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Hal Communications CWR-6850 Telereader RTTY/CW Terminal

ICOM IC-290H All-Mode 2-Meter Transceiver

Tokyo Hy-Power Labs HC-200 Transmatch

Product Review

Conducted By Paul K. Pagel,* N1FB

ICOM IC-290H All-Mode 2-Meter Transceiver

The first reaction to this radio has to be, "Boy, they're sure packing a mountain of features into a molehill of gear these days!" At first glance, the '290H, 25-W successor to the 10-W '290A, could be mistaken for an fm-only box; it's the same size and weight as 2-meter fm gear produced only a few years ago. A second glance at the knobs and buttons on the front panel makes it clear that you're looking at a state-of-the-art multimode transceiver.

Well designed for ease of operation and aesthetics, the front panel has no less than 16 knobs, switches and buttons (others are hidden under the top cover). Each control is marked clearly, making mobile operation, even at night, easy to master. The bright, frequency readout LEDs go to four decimal places (100s of hertz for ssb and cw). Other LEDs indicate that a signal is being received or sent, that a priority frequency (more on that later) is in use, and that the radio is in the DUPLEX mode. An S/RF indicator shows S-units and relative output power in decibels using a row of seven LEDs.

Table 1

ICOM IC-290H Multi-Mode 2-Meter Transceiver, Serial No. 02128

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency coverage: 143.8000 to 148.1999 MHz.	As specified.
Modes of operation: Fm, usb, lsb, cw.	As specified.
Transmitter power output (HI): 25	30
(LO): 1	2
Frequency readout: Digital, 5-digit green LED display, 100-Hz resolution.	As specified.
Frequency resolution: Ssb: 100-Hz steps; fm: 5-kHz steps (1 kHz selectable).	As specified.
kHz/turn of knob: 5 kHz (250 kHz in fm; 50 kHz selectable).	As specified.
RIT range: ±800 Hz.	As specified.
S-meter sensitivity: Not specified.	S1, 0.95 μV; S9, 3 μV; S9 + 20 dB, 6 μV.
Harmonic suppression: 60 dB below peak power output.	62 dB below peak power output.
Current drain at 13.8-V dc: Approx. 6.0 A (max.).	5 4 A (HI), 2.0 A (LO)
Receiver sensitivity: Fm — more than 30 dB S + N + D/N + D at 1 μV. Less than 0.6 μV for 20 dB noise quieting. Ssb, cw — less than 0.5 μV for 10 dB S + N/N.	Receiver dynamics: Noise floor (MDS): −138 dBm. IMD DR: 85.5 dB. Blocking: Noise limited. Third-order intercept: −9.75 dB. Receiver quieting: 0.26 μV/20 dB
Size (HWD): 2.5 × 6.7 × 8.6 in. (64 × 170 × 218 mm).	As specified.
Weight: 5.5 lb (2.5 kg).	As specified.

Features Galore

It's no longer necessary to ask if a radio like this is synthesized, whether it scans or has memory capability. The appropriate questions are: Is it easy to tune? How many scanning functions and memories does it have? Does it have two VFOs for added versatility? How about RIT? A noise blanker? Automatic gain control? Standard tone pad for repeater autopatch use?

The answers: for the most part, four and five, yes, yes, yes, yes, yes. In fact, you'd be hard-pressed to think of a feature it doesn't have, and to find a control that isn't convenient to find and operate. To provide an idea of what this radio is designed to do, let's take a look at the scanning capabilities.

Pressing the S/S (Scan/Stop) button initiates the SCAN mode, indicated by two flashing decimal points in the frequency display. After programming the five memory frequencies, you can scan them (plus the two VFO frequencies) by pressing the button labeled M-R. Or, if you're anxious to find a QSO, you can scan the entire frequency range — all 4.4 MHz of it. Or, you can select the range to cover, for example, only the ssb subband. Want to have the radio stop at any *empty* frequency? Flick the BUSY/EMPTY switch under the top cover.

