Product Review Column from *QST* Magazine

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Product Review

Conducted By Paul K. Pagel,* N1FB

HEATH HX-1681 CW TRANSCEIVER

In both styling and circuit design, the HX-1681 QSK cw transceiver is ideally suited to mate with the HR-1680 ssb/cw receiver.[1] Frequency coverage of the '1681 is 500 kHz on each of four bands from 80 through 15 meters and one 500 kHz segment of the 10-meter band (28.0 to 28.5 MHz). There is virtually no extra coverage above or below these 500-kHz segments and WARC band provisions are not included. The analog dial has 5-kHz incremental markings with frequency resolution to approximately 2.5 kHz. Rated power output for the '1681 is 100 watts on 80 through 15 meters and 80 watts on 10 meters. It has provisions for full break-in operation as well as delayed switching output for keying and external power amplifier.

A straightforward heterodyne design is used in the transmitter. The 5.5- to 5-MHz VFO signal is mixed with the crystal-controlled HFO signal in a doubly balanced diode ring mixer. The output products of the mixer are fed to a switched band-pass filter that passes only the difference frequency. By using the difference frequency the dial will tune in the same direction on each band. The on-frequency signal is amplified by a two-stage, transistorized broadband amplifier, which supplies power to the driver stage. A 12BY7 is used as the power-amplifier driver, with its associated tank inductor switched by one wafer of the band switch. The driver-stage tuning capacitor is adjusted from the front panel. A pair of 6146s, operating Class AB1, is used in the final amplifier stage. The tubes are operated in a parallel, grounded-cathode configuration. Two band-switch wafers are used in the output network. One wafer switches in various capacitors to resonate the final tank circuit, and the other wafer inserts fixed low-pass filters for each band. These filters are designed for a 50-ohm terminating impedance. A built-in T-R switch is used to provide break-in (QSK) operation. When the key is closed, a diode in the receive antenna circuit is reverse biased and none of the transmitter output power will reach the receiver input.

The original keying waveform of the HX-1681 is shown in Fig. 3. Informed that this waveshape produced key clicks, Heath responded by supplying some modifications, which were applied to the review unit. The initial modifications were only partially successful; the waveform was softened, but transients appeared that created loud pops in the receiver audio during QSK operation with the HR-1680 receiver. This problem was eliminated using a circuit developed by staff member George Woodward, W1RN, and the writer. It is shown in Fig. 4 at A and B. This circuit keys the mute-sidetone circuitry independently and has a fast-attack/slow-decay action, which is advantageous during QSK operation. All the additional components are mounted on a terminal strip that is attached to the chassis by means of one of the power-supply circuit-board mounting screws. The waveform that resulted after the changes were made is shown in Fig. 5.

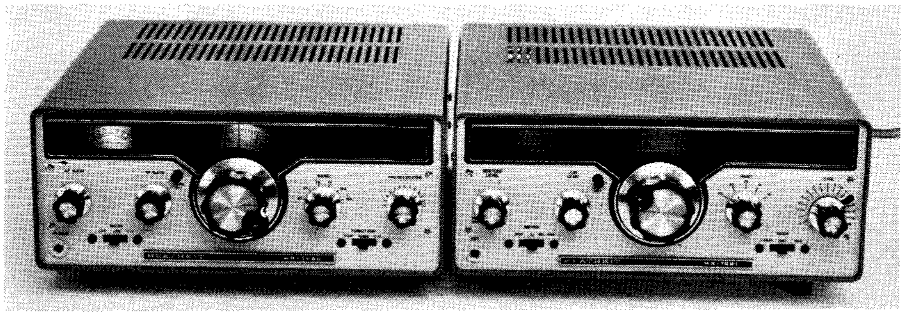

Fig. 1 — The HR-1680 and HX-1681 are compatible in both styling and circuitry. They make an attractive cw-only station.

