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CQ Amateur Radio

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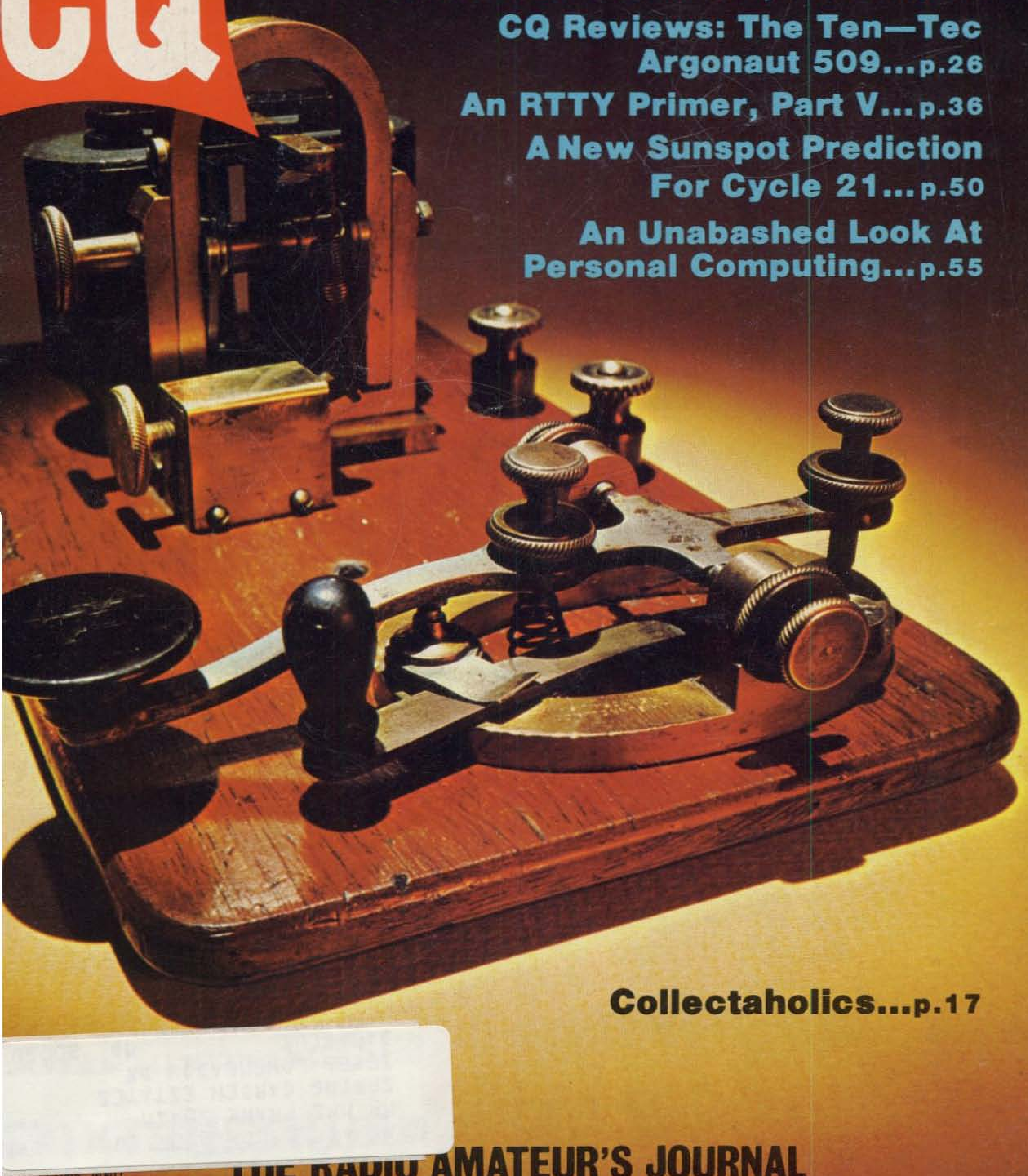
JULY 1978 $1.50