One scanning feature in particular caught my eye. In my review of another manufacturer's fm-only transceiver a couple of years ago, I lamented the lack of a scanning delay; whenever a busy frequency was reached, the scanner would pause, but then travel on its merry way the instant the carrier dropped out. I found this annoying, and said so in the review. ICOM must have been listening, as the IC-290H not only has a scan/stop function, but pause time can be adjusted (by means of a control under the top cover) from 5 to 20 seconds. Problem solved! Scanning speed is also adjustable. A convenient 1 kHz button allows scanning (and tuning) in 1-kHz increments rather than the standard 5-kHz (fm) or 100-Hz (ssb/cw) steps.

The IC-290H sports several other features that set it apart from run-of-the-mill 2-meter transceivers. RIT (receiver incremental tuning) allows you to raise or lower the receive frequency by as much as 800 Hz. This is especially handy for satellite work and for keeping drifting stations within earshot. By pressing the AGC button, you can improve the reception of stations that tend to fade quickly. A noise-blanker (NB) switch activates a circuit that reduces pulse-type noise such as that generated by automobile ignitions. Have a favorite frequency? You can monitor it while enjoying a QSO by pushing the PRIORITY button, which sends the receive frequency to your chosen frequency for an instant every five seconds. The rear panel contains jacks for an external speaker and a key, as well as an accessory socket, power socket and antenna connector.

A second VFO was at one time a luxury reserved only for hf transceivers in the $1000-and-up price range. No longer. The two VFOs in the IC-290 make it simple to find a clear frequency. If you're in the midst of heavy

*Assistant Technical Editor

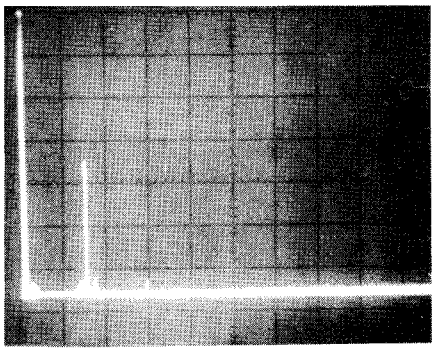


Fig. 1 — Spectral display of the IC-290H. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 30 watts at a frequency of 146.010 MHz. The fundamental has been reduced in amplitude approximately 34 dB by means of notch cavities; this prevents analyzer overload. All spurious emissions are at least 62 dB below peak fundamental output. The IC-290H complies with current FCC specifications for spectral purity.

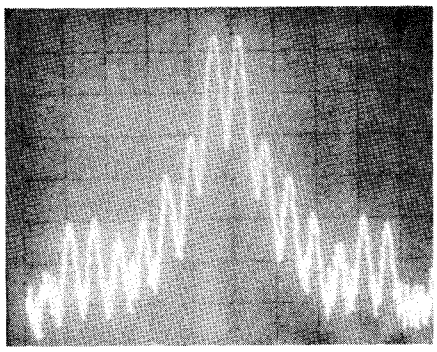


Fig. 2 — Spectral display of the IC-290H output during transmitter two-tone IMD test. Third-order products are 30 dB below PEP and fifth-order products are 40 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The transceiver was being operated at rated input power on the 2-meter band.

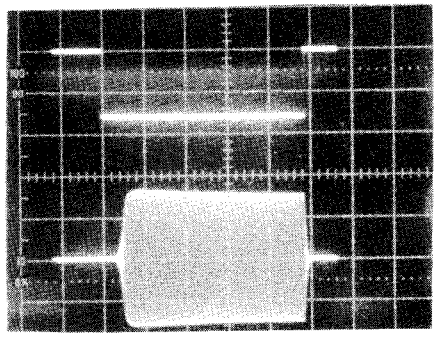


Fig. 3 — Cw keying waveform of the IC-290H. Upper trace is the actual key closure; lower trace is the rf envelope. Each horizontal division is 5 ms. This keyed wave has a rapid fall time.