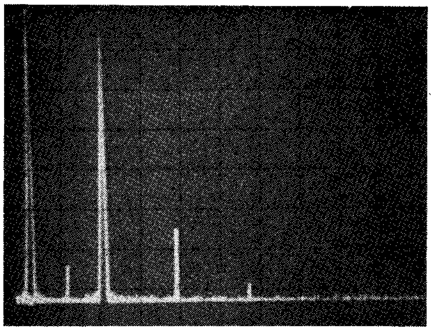

Fig. 2 — A spectrum analyzer photo of the worst-cast output of the HX-1681 transmitter on 80 meters. Vertical divisions are each 10 dB. Horizontal divisions are each 2 MHz. The large pip on the far left is generated by the spectrum analyzer, while the next large pip is the fundamental signal. Worst-case harmonic output is 54 dB down and the worst spurious output is 64 dB down. The HX-1681 complies with present FCC specifications for spectral purity. All measurements were taken in the ARRL lab.

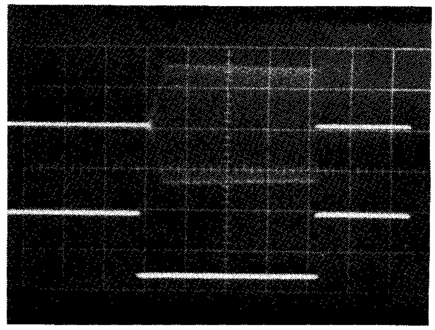

Fig. 3 — The original cw keying envelope of the HX-1681. Each division of the horizontal axis is 5 ms. The lower trace shows the actual key-down time. The wave starts to decay almost instantaneously after key up. The sharp trailing edge will produce key clicks.

These changes were passed on the Heath. The official Heath modification that is being made to all existing stock and is available to '1681 owners at no cost is shown in Fig. 4C; the resultant waveform appears in Fig. 6. Although the rise time is less than 5 ms, no key clicks could be heard in a nearby receiver.

A unique feature of the '1681 is the extensive use of diode switching. By diode switching the HFO oscillators and band-pass filters, many physical construction restrictions are removed and only a 4-section band switch is required.

Four pc boards contain the bulk of the transmitter. Construction of the unit took a total of three weekends. No problems were encountered during construction, except when trying to follow directions in the wee hours of the morning!

Operational Results

On-the-air operation with the HR-1680/HX-1681 combination was superb. The QSK action is very smooth, with no popping evident

Table 1
Heath HX-1681 CW Transmitter, Serial No. 908

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Power output: 100 watts on 80 to 15 meters; 80 watts on 10 meters.	>100 watts on 80 to 15 meters, and >80 watts on 10 meters.
Frequency stability: <100 Hz drift in a 30 min. period after 60 min. warm-up.	500-Hz drift during the first 30 min., <100 Hz per 30 min. period thereafter.
Harmonic radiation: 50 dB down at 100-watts output.	Worst case, 54 dB down.
Spurious radiation: 60 dB down at 100-watts output.	Worst case, 64 dB down.
Tuning rate: 15 kHz/turn.	15 kHz/turn
Tuning backlash: 50 Hz or less.	43 Hz.

*Assistant Technical Editor

[1] The Heathkit HR-1680 Receiver, Product Review, *QST*, January 1977.

in the receiver. If the band noise is objectionable or "semi-break-in" operation is desired, the LINEAR mode can be selected on the transmitter. Such operation is designed for use with an external amplifier; under these conditions, the receiver is muted continuously during transmit with a selectable amount of delay being chosen by the operator. Sidetone injection level is adjustable from the front panel. Received signal reports indicated good signal stability, but hard keying and key clicks were evident until the modifications were performed.