THE RADIO AMATEUR'S JOURNAL

KENWOOD

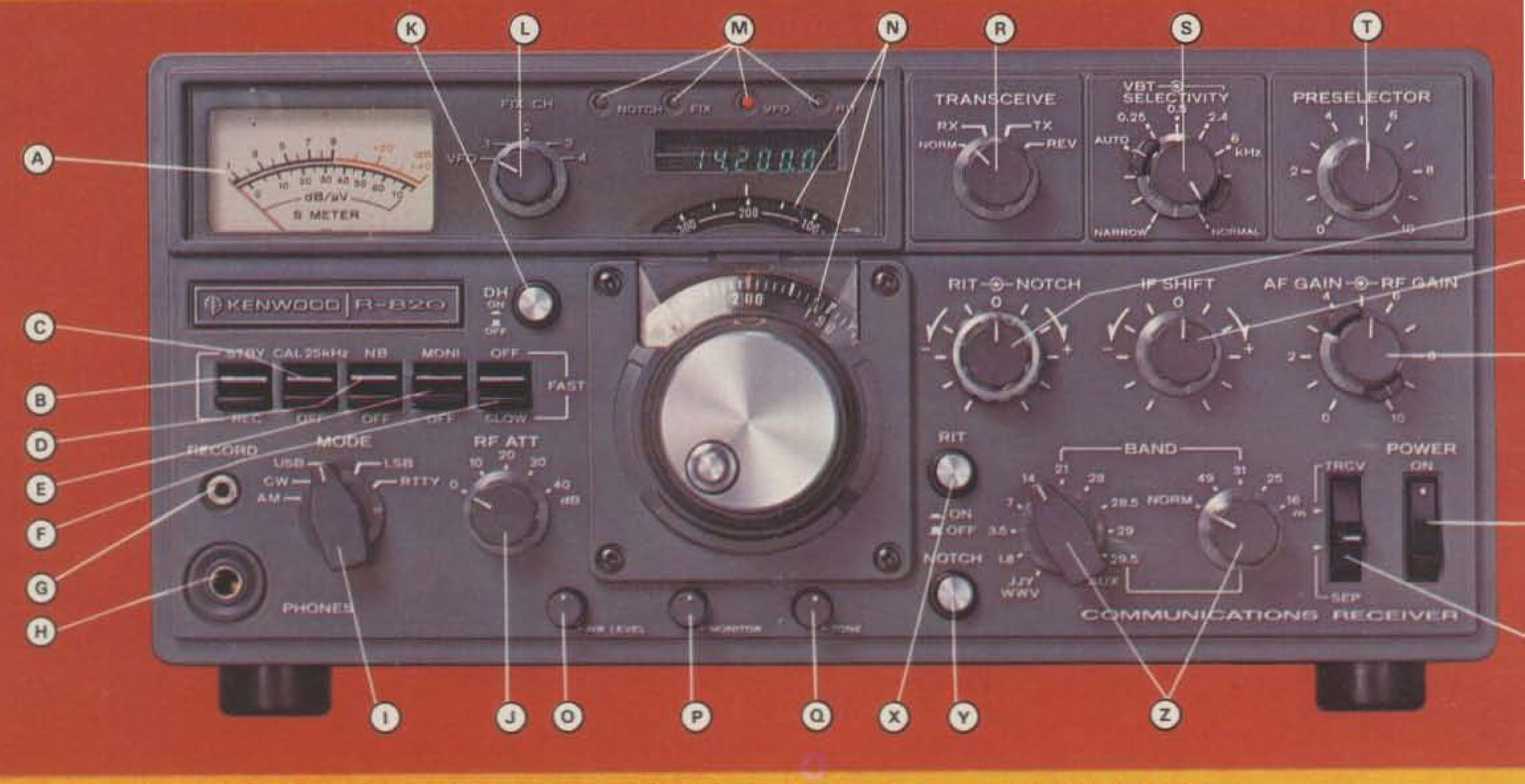
. . . pacesetter in amateur radio

INTRODUCING THE ULTIMATE IN RECEIVER DESIGN . . . THE KENWOOD R-820

With more features than ever before available in a ham-band receiver. This triple-conversion (8.33 MHz, 455 kHz, and 50 kHz IFs) receiver, covering all Amateur bands from 160 through 10 meters, as well as several shortwave broadcast bands, features digital as well as analog frequency readouts, notch filter, IF shift, variable bandwidth tuning, sharp IF filters, noise blanker, stepped RF attenuator, 25 kHz calibrator, and many other features, providing more operating conveniences than any other ham-band receiver. The R-820 may be used in conjunction with the Kenwood TS-820 series transceiver, providing full transceive frequency control.

