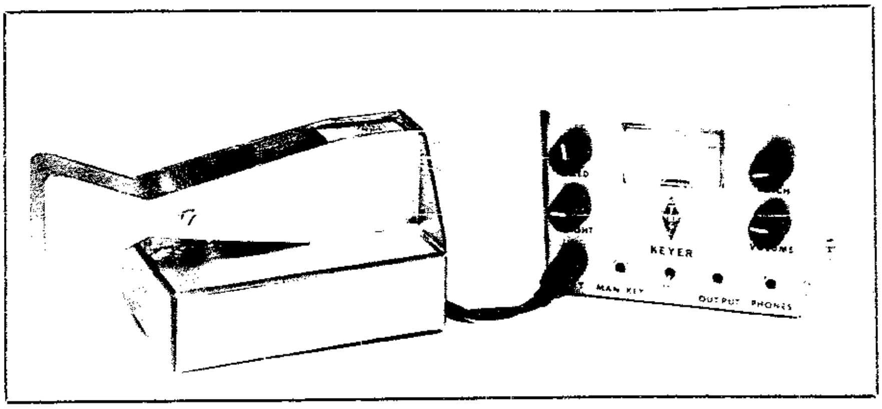
CW on a Chip

QST 12-83

Craving for a suitable weekend project? Keyers have been a longtime favorite of many! You can even wrangle a *free* paddle out of this offering!



By Bob Shriner,* WAØUZO and Paul K. Pagel,** N1FB

Keyers are fun to build! What makes the assembly of a good-quality, flexible keying system a cinch is the use of the Curtis keyer-on-a-chip. A ready-made pc board and kits of parts for the keyer and a unique, *no-cost* (no foolin'!) paddle make such an evening or weekend project that much more attractive. Does all this appeal to you? Then let's get on with it!

For some years now, the Curtis keyer-on-a-chip has been a regular part of the code transmission chapter of the *Radio Amateur's Handbook*. Although schematic diagrams and pictures of completed units using the Curtis ICs have been provided, a circuit-board template for would-be "homebrewers" has never appeared in the *Handbook*. This lack was the seed for this project. It grew rapidly from the presentation of a template only to that of offering a flexible keyer design.

The Curtis Chip

There are basically four varieties of the 8044 IC. Two of these (8044/8044B) are contained in a 16-pin package and the others (8044M/8044BM) in an 18-pin package.[1] The additional pins are connected to internal circuitry that provides a keyer sending speed monitoring function by means of a meter and a few other external components. The whole family of ICs features contact debouncing, rf immunity and self-completing character generation. A weight control, sidetone output and dot memory are also included. The memory function helps to prevent dot loss if the operator "leads" the keyer. With a quiescent current drain of about 50 μA, an on/off switch is not really required.

The "plain vanilla" (no suffix) and B-suffix ICs offer two slightly different iambic (squeeze) keying methods in addition to single-lever (non-squeeze) keying.[2,3] With the no-suffix IC, a dot or dash being sent when the paddles are released is completed and nothing else is sent. The B-suffix IC completes the dot or dash being sent upon paddle release, and then sends an opposite element; that is, a dot after a dash or a dash after a dot. Many squeeze-key operators prefer the latter method of iambic operation. If you're a single-lever paddle operator, you don't have to concern yourself about these factors; either IC should suit you.

Board Design

To make the keyer as universal in application as possible, the board is patterned so that any of the ICs mentioned earlier can be used with or without some of their inherent capabilities.[4,5] The board is single-sided, and is small enough to fit inside almost any transmitter or transceiver.

Any or all of the variable controls may be mounted on the board or brought out for external adjustment. Two on-board output keying options are provided: reed relay output (with or without arc suppression components across the contacts) or a transistor-keyed output that can be configured to fit your requirements.