QRM and want to find another frequency, just change VFOs, search for a clear frequency, and change back. The frequency you left on one VFO is memorized when the VFO is switched. A second VFO is also useful if you'd like to "keep an ear on" a particular frequency while working stations elsewhere on the band.

Another feature worth mentioning is the nonstandard offset selection. For "oddball" repeater splits, the offset can be changed from ± 600 kHz quickly and easily.

Despite the initial challenge of learning the functions and operations of the various controls, the IC-290H is a breeze to use. Right after unpacking the box, I hooked it up to a power supply, plugged the supply into the wall socket, connected an antenna, set the MODE switch to USB, and proceeded to run a slew of nearby stations. I then realized that I had inadvertently chosen to break in the radio during the height of an ARRL VHF QSO Party!

It was a good omen. The ssb subband hasn't seen that level of activity since, but I've made my share of contacts through various conditions and have had no trouble getting into area repeaters. The receiver sensitivity seems excellent, as one would expect from the manufacturer of the IC-2A.

Technical Description

Frequency control is accomplished with a microprocessor-based, 100-Hz-step digital PLL synthesizer. The circuit serves as the local oscillator for both transmit and receive with output approximately 10.75 MHz below the receive frequency. The operating frequency is controlled by pulse signals generated by the rotary encoder at the tuning knob being added to or subtracted from the preset frequencies in the μP. The μP controls the PLL circuit, which in turn determines the output frequency of the VCO.

Incoming signals are mixed with the LO output from the PLL circuit. In the ssb and cw modes, the circuits function as a single-conversion type with a 10.75-MHz i-f; in fm, they function as a dual-conversion type with an additional 455-kHz i-f.

The transmitter carrier frequency is 10.7485 MHz for usb and 10.7510 MHz for lsb. Carrier and voice signals are sent to a balanced modulator, where the dsb suppressed-carrier signal is generated. The unwanted sideband is removed by a crystal filter, and an ssb signal of 10.75 MHz results.

In the cw mode, the usb carrier is shifted up about 800 Hz and is then fed to the transmit mixer. In the fm mode, it uses another crystal oscillator to produce the 10.75-MHz signals that are direct-frequency modulated. The ssb, cw or fm signal is mixed with the LO output from the PLL circuit, and is then amplified, filtered and sent to the antenna.

Manual

Covering 44 pages, the manual is clear, thorough and well-written. There are typographical errors, to be sure, but they are rare. Diagrams liberally sprinkled throughout show how to mount the '290H in a car, an exploded view of the mike plug, the operation of the various scanning functions, AMSAT-OSCAR 8 frequencies and basic operation, the location of key components under the top and bottom covers, and block diagrams of the rf, scan control, main and PLL circuits. In addition, there is a troubleshooting chart, individual descriptions of the various circuits, and photos and identifications of available options, such as ac power supply, scanning mike, mobile speaker and condenser mike.

Separate from the manual are a fold-up, two-color, board-layout diagram and a complete schematic, which should make it easy to identify errant components or to make modifications.

Criticisms

While it has many different features designed to make operating versatile and enjoyable, the IC-290H lacks a couple of circuits that would have made the radio complete. There's no quick and easy way, for example, to decide on the spur of the moment to head for a distant part of the band. If you're listening to a W1AW bulletin on 147.555, for example, and hear that the Perseids are due at any time, you'll want to try to work some meteor scatter at the low end. How do you get there in a hurry? If you haven't programmed an ssb frequency into a memory or a VFO, you can either hit the SCAN button and wait for the frequency to make its way down, or you can rotate the tuning knob about 13 times (in either direction, thanks to the continuous tune feature that prevents out-of-band operation). If you leave the MODE switch in the FM position, the frequency moves in 5-kHz increments (selectable to 1 kHz), so it doesn't take *too* long to find the ssb subband. However you decide to get to the low end of the band, it's a minor inconvenience. A MHz control switch would have been a nice touch. In addition, there is no provision for VOX, and there is no mike-gain control.

