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Product Review

Conducted By Paul K. Pagel,* N1FB

Yaesu FT-707 Transceiver

Do good things still come in small packages? Well, with respect to the FT-707, that old saying could be considered noteworthy depending upon one's point of view — objective, subjective or a little bit of both.

Our review model arrived at Hq. in late October of 1980, just in time for this writer to bundle it up and carry it to Tortola, British Virgin Islands, for a two-week "hamcation" as VP2VGT. It was definitely the proper size for traveling by air after packing it into a portable electric typewriter case along with a keyer, paddle, microphone, antenna wire, coaxial cable and some hand tools. The parcel fit handily under the seat of the 727 jet. The power supply was carried in another suitcase and made the trip in the belly of the plane.

Long Bay Hotel on Tortola proved to be a good testing ground for the FT-707, because the temperature ranged from 75° F (24° C) at night to 95° F (35° C) in the daytime giving the internal cooling fan plenty of exercise whenever the heat sensor actuated it. The fan noise was minimal, but audible, and was considered acceptable in the interest of protecting the transistors in the power amplifier. Also the ac line voltage on the island ramped from as low as 95 to as high as 125 depending on the peak demand at various times of the day. The transceiver continued to operate properly, except for a drop in output power during periods of low line voltage. There were no noticeable effects from the salt air and high humidity respective to overall performance.

We didn't realize it when we left Connecticut, but that particular FT-707 did not contain a cw filter (an accessory). A fair amount of nail biting followed, since 90% of the operation was to be on cw! Fortunately, the FT-707 has an i-f width control, which varies the passband from approximately 300 Hz to 2.4 kHz. This feature made it possible to obtain sufficient selectivity for cw reception, and the problem was solved. It would have been much better, however, to have the 350- or 600-Hz accessory filter installed for enhanced skirt selectivity and ultimate rejection. Both filters are available from Yaesu — so is an i-f filter for a-m reception.

The only anomaly we observed during the two weeks of vigorous operation with the first unit (serial no. OFO20793) was VFO drift. From a cold start to approximately two hours later, the drift was roughly 1.5 kHz. It was gradual enough after the first 15 minutes to pose only minor problems. A second FT-707 (serial no. OJO80841) was obtained after we returned to the USA, and it drifted in a like manner. Scattered reports of substantial drift were also received from owners in the field. We checked this out with Yaesu, and were told that there was no case history problem with drift. We were sent a third review unit, and it drifted only 10 Hz (measured at the antenna jack, key down, 25 watts of output). The test period was one hour long. Close inspection of the VFO interior revealed no evidence of circuit changes or "customizing" of the third review unit. Perhaps the later FT-707s contain different compensating capacitors in the VFO, or the drifting units simply had defective capacitors.

The FT-707 receiver exhibited good dynamic range during the VP2VGT operation. There was no IMD or overloading evident from the strong Region 2 commercial stations to the south of us. Even more dramatic was the ability of the receiver to function satisfactorily when W8JUY/VP2VGW and the reviewer operated the same band (one on cw and the other on ssb). The two stations were only 30 ft (9.1 m) apart and the antennas were even closer. Of course, there were IMD products and hash in the receiver, but no cross-modulation or high-order desensing was noted.

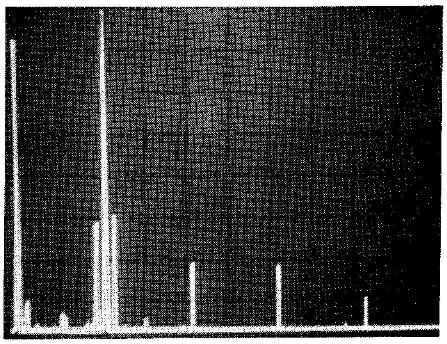

Fig. 1 — Worst-case spectral output of the Yaesu FT-707 operating at 10.1 MHz. Vertical divisions are each 10 dB. Horizontal divisions are each 5 MHz. Worst-case harmonic output is approximately 61 dB down from the fundamental. Worst spurious output is approximately 49 dB down from the fundamental. The Yaesu FT-707 complies with present FCC specifications for spectral purity. All measurements were taken in the ARRL lab.