Assembling the Keyer

Refer to Figs. 1 and 2 and the accompanying photographs during assembly. The parts overlay is shown in Fig. 3; the pc-board layout is in the Hints and Kinks section of this issue. The IC should be the last item installed. We'd recommend using a socket for it. If you install an 18-pin socket, you'll be able to use the 16- or 18-pin IC, the two unused socket positions simply being left empty when the 16-pin 8044 or 8044B IC is used.

You build the keyer to suit your personal requirements. Simply omit any of the components associated with the features you don't need or want. These may include: sidetone output, level and pitch control, and the speed-meter function. If you want transistor-output keying, you don't need to install the relay and arc suppression network. Should you not want the weight control, you'll still need to install a fixed-value 5.6-kΩ resistor between pins 15 and 16 of U1. If the weighting effect appears to be too heavy, reduce the value of C6 at pin 15 or remove it entirely from the circuit. The MANUAL KEY input can be used as a TUNE function; an spst switch that brings the line to ground will create a key-down condition.

If you elect to use the IC with the speed-meter function, any meter with a full-scale

[1]Notes appear on page 19
*P.O. Box 969, Pueblo, CO 81002
**Assistant Technical Editor, ARRL

deflection of from 50 to 500 μA can be used as long as it has a linear scale. A modified VU meter is used in the prototype shown in the photos. A new meter scale was made; it has 2-word-per-minute increments of from 0 to 100.

With the 100-kΩ resistor shown in series with the SPEED potentiometer in Fig 1, the maximum speed of the keyer is about 50 wpm. Alter the value of the fixed resistor to modify the speed range. The keyer has a top-end speed of about 80 wpm.

A switch is included to turn the keyer and/or the transistor audio amplifier, Q2, on and off. You can prolong the life of the battery by leaving the audio amplifier off. The sidetone oscillator probably won't be required since most modern transmitters and transceivers have built-in sidetone monitoring circuits. The keyer monitor does serve as a good indicator of battery condition: As the battery becomes depleted, the note will become quite chirpy.

Relay-Contact Arc Suppression

Certain transmitter keying lines may require the inclusion of an arc suppression network across the keying relay contacts. Most modern transmitters and transceivers should not need this network (C10, R19), as they are usually operated at low voltage levels. But keying some transmitters and transceivers using tubes in the final amplifier may require the relay contact pro-

