Conducted By Mark Wilson, AA2Z
Senior Assistant Technical Editor

ICOM IC-761 160- to 10-Meter Transceiver

Reviewed by Tom Miller, NK1P

With the introduction of the IC-761, ICOM has once again proven their ability to complement operator convenience with superior performance. The IC-761's standard features include a newly designed internal antenna tuner, memories and scanning, general coverage receiver, internal power supply, internal iambic keyer, 500-Hz CW filters and much more.

The first thing that most people notice about the IC-761 is that it's in a *big* box. Unlike most of the previous ICOM models, the '761 has large controls and switches that are easy to find and grab ahold of. With the internal power supply and antenna, the radio weighs in at a hefty 38.6 pounds. Don't worry about trying to find a place for this transceiver in your car, though—there is no provision for connecting it to an external 13.8-V dc supply.

Frequency Control

A large, white, fluorescent frequency display dominates the top center of the front panel. There should be no complaints about the legibility of this display—it's large and easy to read. Some users commented that they think the display is too bright even in a bright room. There is no dimmer switch—the '761's operating and service manuals contain no evidence of one—and operating the '761 in a darkened room is actually hard on the eyes. Here's a plus for display-accuracy fanatics, though: The IC-761 has a *front-panel* display-calibration control!

The IC-761's frequency display resolves frequencies only to the nearest 100 Hz (0.1 kHz) even though the '761's synthesizer tunes in 10-Hz steps at the '761's slowest tuning speed. (There are enough digits on the fluorescent tube's frequency field to *display* frequencies to 0.01-kHz digits, and you can light *all* the digits in the field from the rig's keypad [more on this later], but the receiver's central processing unit ignores the extra information.) How about including 10-Hz display resolution, ICOM?

An optional voice synthesizer provides audible confirmation of operating frequency. The frequency display indicates the carrier frequency in AM, FM, SSB and CW modes (CW signals must be tuned to the proper pitch for display accuracy); the mark frequency is indicated in the RTTY mode. However, the '761's control program doesn't keep the rig tuned to the same carrier frequency when jumping between modes. Fig 1, from the IC-761 service manual, describes this characteristic better than words. Yes, jumping to CW or RTTY from LSB, AM or FM changes the IC-761's frequency display by −600 Hz; jumping to USB from LSB, AM or FM changes the display by −3 kHz.

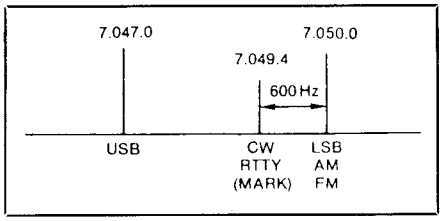


Fig 1—Carrier frequency versus mode selection for the ICOM IC-761 (from the IC-761 service manual).

Receiver or transmitter offset tuning (up to ±9.9 kHz) is displayed to the right of the operating frequency. Operating mode (USB, LSB, CW, RTTY, AM or FM) is displayed above the frequency readout. Indicators for SPLIT operation and VFO A or VFO B selection are located below the frequency readout. Other indicators: SCAN lights when a scan function is selected; MEMO lights when a memory mode is selected; NARROW lights when the narrow CW or RTTY filter is selected; GENE lights when the general-coverage mode is selected.

The IC-761 has two "VFOs"[1] and is capable of split operation. The radio tunes in 10-Hz steps at its slowest speed. Tuning speed is a comfortable 5 kHz per revolution when the knob is turned slowly and 25 kHz per revolution when it is turned rapidly. A third speed, 500 kHz per revolution, is available when TS (tuning speed) is pressed. A LOCK switch inhibits the main tuning dial (only) to prevent an accidental QSY. The large main tuning knob is weighted and has a silky smooth feel. The manual shows how to adjust the brake pressure on the tuning knob shaft to suit individual preferences.

You aren't limited to using the main tuning knob to change frequencies. A numeric keypad located just to the right of the main tuning knob may be used for direct frequency entry. For example, if you want to QSY to 28.885 MHz, press 2 8 8 8 5 0 ENTer. The keypad has the same resolution as the frequency display: It allows direct entry of frequencies only to the nearest 100 Hz even though the tuning knob can tune in 10-Hz steps—another candidate for a fix. Leading zeroes must be included during entry of frequencies below 1 MHz; there is no decimal-point key. A nice feature is that you don't have to enter trailing zeroes if you want to move to an even multiple of 1 MHz. For example, press 1 4 ENT to move to 14.0 MHz.

To change bands, you can enter the new frequency on the keypad, or you can use the UP and DOWN switches located below the keypad. When the '761 is in the general coverage mode, these switches move the frequency up and down in 1-MHz steps. In the ham band mode, they move the operating frequency to the next higher or lower amateur band (including 10, 18 and 24 MHz).

