Product Review Column from *QST* Magazine

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Heath VL-1180 2-Meter Amplifier

Heathkit uMatic Memory Keyer, Model SA-5010

HY-Gain V-2 2-Meter Antenna

Kenwood TR-7730 2-Meter FM Transceiver

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Product Review

Conducted By Paul K. Pagel,* N1FB

Kenwood TR-7730 2-Meter FM Transceiver

☐ I don't "do" fm these days, having sworn off during the era of political mayhem and repeater wars some years ago. But when N1FB said he needed a reviewer for the TR-7730, I volunteered. It seemed worthwhile to acquaint myself with the features of modern fm equipment: The earlier experience was with surplus land-mobile gear and new-to-the-market American 2-meter fm equipment. The TR-7730 offers features and performance that were only dreamed of a few years ago. Furthermore, it is compact and delivers 25 watts of power output. The countless features available in the transceiver should answer the needs of most 2-meter fm operators.

Some Features

The unit contains 15 ICs, 46 transistors, 7 FETs and 91 diodes. It has a frequency synthesizer, a five-channel memory, scanning circuit and digital readout for frequency. The size? Well, the entire works are contained in a 5-3/4 × 2 × 7-3/4 inch (WHD) cabinet. Synthesizer resolution is selectable at 5 or 10 kHz from the front panel. A high-low power switch permits the operator to use 5 or 25 watts of rf output.

The memory (for frequency-pair storage) will retain the data programmed into it as long as the transceiver remains connected to a +13.8-V power source. The operator can add the optional TK-1 battery back-up unit externally (rear-panel connector) if he or she does not want the memories to be erased when the transceiver is disconnected from the primary power source (such as when taking the rig out of the car).

Front-Panel Controls

A memory-selector switch (M. CH) provides for selection of five stored channels. Position 5 allows the storage of odd frequencies (splits), whereas channels 1 through 4 can be used only for standard repeater pairings (600 kHz).

Push-button switch M is used to program the memories in accordance with the frequency displayed on the digital readout. The MR switch is depressed when the operator wishes to recall the frequencies stored in the memories. When MR is not depressed, the transceiver operates on the frequency indicated on the digital display, which is chosen by means of the main tuning knob.

A BUSY indicator lamp will light when the receiver squelch is open, thereby indicating that a channel is in use. This feature is useful when the scan circuit is actuated, and when the receiver audio is turned off. There is also an on-the-air light, as well as lamps that indicate the transmitter-offset state (plus or minus the receive frequency).

The transmitter offset switch (– S +) places the transmit frequency 600 kHz below the receive frequency when set in the minus (–) position. In the plus (+) position the offset is 600 kHz above the receive frequency. Simplex operation can be carried out when the switch is set on S.

Memory scan is initiated when the M.S. switch is depressed. Scanning of the entire range from 144.0 to 148.0 MHz takes place when the SCAN button is pushed in. Adjacent to this button is the HOLD button, which when pressed, stops the scanning action. The microphone push-to-talk (PTT) switch can be depressed to stop scanning action, also. I found the scanning from 144 to 145 MHz an annoyance, since there is no repeater activity in that part of the band for this area. It lengthens the total scan time by an appreciable amount, which is not desirable. The HI-LOW power switch and 5-kHz/10-kHz resolution button are also on the front panel for easy access. Two other controls are on the front panel of the unit. They are the on-off/volume (POWER/VOL) and SQUELCH controls.

A sequential LED bar indicator is used to monitor relative power output and received signal strength. It is located to the right of the digital-display block.

Main tuning is accomplished by means of a rotary click-type control. Frequency coverage in 5- or 10-kHz increments is continuous from 144.0 to 148.0 MHz. A TONE switch is included for those who wish to add the Kenwood tone generator for use with repeaters that require tone access.

Other Comments

The instruction book appears to be complete, and I found it easy to comprehend when learning how to operate the transceiver. Complete instructions for mobile and fixed-station installation are given in pictorial form. An adjustable mobile-mounting bracket is supplied with the TR-7730, as is the standard push-to-talk mike. Those wishing to use the rig with autopatch facilities can obtain the MC-46 accessory mike, which has a TT pad built into it.

