The Peter Hart Review

ICOM IC-729

HF + 50MHz Transceiver

SEVERAL YEARS AGO, Icom introduced the IC-725 small, budget-priced HF transceiver. This was later followed by the IC-726 which also included 50MHz. In my reviews [1, 2] I found them good all-round performers and was sufficiently impressed to buy the IC-726 for my own use.

Last summer Icom introduced the IC-728 and IC-729. These are fundamentally the same as the IC-725 and IC-726 but include passband tuning and a speech processor. The radios have been re-styled and there are several performance improvements. The IC-728 covers the HF bands 1.8 - 30MHz. The IC-729 is essentially the same but also covers 50MHz.

PRINCIPAL FEATURES

THE IC-729 IS a small 12V operated transceiver covering USB, LSB, CW, AM and FM modes. The IC-728 requires the UI7 optional unit to be fitted to cover FM (and AM transmit). The handbook specifies that the IC-729 receiver tunes from 500kHz to 30MHz and 50 to 54MHz but the actual range is 30kHz to 33MHz and 46.2 to 61.1MHz with some reduction in sensitivity outside of the specified range.

The rotary tuning knob tunes in steps of 10, 20 or 50Hz and this corresponds to 2, 4 or 8kHz per revolution of the tuning knob. This is quite a slow rate. However, when operating with 10Hz or 20Hz step sizes, turning the tuning knob quickly engages speed-up which automatically selects the 50Hz step size. For more rapid frequency changes, 1kHz or 1MHz step sizes may be selected (100kHz or 10MHz per revolution of the tuning knob). A band button allows the amateur bands to be selected, returning to the frequency and mode set when that band was last used.

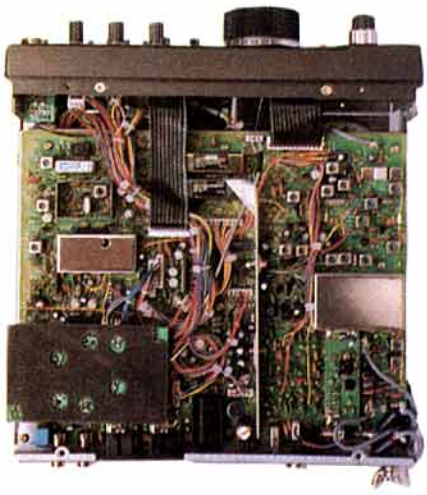
Twin VFOs are incorporated which may be operated split in the usual fashion. There are 26 memories to store frequency and mode. Two memory channels (23 and 24) will each store independent transmit and receive frequencies for split operation and two other memories (25 and 26) store scan frequency limits. The usual read, write and VFO transfer functions are provided including direct VFO from memory, but there is no memory contents preview facility. The memory and VFO contents are retained by a lithium back-up battery with a life of at least five years.

Scanning is provided between two frequency limits or across the memory channels. In addition, scanning can be limited to those memory channels operating on the same mode.

The backlit liquid crystal display (LCD) is bright and easy to read with a wide viewing angle. The display indicates frequency to 10 or 100Hz resolution (as selected by the user), mode, memory number and various status indicators for VFOs, scanning and memories.

Receiver functions include a noise blanker, switchable 20dB input attenuator, switchable input preamplifier, all mode squelch, fast/slow AGC and RIT. The RIT operates on receive only, over a range of +/-1.26kHz in 10Hz steps and the offset may be added onto the basic operating frequency. There is no RF gain control or notch filter but passband tuning is provided. This is a major improvement.

The transmitter provides 100W output on the HF amateur bands and 10W nominal on 50MHz. The power output is variable down to a few watts. CW break-in is incorporated with variable delay. On SSB, there is no VOX but an audio based speech processor is provided, another improvement over the IC-725. The hand microphone supplied (HM-12) uses an electret insert which is polarised to 8V DC via the active mic line. This includes up/down buttons for stepping frequency or memories. Other microphone types are likely to require a DC blocking capacitor.



The three-section construction gives easy access to the circuit boards.