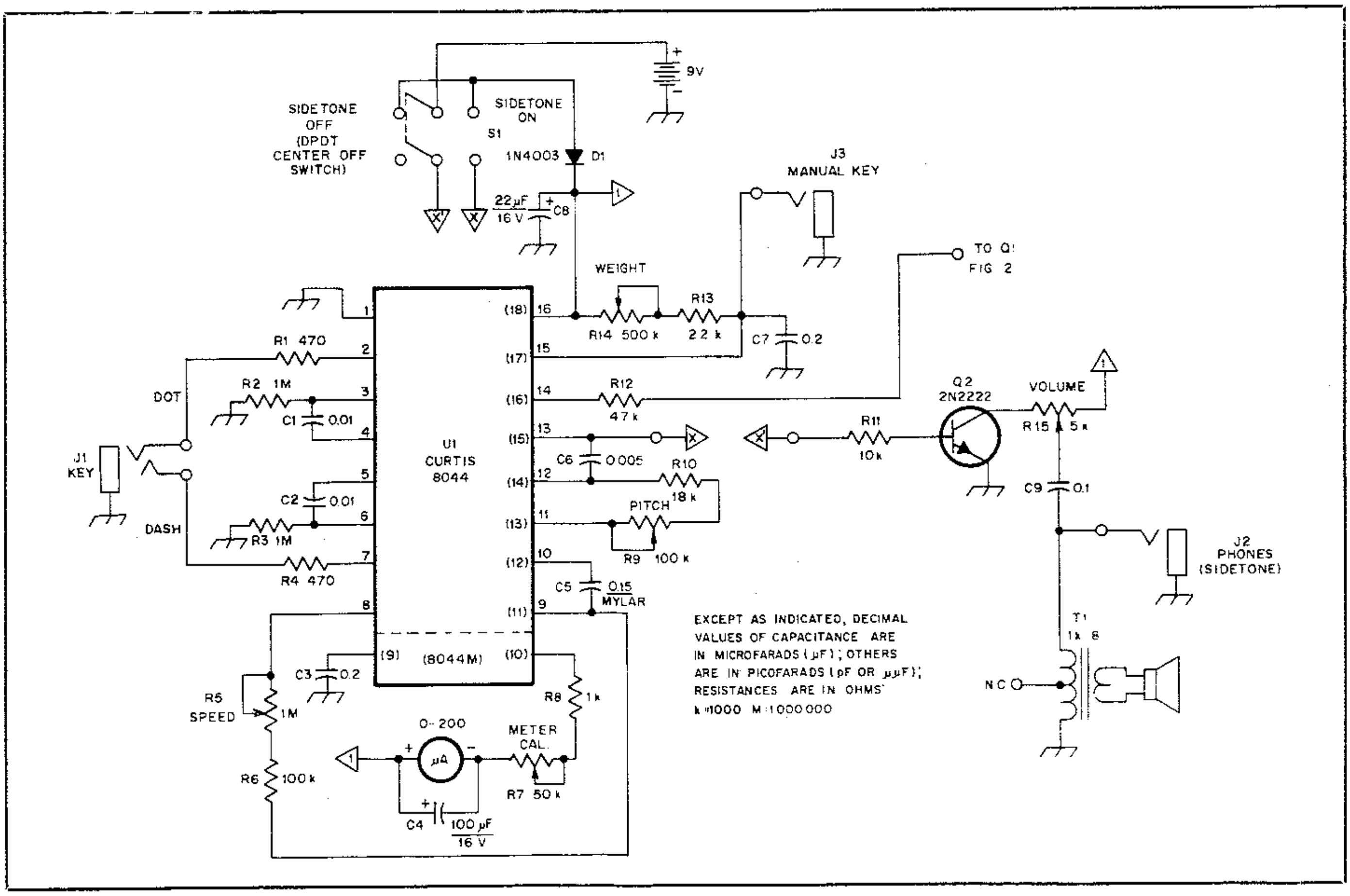
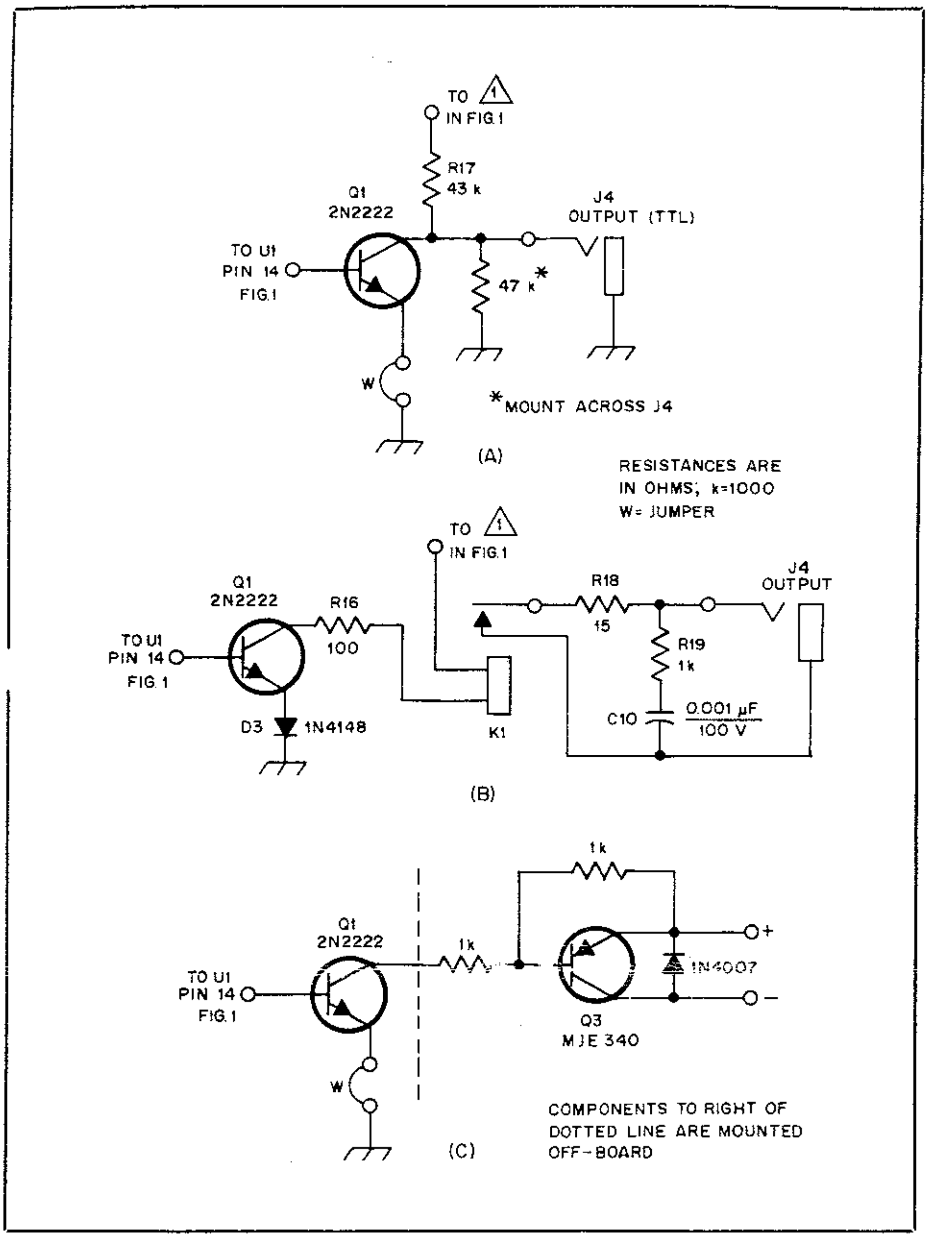