Use of the UP/DOWN switches proved frustrating. In the general-coverage mode, pressing these switches moves you up or down exactly 1 MHz (for example, 7.885 to 6.885 to 5.885 and so on). In the ham

[1]D. Newkirk, "View: DigiVFO," Technical Correspondence, *QST*, Sep 1987, p 43.

Table 1
ICOM IC-761 160-10 Meter Transceiver, Serial no. 01440

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: Receiver, 100 kHz to 30.0 MHz; transmitter, 1.8 to 2.0, 3.45 to 4.1, 6.95 to 7.5, 9.95 to 10.5, 13.95 to 14.5, 17.95 to 18.5, 20.95 to 21.5, 24.45 to 25.1, 27.95 to 30.0 MHz.	As specified.
Modes of operation: USB, LSB, CW, FM, AM, RTTY.	As specified.
Frequency display: 7-digit white fluorescent.	
Frequency resolution: Not specified.	100 Hz.
Power requirement: 100 to 120 V ac, 650 VA max on transmit, 80 VA max on receive.	
Transmitter	*Transmitter Dynamic Testing*
Transmitter output power: Max 100 W PEP on SSB, 100 W on RTTY, CW and FM, 40 W on AM.	Typically 125 W PEP on SSB, 115 W on CW, RTTY and FM, and 63 W carrier on AM. Power output varied slightly from band to band. Minimum SSB/CW/RTTY output power: 7.6 W.
Spurious signal and harmonic suppression: Greater than 60 dB below peak power output.	See Fig 2.
Third-order intermodulation distortion products: Not specified.	See Fig 3.
CW keying waveform: Not specified.	See Fig 4.
Transmit-receive turnaround time (PTT release to 90% audio output with an S9 signal): Not specified.	20 ms.
Receiver	*Receiver Dynamic Testing*
Receiver sensitivity (preamp on): SSB, CW and RTTY: (bandwidth not specified) $<0.5\ \mu V$ for 10 dB S/N from 0.1-0.5 MHz; $<$ 10 dB S/N from 0.5-1.6 MHz; $<0.15\ \mu V$ for 10 dB S/N from 1.6-30 MHz.	Minimum discernible signal (noise floor) with 500-Hz filter: *Preamp on*: 1.0 MHz: -125 dBm; 3.5 MHz: -140 dBm; 14 MHz: -139 dBm *Preamp off*: 1.0 MHz: -125 dBm; 3.5 MHz: -135 dBm; 14 MHz: -132 dBm
AM: (6.0 kHz bandwidth) $<3\ \mu V$ for 10 dB S/N from 0.1-0.5 MHz; $<6\ \mu V$ for 10 dB S/N from 0.5-1.6 MHz; $<1\ \mu V$ for 10 dB S/N from 1.6-30 MHz.	6.0 kHz bandwidth, test signal signal 30% modulated with a 1 kHz tone, preamp on: 1.0 MHz: 0.9 μV 3.5 MHz: 0.48 μV 14 MHz: 0.55 μV
FM: $<0.3\ \mu V$ for 12 dB SINAD from 28-30 MHz.	Preamp on: 0.25 μV for 12 dB from SINAD at 29 MHz.
Receiver dynamic range: 100 dB (preamp on), 105 dB (preamp off).	Blocking dynamic range†: *Preamp off*: 3.5 MHz: 126 dB; 14 MHz: 131 dB *Preamp on*: 3.5 MHz: 120 dB; 14 MHz: 122 dB Two-tone, third-order intermodulation distortion dynamic range†: *Preamp off*: 3.5 MHz: 100 dB; 14 MHz: 102 dB *Preamp on*: 3.5 MHz: 95 dB; 14 MHz: 96 dB Third-order input intercept: *Preamp off*: 3.5 MHz: 15 dBm; 14 MHz: 21 dBm *Preamp on*: 3.5 MHz: 2.5 dBm; 14 MHz: 5 dBm
S-meter sensitivity (μV for S9 reading): Not specified.	*Preamp on*: 58 at 1 MHz; 10 at 1.9 MHz; 10.5 at 14 MHz; 8.5 at 28 MHz *Preamp off*: 58 at 1 MHz; 26 at 1.9 MHz; 27 at 14 MHz; 29.5 at 28 MHz
Squelch sensitivity: $<0.3\ \mu V$.	Min, 0.7 μV; max, 0.5 μV.
Receiver audio output: >2.6 W at 10% distortion with 8 ohm load.	2.76 W at 10% total harmonic distortion (THD) with an 8 ohm load.
Color: Black.	
Size (height, width, depth): 5.9 x 16.7 x 15.4 inches.	
Weight: 38.6 lbs.	