The rig is cooled by an exceptionally quiet fan which comes into operation on transmit and when the heatsink temperature rises. Metering is provided for S-meter on receive and relative power output on transmit. ALC is indicated by brightening the transmit LED.

The rear panel is pictured overleaf. Relay controlled T/R switching and ALC is provided for external linear control and there are three main accessory sockets for interfacing to auto ATU (AH-3 or AT-160), data terminals for RTTY and packet TNCs and general audio lines. There is no provision for low power RF output to drive transverters.

The Icom CI-V serial computer control interface is provided which, via the CT-17 level converter accessory, will allow a PC to control up to four Icom rigs. The format is fully compatible with the IC-725/726 and a useful stand alone remote controller for these Icom radios has been described in *RadCom* [3].

A 52-page instruction manual is provided which is common to both the IC-728 and IC-729. This is an excellent manual and gives clear instructions on installation and operation, external connections, installation of options and some maintenance information. A set of circuit diagrams is included.

Internal options available as extra include narrow CW filter (500 or 250Hz), high stability reference oscillator and programmable tone encoder. These are straightforward to fit. A wide range of external accessories is also available. A carrying handle is available as an extra.

DESCRIPTION

THE IC-729 MEASURES 24.1(W) by 9.4(H) by 23.9cm(D) and weighs 4.6kg. It is ruggedly constructed in three sections which gives easy access to the circuit boards. The lower section contains two large PCBs on either

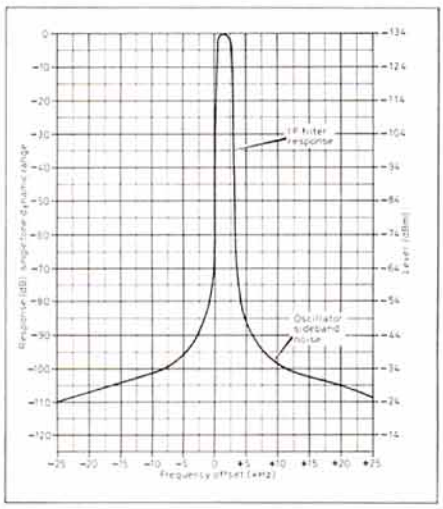


Fig 1: The overall selectivity is very good.

side of a supporting frame. The upper section is an aluminium diecast assembly containing the power amplifier, output filter and fan. A 6.5cm diameter upward facing speaker uses the diecast assembly as a baffle. The third section is the front panel assembly.

The receiver is triple conversion with IFs of 70.45MHz, 9.01MHz and 455kHz. Compared with the IC-725/726 which uses only the first two IFs on SSB/CW, the IC-729 provides a third conversion to 455kHz to implement passband tuning. The main selectivity is provided at the second IF and this is where the optional narrow CW filter is fitted. The transmit signal is generated at 9.01MHz and mixed via 70.45MHz to the final frequency. Separate PA stages are used for HF and 50MHz. The RF amplifier and mixer both use twin FETs which are used also on 50MHz. A second RF amplifier is used on 50MHz only.

A single microcontroller is used to control all functions. The frequency synthesiser uses a combination of DDS (direct digital synthesis) and PLL (phase locked loop) to give fast tuning and good spurious performance with small step size.

MEASUREMENTS

MEASUREMENTS WERE MADE with the IC-729 powered from a 13.6V PSU and are detailed in the table. Additional comments are as follows.

RECEIVER MEASUREMENTS

S-METER CALIBRATION

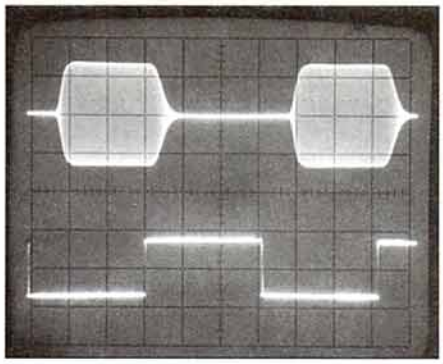
The calibration was similar on all modes except FM and is fairly typical of most transceivers. On FM, the range and linearity were very poor, again like many transceivers.

