The Icom IC-703 HF + 50MHz Transceiver

After Peter Hart had carried out his usual thorough lab measurements and tested the IC-703 in the shack, we sent Tom Robinson out and about with the transceiver and its portable accessories to try it in the field.

The IC-703 has been introduced by Icom to satisfy the growing interest in low power operation. It provides a fully featured HF + 50MHz transceiver with 5 or 10Ω output, tailored to the requirements of the Foundation Licence, and meeting the needs of the QRP enthusiast and the amateur who likes to operate portable. The outward appearance of the IC-703 is virtually identical to the well-established IC-706 series and operation and many of the features are very similar. However, under the bonnet the architecture, circuitry and layout are substantially different.

BASIC FUNCTIONS

The IC-703 is a compact radio measuring 167W x 70H x 235Dmm and weighing about 2kg (the manual has the dimensions incorrect). The front panel is detachable and may be operated remotely with an available separation cable. The microphone, which uses RJ telephone style connectors, may be plugged into either the front panel or the rear panel and an HM-103 electret hand microphone is provided as standard.

The radio is designed to operate with power supplies in the range 9 to 15.8V. Above 11V the transmitter provides 10W maximum power output. Below 11V, the transmitter power is limited to 5W and power saving measures are automatically selected, principally by switching out the LCD backlight and button illuminations but also reducing the receiver current giving a lower dynamic range. Low current consumption has been a major consideration in the overall design of the radio and a power save mode which sequences to lower current with no signal is selectable. All power saving functions are user selectable. The transmit power output can be set to one of five maximum levels: 10, 5, 2.5, 1 or 0.5W and within these maximum levels the power output is fully adjustable down to less than 0.1W.

The receiver tunes continuously from 30kHz to 60MHz and the transmitter is enabled for segments around each of the amateur bands. LSB, USB, CW (normal and reverse), AM, FM and various data modes are provided. Data allows for both FSK and AFSK operation. FSK provides RTTY operation where the radio generates the tones from a digital input. AFSK is provided by SSB-data mode and is used for all audio tone interfaced modes.

Two main printed circuit boards contain the bulk of the circuitry. The lower board contains the power amplifier and output filters, auto ATU and controlling processor. The upper board contains all the remaining signal circuitry including DSP. The detachable front panel contains the control interface and display processors. Overall a rugged construction has been achieved without the need for a fan on transmit. A 6cm diameter speaker fits into the case top. A carrying handle is not provided but is available as an extra if needed, as is a mobile mounting bracket.

The receiver is a double superhet on all modes with IFs of 64.455MHz and 455kHz with the main selectivity being achieved using ceramic filters at 455kHz. One optional extra filter may be fitted from the available filters for narrow CW (250 or 500Hz), narrow SSB (1.8kHz) or wide SSB (3.3kHz). These are quite expensive but give excellent performance. A 500Hz CW filter was provided with the radio and was also useful on data modes. Note that the IC-706 is also double conversion on SSB/CW but with IFs of 69MHz and 9MHz and achieving main selectivity at 9MHz. Optional filters in this frequency range are cheaper.

Two multipin connectors on the rear panel allow interfacing to data terminals, linears and external auto antenna tuners. A 13-pin DIN plug with lead tails is provided, the other is a standard 6-pin mini-DIN. There is a separate connector for the Icom AH-4 tuner and set-up options allow appropriate control of external auto-tuners. The built-in tuner covers all bands from 1.8 to 50MHz for VSWRs up to 3:1 and adopts relay switched inductors and capacitors with memories for fast...
The Field Trials

For the ‘Field Trials’, in addition to the IC-703 itself, Icom (UK) supplied the LC-156 multi-bag, BP-228 battery pack (and its 600mA charger) and OPC-581 separation cable. Because Icom’s promotional literature states the IC-703 is partly aimed at Foundation licensees, all the field trials were conducted using SSB. In keeping with the IC-703’s ‘lightweight’, go anywhere ethos, all the equipment was easily carried to the sites by one person.