Fig 1 — Schematic diagram of the keyer. All resistors shown are ¼-W 5% types.



g. 2 — Some possible output circuit arrangements. The jumper (W) shown at (A) and (C) is in-
ɜrted in place of D3. D3 is included to ensure rapid energization of K1; it may not be needed.
Q3 and the components to the right of the dashed line in (C) are not mounted on the keyer cir-
cuit board.

tection. N1FB has successfully used the prototype keyer with a Kenwood TS-820S transceiver without the arc suppression network; no problems resulted. The key line voltage in that rig is −65-V dc. The appendix information should help you determine the network values required.

Calibrating the Speed Control

Sending speed can be determined by counting the number of dashes sent in a five-second period. That number is the code speed in wpm. A more refined measurement method uses an oscilloscope or a frequency counter connected to pin 12 of U1. Use the formula

$$\text{speed} = \frac{f}{1.2} \qquad \text{(Eq. 1)}$$

where speed is in wpm and f is the dot frequency measured at pin 12 of U1. Thus, for speeds of 10, 25 and 50 wpm, the frequency counter should display dot frequencies of 8.33, 20.8 and 41.6 Hz.

Keyer Case Construction

Two enclosure styles were tried. The first — the rectangular configuration — is easy to assemble. The control labels may be difficult to read at some angles, however. The sloping-panel version is more attractive, but a bit more difficult to put together. Either case style is available from Circuit Board Specialists; specify which you prefer.

Double-sided pc-board material is used for the box parts. Once the box parts have been cut to size, burnish them with fine steel wool. The parts' edges must be beveled to provide a good fit. Use a sharp file to produce this beveled edge. Work slowly and check the parts periodically for a snug fit. Remember: You can always file off more material, but it's impossible to replace material that's been filed away!