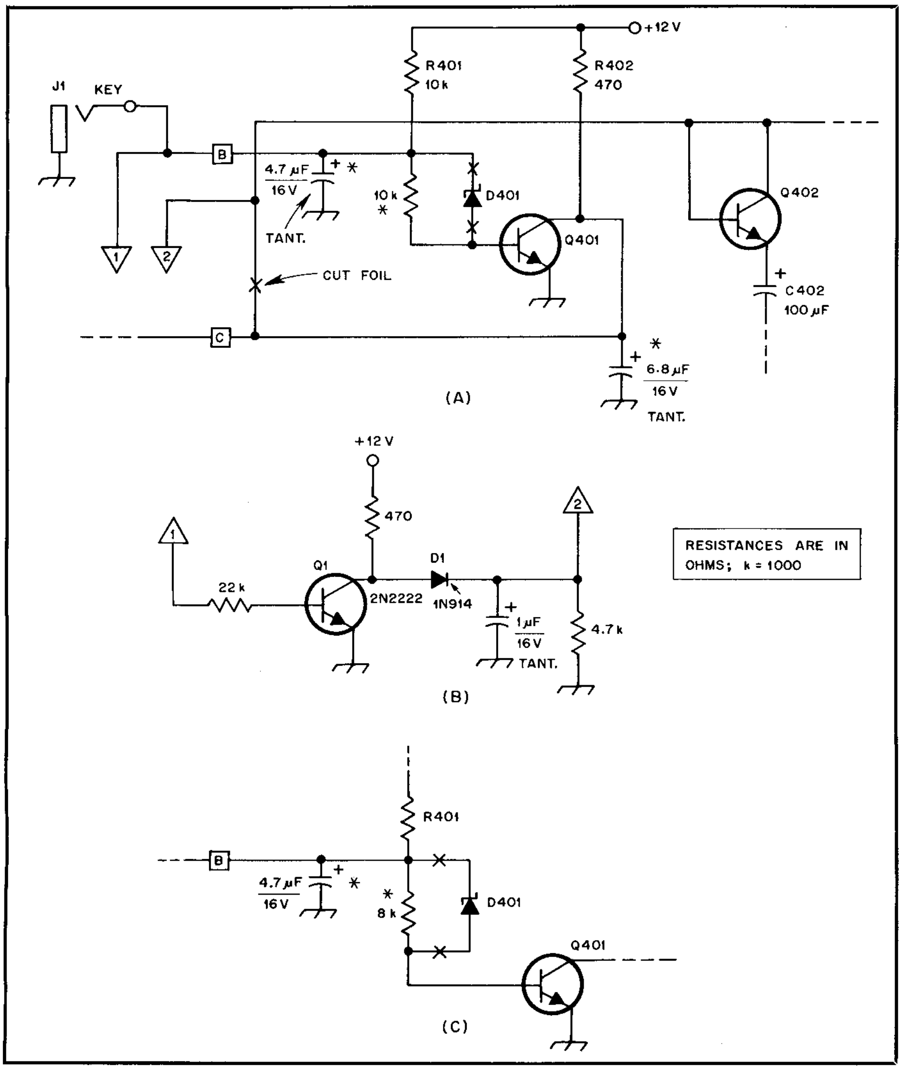

Fig. 4 — The modified circuitry of the HX-1681. At A and B, the circuit as modified in the ARRL lab. One foil cut is required. Added components are denoted by an asterisk; all components at B are added and mounted as described in the text. The circuitry at C uses two added components and does not require the additional components noted at B.

Q1 — Silicon npn 500 mW switching transistor, 2N2222 or equiv.

D1 — Silicon high-speed switching diode, 1N914 or equiv.

While I'm basically pleased with the unit, I'm puzzled by one design feature. There are two tuning controls on the '1681, one for final-amplifier plate tuning and the other for driver plate tuning. If there have to be two controls, why not gang the plate and driver tuning together and have a variable capacitor on the output network to match various load impedances? The fixed 50-ohm output is somewhat of a restriction and a Transmatch must be used with the transmitter to match other than 50-ohm loads.