SPURIOUS REJECTION

The rejection of the first mixer image was in excess of 100dB and IF rejection was in excess of 90dB on all bands except 50MHz. This is extremely good. On 50MHz, however, the 70.45MHz IF rejection was only 50dB which might cause problems if strong 4m signals operate on this frequency. All other responses were in excess of 100dB which is very clean.

SELECTIVITY

The review radio was fitted with the FL-100 500Hz bandwidth CW filter and this is selected in the narrow CW position. With the IC-725, reciprocal mixing limited IF selectivity measurement to -50dB. With the IC-729, this was not a limitation and measurements at -60dB were easily achieved. The skirt selectivity measured was considerably better than the IC-725.



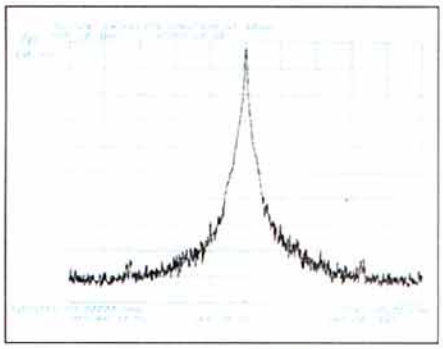


Fig 2: Keying waveform at 40WPM (horiz scale: 10ms/div) and equivalent spectrum (horiz: 1kHz/div; vert: 10dB/div).

STRONG SIGNAL PERFORMANCE

The front-end third order intercept and dynamic range measured with 50kHz tone spacings was extremely good, some of the best figures I have measured on any radio regardless of price. The reciprocal mixing figure is also very good and a considerable improvement on the IC-725/726. This was the one performance limitation of the earlier radio. The close-in dynamic range, however, is rather poor and very much worse than the IC-725. This is surprising considering that the circuitry used in the two radios is identical in this part of the signal flow. Possibly the 70.45MHz IF filter is the culprit? The overall effect of IF filter selectivity and reciprocal mixing is shown in **Fig 1** - a very good result.

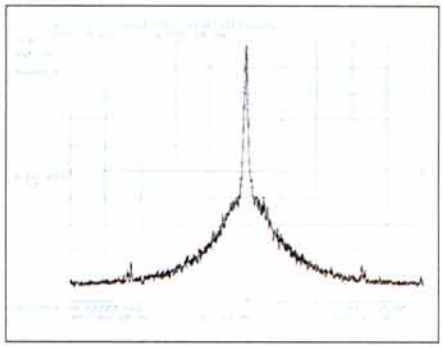


Fig 3: The much improved transmitter noise output.

FREQUENCY CALIBRATION

When measured at room temperature, the receive and transmit frequencies were accurate to within 75Hz. The CW frequency reads correctly for a beat note of 800Hz.

TRANSMITTER MEASUREMENTS

POWER OUTPUT

The power output was variable from the figures given in the table down to 10W on HF or 1W on 50MHz. The power meter, although calibrated in percentage output, read remarkably close to the true power in watts. Into a mismatched load, the power output reduced quite substantially and an ATU would be desirable in this case.

SPURIOUS OUTPUTS

Harmonic and spurious outputs were generally at a very low level.

SSB PERFORMANCE

A fairly typical result for a 12V operated PA. The audio speech processor did not substantially effect the level of distortion products. Higher order products were -60dB at +/-10kHz and -75dB at +/-20kHz.

CW KEYING PERFORMANCE

Fig 2 shows the CW keying waveform at 40WPM and the equivalent keying spectrum. This is close to an optimum result. The first character of a group was noticeably shortened at this speed.

TRANSMITTER NOISE OUTPUT

Transmitter noise output is very much improved over the IC-725. This is illustrated in **Fig 3** and can be compared with the similar plot in the IC-725 review [1].

TRANSMIT-RECEIVE SWITCHING SPEED

The measured figures are good and should

The rear panel carries connections for DC power, key, external speaker and separate antenna sockets for HF and 50MHz.