R-820

- **A S-METER** Easy-to-read, calibrated to S9 + 40 dB full scale and d
- **B STANDBY/RECEIVE SWITCH** Disables audio circuits during mit mode with associated transmitter.
- **C CALIBRATOR SWITCH** Built-in crystal calibrator, settable to provides signal every 25 kHz.
- **D NOISE-BLANKER SWITCH** A specially designed crystal filte nates noise pulses such as ignition-noise interference.
- **E MONITOR SWITCH** RF sampling allows user to hear his ow when using associated transmitter.
- **F AGC SWITCH** Automatic-gain-control circuit switchable to s fast response, or completely off.
- **G RECORD JACK** Makes recording off the air simple.
- **H HEADPHONE JACK** Provision for plugging in headphones.
- **I MODE SWITCH** Selection of AM, CW, upper or lower sid or RTTY.
- **J RF-ATTENUATOR SWITCH** 10 dB steps of attenuation fro 40 dB, to prevent overloading from nearby stations, and for signal comparison.
- **K DIGITAL HOLD** Locks counter and display while VFO is tu another frequency. Helps return to "hold" frequency.
- **L VFO/CRYSTAL SWITCH** Permits VFO control or crystal con four selectable frequencies.
- **M LED INDICATORS** Light-emitting diodes indicate activation o filter, crystal-controlled reception, VFO control, and RIT.
- **N DRS DIAL** Satin-smooth VFO tuning dial system provides ea log frequency readout (useful when digital hold is activated USB, and CW frequencies are accurately read from the same p
- **O NOISE-BLANKER LEVEL CONTROL** Controls level of blank maximum effect in eliminating noise interference.
- **P MONITOR CONTROL** Adjusts level of RF sampling
- **Q TONE CONTROL** Varies audio-output frequency response.
- **R TRANSCEIVE SWITCH** Selects frequency tuning from eit receiver or TS-820 series transceiver.
- **S VBT/SELECTIVITY CONTROLS** Separate controls on th shaft provide variable bandwidth tuning as well as selection IF filters: 250 Hz*, 500 Hz*, 2.4 kHz, and 6 kHz* (*optional). ters function in 455-kHz IF for superior shape factor.
- **T PRESELECTOR** Peaks tuned circuits in RF amplifier st increased selectivity and sensitivity. RF amplifier coil is dual
- **U RIT/NOTCH CONTROLS** RIT allows receiver to be tuned quency, while not affecting transmit frequency, when in tra mode with TS-820. Notch control tunes notch within IF pa for eliminating interference. Notch frequency remains the even when IF shift is utilized.



- **V IF SHIFT** Varies (shifts) IF passband away from interfering signal.
- **W AF GAIN/RF GAIN** Separate controls adjust volume and RF gain.
- **X RIT SWITCH** Allows tuning off frequency with RIT control, and return immediately to VFO frequency by pushing switch.
- **Y NOTCH SWITCH** Takes variable notch filter in and out of circuit.
- **Z BAND SWITCHES** Selects frequency bands from 15 MHz (WWV), 160 through 10 meters, the 49, 31, 25, and 16-meter shortwave broadcast bands, and an auxiliary band.
- **AA TRANSCEIVE/SEPARATE SWITCH** Enables receiver VFO to control the receiver and TS-820 (or TS-820S) frequency (or the TS-820 VFO to control both), or both can function independently.
- **BB POWER SWITCH** Turns receiver on and off.

arma

R-820 PERFORMANCE SPECIFICATIONS

Frequency Range:
- 160 meters (1.8-2.0 MHz)
- 80 meters (3.5-4.0 MHz)
- 40 meters (7.0-7.5 MHz)
- 20 meters (14.0-14.5 MHz)
- 15 meters (21.0-21.5 MHz)
- 15 meters (21.0-21.5 MHz)
- 10 meters (28.0-28.5 MHz)
- 10 meters (28.5-29.0 MHz)
- 10 meters (29.0-29.5 MHz)
- 10 meters (29.5-30.0 MHz)
- 19 meters (15.0 (WWV)-15.5 MHz)
- 49 meters (5.9-6.4 MHz)
- 31 meters (9.4-9.9 MHz)
- 25 meters (11.5-12.0 MHz)
- 16 meters (17.7-18.2 MHz)
- Auxiliary band

Modes: AM, CW, USB, LSB, RTTY

Sensitivity: 160-10 m, 19 m, SSB, 0.25 μV at 10 dB S+N/N
AM, 1.5 μV at 10 dB S+N/N
49, 31, 25, 16 m, SSB, 0.5 μV at 10 dB S+N/N
AM, 3.0 μV at 10 dB S+N/N