†Blocking dynamic range and third-order IMD dynamic range measurements were made at the ARRL Lab standard signal spacing of 20 kHz.

band mode, however, you end up on each band's "initialization frequency." The initialization frequency is about 50 kHz up from the bottom band edge. For example, if you're operating SSB on 21.255 MHz and press the DOWN switch, you'll move to about 14.050 MHz. This characteristic is annoying, especially if you do a lot of band changing (in a contest, for example).

Fortunately, there's another way to change bands. The IC-761's 32 memories store operating mode and filter selection, as well as frequency, and all 32 memories are *tunable*. Once you get used to the memory system, it's like having 32 other "VFOs" in addition to VFO A and VFO B. During a CW contest, I found it convenient to program the first six

memories for the low end of each band, 160 to 10 meters, and use the memory selection rotary switch at the lower right corner of the front panel as my band switch.

The '761 can scan all 32 of its memory channels. If you like, you can scan only those channels with the same operating mode as the main VFO, or you can scan between the frequencies stored in channels one and two. A switch accessible through the bottom panel determines whether opening the squelch gate will suspend or terminate scanning.

The '761 is capable of remote control by means of a serial port located on the back panel. ICOM uses a LAN-type system called Communication Interface-V (CI-V). According to ICOM literature, remotely controllable functions include frequency, mode, VFO selection and memory operation. There isn't any specific information on remotely controlling the '761 in the instruction manual or the service manual.

Good news: The operating program for the IC-761's microprocessor is contained in ROM, not in RAM. This means that when the transceiver's memory-backup lithium cell is exhausted, the transceiver *still works*. In ICOM's words, "The transceiver transmits and receives normally if the backup battery is exhausted but the transceiver cannot memorize frequencies."

Receiver

Signals can enter the receiver chain either from the SO-239 ANTenna connector or through the RECEIVE ANT IN phono jack, allowing use of separate receiving and transmitting antennas. Signals then pass to a 20-dB attenuator, a preamp or directly to the first mixer (a doubly balanced pair of 2SK125 JFETs operating at 13.8 V). The corresponding front-panel switch positions are labeled PRE, ATT OFF and 20dB. The preamplifier works—the ARRL lab measured a change in the minimum discernible signal (MDS) of 5 to 7 dB with the preamp on. It would be nice to have a choice of attenuation, though. There are times, especially on 160, 80 and 40 meters, when 10 dB or 30 dB are more appropriate choices.

The IC-761 employs a quadruple conversion scheme for SSB, CW, RTTY and AM, and triple conversion for FM. Intermediate frequencies are 70.4 MHz, 9.0 MHz, and 455 kHz for FM, with a fourth IF of 9.0 MHz employed in all other modes. (The return to 9 MHz allows the inclusion of passband [variable bandwidth] tuning, IF shift and other features.)

The '761 certainly doesn't lack when it comes to filters. Different combinations of filters can be selected by pressing the FILTER switch, located just above the IF shift and notch filter controls. As the radio comes from the factory, this switch provides bandwidths of 6.0 or 2.6 kHz for AM; 2.6 or 2.4 kHz for SSB; and 2.4 kHz or 500 Hz for CW and RTTY operation. FM operation is limited to a single bandwidth of 15 kHz. This range of selectivity is accomplished by choosing one of four filters in the second IF (9 MHz), and one of six in the third IF (455 kHz). The stock IC-761 is equipped with 2.4-kHz and 500-Hz crystal filters in the second IF and third IF. Optional filters for the second IF and third IF provide 250 Hz bandwidth for CW and RTTY. These filters were not installed in the review unit. There is also an optional 6-kHz second-IF filter for AM operation.

Some other receiver features worth mentioning include the QRM fighting team of passband tuning (PBT), IF SHIFT and the (audio) NOTCH filter. PBT and IF SHIFT work in the CW, SSB and RTTY modes. A single control is used for both PBT and IF SHIFT, and both functions cannot be used at the same time. PBT and IF SHIFT function differently, and both are useful. PBT narrows the passband from either the high side or the low side, while IF SHIFT moves the center frequency of the passband without changing the passband width. I found combining the use of the notch filter and PBT to be just about fail-safe when it came to adjacent channel interference.

Three controls are used for the noise blanker. The NB switch activates a noise blanker that is fairly effective against ignition noise and power-line noise. Although this blanker didn't work on all noise I encountered, it did work most of the time. NB LEVEL varies the threshold of the blanker. The third control, NB WIDE, is used for noise with long-duration pulses, such as the Soviet "Woodpecker" over-the-horizon radar. Again, this blanker was effective much of the time, but not all of the time. Receiver dynamic range is noticeably degraded when the noise blankers are in operation—an effect common to most receivers.