Lay the speaker panel on a flat surface and place the speaker grill in position. Use a toothpick to apply quick-drying epoxy cement to the grill-and-panel joint.

When the box parts are ready, tack solder them together and check for alignment and correct fit. If all is well, lay a bead of solder around each seam. A 25- to 45-W soldering iron should be sufficient. Another pair of hands can help to hold the parts in position.

Finish the case to suit your personal tastes. The original models have a combination of clear polyurethane varnish over most of the box. Light-blue epoxy spray paint accents some panels.

Install the panel mounted controls, jacks, meter and speaker. When mounting the keyer board, orient it with the meter-calibration potentiometer on the bottom.

A Free Paddle

Feast your eyes on that dandy paddle in the title photo! If anything has possibilities, that's it! To fishing enthusiasts, it might appear as a side view of headless, parallel-swimming fish — perhaps deserving the name "Tuna Twin Paddle." One might modify the design slightly to provide heads for the fish and have the output line exiting as a fishing line. Boaters might choose a different form and evolve a "Canoe Paddle." The possibilities are endless! Use your imagination and come up with something entirely "you."

To top all this excitement off, you can get the paddle parts *free!* Yes, indeed! Your request for the paddle parts will be honored by the delivery to your domicile of the pc-board material you'll need to construct one of these divine digital dexterity determinators.[6]

For someone wishing to experiment with iambic keying, this is an inexpensive route to follow. Sure, it's not the best paddle in the world, but it will give a good account of itself (more on that later).

Outside of the pc board material required, you'll need a couple of contacts from a junk-box relay and some machine screws and nuts to fashion the contact points. Some lead shot or other material can be used to fill the base. Scroungers can pick up lead shot from the shooting area of a local skeet-shooting club, about 150 yards from the firing line. (Please wait until the shooting is over.) Or, you might try the local garage; perhaps they can supply you with some lead tire-balancing weights.

Constructing the Paddle

Cut the paddle parts to shape. Dress up the parts' edges using a sharp file. Be careful not to get them out of square. With some steel wool, buff the parts to a sheen and spray them with a coat or two of clear acrylic lacquer to retain the finish. Paint the paddle if you wish.

First assemble the base and fill it with the lead shot or other weighting material. Pour in some epoxy cement to hold the material in place. To prevent marring the surface of your operating desk, cover the bottom of the base with a piece of felt or install some rubber feet. Be sure to drill the holes in the paddle arms for the contact screws and drill a hole in the rear panel to pass the key wires. Also, remove a strip of copper from each side of the contact-mounting block to isolate the contacts from the key frame and one another.

You'll need an extra pair of hands to hold the paddle parts in place while you tack solder them together. Once they are aligned properly, solder them along the entire seam.

Break off a couple of contact points from a discarded relay. Solder them to the upright contact piece between the two paddles and attach the output line. Two no. 4-40 machine screws are passed through holes drilled in the dot and dash paddles and secured with one nut on each side of each paddle. These are then adjusted to provide the contact spacing you desire. If the paddle is too stiff to suit your keying style, file the paddle arms to achieve a lighter touch.

How's It Work?

Admittedly, there were some chuckles, grins and outright guffaws when some members of the Hq. staff eyeballed the paddle. Not to laugh! Cw is serious business! Undaunted, N1FB toted the Dual Dolphin home. On the way, he found that the paddle rested rock solidly on the console of his car, the keyer occupying the passenger's seat. With this arrangement, he could easily send 20 wpm while zipping along at 55 mph. (Oh, for a 40-meter mobile rig and antenna!) The paddle/keyer combo became the main means of cw generation at N1FB. Keying must have been decent, since at least one station, during a long cw chat on 10-MHz, asked if he was using a "pokeboard" (keyboard)!

Lest you think this is a fish story, give the combination a try yourself. Perhaps you may even think of a minor modification or two. What the heck, the paddle shouldn't cost you anything and the keyer's a worthwhile addition to any shack.