Selectivity: CW (with optional 250-Hz filter), 250 Hz (—6 dB), 500
CW (with optional 500-Hz filter), 500 Hz (—6 dB), 850
SSB (2.4-kHz filter), 2.4kHz (—6 dB), 4.4 kHz (—60 dB
AM (6-kHz filter), 6 kHz (—6 dB), 12 kHz (—60 dB)

Image Ratio: 160-10 m, 19 m, 80 dB
49, 31, 25, 16 m, 60 dB

IF Rejection: 160-10 m, 19 m, 90 dB
49, 31, 25, 16 m, 50 dB

Power Requirements: 100/120/220/240 VAC, 50/60 Hz, or 12-

Dimensions: 13-1/8" (333 mm)W x 6" (153 mm)H x 13-3/16" (33

Weight: 26.4 lbs (12 kg)

TRIO-KENWOOD COMMUNICATIO
1111 WEST WALNUT/COMPTON, CA

This NEW MFJ Versa Tuner II . . .

has SWR and dual range wattmeter, antenna switch, efficient airwound inductor, built in balun. Up to 300 watts RF output. Matches everything from 160 thru 10 Meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines.

BRAND NEW

$79.95

Antenna matching capacitor. 208 pf. 1000 volt spacing.

Sets power range, 300 and 30 watts. Pull for SWR.

Meter reads SWR and RF watts in 2 ranges.

Efficient airwound inductor gives more watts out and less losses.

Transmitter matching capacitor. 208 pf. 1000 volt spacing.

Only MFJ gives you this MFJ-941 Versa Tuner II with all these features at this price:

A SWR and dual range wattmeter (300 and 30 watts full scale) lets you measure RF power output for simplified tuning.

An antenna switch lets you select 2 coax fed antennas, random wire or balance line, and tuner bypass.

A new efficient airwound inductor (12 positions) gives you less losses than a tapped toroid for more watts out.

A 1:4 balun for balance lines. 1000 volt capacitor spacing. Mounting brackets for mobile installations (not shown).

With the NEW MFJ Versa Tuner II you can run your full transceiver power output — up to 300 watts RF power output — and match your transmitter to **any** feedline from 160 thru 10 Meters whether you have coax cable, balance line, or random wire.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

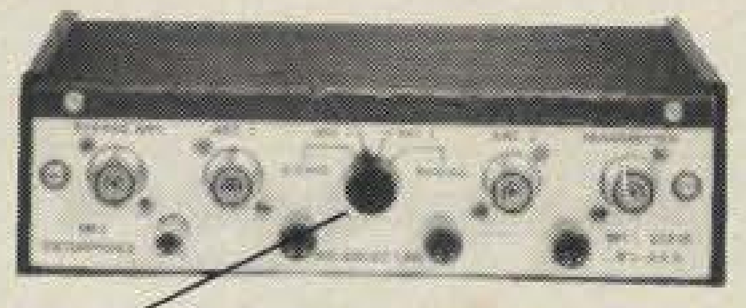
You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid state rigs (like the Atlas) and with all tube type rigs.

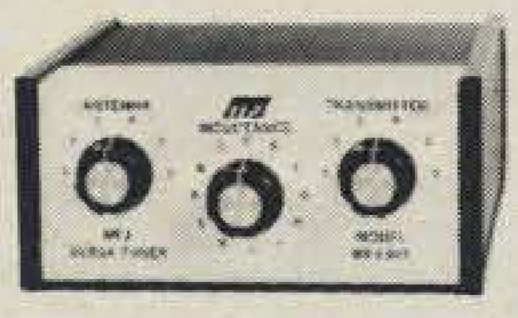
It travels well, too. Its ultra compact size 8x2x6 inches fit easily in a small corner of your suitcase.

This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas. Quality five way binding posts are used for the balance line inputs (2), random wire input (1), and ground (1).



ANTENNA SWITCH lets you select 2 coax fed antennas, random wire or balance line, and tuner bypass.



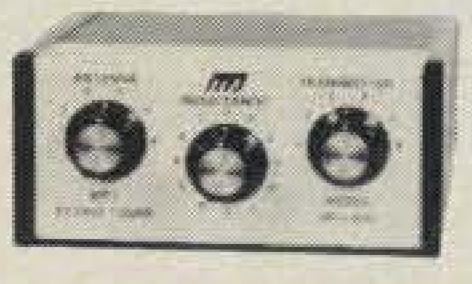
$59.95

BRAND NEW

MFJ-901 VERSA TUNER

New efficient air wound coil for more watts out.