The AGC in the '761 is a joy to use. For casual SSB work with strong signals, the SLOW time constant position (fast attack, slow release) is the right choice. AGC action is smooth, and signals are easy to listen to. For CW and for SSB contesting and DXing, though, FAST AGC is the better choice. FAST AGC doesn't thump at all. Also, the AGC has depth—strong signals sound louder than weaker ones, making it easier to dig out weak signals sharing the passband with stronger ones.

The '761's clean receiver audio is compromised just a bit by a hissy audio power chip. Adjusting the rig's TONE control doesn't touch this hiss—a pity because the '761's quiet IF strip can't be fully enjoyed in the presence of such noise.

Transmitter

With harmonic suppression approaching 60 dB on all bands, the IC-761 is definitely one of the cleanest new rigs available (see Fig 2). This can be attributed to proper filtering and five relatively low-gain stages in the transmit amplifier chain. Of course, there is no need to tune up the '761—just set drive level and audio gain (if applicable) and you're ready to go. Fig 3 shows the transmit audio during two-tone testing.

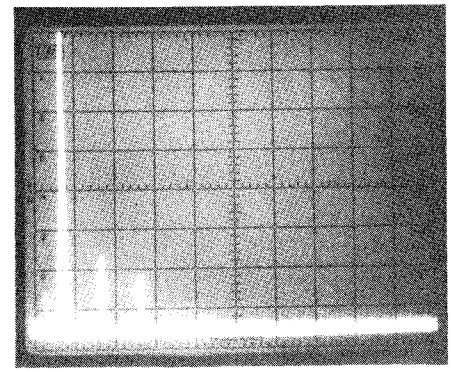


Fig 2—Worst-case spectral display of the ICOM IC-761. Horizontal divisions are each 2 MHz; vertical divisions are each 10 dB. Output power is approximately 110 W at 1.85 MHz. All harmonics and spurious emissions are at least 56 dB below peak fundamental output. The IC-761 complies with current FCC specifications for spectral purity.

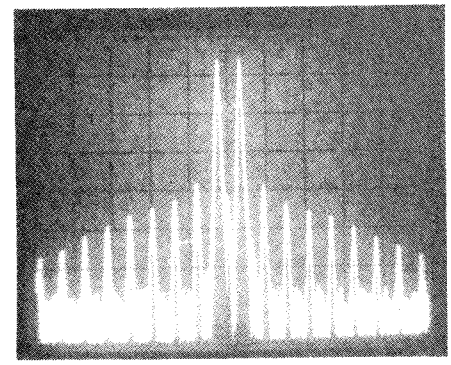
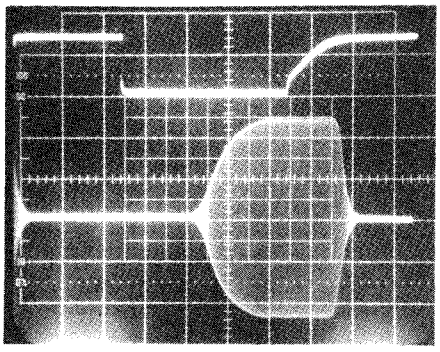


Fig 3—Spectral display of the ICOM IC-761 during two-tone intermodulation distortion (IMD) testing. Third-order products are approximately 37 dB below PEP output, and fifth-order products are approximately 45 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 2 kHz. The transceiver was being operated at 100 W PEP output on 14 MHz.

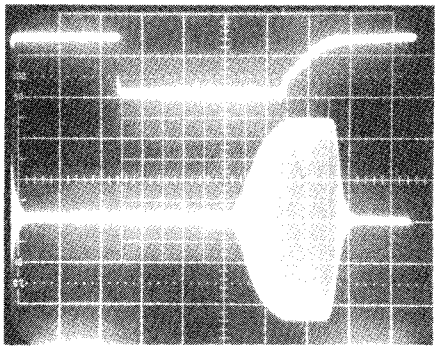
Antenna Tuner

If you're like me, with narrow bandwidth antennas, you'll appreciate the 160 through 10 meter built-in antenna tuner. ICOM claims a matching range of 16.7 to 150 ohms, and a maximum tuning time of three seconds. The internal tuner uses a tapped coil and two motor-driven variable capacitors, forming a T match.

To achieve the fast tuning specification,



(A)



(B)

Fig 4—CW keying waveform for the ICOM IC-761. The photo at A is with the IC-761 in the semi-break-in mode. The photo at B is with the IC-761 in the full-break-in (QSK) mode. In each photograph, the lower trace is the RF envelope; the upper trace is the actual key closure. Each horizontal division is 5 ms.