If you're a Novice or just have a flair for cw, the HX-1681 will provide you with a solid signal on the 80- through 10-meter bands. The transmitter measures 6-3/4 × 12-3/4 × 12 inches (170 × 320 × 300 mm) HWD. It requires a power supply that will deliver approximately 800 V dc at 250 mA, 250 V dc at 50 mA, − 130 V at 10 mA, and 12.6 V ac/dc at 2.5 A. A Heath PS-23 was used with the review transmitter. Price class of the HX-1681 is $240. It is available from the Heath Company, Benton Harbor, MI 49022. — *Gerry Hull, AK4L*

C-PROBE II

A nifty product of International Instrumentation, Inc. is the C-Probe II. This lightweight, palm-sized device, when connected to a frequency counter, enables the counter to furnish direct readout of capacitance values from 0.1 pF to over 10,000 µF. An optional circuit provision extends the high-capacitance range to 30,000 µF. The high µF option was not included with the unit tested in the ARRL laboratory.

Features of the C-Probe II include a crystal-controlled time base, 10-turn potentiometers for pF and µF calibration and a 10-turn zero-control potentiometer to compensate for stray capacitance up to 50 pF. Gate times are user selectable. Direct use of the C-Probe II with any frequency counter that has gate times equal to those used by the C-Probe II (0.1, 1 or 10 seconds) is another feature. It will work directly with BK, CSC, Data Precision, Davis, Fluke, Formula Int., Heathkit, HP Leader, Monsanto, NLS, Optoelectronics, Phillips, Poly-Pak, Quest, Radio Shack, Ramsey, Sabtronics, Sencore, Simpson, Systron-Donner and Tektronix counters. The C-Probe II emits frequency bursts containing a number of pulses per output gate time. These are effectively equivalent to the value of the capacitor under test.

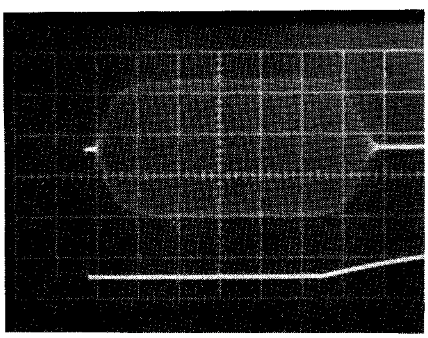

Fig. 5 — The cw waveform shown here, which results after installing the modification of Fig. 4 (A and B), produces no key clicks. At key up, the wave begins an approximate 7-ms decay cycle.

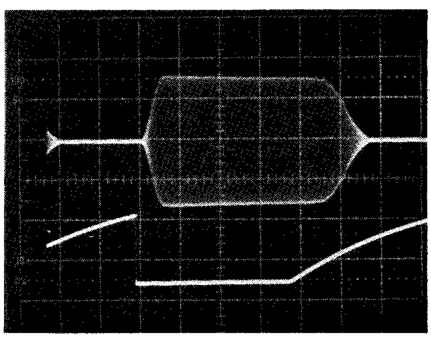

Fig. 6 — This waveshape, with the circuit of Fig. 4C installed, has an approximate 5 ms delay between key up and the start of the wave decay time. This delay may be disadvantageous at higher keying speeds.

Fig.7 — The C-Probe II. This accessory for frequency counters enables capacitance measurements to be read with the counter. The device is classified as a precision test instrument.

Table 2
C-Probe II Resolution

Range Switch	*pF*		*µF*	
Resolution Switch	× 1	× 10	× 1	× 10
Measurement Range	$1 - 10^7$ pF	$0.1 - 10^6$ pF	$0.001 - 10^4$ µF	$0.0001\text{-}10^3$ µF
Accuracy	0.25%	0.25%	0.5%	0.5%
Resolution	1 pF	0.1 pF	0.001 µF	0.0001 µF

Operating power for the C-Probe II is furnished by either an internally mounted 9-V battery or by an optional ac adapter unit. The unit tested had this convenient ac accessory. Other optional items may be ordered at the time of purchase. For instance, the Variable-Output-Attenuation Option is particularly useful with highly sensitive counters. Its purpose is to provide adjustment of the output amplitude of the C-Probe II from 10 mV to 5 V. If the option is ordered with the basic C-Probe II, it is factory installed. When ordered separately, this option is shipped in the form of a kit that is to be installed by the user.