On the plus side, the '290H is better suited than its predecessor for working through the amateur satellites, as it tunes in either direction when in the transmit mode. (The '290A tuned only upward in frequency, making it nearly impossible to send a string of dots to tune in your signal through the satellite.)

Two other changes from the '290A are worth mentioning: Bright-green frequency-readout LEDs replace the red ones, making them easier to read in sunlight, and a yellow "caution" sheet warns of a potential readout problem. It explains that the program that initializes the operating condition of the transceiver may malfunction because of an intermittent connection of the power plug or the power switch being turned off and on too quickly. Although the sheet says it's "not an equipment malfunction," I'm not sure how else it can be described. The problem never arose in the review model, however, and it probably doesn't happen too often. In case it does, the sheet gives a procedure that should solve the problem.

The ICOM IC-290H is distributed in the U.S. by ICOM America, Inc., 2112 116 Ave., N.E., Bellevue, WA 98004. Price class: $550. — *Joel P. Kleinman, N1BKE*

HAL COMMUNICATIONS CWR-6850 TELEREADER® RTTY/CW TERMINAL

□ While searching for RTTY equipment to use on our St. Paul Island DXpedition,[1] I came across the advertisements for the HAL CWR-6850. It looked like it would fit our needs perfectly. We arranged to have one shipped to Hq. for Product Review and use during the DXpedition.

The '6850 Telereader is a portable RTTY/cw terminal that can send and receive the ASCII and Baudot teleprinter codes as well as international Morse code, at the speeds summarized in Table 2. In the unit are tone generators and demodulators for both the high and low afsk tones. Provision for fsk is also made. Receive

[1]"Canadian NewsFronts," *QST*, November 1982.

and transmit data are displayed on a green, 5-inch CRT. Interface circuitry for driving an external video monitor and a Centronics-compatible printer is included. The entire package weighs just 16.5 pounds,[2] and operates from a 13.8-V dc power source.

Features

It would take many pages to describe every feature of the Telereader. I will highlight the basic modes and features.

Display: In any of the three modes of operation, four "pages" of data can be displayed on the CRT. A page consists of character data in a 32-character-per-line, 20-line-per-page format. The pages are numbered Ø through 3. Page Ø displays the first 19 lines of the receive buffer (608 characters). Page 1 displays 15 lines of the receive buffer, the status line, tape-storage-buffer line and three lines of the transmit buffer. Page 2 is the reverse of page 1 — it displays the entire transmit buffer (480 characters), three lines of the receive buffer and the status/tape-storage-buffer lines. Page 3 displays the six HERE IS messages, three lines each of the transmit and receive buffers, and the status and tape-buffer lines. The status line indicates the page in use and whatever special functions are active. When using an external (optional) tape recorder to store or send messages, the tape-storage-buffer line displays the data going to (from) the tape. The page selected for viewing can be controlled from the front panel or the keyboard.

Keyboard: The keyboard is a stand-alone, ASCII-encoded unit that connects to the main "box" through a multiconductor cable. The keytops are gray plastic with white lettering, and the "feel" of the keys is quite light. Several useful functions can be activated from the keyboard by use of the CTRL key. A list of a few of these functions is shown in Table 3.

Front Panel: There are *30* front-panel controls on the '6850, four of which are slide potentiometers. The INPUT and VOLUME controls set the audio input level and internal-audio-oscillator level, respectively. Morse code speed is set by the SPEED control. The center frequency of the RTTY demodulators can be altered slightly by the FINE control. Two large lever switches control the main POWER and the transmit/receive condition (RECEIVE/TRANSMIT/AUTO). The remaining 24 switches select the display PAGE, the operating mode (MORSE/RTTY, ASCII/BAUDOT); the RTTY BAUD rate (45, 50, 57, 75, 110 or 300) and the RTTY TONE pairs (HIGH or LOW). Other function switches control the unshift-on-space (UOS) function, NORmal or REVerse RTTY receive sense, the cw receiving program (SPACE/NARROW) and the cw receive-FILTER mode.