Appendix

Most modern Amateur Radio transmitters, particularly solid-state designs, do not require additional relay-contact protection. Should your transmitter key line be a low-voltage type and not tolerate or require R18, it can be removed or jumpered.

Some grid-block-keyed transmitters will require additional relay-contact protection in the form of an added series-connected resistor if the key-line voltage exceeds 70 and a large-value bypass capacitor is tied between the key line and ground. Select the appropriate resistor value according to the accompanying table. Determine the resistor power rating by multiplying the resistor value by the square of the key-down circuit current in amperes. The added resistor can often be placed within the body of the key-line plug. For keying inductive loads (such as another relay), a silicon diode should be connected across the contacts of K1 (in place of C10, R19) to absorb the inductive kick.

Voltage	*Series Resistor Value (ohms)*
70	100
100	200
150	450
200	800

Notes

[1]Curtis Electro Devices, Inc., generously supplied the ICs used in this project.
[2]L. Fay, "The Iambic Gambit," *QST*, July 1981, p. 52.
[3]Curtis Electro Devices Lil' Bugger, Product Review, *QST*, March 1982, p. 47.
[4]A complete kit of parts is available from Circuit Board Specialists, P.O. Box 969, Pueblo, CO 81002.
[5]The keyer ICs are available from Curtis Electro Devices, Inc., Box 4090, Mountain View, CA 94040. Be sure to specify which IC you prefer.
[6]Templates for the sloping-panel keyer cabinet and paddle, and free paddle pc-board material are available from ARRL Hq. Send a business-size envelope and $2 to cover template and postage costs.

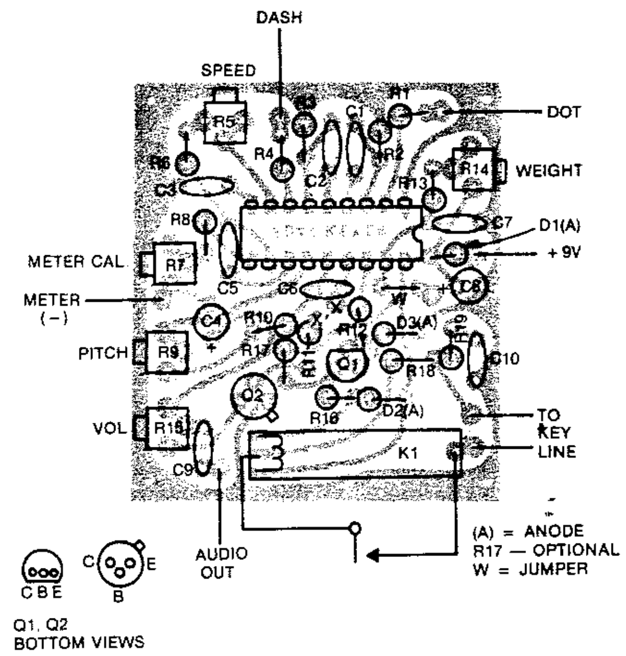


Fig 3 — Parts-placement guide for the Curtis-IC keyer. Parts are placed on the nonfoil side of the board; the shaded area represents an X-ray view of the copper pattern. The etching pattern appears in the Hints and Kinks section of this issue.

Strays

QEX: THE ARRL EXPERIMENTERS' EXCHANGE

☐ Wonder what you've been missing by not subscribing to *QEX*, the ARRL newsletter for experimenters? Among the features in the November issue were:

- "Equipment for CW-Meteor Scatter Operation," by Jan-Martin Noeding, LA8AK
- "MINIMUF for the Ham and the IBM Personal Computer," by John E. Anderson, WD4MUO
- More on AMTOR Protocol Change

QEX is edited by Paul Rinaldo, W4RI, and is published monthly. The special subscription rate for ARRL members is $6 for 12 issues; for nonmembers, $12. There are additional postage surcharges for mailing outside the U.S.; write to ARRL Headquarters for details.