ICOM uses a clever scheme to preset the capacitors for each band. When initializing these presets, you transmit at low power and let the IC-761 find the right match on its own. Once a match is found, you open a cover on the top panel of the transceiver, flip the PRESET/AUTO switch to PRESET and adjust a pair of potentiometers (there is one pair per band) until four LEDs go out. Repeat the process for each band. From then on, when a band change is made, the tuning capacitors move to the preset positions and fine tune from there. The result is an automatic antenna tuner that works quickly and is almost transparent to the operator.

As with any automatic antenna tuner, there are times when it is not capable of finding a match. This is not a dead end in the case of the '761, as the preset potentiometers can be used to manually tune the T match capacitors. This procedure worked for me when I tried to match a 40-meter dipole on 160 meters! (No, I don't *normally* use my 40-meter dipole on 160.)

CW Operation

Another nice feature of this rig is the built-in iambic keyer. (Of course, you can still use the external key or keyer of your choice.) The keyer is enabled by pressing ELEC KEY located to the right of the noise blanker controls. A speed control is provided just above the enable switch, and a weight control is located inside the rig. Whether or not the internal keyer is used, key(er) connection is made via a ¼-inch stereo jack on the rear panel.

CW offset is set at 700 Hz. Some operators prefer a lower offset, and internal adjustment—to about 550 Hz—is possible.

Both full-break-in (QSK) and semi-break-in operation are available. The QSK mode sounds a bit thumpy because of sidetone transients, but receiver blanking is perfect. Unfortunately, the transmitted CW sounds choppy in QSK, especially at speeds of about 20 WPM and higher (see Fig 4). This occurs because of a delay between the time that the key line is closed and the transmitter RF output is generated. It is possible to compensate for this problem by adjusting keyer weighting.

Phone and RTTY Operation

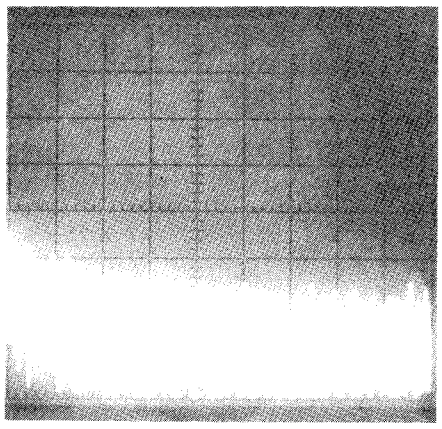
For phone ops, the IC-761 has a good sounding speech compressor (according to numerous reports) and a transmit audio monitor, which I think *all* rigs should have. At the beginning of the review, I used ICOM's SM-10 desk microphone. Many reports indicated that although the audio "wasn't objectionable," it sounded kind of "blah." (Several people who used the '761/SM-10 combination reported similar on-air comments, so the problem probably wasn't my voice.) Adjustment of the microphone's equalizer and compressor controls didn't improve the audio—in fact, many settings made the transmit audio sound awful. Note that the SM-10's built-in compressor has only LOW, MED and HIGH positions—but no OFF position! Later in the review period, I switched to a Heil HM-5 microphone. The Heil worked very well with the IC-761, and I received a number of excellent audio reports.

RTTY operation is also a snap, with capabilities for AFSK and true FSK included. For AFSK, all connections can be made through the microphone plug on the front panel or through the 8-pin ACC(1) jack on the rear panel. For FSK operation, a key line is provided (called RTYK) in the ACC(1) jack. Switches inside the rig select 850 or 170 Hz shift and reverse mark/space relationship.

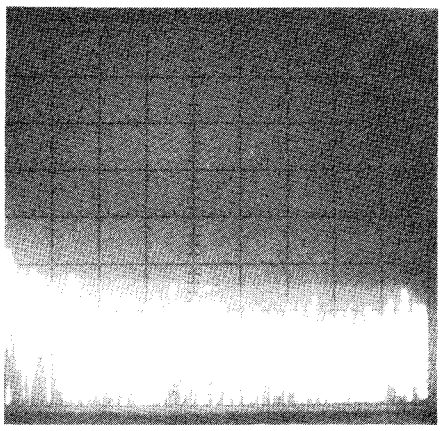
Synthesizer

ICOM has a relatively quiet synthesizer, as shown in the ARRL Lab phase-noise photos in Fig 5. In use, this translates to an absence of pops, clicks and birdies in the receiver. During contest periods, even on bands filled with strong signals, I did not notice any phase-noise problems.