*Assistant Technical Editor

Kenwood TR-7730 2-Meter FM Transceiver, Serial No. 2011236

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: 144.0 to 147.995 MHz.	143.900 to 148.990 MHz.
Readout: Digital	As specified; four 1/2-inch LED blocks.
S-meter sensitivity: Not specified	LED sequential bar type. S1 = 0.9 μV; S5 = 2.1 μV; S9 = 4.5 μV.
Receiver sensitivity: Better than 0.5 μV for 30 dB S/N.	For 20-dB quieting, 0.38 μV.
Squelch threshold: 0.16 μV	0.8 μV
Spurious response: Better than −60 dB from peak power output.	See Fig. 1
Receiver spurious (birdies): Not specified.	None observed.
Receiver audio output: More than 2 W at 10% distortion (8 ohms).	1.2 W maximum (8 ohms).
Transmitter output power: 5 W (adjustable) and 25 W (minimum).	5 W and 30 W.
Current drain: Receive, 0.4 A; transmit (low), 3 A; transmit (HI) 5.5 A.	Approx. as specified.
Operating voltage: + 13.8 V dc.	As specified.
kHz per turn of main tuning knob: Not specified.	50 or 25 kHz, at 5-kHz and 10-kHz resolution, respectively.
Size (HWD): 2 × 5-3/4 × 7-3/4 inches.†	
Weight: 3.3 pounds.	
Color: Black.	

†mm = inches × 25.4; kg = pounds × 0.454

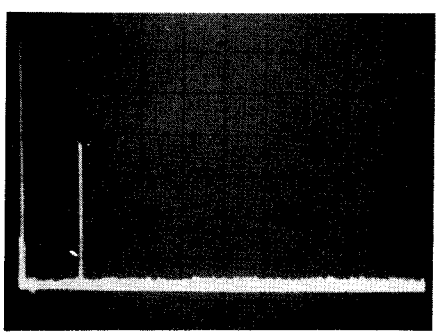


Fig. 1 — Spectral display of the Kenwood TR-7730. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 30 watts at a frequency of 146.52 MHz. The fundamental has been reduced in amplitude approximately 33 dB by means of notch cavities; this prevents analyzer overload. The TR-7730 complies with current FCC specifications for spectral purity.

The mike also has up-down switching for changing the transceiver frequency — a definite advantage while driving the automobile.

Performance in my car over a two-month period (hot and cold weather conditions) was without mishap. If I were to criticize the transceiver, I would mention that the frequency display is useless in bright daylight. How nice it would be if one could read the digital displays of mobile equipment in bright-day periods! Most rigs fail in this regard.

Another problem I encountered was inadequate undistorted receiver audio level when the ambient noise in the car was high. This is a common malady with many mobile transceivers, owing to the speaker pointing toward the floor instead of outward toward the operator. A quick and satisfactory fix resulted when I added the Kenwood SP-40 external speaker. I attached it to the ash tray in the center of the dashboard (mag-mount), pointed it toward my face, and eliminated the poor audio quantity and quality I first experienced. I highly recommend this speaker to anyone who operates mobile. It is small, but it has a big voice! Distributed in the USA by Trio-Kenwood Communications, 1111 West Walnut St., Compton, CA 90220. Price class: TR-7730 and MC-46 Touch-Tone microphone, $349; SP-40 speaker, $25.95. — *Doug DeMaw, W1FB*

HEATH VL-1180 2-METER AMPLIFIER

☐ If you're looking to put a little more "punch" into your mobile 2-meter signal, this little box of watts may be the answer. Of course it isn't limited to mobile-only use; it's at home at the base station, too. The VL-1180 and VL-2280 are basically similar, but the VL-2280 has been designed specifically for base station use and has a built-in power supply and metering circuit.

The '1180 is an "all-mode" (fm, cw or ssb) amplifier designed for use with any transmitter or transceiver capable of providing 1 to 10 watts of driving power. With about 10 watts of drive, the power output of the '1180 is rated at a nominal 75 watts.

Automatic T-R switching is accomplished by a built-in relay and rf sensing circuit. The drop-out delay is selected by means of a jumper wire on the circuit board. When the jumper is grounded, the amplifier relay will remain energized for approximately one second. This prevents relay chatter when ssb VOX operation is being used.

Construction and Circuit Description

It took me almost seven hours to construct the '1180. No problems were encountered during assembly. There are two circuit boards in the amplifier: an antenna transfer circuit board and the amplifier circuit board. The antenna-transfer board contains the T-R relay switching components and a low-pass output filter. A Darlington amplifier transistor is used to operate the dpdt relay when the amplifier is in use. When the amplifier is switched off, the relay is prevented from being energized, and the exciter rf energy is fed through the normally-closed relay contacts and the low-pass filter to the antenna.