The Hi-Mfd Option, mentioned above, provides a third range for the C-Probe II. This third range extends the upper measurement limit of the C-Probe II to 30,000 µF. If the Hi-Mfd Option is ordered at the same time as the basic unit, it too will be installed and calibrated. It is also available in kit form.

Some limitations in the use of the C-Probe II may be offered by counters with an insufficient number of digits in the readout. A seven-digit counter is sufficient for all measurements made by the probe. A six-digit counter is sufficient for measurements made in the × 1 resolution setting. This device, furthermore, is not intended to be used with counters that exhibit nonrepetitive gate and display times.

Table 2, prepared by the manufacturer, gives the range and resolution for the various settings of the range and resolution push buttons located on the panel of the C-Probe II. Verification of the degree of accuracy would have required precision equipment that was unavailable in the Hq. laboratory.

Dimensions for the C-Probe II are 2.5 × 4 × 5 inches (64 × 102 × 127 mm). Weight, including the battery, is 6.5 oz (184 gm). The enclosure is a molded plastic. Price class: $80. Orders may be sent to International Instrumentation, Inc., Box 3751, Thousand Oaks, CA 91359 — *Stu Leland, W1JEC*

HEATHKIT EE-104 PHASE-LOCKED-LOOP COURSE AND ET-3300 BREADBOARD

If somebody tells me something, I will remember about 10% of it. If they show me something, I will remember about 15% of it. But if they involve me in it, I probably will remember 90% of it. I cut my electronics "teeth" on Heathkits. Over the years, I have had a fondness for their products — partially because they have been very successful in giving me a sense of involvement with the equipment I have built.

It is easy for a programmed text to fall into a trap of merely showing the reader information without eliciting any involvement. Being a bit of a cynic, I wondered how well Heath had avoided this potential pitfall in their phase-locked-loop course. I was pleased to find that the text was authored by Howard Berlin, W3HB, [author of numerous articles in *QST* and other amateur publications. — Ed.]. Usually there are more people involved in the production of a programmed text than just the author; having a good writer didn't ensure that the course would be good, but it certainly didn't hurt either.

Before actually starting the course, I constructed the ET-3300 laboratory breadboard. Either this breadboard or something similar to it is required for full participation in the course. The ET-3300 consists of a chassis with four large breadboarding sockets installed on the top surface. Three dual-wire bus sockets are mounted between the four breadboarding sockets. These bus sockets are particularly useful for connecting various ICs and components to the appropriate power sources or ground. The ET-3300 has three power supplies built in: +5 V at 1.5 A, +12 V at 0.1 A and −12 V at 0.1 A. The supplies are voltage-regulated, current-limiting sources that can save a lot of headaches if a circuit is inadvertently wired improperly.

Each chapter of the program (total of six chapters) begins with an overview and lists the objectives of the unit. Then follows a detailed discussion of the theory of operation of the particular components under study. From the theory, the course moves into the "hands on, build-it-and-see-what-it-does" laboratory section where the student sets up experiments that demonstrate the theories presented earlier. Each chapter concludes with an examination of the most important aspects of the unit. On the page following the examination, Heath has provided answers to the questions. If the student has not answered the questions to his own satisfaction, he is encouraged to go back over the material and work with it until he has mastered it.

Topics covered include phase detectors, VCOs, loop filters, digital synthesizers using divide-by-N counters, and monolithic IC PLLs. Devices that are covered in some detail include the 560 series, the 4046 and the HCTR 0320. In addition to the theoretical discussion and experiments with these devices, there is an appendix that contains extensive manufacturer's data sheets for each chip.