FT-707 Features

The operating modes are ssb and cw, with a rating of 100 watts output. There is also an a-m mode, for which the output power is specified as 50 watts. Frequency readout is by means of a digital display, but analog readout is also provided.

The S meter uses a string of LEDs, illuminating left to right in accordance with the incoming signal strength. Green, yellow and red banks of lights indicate different regions of signal strength. We had fun giving out signal reports such as, "you're Q5 and S red." The LED "meter" also indicates relative power output and the alc level during ssb operation. There is a built-in speaker, noise blanker, RIT and crystal calibrator. The VOX controls are located on the front panel for easy access.

One can purchase the FP-707 ac-operated power supply as an accessory. It delivers 13.5 volts dc and has a built-in speaker. Another accessory is the synthesized outboard VFO (FV-707DM), which has 12 memory channels. The resolution is 10 Hz. When using the YM-35 mating microphone and FV-707DM synthesizer, the operator can shift the frequency up or down by means of QSY buttons on the microphone — ideal for mobile operation. Yaesu also sells an FC-707 mating Transmatch. The entire setup can be mounted in a special

*Assistant Technical Editor

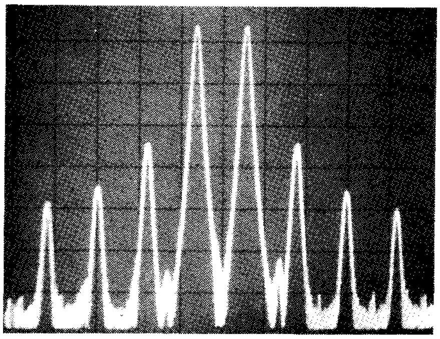

Fig. 2 — Spectral photograph of the two-tone, third-order transmitter IMD characteristics of the FT-707. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. Third-order IMD products are down approximately 34 dB from the PEP level, and fifth-order products are down approximately 44 dB. Each tone is 6 dB below the PEP level.

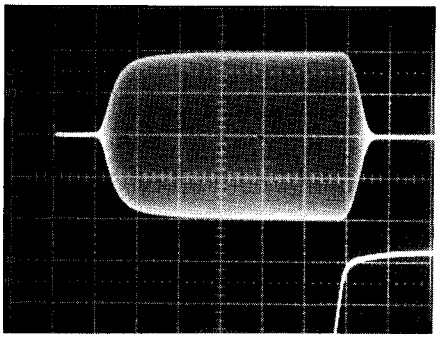

Fig. 3 — Cw keying waveform of the FT-707. The partially visible lower trace is the switching waveform at the key jack, and the upper trace is the output envelope. Output is generated approximately 5 ms after key closure. Good rise and fall times as indicated produce a clickless wave.

Yaesu FT-707 Transceiver Serial No. OJ100772

Manufacturer's Claimed Specifications	*ARRL Lab Measurements*
Frequency coverage: 80-10 meters, inclusive of WARC bands.	As specified plus approx. 60 kHz on low ends of bands and 10 kHz on high end of 80 m. 150 kHz or more on high end of remaining bands.
Readout: Analog and digital.	As specified.
Resolution: Analog — 1 kHz; digital — 100 Hz.	As specified.
KHz, one turn of knob: Not specified.	15
Backlash: Not specified.	Nil.
RIT/XIT range (kHz): ±3	−3 to +3.5
I-f width control: 300 Hz to 2.5 kHz.	As specified.
Receiver attenuator: None.	—
S-meter sensitivity (μV/S9): Not specified.	80 m — 30; 40 m — 27; 30 m — 27; 20 m — 40; 17 m — 45; 15 m — 45; 12 m — 45; 10 m — 71.
Receiver sensitivity: Ssb/cw — 0.25 μV for 10 dB S/N; a-m — 1.0 μV for 10 dB S/N.	Dynamic range measured with optional 600 Hz i-f filter installed.