PHOTO YEARBOOK AVAILABLE

☐ The first annual *Amateur Radio Operators' Yearbook* will include names, addresses, call signs and photographs of ham radio operators worldwide. The *Yearbook* will be available for sale to anyone who wishes to have his or her photo included. For more information, write to Lee Roy Kent, NØEMN (ex-WDØFFZ), AROY, P.O. Box 257, Malden, MO 63863.

I prefer to be able to adjust the level of the sidetone monitor from outside the rig after the internal trimmer is set to an acceptable level Fig. 5 shows a simple modification that allows the sidetone level to be adjusted by turning the af gain control. Remove R515 and replace it with a new resistor of 3.3 kΩ, but connect the top of this new component to the opposite side of R514, as shown — *D. Vassiliades, SV2IL, Thessaloniki, Greece*

RETUNING TRAPS FOR THE WARC BANDS

☐ Now is the time to start looking for antennas to use on the 18- and 24-MHz WARC bands. You can learn about propagation on these bands by listening, even before they are opened for amateur use The traps in a Hustler 4BTV or 5BTV are tunable, so it is easy to convert one of these antennas for coverage of the new bands.

To retune a trap, remove it from the antenna If you remove more than one trap at a time, be sure you can read the label or have some other way to tell them apart. Couple a dip meter to the trap and check its resonant frequency The method you use to couple to the trap may vary with the type of meter you are using I simply connected a 5-pF capacitor between the inner end of the trap and the hot side of my dip-meter coil Each trap should give an indication of resonance in the band it was intended for If not, then you should take the trap apart and look for a damaged coil. The outer shell is one plate of the resonating capacitor for these traps If your trap checks out okay, readjust the resonant frequency by sliding the outer shell up or down the coil. The tuning range seems to be as much as ±20% of the marked frequency I moved the 10-meter trap to 24 8 MHz and the 15-meter trap to 18.1 MHz.

When you reassemble your antenna, you will have to adjust the section lengths for the new bands. The lengths I used are given in Table 1. Each length includes the length of the trap, to the bottom of the next trap or the top of the antenna. You may have to use some new tubing sections.

Joseph Boyer, W6UYH, wrote a series of articles in *CQ* about calculating the lengths of elements for multiband trap vertical antennas [7]

[7] J. Boyer, The Multi-Band Trap Antenna,' *CQ* Feb.-May 1977

I recommend that you read this series if you want to calculate the new lengths for other frequencies.

Mount the antenna and connect at least four radials, each one about ¼ λ at the lowest operating frequency. Check the SWR and readjust the section lengths if necessary Start with the highest frequency band. If you run out of adjustment range, you can use a capacitance hat to lower the resonant frequency. The Hustler design should give some ideas on this.

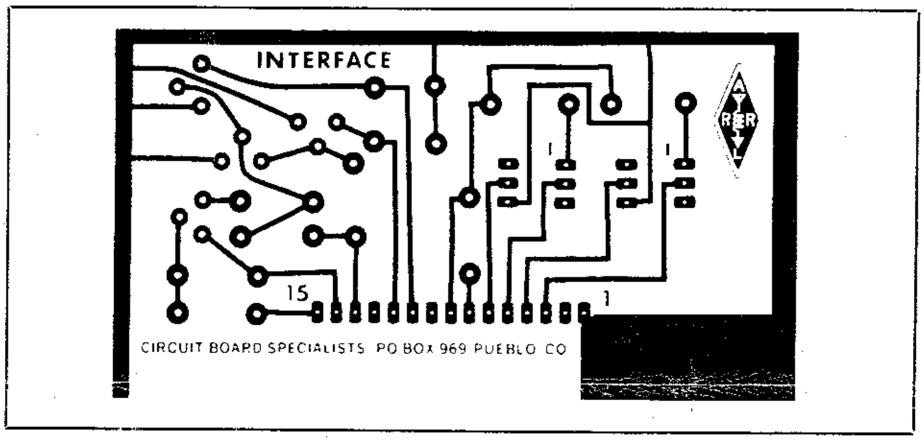
Some trap antennas do not use this type of trap Some use sealed capacitors, and in others the entire trap is sealed If your antenna uses traps with sealed capacitors, you should be able to retune them by rewinding the coils Sometimes this requires using smaller wire to allow more turns to fit into the space. With care you should be able to retune most types of trap antennas. — *R P. Haviland. W4MB, Daytona Beach, Florida*