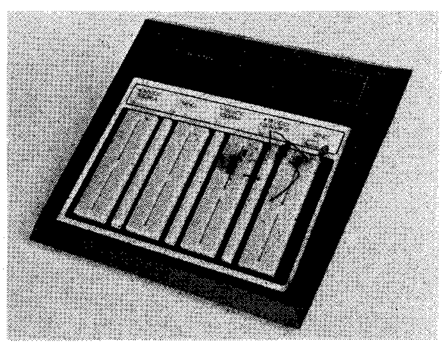

Fig. 8 — The ET-3300 is housed in an attractive case. The breadboarding sockets are made of a high quality plastic. The replaceable, silver-plated contacts also add to the durability and longevity of the unit. It compares very favorably with factory-built models costing up to twice as much.

If I have a criticism of the course, it is that some of the theory could have been backed up with more examples. It is logical and well thought out, but some of the concepts are difficult; some additional elaboration would have helped ease the way past these concepts. (That just means that some of us have to work a little harder.) Heath points out in their catalog that a dc voltmeter and a single-channel oscilloscope are needed to complete the experiments. They recommend a dual-channel scope and an audio signal generator if available. I would concur that some kind of scope and voltmeter are absolutely necessary, but I would add a frequency counter to the list of suggested additional test equipment. A frequency counter won't replace a scope, though. At times it may be advisable to double check the readings of a frequency counter against the scope; the low-percentage duty cycle of some of the wave shapes caused the frequency counter I used to give a false reading.

If the student scores at least 70% on the optional final exam, he'll earn a Certificate of Achievement plus three Continuing Education Units (CEUs).

Recently I enrolled in a college course. Tuition was $360 and the text book was $27.95. The text is full of ambiguities and sometimes about as clear as mud. The professor seems to be struggling to present the author's ideas in some coherent fashion. Also, I am out of the house away from my family two nights a week. Compare that with the Heathkit course — it costs only about $50 and it hasn't kept me away from my family any evening. The text is clear and well written. I've had hands-on experience which I might not get in a college course. Too bad the local college doesn't have the same money-back guarantee that Heath has! If you want to get a quick, inexpensive look at phase-locked-loops, then you may want to consider this course. Price class: course, $50; breadboard, $90; purchased together, $130. — *Peter O'Dell, KB1N*

B&W MODEL 370-15 ANTENNA

Dubbed a broadband folded dipole, this antenna is designed for operation within the frequency range of 3.5 to 30 MHz. The manufacturer claims a power-handling capability of 5000 watts PEP. The 370-15 requires no measuring or cutting; it is fully assembled and pretuned. The radiating elements are made of no. 14 stranded copperweld wire separated by lengths of PVC tubing 17/16 inch (21 mm) in diameter and 17 inches (432 mm) long. A 12:1 balun is supplied, to which is attached a 50-foot (15-m) length of RG-8/U coaxial cable. This balun contains a ferrite core made up of six 1/8 inch (3 mm) thick flat ferrite sticks approximately 4 inches (102 m) long and 7/8 inch (22 m) wide. At the midpoint of the opposite radiator is a balancing network. Investigation showed this network consists of six 3600-ohm noninductive resistors connected in parallel. Each resistor appears to be capable of dissipating approximately 50 watts. Therefore, the network would present a 600-ohm impedance with an approximate 300-watt dissipation factor.

Installation

B&W recommends the 370-15 be installed as a flat-top or sloper with the low end of the antenna as close as 6 feet (1.8 m) to the ground. The only items necessary for the erection of the antenna are some lengths of rope and a couple of supports. Suggested antenna heights are a minimum of 15 feet (5 m) or an average height of 25 to 40 feet (8 to 12 m). The user is cautioned to uncoil only half of the antenna at a time and not to do so until ready for the actual installation. This is a precaution worth observing since you will more than likely wind up with a "bird's nest" of tangled wires, insulators, coax and homo sapiens if you don't!