Rear Panel: The rear panel is filled with jacks, mostly phono types which are used for input/ouput interfacing with a transceiver. Other types of connectors are used for the keyboard, printer, external video monitor, cw key (1/4-inch phone jack) and the dc power connector (polarized).

Firmware: Much of today's communications equipment uses microprocessors, and the CWR-6850 is no exception. The program controlling the '6850 operation is contained in several ROMs. It is quite versatile — for example, the section used to decode international Morse has a special mode which enables the unit to copy poor fists (QLF?). Another feature is the ability to copy any mode while sending ASCII data to the printer.

[2]kg = lb × 0.454

On-the-Air Operation

Initial checkout of the Telereader at my home station indicated no defects. The unit was then repacked in a watertight container for our trip to St. Paul Island.

Our DXpedition RTTY setup consisted of the CWR-6850, a Kenwood TS-520S hf transceiver and a Cushcraft A3 triband Yagi. After our first RTTY CQ, a large pileup ensued. If that wasn't a test for the RTTY filters, nothing was! The unit performed admirably. Although many stations were calling, I had no trouble in "printing" the caller's call signs on the screen. During our entire operation, we had no troubles with the unit. I was amazed of the ability of the '6850 to operate perfectly with widely varying supply voltages; several times the supply voltage dropped to 11 volts and the only ill effect was a slight shrinking of the CRT video.

Back Home

After the trip home, the Telereader was put through the paces at several Hq. employees' ham shacks. Almost all reports were positive. The RTTY filter/demodulator is not as good a performer when copying weak signals, as is true of some other systems. Also, many RTTY terminals provide a "diddle" function that sends the ASCII NUL code or Baudot LTRS code when no character data is present in the transmit buffer. (This function is useful because it keeps the receiving station printer in sync.) On other RTTY systems, the "diddle" function (when enabled) comes on as soon as the operator initiates transmission. The "diddle" then fills in gaps between groups of data. With the '6850 (operating in the CONTINUOUS or "letter" mode) the "diddle" must be turned on and off independently of the status of the transmit line, and it must be turned off before any character data can be sent! In the WORD mode (data transmission being enabled by the detection of a space followed a word) the diddle works as would be expected.

The 32-character-per-line format is somewhat small but necessary when using the built-in 5-inch display. When using an external video monitor, however, 40 or 64 characters is to be preferred.

Table 2

Speeds Available on Telereader Terminal

Code	*Speeds Available*
Morse	4-33 wpm transmit (can be modified); 1-100 wpm receive
Baudot	45.45, 50, 56.88, 74.2, 110 and 300-baud transmit; up to 110-baud receive.
ASCII	Same as Baudot.

Table 3

Keyboard Functions

CTRL:	*Function*
A	On-off control of automatic send-receive (KOS)
D	Extends cw transmit dash length by 25%, increasing the cw weighting.
E	On-off control of the echo from transmit to receive buffers.
I	Changes transmit mode from RTTY to cw, and vice versa.
N	Turns the "diddle" on and off.
P	Turns the printer on and off.
Q	Sets the display page.
U	Slows the rate at which data comes out of the transmit buffer. The effective baud rate is 25 regardless of the speed selected.

Conclusions

What an amazing terminal! It is hard to imagine how they pack all those features into such a small package. The versatility of the Telereader makes it ideal for both portable and fixed-station use. It is unfortunate that a little more design effort was not placed in the display and software. Overall, I would rate the CWR-6850 as an excellent, well-built product worth the asking price. It is one of the first imported products offered by HAL. For more information, contact HAL Communications, Box 365, Urbana, IL 61801. Price class of the CWR-6850 Telereader is $1000. — *Gerald B. Hull, VE1CER/W1*

TOKYO HY-POWER LABS HC-200 TRANSMATCH

☐ If you operate with medium power, go out for portable operation or just need a Transmatch to use your 40-meter dipole on the 30-meter band, consider the HC-200. Size and weight make it a viable candidate for mobile operation as well.