	80 M	*20 M*
MDS (dBm):	−126	−127
Blocking DR (dB):	noise limited	noise limited
IMD DR (dB):	77 lo 76 hi	83 lo 80 hi
3rd-order input intercept (dBm):	−10.5 lo −12.0 hi	−1.5 lo −6.0 hi

Audio power output (4 ohms): 3 watts.	As specified. Quality good.
Power consumption: At 13.5 volts dc, 20 A (transmit) and 1.5 A (receive).	Not measured.
Transmitter power output (watts): Not specified. Input: 240 watts for ssb and cw; 80 watts a-m.	80 m — 135; 40 m — 120; 30 m — 120; 20 m — 120; 17 m — 120; 15 m — 120; 12 m — 125; 10 m — 125.
Spurious suppression: At least 50 dB.	Approximately 49 dB (see spectral photograph).
Harmonic suppression: Not specified.	>60 dB
Transmitter two-tone, 3rd-order IMD: At least −31 dB.	−34 dB. See spectral photograph.
Key-down limitation: 30 seconds with a 2-minute pause between key-down periods.	Not measured.
Frequency stability: 300-Hz drift over 30 minutes after 10-minute warm-up; then 100-Hz drift after 30-minute warm-up.	10-Hz drift from cold start to 1 hour later. Measured at antenna jack with transmitter key down, 25 watts output.
Size (HWD): 3-5/8 × 9-1/2 × 11-5/8 in. (93 × 240 × 295 mm).	As specified.
Weight: 15 lb (6.5 kg).	Not checked.
Color: Two-tone gray.	As specified.

mainframe that is available from the manufacturer.

Other Considerations

No mention of use with an external amplifier is found in the instruction book, and two letters to Yaesu inquiring about the use of outboard amplifiers elicited no response. There are no terminals available for actuating the T-R circuitry of an outboard amplifier. It appears, however, that the operator could connect an external 12-V relay in parallel with the FT-707 VOX/PTT relay for use in controlling a separate amplifier.

The three WARC-sanctioned amateur bands (10, 18 and 24 MHz) are included in the 80-through 10-meter coverage of this transceiver. *Warning: The U.S. Government has yet to authorize amateur use of these bands!*

The FT-707 appears to be an excellent unit for mobile operation and field use. It can serve nicely as a home-station transceiver as well, and should appeal particularly to those who favor compact equipment. — *Doug DeMaw, W1FB*

THE KLM KT-34XA TRIBAND YAGI ANTENNA

☐ When one thinks of the usual triband antenna, a vision of compactness and compromise generally comes to mind. Not so with the KLM KT-34XA. This antenna is a direct descendant of the KT-34A (a KT-34A to XA conversion kit is available for $225). For a tribander, the '34XA is big: It weighs 68 pounds (31 kg), has a longest element length of 24 feet 8 inches (7.5 m), a 3-inch (76-mm) diameter, 32-foot-long (9.6-m) boom (braced by means of overhead cables) and a projected wind surface area of 9 square feet (0.84 m^2). The turning radius is 21 feet 6 inches (6.5 m), and KLM rates the antenna at a 4-kW capability and a wind survivability of 100 mi/h (161 km/h). A full-sized, 10-meter element has been added as has another tri-resonant element. There are now six working elements on 10 meters and five elements on 15 and 20 meters. KLM suggests that suitable rotators may include the TR-44, Ham M types, HD and KR-400.

Assembly

If your usual plan for antenna erection is from box to tower in one day, forget it! It took about an hour to open and empty the single carton and check the contents against the parts list. There are *many* parts. Approximately 25 hours were required to bring the antenna to the

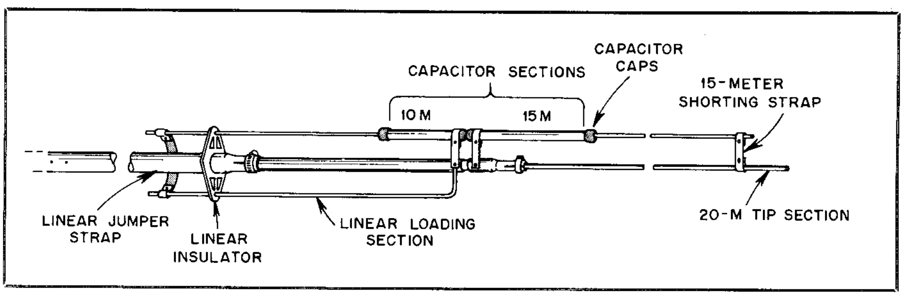

Fig. 4 — A tri-resonant section of the KT-34XA antenna. There are two of these sections in each of five elements. The sixth element is a separate 10-meter director.