When the antenna arrived at Hq., its construction stirred some memories. A bit of investigation revealed a close resemblance between the 370-15 and an antenna described some years ago both in *QST* and *CQ*.[1,2,3] Some of the OTs in the crowd might remember that antenna as the "T2FD." The basic design of the T2FD antenna suggests a feed-point impedance of 600 ohms, which would require a 12:1 balun to match to 50-ohm coaxial cable. Physically, though, the dimensions suggested by Countryman and those used for the B&W antenna differ somewhat. The latter, designed for 80-meter coverage, uses a combination of the 40-meter radiator spacing and 80-meter radiator length used by Countryman.

In Use

Comparisons were made between the 370-15 and a 40-meter dipole, both configured as slopers. Both antennas were hung in the same plane with one end of each antenna at a height of about 28 feet (8.5 m) and the other ends 6 feet (1.8 m) above the ground; feed-line lengths each approximated 50 feet (15 m). Reports received on 40 meters consistently showed the 40-meter sloping dipole to be between one to two S units better than the 370-15. Results on 20 and 15 meters (the apparent resonant frequency of the B&W antenna) still favored the 40-meter sloper, while on 10 meters the 370-15 took the lead. Results of SWR measurements taken at the band edges are shown in Table 3. A Bird model 43 Thruline wattmeter with a 100-watt element was used to make these measurements. All measurements were made at the transmitter end of the length of coaxial cable supplied with the antenna.

The model 370-15 is available from Barker and Williamson, Inc., 10 Canal St., Bristol, PA 19007. Price class: $150. — *Paul K. Pagel, N1FB*

[1]Countryman, "An Experimental All-Band Non-directional Transmitting Antenna," *QST*, June 1949.
[2]Countryman, "Performance Of The Terminated Folded Dipole," *CQ*, November 1951.
[3]Countryman, "More On The T2FD," *CQ*, February 1953.

Table 3
B&W 370-15 Antenna

Sloping Dipole Frequency	*SWR*
3.5 MHz	5:1
3.9	4.5:1
7.0	5:1
7.3	4:1
14.0	2.5:1
14.350	2.25:1
21.0	1.8:1
21.450	1.5:1
28.0	2.5:1

New Books

☐ *A DXer's Technical Guide,* published by the International Radio Club of America, P. O. Box 21074, Seattle, WA 98111. Softbound, 8-1/2 × 5-1/4 inches, 98 pages, $5 postpaid.

One branch of the radio hobby is broadcast-band DXing. It dates back to the 1920s and still attracts its share of radio enthusiasts. Perhaps the oldest of the DXer's associations is the Newark News Radio Club, started by the Newark (New Jersey) *Evening News* back in the '20s; running a close second is the National Radio Club. Coming into existence more recently is the International Radio Club of America with home bases in both Victoria, British Columbia, and Seattle, Washington. I recently came across one of the IRCA publications, *A DXer's Technical Guide,* a 98-page volume that contains useful background information that should appeal to the DX fan.

Contained in *A DXer's Technical Guide* are reviews of some of the popular receivers used by many DX fans. Included are portables, table sets and communication types. Ten pages are devoted to audio filters, tape recording of DX stations and frequency measurement. Even receiver modification is not overlooked.

Readers will find the section on antennas of particular interest, for without an appropriate receiving aerial, DX-chasing can be a lost cause. There are practical suggestions on random-length wires, phased antennas, loops and the Beverage antenna. The book also provides information on getting the best transfer of signal energy from the antenna to the receiver by means of matching networks.

For the DXer who is not adverse to construction, this DXer's guidebook provides useful hints along with a list of parts suppliers. A handy display of schematic symbols is also provided. In addition, the editors have thoughtfully furnished a tabulation of reference books that can be of assistance to the DXer.