The amplifier board uses strip-line construction, but also employs four air-wound inductors, three of which are adjusted during tune-up. Assembly of the board requires the insertion of 47 rivets to ensure proper bonding between the ground foils on opposite sides of the board. The amplifier transistor and biasing diode are thermally bonded to the heat sink through holes in the board. This arrangement provides bias voltage tracking, ensuring linear operation at all operating temperatures.

Heath supplies small-diameter Teflon coaxial cable for making the required internal connections and for use as a 1/4-wave transmission-line section. The latter acts as a

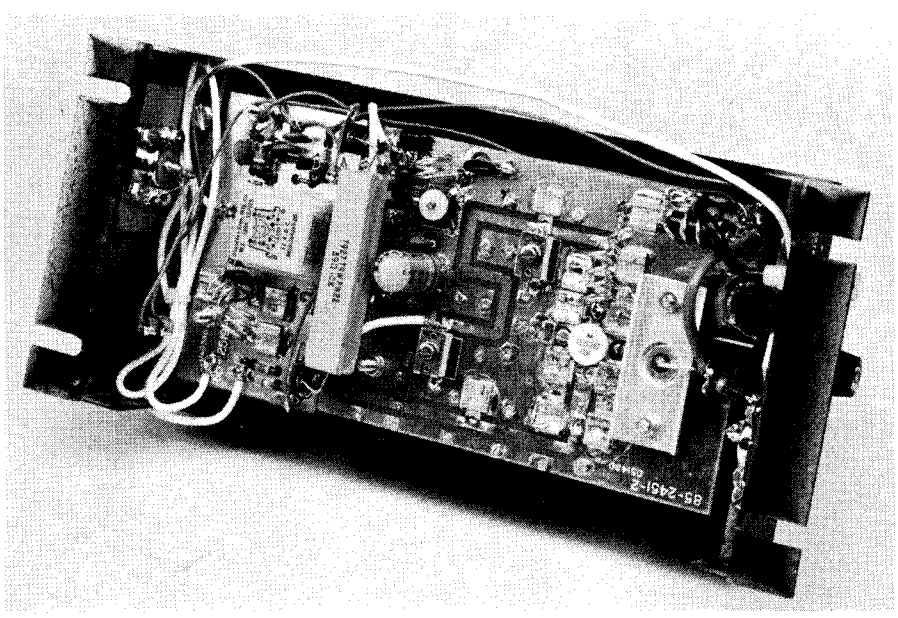


Fig. 2 — An inside view of the VL-1180. The bias diode is immediately to the right of the output transistor, supported by the metal bracket.

Heath VL-1180 2-Meter Amplifier

Manufacturer's Specifications	*Measured in ARRL Lab*
Frequency range: 144 to 148 MHz.	As specified.
Power output: 75 W (nominal) at 13.6 V dc with 10 W drive.	82 W, 144 to 147 MHz; 80 W, 147 to 148 MHz.
Input VSWR: 2:1 maximum	Less than 1.2:1.
Spurious and harmonic output: −60 dB or better.	−64 dB (see Fig. 3).
Third-order distortion: −30 dB referenced to cw power.	Limited by test equipment capability.
Size: 2-3/4 × 4-3/4 × 10-3/4 in. (HWD).†	
Weight: 3-1/4 lb.	

†mm = inches × 25.4; kg = lb × 0.454

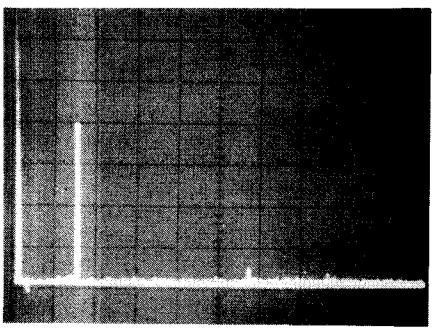


Fig. 3 — Spectral display of the Heath VL-1180. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 82 watts at a frequency of 146 MHz. The fourth harmonic is just visible at approximately 64 dB below peak fundamental output. The fundamental has been reduced in amplitude approximately 30 dB by means of notch cavities; this prevents analyzer overload. The VL-1180 complies with current FCC specifications for spectral purity.

half-wave stub at the second harmonic of the desired output frequency, thereby providing harmonic energy attenuation. With the lead lengths involved, the Teflon properties of the cable are welcome. If a standard type of cable were used, you'd probably wind up with a melted dielectric and/or shorted cables. Caution should be observed when cutting the transmission-line trap to ensure the proper length is maintained. Otherwise, a deterioration of the second-harmonic suppression will occur.