point where it was ready for the final test. The excellent instructions include fully detailed drawings of each step of assembly. They are, without a doubt, the best instructions I've seen supplied with any antenna. There are no ambiguities, and it would be difficult to imagine anyone having a comprehension problem despite the antenna complexity.

The hardware is aluminum and stainless steel, with the exception of the cadmium-plated U bolts. This antenna is first class, from nuts to bolts.

The KT-34XA is fed by means of 50-ohm coax through a 4:1 balun (supplied). Transposed aluminum straps are used to drive the second and third elements from the rear, out of phase with respect to each other. The design permits full coverage of 15 and 20 meters and optimized 10-meter coverage from 28 to 29 MHz for the DXer. (Measurements at W1SE indicated the SWR rising only to 1.8:1 at 29.3 MHz.)

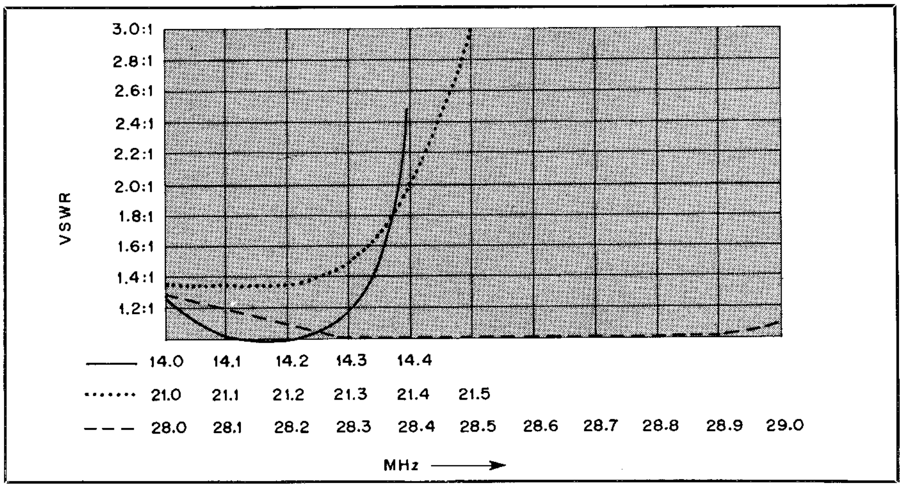

Fig. 5 — SWR curves of the KLM KT-34XA triband Yagi antenna.

Testing

After assembly, following the final test on a short mast, it was necessary for me to partially disassemble the right side of the elements and to remove the elements from the boom. (Marking element lengths and their position on the boom with an indelible marker is a great time saver.) Everything was then taken to the other side of a small brook, over which my tower folds. Here the boom was installed on the tower mast, and the left side of the elements were mated with the boom. The tower was then raised progressively to permit the installation of the right side of the elements. At the point where the top of the mast was approximately 13 feet above ground, the antenna was high enough to permit the insertion of the right-side element tips. Following this, the tower was brought erect, and the installation was complete. Depending on tower type, one could be faced with a different set of circumstances in the final mounting of antenna to tower. At W1SE, the antenna is 60 feet (18.3 m) above the earth.

The first SWR measurements were a disappointment. The SWR at the low end of each band was 2:1 or more. Discussion with KLM disclosed that they had made a change in the plastic material used to form the concentric tubing capacitors in each element. It turned out the plastics supplier had not given them all the information on the characteristics of the plastic. Subsequent changes that KLM made in the plastic material, after the design was "frozen," brought about changes in the resonant frequencies. Changes in the SWR resulted at the most desirable points. KLM did, however, recognize its responsibility to provide kits containing new plastic caps, several larger pieces of aluminum tubing and a new set of instructions and assembly measurements. The old plastic caps are black, while the new ones are off-white and UV resistant.