Other IRCA publications include *Principles of Broadcast Band DXing, The IRCA Foreign Logs* and *The IRCA Almanac.* Best known of the IRCA publications is *The DX Monitor,* which serves as the official club news bulletin. It is published 34 times per year. For information about these and membership in the IRCA, write to the IRCA, Box 21074, Seattle, WA 98111. — *Stu Leland, W1JEC*

☐ *The Radio Amateur's Conversation Guide,* by Jukka (OH1BR) and Miika (OH2BAD) Heikenheimo. Published by Transelectro Oy, Samsantie 46, SF-00610, Helsinki 61, Finland. Available in the U.S. from: Wayne Gingerich, W6EUF, 2301 Canehill Ave., Long Beach, CA 90815. Soft cover, spiral bound, 6 × 8-1/2-in., 92 pp., $10.

The Radio Amateur's Conversation Guide fills a long-empty gap in amateur literature. Its pages contain a wealth of information in eight different languages: English, German, French, Italian, Spanish, Portuguese, Russian (and Russian phonetics) and Japanese. Supplements are available in Finnish, Serbo-Croatian and Swedish. In addition, cassette tapes prepared by speakers using their native language may be purchased; they're an aid to learning correct pronunciation.

The book is divided into three sections. The first part lists the phonetic alphabet in each language (except Japanese, for some reason), along with cardinal (1, 2, 5, 100, etc.) and ordinal (1st, 3rd, 10th, etc.) numbers. The major portion of the book contains 147 variations of commonly used phrases grouped into several basic subject areas: ending the QSO, contests, regulations and so on, making it a useful tool for anyone involved in international QSOs. The last section of the book is a 450-word dictionary of Amateur Radio and electronic terms generally not given in the phrase section.

Using the book effectively may require a few tries, as most of us are in the habit of using short sentences or abbreviations and the phrases provided often contain more words than you might need ("Please repeat your QTH" instead of, simply, "QTH?"). There is no attempt to guide the reader on pronunciation — that's the job of the cassette tapes. "Espana" looks easy to pronounce, but would you have guessed ESS-PAHN-YA? Or, how about: "mnje" or "fsjo" in Russian? The cassette tapes would be a necessity if you've had no previous experience with the particular language. For use on cw or for adding to the back of a QSL card, however, the phrases work very well; just be ready for the reply!

English is probably the most widely used language in Amateur Radio, but how many foreign stations know much more English than that necessary to be able to give the standard signal report, operator name and QTH? This guide will be a big first step toward better communication. — *Tom Frenaye, K1KI*

Feedback

☐ Author Sherwood has some additional information for his article, "Improved RTTY Reception with the Yaesu FT-101," *QST*, November 1980. There should be no connection between S2A-5 and the accessory socket. If there is a wire at that point, move it to S2A-4. The blue coaxial cable lead should not be connected to S2E-5; disconnect, insulate and tie it back. Some FT-101E models require a diode instead of a direct connection between S2C-1 and S2B-5. The cathode is attached to S2B-5. Another diode, with the anode connected to S2B-1,2 and the cathode to S2B-5, is also required. The circuit modifications render the cw VOX feature inoperative and MOX or PTT must be used.

☐ The following corrections should be made for Di Julio's article, "A State of the Art Terminal Unit for RTTY," December 1980 *QST*. In Fig. 1, C8 is 0.005 μF; R15 only is connected between the collector of Q3 and the base of Q4. R14 is wired between the collector of Q3 and the +9-V line. Mark the audio level control connected to U2 as R4. On the parts layout, Fig. 3, change Q5 to read Q3. Rearrange the 1N4003 diode markings so that D4 becomes D6, D5 becomes D4 and D6 becomes D5, to agree with the schematic diagram.

☐ Frank Jaeger, WA9SQN, author of "The ARES Standard-Tone Alert System" (January 1981 *QST*, pp. 24-27), wishes to make clear that the lead marked K2 (near Q1) in the parts diagram should be connected to the K2 lead near Q2 *only* if the decoder is to latch a single relay on receipt of either tone. If a separate relay is used for 1050 Hz, the terminal near Q1 is unused. Pin connections 1 and 2 of U2 (NE567) should be interchanged on the schematic diagram to agree with the parts diagram.