Only MFJ uses an efficient air wound inductor (12 positions) in this class of tuners to give you more watts out and less losses than a tapped toroid. Matches everything from 160 thru 10 Meters: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balance lines, coax lines. Up to 200 watts RF output. 1:4 balun for balance lines. Tune out the SWR of your mobile whip **from inside your car.** Works with all rigs. Ultra compact 5x2x6 inches. SO-239 connectors. 5 way binding posts. Ten Tec enclosure.



$49.95

BRAND NEW

MFJ-900 ECONO TUNER

Same as MFJ-901 Versa Tuner, but does not have built-in balun for balance lines. Tunes coax lines and random lines.

$39.95

MFJ-16010 RANDOM WIRE TUNER

Operate 160 thru 10 Meters. Up to 200 watts RF output. Matches high and low impedances. 12 position inductor. SO-239 connectors. 2x3x4 inches. Matches 25 to 200 ohms at 1.8 MHz.

$39.95

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MFJ-400 8043 ECONO KEYER

MFJ brings you a reliable, full feature economy keyer using the famous CURTIS-8043 keyer-on-a-chip.

Panel Controls: Speed (8 to 50 WPM), pull-to-tune; volume, on-off; 3 conductor, ¼ inch phone jack for keying output and key paddle input.

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CIRCLE 32 ON READER SERVICE CARD

CIRCLE 50 ON READER SERVICE CARD

CQ

JULY, 1978 VOL. 34, NO. 7

The Radio Amateur's Journal

FEATURES

DEPARTMENTS

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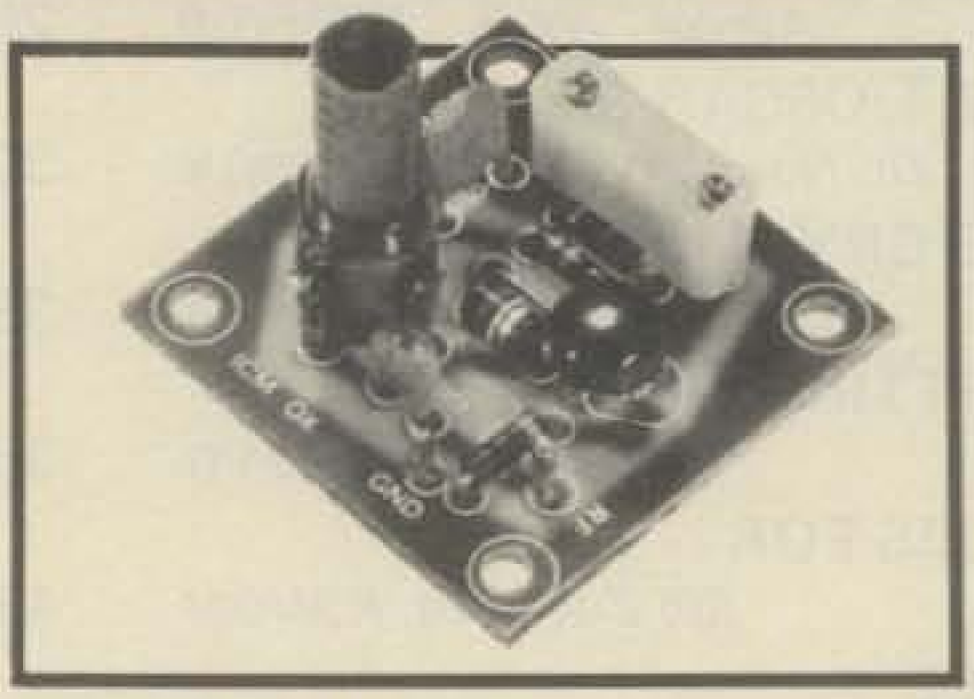
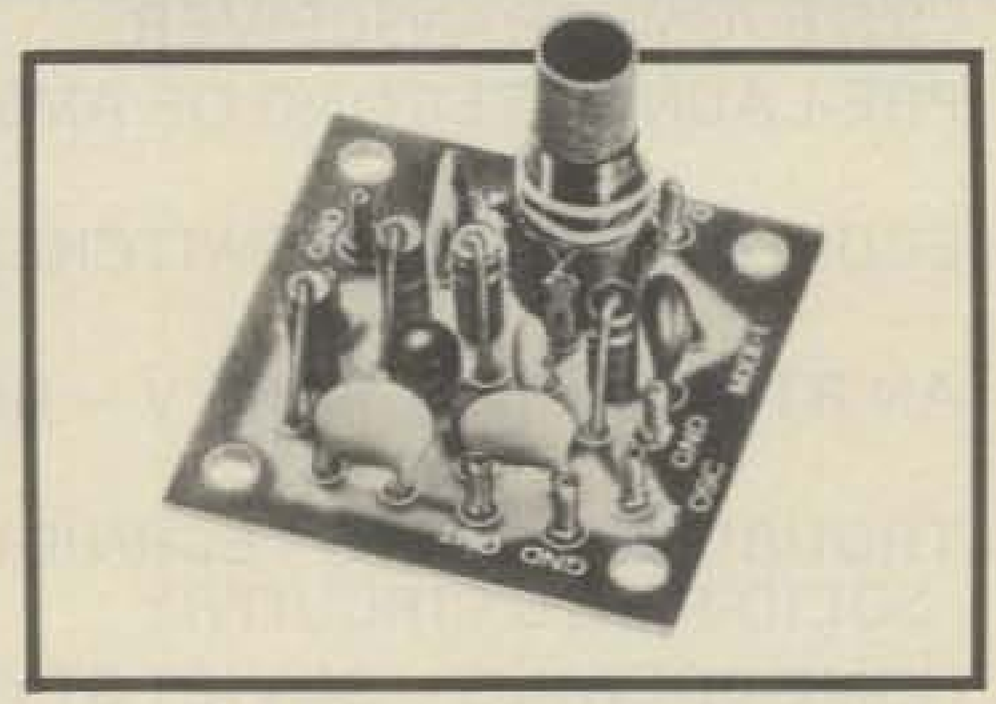