The antenna was subsequently removed from the tower, the tri-resonant sections disassembled, then reassembled with the new hardware, and the entire erection procedure repeated. Fortunately, this was all during the late summer and early fall; at least we beat the New England winter!

Results

The KT-34XA has now been in use for several months, and extensive operations have been conducted on each band. Operating "barefoot," this reviewer has been able to crack countless DX pileups, frequently with only a second or third call, on both ssb and cw. The number of responses to "first-time" calls has been very gratifying.

Repeated, careful observations at W1SE appear to indicate good gain, front-to-back and front-to-side ratios. Signals that arrive at a high angle will, of course, reduce these ratios. On those occasions, however, when the band is either just opening or closing and the angle of signal arrival is lowest, the ratios appear greatest, and the true performance of this antenna is realized. The KT-34XA triband Yagi antenna is manufactured by KLM, 17025 Laurel Rd., Morgan Hill, CA 95037. Price class: $570. — *Lee Aurick, W1SE*

ICOM IC-551 6-METER TRANSCEIVER

☐ Do you remember the excitement of working DX on the 50-MHz band back in cycle 19 or 20? During those days the standards of comparison were such rigs as the Drake TR-6 and the Heath SB-110. As the sun cranks down after a flurry of activity during the peak of cycle 21, many new DX achievements have been made on 6 meters, and no doubt the ICOM IC-551 played a role in helping vhf operators reach their goals. The size and complexity of the '551 make it light-years ahead of the older tube-type transceivers, yet costs less than, for example, the Drake TR-6 (relative to 1960s prices).

Compact, portable and versatile are the catchwords to describe this transceiver. Operating modes include ssb (both upper and lower sideband), cw, a-m and fm with an optional fm board installed. Frequency control is accomplished by means of two built-in digital PLL VFOs, sharing a common tuning dial. The VFOs may be selected separately, or each used

as a transmit or receive "remote" for split operation. Popular frequencies may be programmed into three memories available to the user. The memories may be recalled by means of a front-panel switch, or monitored by means of a built-in scanning function. Scanning may also be used to search for signals contained in a specific frequency block. The user selects the frequency block by storing the upper and lower frequency limits in two of the three internal memories.

Other features include dual-speed tuning, an electronic dial lock (useful for mobile operation), fast or slow agc speed selection and RIT. Optional equipment included with the review unit was the VOX unit, the fm unit and the passband-tuning/rf-speech-processor unit.

Some Highlights

A unique feature of modern transceivers is the use of microcomputers to control the frequency selection circuitry and so forth. The IC-551 is no exception. It uses a microcomputer to control its two VFO circuits, the scan and memory functions, and the frequency display. The microcomputer in the radio is a dedicated device; in other words, the user can "program" it only by use of the front-panel controls.

The '551 is one of the first amateur transceivers to use a switch-mode power supply. A switch-mode power supply differs from the standard power supply in that it operates at a much higher frequency than the 60-Hz line. This allows the inductors in the supply to be very small, resulting in high efficiency.

I would suggest that the prospective or new owner sit down and read the instruction manual thoroughly before firing up the rig. Without reading it you will be able to operate the '551, but no doubt you will miss some of its unique functions.

Performance

On-the-air operation with the '551 was a pleasure, with a few exceptions. The receiver performed well in the presence of strong signals — W1AW is just 3/4 mile (1.2 km) from the reviewer's QTH — and the sensitivity was adequate except for the most demanding weak-signal work. (Jacks are provided for the addition of an external preamplifier.) There is no fixed attenuator in the receive line, but the rf gain control provided enough range for the signals encountered. When the review unit was first operated in the ssb mode, the transmitted audio reports received were very poor, and the passband tuning unit did not function properly. Tests in the ARRL lab confirmed that a problem existed. The unit was shipped to ICOM, and within a few weeks it was returned with defects corrected. According to ICOM, it had been misaligned and had a few bad components. Further checks with the unit operating in the SSB mode resulted in good audio reports being received, but distant stations could not see any signal improvement with the rf speech processor turned on. A-m operation can be quite difficult to use because the transmitted a-m is actually lower sideband with carrier (A3H), and during receive the unit is in the lower sideband SSB mode. This results in having to zero beat the received a-m carrier, but is a problem only if the a-m station is using older gear that tends to drift.