ICOM IC-729 MEASURED PERFORMANCE

RECEIVER MEASUREMENTS

FREQUENCY	SENSITIVITY SSB 10dBs+n:n PREAMP IN	PREAMP OUT	INPUT FOR S9 PREAMP IN	PREAMP OUT
1.8 MHz	0.13µV (-125dBm)	0.32µV (-117dBm)	25µV	79µV
3.5 MHz	0.13µV (-125dBm)	0.32µV (-117dBm)	20µV	89µV
7 MHz	0.13µV (-125dBm)	0.28µV (-118dBm)	20µV	71µV
10 MHz	0.16µV (-123dBm)	0.28µV (-118dBm)	22µV	71µV
14 MHz	0.14µV (-124dBm)	0.25µV (-119dBm)	22µV	63µV
18 MHz	0.14µV (-124dBm)	0.25µV (-119dBm)	22µV	63µV
21 MHz	0.14µV (-124dBm)	0.25µV (-119dBm)	23µV	63µV
24 MHz	0.14µV (-124dBm)	0.25µV (-119dBm)	25µV	63µV
28 MHz	0.14µV (-124dBm)	0.32µV (-117dBm)	22µV	71µV
50 MHz	0.1µV (-127dBm)	0.16µV (-123dBm)	9µV	25µV

S-READING (14MHz)	INPUT LEVEL SSB	FM
S1	2µV	0.5µV
S3	3.2µV	0.9µV
S5	5.3µV	1.3µV
S7	10µV	1.7µV
S9	22µV	2.1µV
S9+20	224µV	3.3µV
S9+40	1.4mV	4.2µV
S9+60	14mV	6.3µV

MODE	IF BANDWIDTH -6dB	-60dB
SSB	2240Hz	3410Hz
CW(N)	595Hz	1520Hz
AM	7280Hz	13.7kHz
FM	11.5kHz	23.7kHz

AM sensitivity (28MHz): 0.9µV for 10dBs+n:n at 30% mod depth

FM sensitivity (28MHz): 0.2µV for 12dB SINAD 3kHz pk deviation

AGC threshold: 0.5µV

100dB above AGC threshold for +3dB audio output

AGC attack time: 3ms

AGC decay time: 0.2s (fast), 1.2s (slow)

Max audio before clipping: 2.1W into 8Ω at 1% distortion

Inband intermodulation products: -30 to -40dB

	INTERMODULATION (50kHz Tone Spacing) PREAMP IN		PREAMP OUT	
Frequency	3rd order intercept	2 tone dynamic range	3rd order intercept	2 tone dynamic range
1.8 MHz	+7dBm	95dB	+20dBm	98dB
3.5 MHz	+12dBm	98dB	+25dBm	101dB
7 MHz	+14dBm	99dB	+27dBm	103dB
14 MHz	+20dBm	103dB	+27dBm	104dB
21 MHz	+23dBm	105dB	+29dBm	105dB
28 MHz	+15dBm	99dB	+23dBm	100dB
50 MHz	-3dBm	89dB	+2dBm	90dB

TONE SPACING (7MHz BAND)	3rd ORDER INTERCEPT	2 TONE DYNAMIC RANGE
5 kHz	-42dBm	62dB
10 kHz	-28dBm	71dB
15 kHz	-13dBm	81dB
20 kHz	+5dBm	93dB
30 kHz	+8dBm	95dB

FREQUENCY OFFSET	RECIPROCAL MIXING FOR 3dB NOISE	BLOCKING	TX NOISE IN 2.5kHz BANDWIDTH
3 kHz	86dB	-27dBm	-81dBC
5 kHz	91dB	-27dBm	-87dBC
10 kHz	100dB	-27dBm	-92dBC
15 kHz	103dB	-24dBm	-94dBC
20 kHz	106dB	-18dBm	-96dBC
30 kHz	110dB	-8dBm	-98dBC
50 kHz	114dB	0dBm	-101dBC
100 kHz	120dB	0dBm	-103dBC
200 kHz	125dB	0dBm	-104dBC