Good quality components are used throughout. The power-amplifier transistor is an MRF247 — a rugged device. If you can remember what a tube is (those things that look like bottles that glow), you'll marvel at that little piece of silicon being able to generate over 75 watts of *output* power at 2 meters! You'll find no VSWR protection circuit in the amplifier; the MRF247 doesn't need it. It is rated to withstand an SWR of 30:1 at full power input at all phase angles! That should make it just about "klutz proof."

Tune-Up

Initial tune-up and testing can be accomplished in a matter of minutes. Although a voltmeter can be used as an output indicator during the tune-up procedure, to be sure a minimum SWR exists between the exciter and the amplifier, a wattmeter or VSWR indicator should be employed. A dummy load capable of dissipating the amplifier power output and an exciter capable of providing 1 to 10 watts of output power are also needed.

For me, all went well until the power output was measured. Lo, only 72 watts. Because the power output level was below that specified by Heath, the factory was contacted and the problem explained. Another MRF247 was shipped, installed (that took a bit of doing!), and when the output power was measured again, the wattmeter showed 82 watts being delivered from 144 to 147 MHz and 80 watts at 148 MHz, well above that specified by Heath.

Spectral purity and third-order IMD tests were run in the ARRL lab. Because of the limits imposed by the test equipment used, the third-order IMD figures specified by Heath could not verified.

Summary

During construction of the antenna-transfer circuit board, you are asked to decide whether or not ssb operation is intended. If so, the jumper wire mentioned previously is connected to the ground foil. This adds a capacitor to the relay driver circuit, which then acts to delay T-R relay drop out during ssb VOX operation. It would be a simple matter to mount an spst switch on one amplifier end panel to allow external switching of the jumper. This would eliminate having to make an internal change should you wish to use the amplifier for all-mode operation.

If you have a base station power supply capable of supplying 13.6-V dc at 12 A, you can turn the VL-1180 all-mode amplifier into an all-purpose amplifier as well. This little black box of watts may be just what you need to make your presence known on the 2-meter band. For further information, contact Heath Company, Benton Harbor, MI 49022. Price class: $138. — *Paul K. Pagel, N1FB*

THE HY-GAIN V-2 2-METER ANTENNA

☐ It is possible to improve the old tried and true 2-meter vertical, you ask? You bet it is, and Hy-Gain has done just that! The model V-2 antenna solves a problem not considered until recently — that of radiation-pattern distortion.

Back in the "good ol' days" we simply put up a 1/4 λ or collinear vertical for 2-meter fm work and accepted the performance. Just how could you improve the omnidirectional vertical, anyway? Eliminate the pattern skewing, for one! Fact is, the typical 2-meter vertical suffers from a less than ideal radiation pattern. If the coaxial feed line and supporting mast are not properly isolated from the antenna, interaction results. This may cause a number of problems, including unwanted lobes of high-angle radiation, along with a horizontally polarized component. Keep in mind that for the majority of 2-meter fm and repeater work the ideal antenna would provide only vertically polarized radiation, and aim it entirely at the horizon. After all, the horizon is where distant repeaters and mobile stations are lurking, not up in space somewhere!

The Hy-Gain V-2 is an omnidirectional collinear antenna consisting of two 5/8-λ vertical sections in phase, as can be seen in Fig. 4. It utilizes two sets of 1/4-λ radials to decouple the lower 5/8-λ radiating section from the mast and feed line. According to the manufacturer, the resulting isolation allows the V-2 to provide a clean radiation pattern, and concentrate the power along the horizon where it is needed most.

Construction

The V-2 comes supplied as an easy-to-assemble kit. All components are precut, drilled and made of the highest quality materials. The aluminum used is of the 6063-T832 variety, and all hardware is rust-proof, plated steel. A screwdriver, adjustable wrench and pliers are the only tools necessary for construction, which took approximately one hour. The instructions supplied are complete and easy to understand. A chart is provided so that the antenna length may be adjusted to the desired frequency. An interesting feature is the feed arrangement, where the coaxial cable is positioned *inside* the bottom