When using the '551 in the cw mode the operator may select either semi-break-in (VOX) or manual transmit/receive switching. The RF POWER control varies the cw output

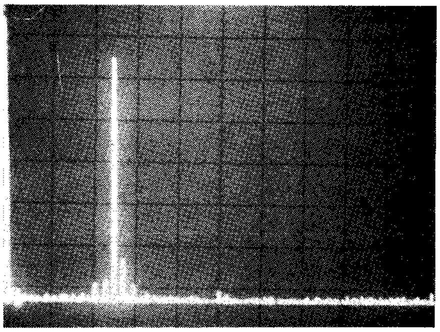

Fig. 6 — Worst-case harmonic and spurious output. At 10 watts output all spurious outputs are at least 63 dB down. Vertical scale is 10 dB per division. Horizontal scale is 20 MHz per division. The tall pip at the extreme left of the photo is the spectrum analyzer zero reference. The IC-551 complies with current FCC spectral purity requirements.

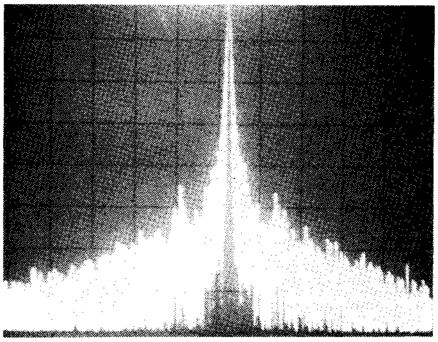

Fig. 8 — Single-tone, narrow-band spectrum of the IC-551. The excessive noise around the carrier is probably from noise generated in the synthesized local oscillator. Vertical scale is 10 dB per division. Horizontal scale is 2 kHz per division.

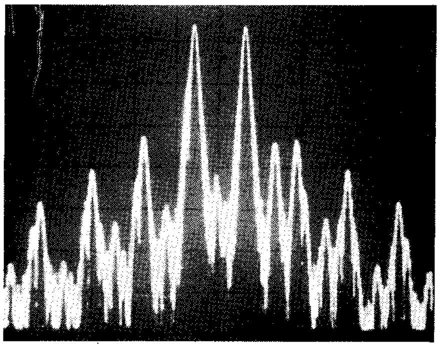

Fig. 7 — Two-tone, third-order IMD spectral photograph of the IC-551. Each tone is 6 dB below the rated PEP output. The test tones are 700 and 1900 Hz. Vertical scale is 10 dB per division. Horizontal scale is 1 kHz per division.

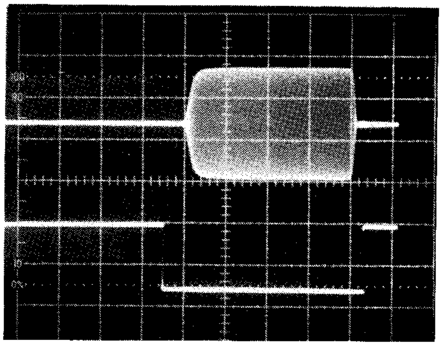

Fig. 9 — Rf envelope and switching waveform of the IC-551. Horizontal divisions are 5 ms. Rise time is approximately 1.5 ms and decay time 1.0 ms. There is 2.5 ms delay between key down and the start of the rf envelope. This waveform will produce key clicks.