Table 1

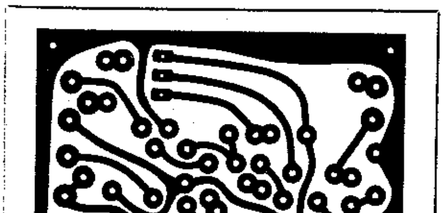
Trap Vertical Element Lengths

Band (MHz)	*Section Length (in)*
24	108
18	24
10	49

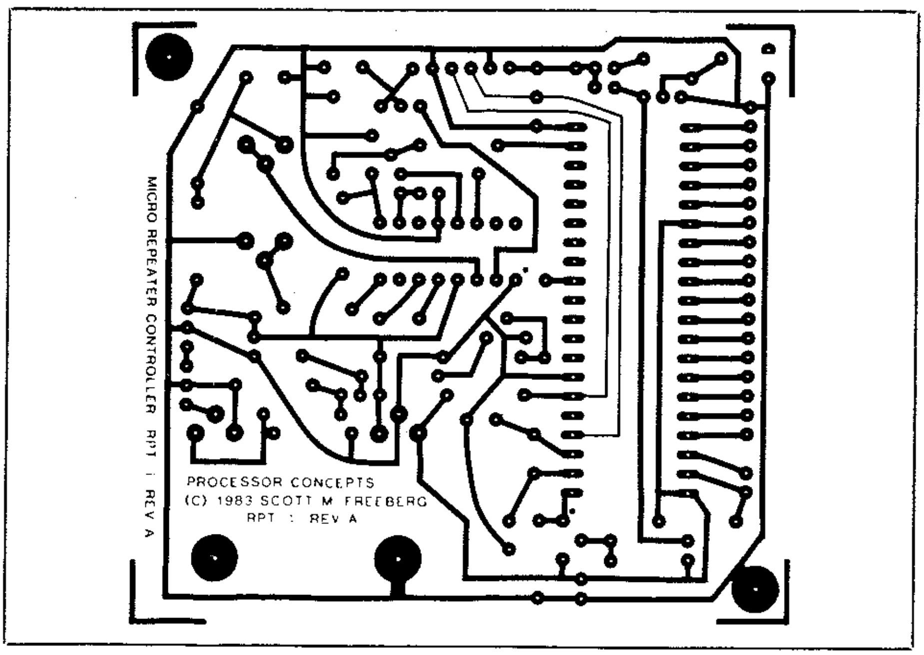
mm = in. × 25.4.



Etching pattern for the interface circuit board. Black represents unetched copper, viewed from the foil side of the board The pattern is shown full size A parts-placement diagram is shown in Fig 5, page 40



Circuit-board etching pattern for the Curtis-IC keyer The pattern is shown full size from the foil side of the board. Black areas represent copper foil. The parts-placement guide appears on page 19



A full-size etching pattern for the Microcomputer Repeater Controller. The board is shown from the foil side and black represents unetched copper A parts-placement diagram appears on page 31

This page has not yet been updated for the v5 release. Some information may be outdated. The ChipWhisperer-Lite Bare Board consists of two main parts: a multi-purpose power analysis capture instrument, and a target board. The target board is a standard microcontroller which you can implement algorithms onto. For example if you wish to evaluate an AES library, you can program that library into the target board and perform the power analysis.