The IC-761 is not without synthesizer-related problems, though. Synthesizer phase noise is relatively low partly because the acquisition time is relatively long. That is, when you change frequency, it takes a relatively long time for the synthesizer to lock. We're only talking milliseconds here, and the longer acquisition time is not apparent to the operator and causes no problems *except during QSK CW operation when the transmitter and receiver frequencies are offset more than 300 to 500 Hz.* During split-frequency QSK operation, the synthesizer lockup time is longer than the transceiver TR switching time. The transmitter puts out RF *before* the synthesizer locks. The result: The trans-

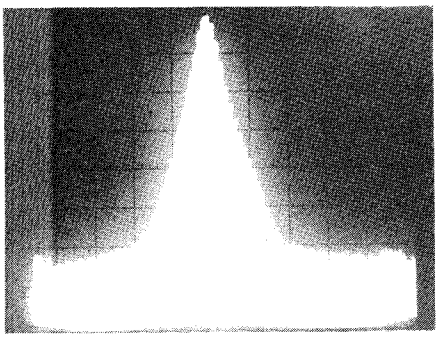


(A)

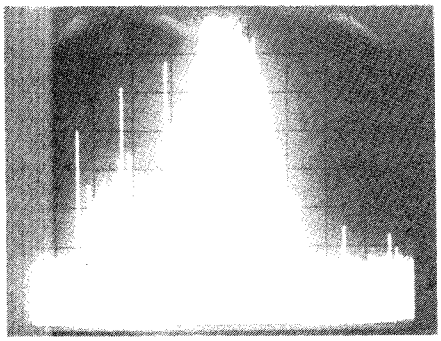


(B)

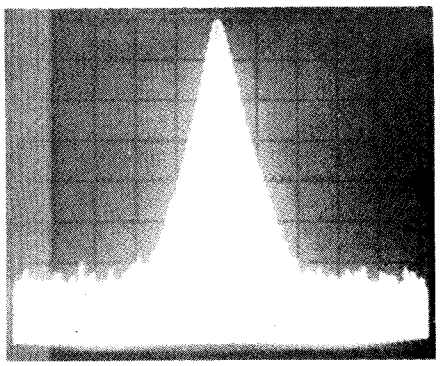
Fig 5—Spectral display of the ICOM IC-761 transmitter output during phase-noise testing. Power output is 100 W at 3.5 MHz (A) and 14 MHz (B). Each vertical division is 10 dB; each horizontal division is 2 kHz. The scale on the spectrum analyzer on which these photos were taken is calibrated so that the log reference level (the top horizontal line on the scale in the photos) represents −60 dBc/Hz and the baseline is −140 dBc/Hz. Phase-noise levels between −60 and −140 dBc/Hz may be read directly from the photographs. The carrier, which would be at the left edge of the photographs, is not shown. These photographs show phase noise at frequencies 2 to 20 kHz offset from the carrier.



(A)



(B)



(C)

Fig 6—These spectral photographs taken in the ARRL Lab show CW keying sidebands when the IC-761 is used for full-break-in (QSK) CW operation. See text for further discussion. Vertical divisions are each 10 dB; horizontal divisions are 1 kHz. Bandwidth is 300 Hz. In all cases, the transceiver is in the CW position and is being keyed with a series of pulses 30 ms on, 30 ms off. The photo at A shows the transmitter output of the unmodified IC-761 operating full-break-in (QSK). The receiver is using VFO A and the transmitter is using VFO B; both VFOs are set to 14.0495 MHz. Everything looks normal. The photo at B shows what happens to the unmodified IC-761 during QSK operation when the transmit and receive frequencies are offset by as little as 500 Hz. In this photo, the transmitter is using VFO B, set for 14.0495 MHz; the receiver is using VFO B, set for 14.0490 MHz. Note that the signal is broader and that there are a number of discrete spurious signals near the carrier. The on-air signal sounds broad and has a noticeable chirp. The photo at C shows the results of ICOM's suggested modifications. Here, the IC-761 is operating full-break-in with the transmit and receive frequencies offset by 20 kHz. The signal appears normal, and the on-air sound is fine.

mitted signal sounds chirpy, and the transmitter puts out spurious signals. See Fig 6 for ARRL Lab spectral photos of this effect.

Let me emphasize that there is no problem with the unmodified IC-761 during CW semi-break-in operation or voice operation at any frequency split, or during QSK operation when the transmitter and receiver are on the same frequency. This problem only occurs during CW *QSK* operation at frequency splits greater than about 300 to 500 Hz.

Tom Moore, KF7GH, and Russell Dudley, KW5O, of ICOM acknowledged the problem and provided us with four modifications for the IC-761. These modifications are described in ICOM service bulletins 24287-002, 24287-005, 24387-001 and 7088-001. Two of the modifications (24287-005 and 24387-001) had already been incorporated in our IC-761 during production; the other two were performed by ARRL Lab Engineer Ed Hare, KA1CV. The remaining two modifications involve changing resistors on the main board and the PLL board, and readjusting a potentiometer.