ICOM IC-551 Transceiver Serial No. 01575

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 50-54 MHz.	As specified.
Modes of operation: Ssb/cw/a-m/fm	As specified.
Readout: 6 digit, fluorescent-blue digital display.	0.25-in. (6.4-mm) digits.
Resolution: 100 Hz on ssb, cw and a-m; 1 kHz on fm.	As specified.
KHz/turn of knob: Not specified.	On ssb, cw and a-m: selectable, 5 or 50; on fm: 50 or 500.
Backlash: Not specified.	Nil.
RIT range: ± 1 kHz.	± 1 kHz.
S-meter sensitivity (μV/S9): Not specified.	50.01 MHz, 3.9; 53.9 MHz, 3.
Receiver sensitivity: <0.5 μV for 10 dB S + N/N ratio.	Noise floor (MDS) dBm: − 134 Blocking DR (dB): 108 Two-tone third-order IMD DR (dB), high (h) and low (l) products: 82(l), 81 (h). Third-order input intercept: − 11 (l), − 10 (h).
Audio power output (8 ohm load): More than 2 watts.	1.5 watts.
Power consumption: Receive: Dc — 1.1 A; Ac — 41 W Transmit: Dc — 3.3 A; ac — 98 W	Not measured.
Transmitter rf power output: ssb, cw, fm — 10 W, a-m 4 W.	Ssb, cw, fm — 11.4 W, a-m — 4 W.
Spurious suppression: Better than 60 dB.	63 dB.
Carrier suppression: Better than 40 dB.	Not measurable because of in-band noise.
Third-order IMD: Not specified.	− 34 dB (see spectral photos).
Key-down time limitation: Not specified.	No excessive heating noted at 10 W output for 1 hour.
Frequency stability: < ± 500 Hz for 60 min, <100 Hz per hour thereafter.	140-Hz drift from cold start to 1 hour later at 5-W cw output.
Size (HWD): 4.3 × 9.5 × 12 in. (111 × 241 × 311 mm).	
Weight: 13.4 lbs. (6.1 kg).	
Color: Black.	

power, which is useful for trying QRP operation. No cw filter is included with the unit, and there are no provisions for the addition of a filter. Nearby stations reported that the keying of the IC-551 sounded very hard and produced clicks in their receivers. Tests in the ARRL lab confirmed the reports. The keying waveform is shown in Fig. 9. When informed of the keying problem, ICOM America told us they would look into the problem, but we have, to date, received no circuit modifications.

One glitch was found in operation during memory scanning in the SSB mode. If two frequencies separated by more than 1.5 MHz (such as the 50.110- and 52.525-MHz ssb and fm calling frequencies) are loaded into memory and you wish to scan these frequencies, you may experience a problem. The frequency synthesizer randomly does not lock quickly when jumping over a large frequency range. The receiver then "cracks" audibly because of the excessive lock-up time, and this "crack" causes the squelch to open, halting the scanning. This can be quite annoying.

The optional fm unit worked well, and audio quality on both transmit and receive sounded very good. During fm operation the S meter serves a dual purpose — as a signal strength meter and as a zero-center discriminator meter.

Overall, I am pleased with what ICOM has done with such a small package. An optional i-f cw filter would have been nice. On this model ICOM left out the remote frequency-control provision, which makes computer interfacing difficult. Those amateurs who are just gaining an interest in the vhf bands, or old-timers looking for a new 50-MHz rig, should take a serious look at this piece of equipment — not just as a 6-meter radio, but as a tunable i-f for the higher frequency bands. The IC-551 is available from ICOM dealers throughout the U.S. and Canada. In the U.S., the manufacturer's address is: ICOM East, Inc., Suite 307, 3331 Towerwood Dr., Dallas, TX 75234. Price class: IC-551, $480; VOX unit, $55; fm adapter, $105; passband tuning and rf processor, $105. — *Gerry Hull, AK4L*

New Books

☐ *The Art of Electronics,* by P. Horowitz, W1HFA, and W. Hill, published by Cambridge University Press, 32 E. 57th St., New York, NY 10022. Hard-cover edition, 7-1/4 × 10 inches, 716 pages, $24.95.

Paul Horowitz is well known among amateurs for his expertise in circuit design: He developed an amateur-built cw keyboard keyer described in August 1965 *QST*. He is a professor of physics at Harvard University. His co-author, Winfield Hill, is president of Sea Data Corporation.