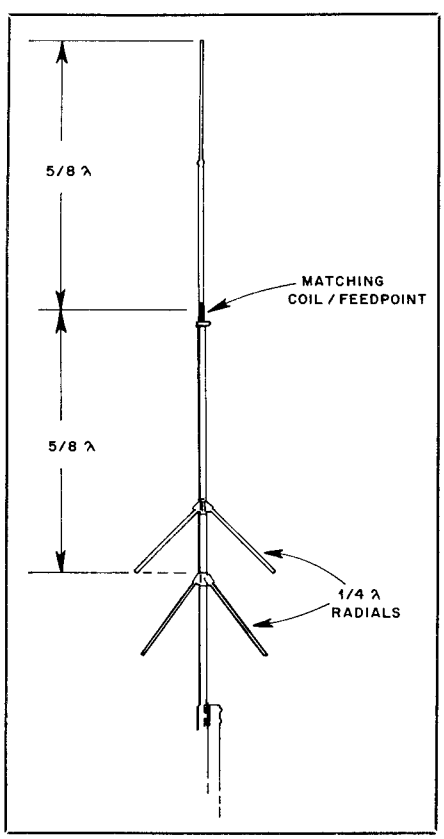


Fig. 4 — Physical configuration of Hy-Gain V-2 2-meter antenna.

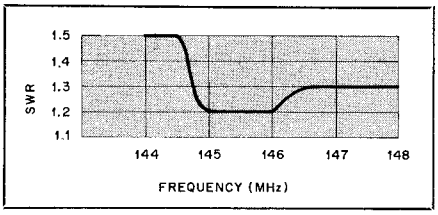


Fig. 5 — SWR curve for Hy-Gain V-2 antenna. Resonance was adjusted to 146 MHz.

half of the antenna to mate with a centrally located, 200-watt matching coil. The feed system places the entire antenna at dc ground, providing a degree of lightning protection. This arrangement also provides excellent weatherproofing for the coaxial connectors and feed point. Total antenna height is 122 inches,[3] and wind loading is a mere 0.67 square feet.

Performance

Although the V-2 may be fine-tuned for any frequency between 138 MHz and 174 MHz, I learned quickly that the exact choice of frequency is not critical. The manufacturer specifies a 2:1 VSWR bandwidth of at least 7 MHz! Our antenna was set for 146 MHz, and checked for SWR. The results can be seen in Fig. 5. As specified, the V-2 was found to provide an extremely broadband match. It was time to try out the antenna.

Perched 50 feet high on top of the Hq. building, the V-2 has provided very good performance. Using only 10 watts output at W1INF, the Hq. Operator's Club station, literally dozens of repeaters in southern New England and New York state were accessed within an hour. Signal reports were always good — including full quieting through the Mount Greylock, Massachusetts, repeater — located a mere 85 miles to the north! Need more be said?

The Hy-Gain V-2 is an excellent choice for the operator who wishes to catch those distant repeaters and still retain omnidirectional coverage. Price class — $39.95. For more information contact the Hy-Gain division of Telex Communications, Inc., 9600 Aldrich Ave. So., Minneapolis, MN 55420 — *Dennis J. Lusis, W1LJ*

HEATHKIT μMATIC MEMORY KEYER, MODEL SA-5010

☐ Microprocessors are "taking over the world." It seems that almost every major piece of electronic equipment being introduced these days has a microprocessor in it. Sometimes the design is defective or the internal programming is inadequate, resulting in a piece of equipment that just doesn't meet the potential. I am happy to report that such is not the case for the Heathkit μMatic Memory Keyer.

One of my co-workers points out that the Heath designer was smart enough to use "big computer" techniques on a "little computer." What does that mean? Let's take a look at the features of the SA-5010.

Characteristics

The SA-5010 uses a custom 3870 microprocessor IC to perform all the main functions of the keyer. Such an approach should provide the user with tremendous flexibility — and it does! Most of the operating parameters are set with the 20-key pad located on the top of μMatic. The user can choose any speed between 1 and 99 wpm. If the operator desires, the spacing between characters may be increased to provide a "fast code" effect, which can be useful when building code speed. Weighting is also variable (five light, five heavy settings and normal, i.e., a dash is three times as long as a dot).

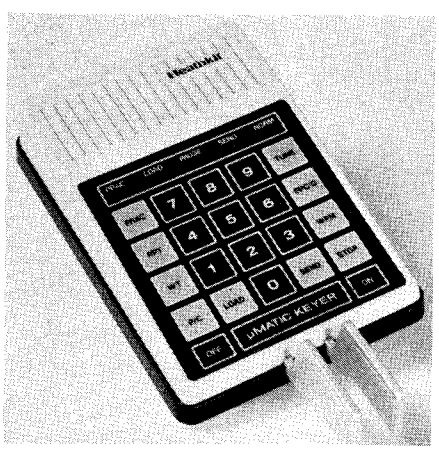
Heath has provided 10 memory buffers in the SA-5010. A total of 240 character spaces are available for the memory. The user can load as many or as few characters into any memory (soft partitioning) as desired. Command strings can also be stored in the memory buffers. When room for 20 or fewer characters remains in memory, the sidetone pitch drops noticeably as a warning. A pause may be programmed into any memory (e.g., for inserting an RST report). The memory automatically repeats up to nine times.