Muted green lettering stands in pleasant

Table 4

Tokyo Hy-Power Labs HC-200 Transmatch, Serial no. 829113

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequencies: 80-10 m (8 bands)	
Power-handling capability: 200-W PEP (100-W cw) at 50 ohms	As specified.
Input impedance: 50 ohms (at matched condition)	As specified.
Output impedance: 10-250 ohms unbalanced	
Meter ranges: 20, 200 watts (forward) and SWR	As specified.
Connectors: Three SO-239 and one single-wire terminal	As specified.
Weight: approx. 4.84 lb†	
Size: 3.3 × 8.26 × 7.36 in. (HWD)	

†kg = lb × 0.454; mm = in. × 25.4

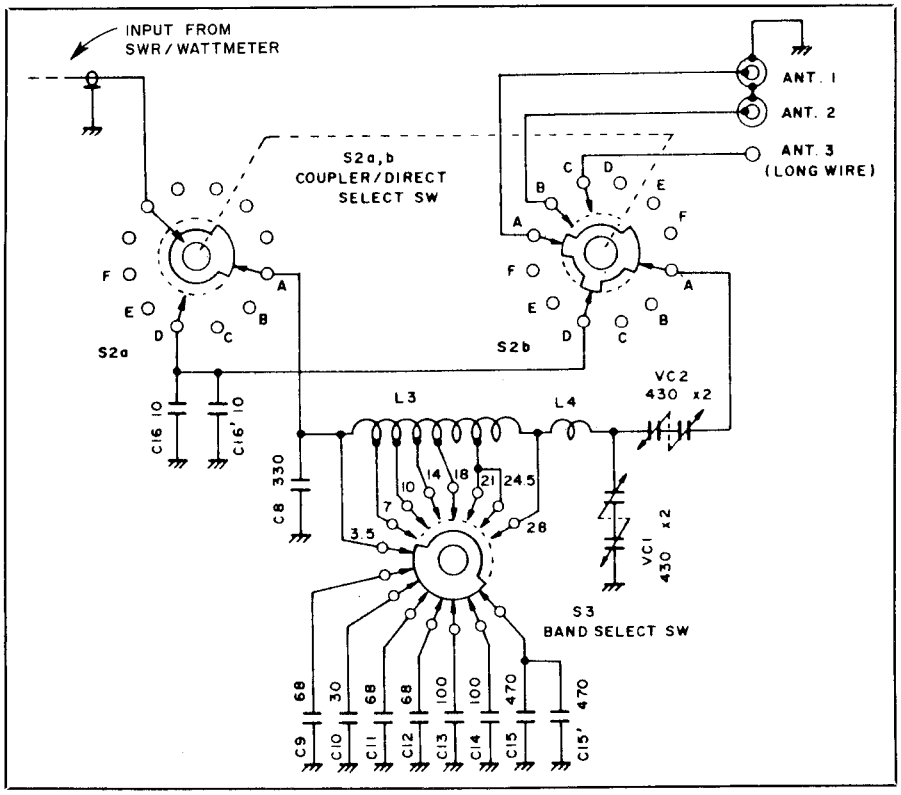
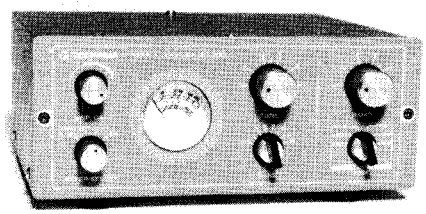


Fig. 5 — HC-200 matching-network schematic diagram copied from the operating manual. Metering section is not shown.

relief to the gray of the extra-thick front panel. Bright aluminum knobs, two with black plastic inserts, a round meter and a black cover combine to give the unit eye appeal.