The authors have demonstrated clearly that a technical book does not need to be saturated with lofty terms, stilted narrative and "yard-long" equations in order to fit the measure of much of today's professional writing. *The Art of Electronics* gets immediately to the point in simple language for each subject treated. It contains the most lucid narrative that this reviewer has found in any similar professional volume in recent years. The presentation of theory and application is not unlike that in *The Radio Amateur's Handbook* (ARRL). In fact, this book would serve nicely as an extension of the *Handbook*. Furthermore, exercises, provided throughout the text, serve as a learning and testing aid. D. Larson of the University of Virginia said that the text of this book "succeeds in taking the student from very close to zero knowledge of electronics (or even electricity) to a point where he would be considered fully knowledgeable, and perhaps even an expert, by typical researchers in the physical sciences."

The book contains 14 chapters, 11 appendices and 44 tables. Chapter 1 covers *E, I* and *R*; signals; capacitors and ac circuits; inductors and transformers; impedance and reactance; diodes and other passive components. Chapter 2 deals with basic transistor circuits. Chapter 3 treats feedback and op amps. Active filters and oscillators are discussed in chapter 4. The list goes on and on as one advances through the book. For example, thorough discussions are given on the subjects of power circuits and regulators, FETs, low-noise techniques, digital electronics, digital interface to analog, microcomputers and electronic construction methods. In chapter 13 the authors address the subjects of high-speed and high-frequency techniques, while measurements and signal processing are covered in chapter 14. Each chapter subject has many subheadings and texts that deal with the many facets of overall chapter titles.

This book is highly recommended to amateurs who want to learn modern circuit techniques. It is also an excellent course book for those wishing to teach electronics. You may want this volume in your Amateur Radio library. — *Doug DeMaw, W1FB*

☐ *Seven Steps to Designing Your Own Ham Equipment,* by L. B. Cebik, W4RNL. Published by Howard W. Sams & Co., Inc., Indianapolis, Indiana. Soft cover, 6 × 9 inches, 218 pages plus index, $9.95.

In the last few years political pundits have been fond of saying that the most oppressed group in the United States is the middle class — the rich have no money worries and can afford to pay for anything that they might need, while the poor have no money and the government will take care of their needs. The middle class is left to fend for itself on an insufficient income. Of course, such a statement is a gross oversimplication; however, there is enough truth to it for it to have become a popular cliche.

An analogous situation exists in Amateur Radio. Electrical engineers already know the basics of design and need little help with it. The technically inept appliance operator lets the professional engineer supply all technical information and consideration for him. Heaven help the ambitious, enthusiastic hobbyist who is not a professional engineer but who does not wish to be relegated to the ranks of the appliance operator or perennial kit builder! It is to this audience that L. B. Cebik has addressed *Seven Steps to Designing Your Own Ham Equipment.*

The main purpose of the book is to give the reader a practical *method of thinking* that will result in successful home-designed and -built equipment. This is a "how-to" book on developing a philosophy for dealing with a technical subject, as opposed to being a "how-to" book on a technical subject. Although the book is chock full of schematic diagrams of everything from simple audio oscillators to computers, it is unlikely that anyone would build a circuit from this book. The diagrams are there for instruction, not construction.

Cebik takes the reader from base zero through the final stages in logical, well-laid-out steps. Those beginning design work must first collect a large number of ideas and thoughts. Cebik shows how to go about doing so, but more importantly he shows how to organize and keep them so that the reader can get maximum use from them. The author has included a great deal of information designed to help the reader get maximum benefits from his limited time.

Once the information has been gathered, Cebik feels that the next step is setting goals for the particular piece to be designed. Logical, well-thought-out plans come next. What parameters are important in any given circuit? What aren't? How does one go about logically approaching the layout stage? What is the difference between a good layout and a bad one? Which building techniques will work best? What portion of the circuit should be built first? Why test? Why document? Cebik answers all these questions and more.

Some people (particularly theory-oriented engineers) may disagree with Cebik's seat-of-the-pants approach, but I have found it to be quite useful. I would recommend this book to anyone who wants to build and design, but who has been intimidated by the awesome complexity of modern electronic technology. The little guy in the middle asks, "How do you eat an elephant?" Cebik answers, "One bite at a time. Here is a knife and fork." — *Pete O'Dell, KB1N*