Did the modifications work? Yes—to a degree. The modifications improve the situation dramatically at frequency splits up to 30 kHz or so. Up to about 30 kHz, the chirp and spurious signals are gone, and the radio is perfectly usable. At wider frequency splits, the synthesizer still has problems locking before transmitter RF output, and a very rapid chirp is noticeable on the signal, as are clicks several kilohertz either side of the main signal. Although the modifications don't solve the problem perfectly, they are a tremendous improvement and make the '761 usable for most split-frequency QSK operation.

If you have an IC-761 and want to attempt the modifications yourself, you'll need a copy of the IC-761 service manual, a dual-trace oscilloscope and some experience working on electronics equipment. According to ICOM's customer service people, they will modify—free of charge (except to-ICOM shipping costs)—any IC-761 with split-frequency QSK CW problems. This applies to all units—even those outside the normal warranty period. If you have questions about modifying your '761, contact ICOM's customer service department.

ICOM deserves recognition for being very responsive to fixing a major flaw in an otherwise fine radio. It's also reassuring that they stand behind their gear after the sale and update older transceivers at no charge.

Operation

Hooking up the IC-761 was easy. It's worth reading the manual first, however. The CW key jack is a two-circuit unit to allow the dot, dash and common connections required for the IC-761's internal keyer, and probably isn't compatible with whatever you're using with other radios. The wiring instructions for this jack are clear, however, and ICOM even includes a suitable plug. Assuming you've plugged your paddle into the rear panel KEY jack, the '761's electronic keyer circuitry makes a straight key unnecessary for key-down tests: When the keyer is not selected (ELEC-KEY button out), the paddle dot lever functions as a straight key.

If you plan to use a linear amplifier with the '761, you'll appreciate the fact that the amplifier key line terminates in a phono jack instead of being buried in a multi-pin connector. What you may not appreciate, however, is this warning in the instruction manual: "**DO NOT** attempt to switch greater than 50V DC, 0.5A." If you use an amplifier with a higher relay keying voltage (a Heath SB-220/221 or Alpha 77, for example), plan to add a relay or transistor switch between the IC-761 and your amplifier.

I must say I was intimidated at first by the apparent complexity of the '761's front panel. After spending some time reading the instruction manual with the rig in front of me, though, operating techniques quickly fell into place. Control feel and placement complement the rig's superior design, resulting in a quality piece of equipment. Since I find myself operating at a number of locations, having the built-in keyer and antenna tuner saved trunk space and reduced setup complexity.

The IC-761 received a thorough workout in several phone and CW contests. It performed very well under extreme conditions, and its superior receiver performance was noticeable. Even on 40-meter CW, it was usually possible to find a spot to call CQ—sandwiched in between a couple of strong stations!

The IC-761 includes an excellent general-coverage LF/MF/HF receiver. Its AGC works as well for reception of full-carrier AM stations as it does for CW, SSB and RTTY. Short-wave listening enthusiasts may find that the IC-761 exhibits a few rough edges, however. The transceiver's trait of not staying tuned to one carrier frequency during all possible mode changes is particularly annoying during reception of full-carrier AM signals as SSB—a technique in which sideband switching is routine for listeners intent on dodging interference. The transceiver's stock "AM wide" selectivity—6 kHz at −6 dB and 18 kHz at −50 dB—is a bit too wide for comfortable reception in crowded short-wave broadcast bands. (Addition of the optional 9-MHz AM filter [6 kHz at −6 dB and 18 kHz at −60 dB] may tighten up somewhat, although 4 kHz at −6 dB would be a better choice for both filters.) This isn't much of a problem, though, because the '761 does a superlative job

receiving full-carrier AM signals as SSB signals, carrier tuned as close to zero beat as possible with the rig's 10-Hz tuning steps. (Note: In some spots throughout the world, IC-761 users may experience *tweet* interference in the medium-wave broadcasting band. You've heard of birdies, of course; *tweet* is the decades-old term for interference caused by harmonics of a receiver IF beating with incoming signals. Sound impossible? It's not: Tweet interference occurs in the IC-761 when the rig is tuned to Connecticut local broadcast station WRCQ, 910 kHz—twice the '761's second IF (455 kHz). Luckily, the tweet is close enough to zero beat to be inaudible with 'RCQ tuned on the nose—but its presence prohibits IC-761 owners wanting to listen to their 910-kHz locals from offsetting the '761's tuning for better recovery of high modulating frequencies.)

I really enjoyed using the IC-761 and found it an excellent transceiver, except for the problems with split-frequency QSK operation. It is easy to use, it looks great, and the controls feel good. ICOM has done an outstanding job with both the operating and service manuals. Both are easy to read and informative.

I would like to thank Bill Myers, K1GQ, Dave Newkirk, AK7M, and Mark Wilson, AA2Z, for using the IC-761 and providing comments that were incorporated in this review.

