5%, across the whole frequency and power range.

**SPURIOUS OUTPUTS**

The second mixer image problem on receive also manifests itself on transmit. Spurious outputs were observed on all bands except 28MHz at +/-455kHz and +/-910kHz. The 910kHz spuri were the more significant, at levels between 50dB and 60dB down on the main signal Fig 2 shows the transmit output spectrum on 3.5MHz.

**SSB PERFORMANCE**

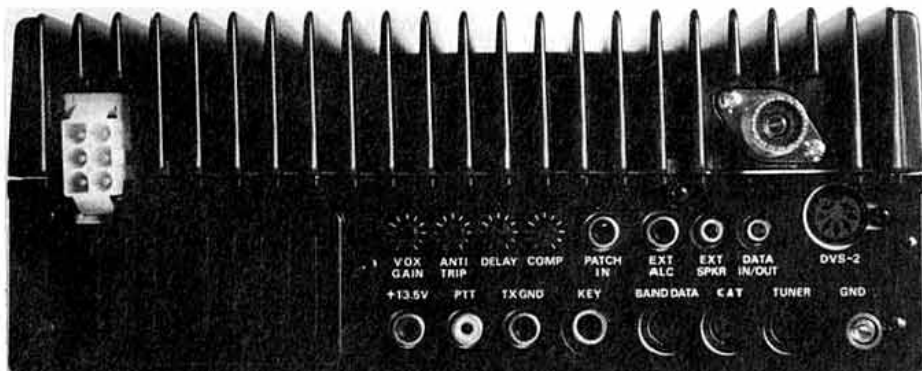
The distortion figures could be improved very markedly by keeping the power down to 100W output or less.

**CW KEYING PERFORMANCE**

Fig 3 Shows the keying waveform on semi break-in at 40WPM. The spectrum is narrow, the characters are well shaped but there is noticeable shortening on full break-in at this speed.

**ON-THE-AIR PERFORMANCE**

THE FT-890 GENERALLY PERFORMED well. I used the radio 'barefoot' and also in conjunction with a TL922 linear. The linear switching contacts via TX GND are rated to switch high voltage relays as are used in the



**YAESU FT-890 MEASURED PERFORMANCE**

**RECEIVER MEASUREMENTS**

FREQUENCY	SENSITIVITY SSB 10dB s+n:n		INPUT FOR S9	
	NOR	IPO	NOR	IPO
1.8 MHz	0.21µV (-121dBm)	0.45µV (-114dBm)	105µV	400µV
3.5 MHz	0.15µV (-124dBm)	0.40µV (-115dBm)	95µV	350µV
7 MHz	0.15µV (-124dBm)	0.40µV (-115dBm)	90µV	350µV
10 MHz	0.16µV (-123dBm)	0.40µV (-115dBm)	90µV	350µV
14 MHz	0.14µV (-124dBm)	0.40µV (-115dBm)	80µV	350µV
18 MHz	0.15µV (-124dBm)	0.40µV (-115dBm)	85µV	350µV
21 MHz	0.15µV (-124dBm)	0.40µV (-115dBm)	90µV	350µV
24 MHz	0.15µV (-124dBm)	0.40µV (-115dBm)	95µV	370µV
28 MHz	0.17µV (-123dBm)	0.42µV (-115dBm)	110µV	370µV

S-READING (14MHz)	INPUT LEVEL NOR
S1	2.2µV
S3	4.2µV
S5	8µV
S7	19µV
S9	80µV
S9+20	700µV
S9+40	5.6mV
S9+60	63mV

AM sensitivity (28MHz): 0.65µV for 10dB s+n:n at 30% mod depth  
 FM sensitivity (28MHz): 0.13µV for 12dB SINAD 3kHz pk deviation  
 AGC threshold: 1.8µV  
 100dB above AGC threshold for +1.5dB audio output  
 AGC attack time: 2-3ms  
 AGC decay time: 0.3-0.9s (fast), 2-3.5s (slow)  
 Max audio before clipping: 8Ω-1.5W, 4Ω-2.1W at 2% distortion  
 Inband intermodulation products: -26 to -40dB (see text)

FILTER	BANDWIDTH	
	-6dB	-60dB
SSB, CW(W)	2600Hz	4420Hz
CW(N)	535Hz	1940Hz
AM(W)	6900Hz	14070Hz
FM	6860Hz	16130Hz

FREQUENCY	INTERMODULATION (50kHz Tone Spacing)			
	NOR		IPO	
	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE
1.8 MHz	-1dBm	87dB	+17dBm	94dB
3.5 MHz	+4dBm	92dB	+17dBm	95dB
7 MHz	+6dBm	93dB	+18.5dBm	96dB
14 MHz	+6.5dBm	94dB	+19dBm	96dB
21 MHz	+6dBm	93dB	+18dBm	96dB
28 MHz	+2dBm	90dB	+10dBm	90dB