A left-handed user may reverse the paddles by making the appropriate entry. A battery (three "watch" cells) retains the memory when the μMatic is not connected to a power source. Each time the keyer is turned on, the microprocessor initiates a diagnostic program to ensure all is well. If the test fails, all the LEDs light and the sidetone sounds constantly. While turned off, the SA-5010 retains the last entered speed and other operating parameters.

Heath has given consideration to the operator who wants to practice copying code. The user selects alphabetic characters, alphanumeric characters, alphanumeric character and common punctuation, or alphanumeric characters and all punctuation. The keyer has over 6000 different practice sequences available. As with normal keyer operation, the user can vary the speed, spacing and weight. Also, the code practice keys the output stage.

The μMatic output is solid state. Two jacks, located on the rear panel, provide for positive (250 V at 100 mA) or negative keying (−200 V at 40 mA). The user has access to the sidetone volume and pitch controls through two holes in the case bottom.

Heath has included built-in paddles. Unlike the more common mechanical variety, these paddles operate on a proximity principle instead of a switch closure. When the user presses a finger against the metal paddle, his body capacitance is added to that of the circuit. This causes a transistor to conduct. Sensitivity controls for the paddles are located on the circuit board and are accessible through two holes in the case bottom.



I've been using mechanical paddles for years and found it difficult to adjust the paddle sensitivity to accommodate my fist. This probably would not be a problem for most operators — particularly those not already accustomed to mechanical paddles. The user can attach external mechanical paddles through a rear panel jack. If you have paddles that you are comfortable with, use them; if not, you may not need to spend $20 to $50 or more for paddles!

Using the Memories

Probably the most revolutionary concept in the SA-5010 is the ability to handle command strings. What is a command string? Suppose MEMORY 1 has "CQ" programmed in it. MEMORY 2 has "DE" and MEMORY 3 has "KB1N." MEMORY 0 can then be programmed to repeat MEMORY 1 nine times at 20 wpm with normal spacing and weight. The program continues with MEMORY 2 sent once, and concludes by sending MEMORY 3 twice at 18 wpm, heavy weighting and 15-wpm spacing. Sending MEMORY 0 causes the keyer to produce 10 CQs followed by one DE (all at 20 wpm with normal spacing and weighting) followed by three KB1Ns. However, the KB1Ns will sound different because the dots, dashes and intracharacter spacing will be generated at a 15-wpm rate. Additionally, the weighting will be different. MEMORY 0 is an example (albeit, somewhat contrived) of a command string.

Creative operators could store a complete QSO (Novice style) in the memory and still have a couple of buffers and several characters left over. All they would have to do is load the other station call sign into a buffer at the beginning of the QSO and push buttons. Users can make operation as simple or as complex as they choose. That's what my co-worker meant about the designer being smart enough to use "big computer" techniques on a "little computer."

Construction

The SA-5010 is a moderately easy-to-assemble kit. Heath describes it as a two-evening kit. I clocked about six hours of actual construction time. The instructions are clear, precise and easy to follow — just what I expect from Heath! Other kit manufacturers would do well to mimic the Heath style. I found only one problem in the instruction manual. Pictorial 2-6 details the installation of a single-in-line-package socket. The builder positions the socket by locating the side with the slot and orienting to one side of the circuit board. The pictorial reminds me of optical illusion drawings that I've seen in puzzle books. I installed the socket — backwards! When I tried to plug the ribbon from the keyboard into the socket, I discovered my mistake. Because I destroyed the socket removing it from the board, I had to wait a few days for a replacement. If you are building the SA-5010 and are confused by Pictorial 2-6, flip ahead in the construction manual and assure yourself that the socket is oriented properly.

The keyer has performed flawlessly on the air while keying a TS-130S transceiver driving a kilowatt amplifier. I am delighted with it! Oh, yes, the SA-5010 even turns itself off if the operator forgets to do so!

Price class for the μMatic and matching ac power supply is $110. More information may be obtained from Heath Company, Benton Harbor, MI 49022. — *Peter O'Dell, KB1N*

[3]mm = in. × 25.4; m^2 = ft^2 × 0.0929.