TRANSMITTER MEASUREMENTS

FREQUENCY	CW POWER OUTPUT	SSB(PEP) POWER OUTPUT	HARMONICS	INTERMODULATION PRODUCTS 3rd order	5th order
1.8 MHz	116W	118W	-70dB	-40dB	-42dB
3.5 MHz	118W	118W	-65dB	-34dB	-40dB
7 MHz	118W	116W	-58dB	-26dB	-40dB
10 MHz	118W	116W	-62dB	-26dB	-34dB
14 MHz	118W	118W	-64dB	-32dB	-32dB
18 MHz	118W	118W	-70dB	-22dB	-31dB
21 MHz	120W	119W	-70dB	-21dB	-30dB
24 MHz	122W	122W	-64dB	-20dB	-29dB
28 MHz	116W	115W	-75dB	-22dB	-30dB
50 MHz	13W	14W	-72dB	-26dB	-38dB

Carrier suppression: 60dB. Sideband suppression: 70dB. Transmitter noise: see table above. Transmitter AF response at -6dB: 460-2820Hz (USB), 315-2590 (LSB). Transmitter AF distortion: <1%. Microphone input sensitivity: 6mV for full output. T/R switching speed (SSB): mute-TX 7ms, TX-mute <1ms, mute-RX 17ms, RX-mute 1ms. Power into load mismatch: 2:1 VSWR 30-40W, 3:1 VSWR 15-16W

NOTE: All signal input voltages given as PD across antenna terminal. Unless stated otherwise, all measurements made on SSB with the receiver preamp switched in and operating from a 13.6V PSU. All two-tone transmitter intermodulation products quoted with respect to either originating tone.

permit entirely satisfactory operation on all data modes.

ON-THE-AIR PERFORMANCE

I USED THE IC-729 side by side with my IC-726 and it generally performed similarly. With crowded band conditions, the IC-729 had a slight edge due, no doubt, to the improved selectivity and synthesiser noise performance. The passband tuning was very useful and the extra punch provided by the speech processor on transmit was a definite advantage. The radio is easy to drive with some good ergonomics. However, I am not keen on the auto speed-up which is used with 10Hz and 20Hz tuning step sizes and I tended to use 50Hz steps as much as possible.

The receiver sensitivity was good, no strong signal problems were experienced and the tuning was entirely free of clicks. I never found it necessary to use the receiver input attenuator. However, the audio quality was a little 'boxy' and on CW the 800Hz netting offset rather high. I prefer a lower pitch.

Good reports were received on transmit. The speech processor added extra punch and the CW was free of clicks and noise. With the CW delay at minimum, full break-in was possible at speeds approaching 30WPM. However, as the delay control is a screwdriver adjustment on the rear panel it is more in the category of adjust and leave alone. I used the radio in conjunction with a TL922 linear which it drove with no problem. Note that the linear switching contacts are only rated at 16V 2A and for switching linears such as the TL922, which use higher voltage relays, an additional external relay is needed. I use this arrangement also with my IC-726.

CONCLUSIONS

THE IC-729 IS A GOOD all purpose radio for HF and 50MHz. It has good features and performance for home use yet it is small enough to be taken on holiday or used in the car. It is easy to use and the overall performance is excellent. The synthesiser noise is very much better than the IC-725/726 - did the Icom engineers read my review I wonder?

The list price of the IC-729 at the time of writing this review was £1185 inc VAT and the IC-728 was £925. These prices compare most favourably with other similar radios on the market. The narrow CW filters cost an extra £60 for the 500Hz FL100 or £64 for the 250Hz FL101. In addition for mains power use, a 12V power supply is needed capable of delivering around 20A.

ACKNOWLEDGEMENT

I WOULD LIKE TO THANK ICOM (UK) of Herne Bay, for the loan of the equipment.

REFERENCES

[1] 'ICOM IC-725 HF Transceiver', Peter Hart, G3SJX, *RadCom*, September 1989, p56.

[2] 'ICOM IC-726 Review', Peter Hart, G3SJX, *RadCom*, February 1990, p 44.

[3] 'A Remote Controller for the IC725/726/735', Bob Harris, G4APV, *RadCom*, October 1992, p 27 and November 1992, p49.

Peter Hart, G3SJX