ACCESSORIES USED
The BP-228 9.6V 2800mAh NiCd battery pack weighs 1lb 9.5oz (715g) and took six hours to charge using the supplied charger. It performed well in the field, giving well over two hours of 75:25 receiving/transmitting and still allowed a further three hours of listening in the shack, at the end of which it still had spare capacity. During this period output was limited to 5W by the IC-703’s effective power saving circuits. The supplied LC-156 multi-bag, OPC-581 separation cable. Because Icom’s promotional literature states the IC-703 is partly aimed at Foundation licensees, all the field trials were conducted using SSB. In keeping with the IC-703’s ‘lightweight’, go anywhere ethos, all the equipment was easily carried to the sites by one person.

FIELD TEST RESULTS
The field tests comprised two ‘picnic table portable’ and two pedestrian mobile (manpack) configurations.

The first test was also the most complex configuration: a W3EDP 8ft (25.6m) wire antenna plus counterpoises, 4½ balun, ‘curly tail’ earth spike, 33ft (10m) and 18ft (5.5m) fibreglass support masts (conveniently sited trees are not available at the trial site), and a 7000mAh gelcell battery. The IC-703’s internal ATU was able to tune this end-fed wire/counterpoise system on all bands from 80m to 10m via the balun. I measured the SWR band-by-band using an Autek RFI analyser. The worst case SWR was 8:1 on 40m but the auto tuner effortlessly brought down the SWR to 1.3:1 or less, as measured with the IC-703’s meter. This was a much better performance than I expected, given the specification’s 3.0:1 SWR maximum.

Encouraged by this, I listened on the bands: 17m was almost dead and 20m not too lively. I heard a pile-up working JW6VJA (Svalbard) and gave him a call. He congratulated me on breaking the pile-up with 10 watts. A new DXCC country for me with my first IC-703 portable QSO! Contacts followed on 40 and 80m with favourable comments on the audio and signal strength. I tried 17m and worked VE3KND in New Brunswick.

The DSP auto notch filter effectively eliminated ‘tuner upper’ and the DSP noise reduction helped improve reception on 80m.

A more easily-erected ‘picnic table’ station used the Buddipole, a commercial coil-loaded dipole covering 40 to 10m supported on an 11.5ft (3.5m) fibreglass painter’s pole fastened to an in situ wooden post. Again, the gelcell battery was used. The antenna was only 15ft above ground so I operated NWS on 40m. The Buddipole does not require a tuner, but careful adjustment is needed to get a 1:1 SWR. The internal tuner on the IC-703 made light work of bringing an intentionally poorly adjusted Buddipole to less than 1.3:1.

The IC-703/Buddipole combination seemed to work as well as most of the other stations heard on 40m. 57 reports were typical from British, German, French and Russian stations and mini-pileups associated with special event stations and LX7PA1AT proved no problem.

For pedestrian mobile operation, the LC-156 multi-bag, OPC-581 separation...
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The ‘Buddipole’ portable site.

Tom Robinson, G0SBW

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only a higher and programmable tuning rate is selectable together with 1MHz steps. At high tuning speeds auto speed-up is engaged fairly seamlessly. The receive frequency can be shifted independently of the transmit frequency using the RTI control on all modes except AM and FM over the range ±10kHz. Alternatively this control can be assigned to parallel the main tuning knob. Bands are selected by up/down buttons returning a single frequency per band.

The usual A/B twin VFOs are provided with split frequency capability, a check/set TX frequency and a quick split function. There are 99 regular memory channels and a further six for storing scan edge frequencies, and memories can be tagged with alphanumeric names up to nine characters long. There is a one press store and recall quick memory feature allowing five or 10 frequencies to be accessed rapidly providing the relevant menu line has been actively selected. Scanning features allow scanning between two programmed frequencies, across all non-empty memory channels or across selected memory channels. One memory channel can be designated as priority watch for repeated checking.

Receiver features include selectable RF preamplifier/attenuator, fast/slow AGC, IF noise blanker for ignition type noise and IF shift to move the receive passband away from interfering signals. Audio DSP provides a noise reduction facility and an automatic notch filter that has the capability of notching multiple and moving tones. Having incorporated DSP, it is surprising that more DSP features were not provided, eg audio filters. The DSP unit is fitted as standard in the UK but this is not necessarily the case in other countries. A combined RF gain/squelch control may be programmed to function as either an RF gain control or squelch separately on SSB/CW and AM/FM modes.