Price class: IC-761, $2700; SM-10 desk microphone, $140. Manufacturer: ICOM America, Inc, 2380-116th Av NE, Bellevue, WA 98004, tel 206-454-7619.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

[In order to present the most objective reviews, ARRL purchases equipment "off-the-shelf" from Amateur Radio dealers. ARRL receives no remuneration for items presented in the Product Review or New Products columns.—Ed]

The following ARRL-purchased Product Review equipment is for sale to the highest bidder. Prices quoted are minimum acceptable bids and reflect a discount from the purchase price.

Sealed bids must be submitted by mail and be postmarked on or before September 27, 1988. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In the case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

Please clearly identify the item you wish to bid on, using the manufacturer's name, model number, or other identification number if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by the successful bidder, FOB Newington. The successful bidder will be advised by mail of the successful bid. No other notifications will be made, and no information will be given by telephone to anyone regarding final price or identity of the successful bidder.

Please send your bids to Kathy McGrath, Product Bids, ARRL, 225 Main St, Newington, CT 06111.

Kenwood TS-140S 160-10 meter transceiver, s/n 8101427, with 500-Hz CW filter and PS-430 power supply (sold as a package only; see Product Review, Jun 1988 *QST*). Minimum bid $784.

Kenwood TM-221A 2-meter FM transceiver, s/n 9020515 (see Product Review, Jul 1988 *QST*). Minimum bid $238.

Kenwood TM-321A 220-MHz FM transceiver, s/n 8090113 (see Product Review, Jul 1988 *QST*). Minimum bid $248.

Kenwood TM-421A 440-MHz FM transceiver, s/n 8090067 (see Product Review, Jul 1988 *QST*). Minimum bid $244.

New Products

MN ANTENNA ANALYSIS SOFTWARE FOR THE IBM PC

☐ Brian Beezley, K6STI, has dramatically enhanced the MiniNEC antenna analysis program developed by NOSC. MN (for IBM® PC and compatible computers) allows modeling of almost any antenna made of wire or tubing, at any frequency. Antennas can be modeled over real or perfect ground, or in free space. MN gives forward gain, front-to-back ratio, maximum sidelobe levels, beamwidth, vertical radiation angle, input impedance, SWR, element currents, far-field radiation patterns and near-field intensity. MN also allows performance comparisons between antenna designs.

MN is menu driven, and has extensive, easy-to-read documentation. Basic system requirements include an IBM PC or compatible with a single floppy disk drive, at least 300 kbytes of free memory (450 kbytes if the plotting routine is to be used during MN operation), a CGA, EGA or HGC card, and a text editor or word processor (for creating and modifying antenna files). A math coprocessor will speed up MN calculations by 15 to 20 times, but is not a system requirement. A hard disk is not necessary. The basic MN package includes MN.EXE (executable program file), sample antenna files, a demonstration plotting program, and documentation. The complete MN package consists of all the files in the basic package as well as MNPLOT.EXE (executable plotting routine for graphics cards), the complete antenna library (over 50 antennas), the plot library (antenna-file plots), a guide to plot comparisons, and additional documentation.

Antenna patterns can be plotted using the MNPLOT program. Azimuth- and elevation-plane far-field polar patterns can be plotted on the standard ARRL log-decibel grid (so that patterns generated using MNPLOT can be compared to those in ARRL publications), or patterns can be plotted on a linear-decibel grid. MNPLOT also allows plotting patterns in rectangular form. MN is provided on a single 360-kbyte floppy disk via first class mail. Price: Basic MN Package, $25; Complete MN Package, $75. If you purchase the Basic MN Package and order the Complete MN Package within 30 days, you'll receive full credit for the purchase of the Basic MN Package. More information and the MN software packages are available from Brian Beezley, K6STI, 507½ Taylor St, Vista, CA 92804.—*Rus Healy, NJ2L*

ARD HEAVY DUTY ANTENNA ROTATOR

☐ Looking for a *substantial* antenna rotator? Advanced Radio Devices has introduced the R9100—an RS-232-C controllable monster rotator capable of 10,000 inch-pounds of torque and 23,000 inch-pounds of braking capability. The R9100 has a 2000-pound vertical-load capability, weighs 230 pounds, and fits inside a Rohn 45 tower. Software to use the computer-control capability is included with the R9100. It allows you to enter a call-sign prefix on your computer keyboard, and turns the rotator to the correct beam heading automatically. The control unit for the R9100 has both analog and digital displays. The ARD R9100 is sold exclusively by EEB of Vienna, Virgina. Suggested price: $3975. For availability information, contact EEB at 800-368-3270 or 703-938-3350. ARD can be contacted at 103 Carpenter Dr, Sterling, VA 22170, tel 703-478-3100.—*Rus Healy, NJ2L*