TONE SPACING (7MHz BAND)	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE
3 kHz	-36dBm	65dB
5 kHz	-30dBm	69dB
10 kHz	-1dBm	89dB
15 kHz	+8dBm	95dB
20 kHz	+8dBm	95dB
30 kHz	+7dBm	94dB

FREQUENCY OFFSET	RECIPROCAL MIXING FOR 3dB NOISE	BLOCKING NOR	TX NOISE IN 2.5kHz BANDWIDTH
3 kHz	76dB	-24dBm	-72dBC
5 kHz	82dB	-24dBm	-77dBC
10 kHz	91dB	-14dBm	-84dBC
15 kHz	97dB	-4dBm	-91dBC
20 kHz	101dB	-4dBm	-95dBC
30 kHz	107dB	-4dBm	-101dBC
50 kHz	113dB	-4dBm	-104dBC
100 kHz	119dB	-4dBm	-106dBC
200 kHz	122dB	-4dBm	-106dBC

**TRANSMITTER MEASUREMENTS**

FREQUENCY	CW POWER OUTPUT	SSB(PEP) POWER OUTPUT	HARMONICS	INTERMODULATION PRODUCTS	
				3rd order	5th order
1.8 MHz	118W	128W	-65dB	-30dB	-40dB
3.5 MHz	115W	122W	-66dB	-30dB	-40dB
7 MHz	115W	120W	-70dB	-26dB	-38dB
10 MHz	114W	120W	-56dB	-22dB	-34dB
14 MHz	111W	120W	-64dB	-22dB	-40dB
18 MHz	116W	120W	-54dB	-22dB	-34dB
21 MHz	118W	120W	-70dB	-20dB	-32dB
24 MHz	117W	122W	-66dB	-30dB	-30dB
28 MHz	111W	120W	-70dB	-24dB	-30dB

Carrier suppression: 55dB. Sideband suppression: 55dB. Transmitter noise: see table above. Transmitter AF response at -6dB: 320-3050Hz. Transmitter AF distortion: 1%. Microphone input sensitivity: 1mV for full output. T/R switching speed (SSB): mute-TX 18ms, TX-mute 3ms, mute-RX 20ms, RX-mute 1ms.

**NOTE:** In the above table, the receiver NOR setting corresponds to RF amplifier switched in and IPO to RF amplifier switched out. All signal input voltages given as PD across antenna terminal. Unless stated otherwise, all measurements made on SSB with the receiver preamplifier in circuit. All two-tone transmitter intermodulation products quoted with respect to either originating tone.

TL922. As supplied from the factory, these linear switching contacts are disabled but can be simply enabled via a switch accessible through the bottom cover. The ergonomics of the radio are very good, the controls well positioned and all main features are easy to operate. The rotary frequency control is 'silky smooth' with no trace of synthesiser clicks and no roughness when rotated at speed. This is a consequence of adopting direct digital synthesisers.

The receiver performed well under both weak signal and strong signal conditions. On the LF bands it was often advantageous to switch out the preamp but I never found it necessary to switch in the attenuator. The receiver sounded slightly noisier than my Ten-Tec Corsair particularly on 40m, almost certainly due to the receiver spurious problem identified during the measurements. I was never particularly conscious of 'phantom' signals but responses could certainly be found 910kHz away from strong broadcast stations. The notch filter was quite effective considering the high frequency at which it operates, but it was a bit wide.

On SSB transmit with the MH-1B8 hand microphone, good quality reports were received, particularly with tone position 2 on the microphone. Tone position 1 gave rather too much bass. The speech processor gave a little more punch and was nice sounding. The shift facility did not generally improve matters with the MH-1B8 but may be useful with other microphones.

On CW, the transmission sounded good and was narrow with no clicks, and full break-in QSK was very effective. Selecting MOX on full break-in engaged key down which I found convenient for tuning the linear. The blower in the FT-890 is fairly noisy but only comes on for short periods when the heatsink is warm.

**CONCLUSIONS**

THE FT-890 PROVIDES AN economical and effective transceiver for home, mobile and portable use. Apart from the spurious problem, it has good all-round performance and is easy to use with plenty of useful features.

The current list price is £1075 without internal ATU or £1250 with ATU. The higher performance SSB filter (YF101) and 500Hz CW filter (YF100) each cost £59 and the 250Hz CW filter £76. For mains operation, a 12V PSU is needed, capable of delivering 20A. The matching FP-800 PSU and external speaker costs £249 although other suitable PSUs are available at lower cost. All quoted prices include VAT.

**ACKNOWLEDGEMENTS**

I WOULD LIKE TO THANK South Midlands Communications Ltd of Eastleigh, Hants for the loan of the equipment.

**POSTSCRIPT**

A RECENT YAESU SERVICE bulletin describes a modification to improve the second mixer image performance. This involves extra decoupling capacitors, earthing and careful alignment to achieve an improvement of approximately 30dB.

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