All eight amateur bands from 3.5 to 30 MHz, including WARC bands, are covered by the '200. A power-handling capability of 200-W PEP (100-W cw) is well suited to most modern transceivers. I tried the '200 with a variety of loads on several different bands at home and in the ARRL lab. The results were satisfying — particularly when using my 40-meter dipole in the 30-meter band. During the DX contest, the '200 saved the day by allowing a solid-state transceiver to drive the untuned input of a kilowatt amplifier.

Perhaps the most striking visual feature of the '200 is the round meter. Control of metering functions is by means of METER SELECT and SWR CAL knobs. Those functions include SWR (FWD and REV), 200 W and 20 W (forward power). Separate SWR calibration scales for 200-W and 20-W power levels is an excellent feature. Diodes are notoriously nonlinear, particularly at lower power levels. I compared meter readings from the '200 with readings taken on a Bird model 43 wattmeter. The results are shown in Tables 5 and 6. The metering circuit may not qualify as a lab standard, but it is good enough for the average amateur.



Matching Network

The right-hand side of the front panel has four knobs that are used to control the matching network. The large TUNE and LOAD knobs look good and are easy to use. The two remaining control knobs, BAND and MODE have black plastic inserts that serve the dual function of making it easy to operate the associated switches and providing a positive indication of switch position.

Fig. 5 shows the schematic diagram of the matching circuit. You can see that it looks like a pi network with a series capacitor at the output. That series capacitor increases the matching range of the network.

I was curious as to what the response of the circuit was. The spectrum analyzer and tracking generator in the ARRL lab revealed an interesting situation. The results can be seen in Fig. 6. The matching network exhibits a bandpass response; frequencies above and below the desired band are attenuated. I like that!

The '200 is designed for use with unbalanced loads. There are three antenna connections on the rear panel: two SO-239 coaxial connectors and a single wire terminal. The MODE switch allows any of these three antennas to be selected, routing it either through the matching network or bypassing the matching section altogether. The K8CH antennas are resonant at my favorite portion of each band. Full coverage of some bands does require the use of a Transmatch. This sometimes-yes/sometimes-no situation makes me appreciate the ability to easily switch the matching network out of the line!

The rear panel also contains an SO-239 connector for IN/TX and a bolt and wingnut combination for a GND connection. I found the '200 easy to operate and the documentation complete. There is even a table of typical settings for operation into 50 ohms on each of the bands.

The '200 is available from Encomm, Inc., 2000 Ave. 'G', Suite 800, Plano, TX 75074. Price class is $100. — *Chuck Hutchinson, K8CH*

Table 5

Comparison of HC-200 and Bird Model 43 SWR Readings (70 W)

	21 MHz			*7 MHz*	
R_{load}	SWR	'43	'200	'43	'200
112.5	2.25	2.2	2.4	2.2	2.1
25	2.0	2.1	1.4	1.9	1.6

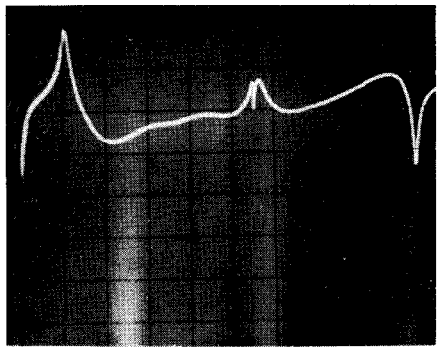


Fig. 6 — Network frequency-response curve. Horizontal divisions are 20 MHz; vertical divisions are 10 dB. The network is adjusted for 50 ohms input and output at 21.050 MHz.

Table 6

Comparison of HC-200 and Bird Model 43 Power Readings (21 MHz)

'43	*'200*
200-W range	
100	90
60	60
40	42
20	22
20-W range	
20	19
10	9
5	4