Transmit features include a speech compressor and VOX on SSB and full or semi break-in together with a full message keyer on CW. Keyer parameters are programmable and three message stores with up to 50 characters per store are provided together with contest serial number auto-incrementing and auto-repeat of messages.

For the FM operator, the radio is equipped with a CTCSS tone

and most comfortable pedestrian mobile backpack I have worn, and would provide a suitable arrangement for a dedicated QRPer. The breakthrough and RF feedback problem mentioned in Peter Hart’s review did not occur on SSB but during a short CW test with the LC-156BP-228 and short whip configuration feedback was noticeable.

One drawback of using the LC-156 in this way is that Icom suggests the IC-703’s power output be limited to 5W, presumably to prevent the rig from overheating. However, I wanted to assess the rig’s pedestrian mobile performance at its maximum 10W using a larger antenna. I therefore used my own ventilated backpack with its 15.25ft (4.65m) vertical antenna and the 7000mAh gelcell for heating. However, I wanted to assess the performance and there were a number of facilities such as DSP, SWR and battery voltage monitor a boon.

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The ‘LC-156’ operating position.

Close-up of the LC-156 operating position.
encoder and decoder to provide repeater access and tone squelch operation. Repeater access makes use of the split frequency function and to avoid a complex set-up procedure each time a repeater is used, repeaters are best accessed from memory; memory channels store all necessary data.

Special features include a simple spectrum scope giving some indication on the LCD panel of signals on adjacent frequencies. The scan is performed while the receiver muted while the scan is in progress. Antenna SWR can be displayed whilst on communication. In addition, a simple plot of SWR against frequency can be made. The radio is fitted with a temperature compensated crystal oscillator (TCXO) as standard. This has proved to be an optional extra on most other radios. With a frequency stability of ±0.5 ppm over the temperature range 0 to 50 °C negligible drift is guaranteed for the most critical digital signals.

ICOM IC-703 MEASURED PERFORMANCE

TRANSMITTER MEASUREMENTS

TRANSMITTER RESPONSE (28MHz - 210MHz)

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>OUTPUT POWER</th>
<th>RECEIVER GAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>28MHz</td>
<td>10.5W</td>
<td>15dB</td>
</tr>
<tr>
<td>24MHz</td>
<td>10.5W</td>
<td>15dB</td>
</tr>
<tr>
<td>14MHz</td>
<td>10.1W</td>
<td>15dB</td>
</tr>
<tr>
<td>7MHz</td>
<td>9.6W</td>
<td>15dB</td>
</tr>
<tr>
<td>3.5MHz</td>
<td>9.7W</td>
<td>15dB</td>
</tr>
<tr>
<td>1.8MHz</td>
<td>10W</td>
<td>15dB</td>
</tr>
</tbody>
</table>

**FREQUENCY MIXING FOR BLOCKING**

INTERMODULATION (50kHz Tone Spacing)

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>3rd order intercept</th>
<th>2 tone dynamic range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5MHz</td>
<td>10.5dB</td>
<td>80dB</td>
</tr>
<tr>
<td>7MHz</td>
<td>10.5dB</td>
<td>80dB</td>
</tr>
<tr>
<td>14MHz</td>
<td>10.5dB</td>
<td>80dB</td>
</tr>
<tr>
<td>28MHz</td>
<td>10.5dB</td>
<td>80dB</td>
</tr>
</tbody>
</table>

S9+60 2.2mV 5.6mV
S9+40 800µV 2.5mV
S9+20 100µV 250µV
S7 5.6µV 16µV
S3 2.1µV 5.6µV
S1 1.8µV 5µV

On transmit excellent audio reports were received. CW semi and full break-in were effective and a pleasure to use at reasonable speeds but I did have a problem with RF getting into the keying line latching on to key down when using my long wire antenna entering the shack. No problems on SSB or with antennas further from the house and maybe some added filtering is needed on the keying lines.

**CONCLUSIONS**

The IC-703 performs admirably as a highly featured lower power and highly portable radio. Generally a good performer but some strong signal problems may be seen on 20m at times and CW keys may need filtering.

**Peter Hart, G3SJK**