OX OSCILLATOR

Crystal controlled transistor type. 3 to 20 MHz, OX-Lo, Cat. No. 035100. 20 to 60 MHz, OX-Hi, Cat. No. 035101.
Specify when ordering.

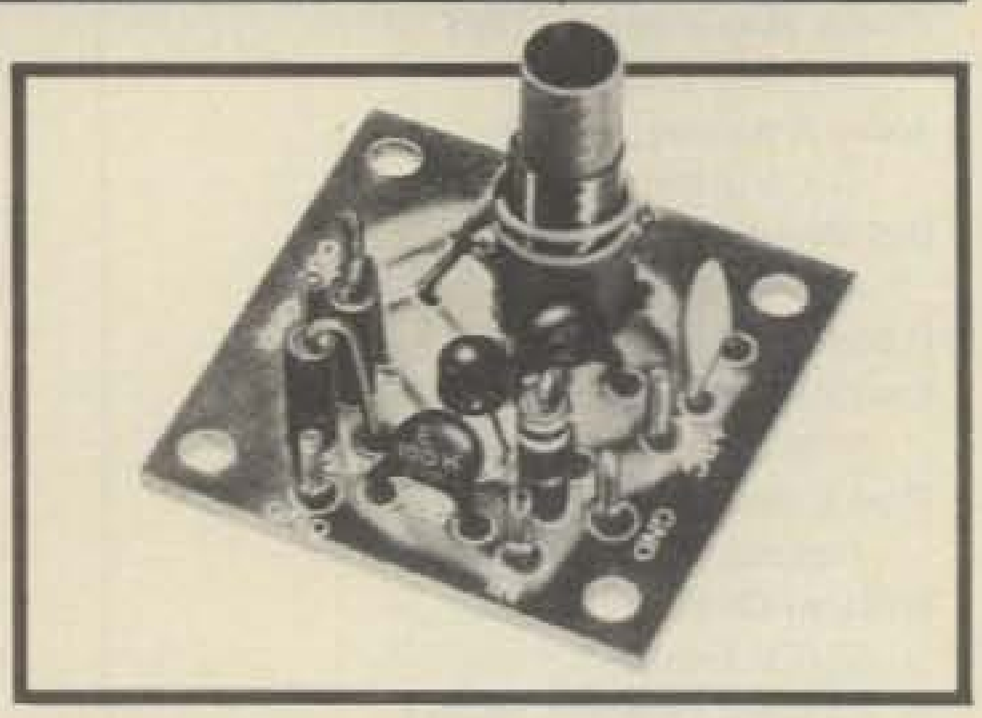
$4.95 ea.



MXX-1 TRANSISTOR RF MIXER

A single tuned circuit intended for signal conversion in the 30 to 170 MHz range. Harmonics of the OX or OF-1 oscillator are used for injection in the 60 to 179 MHz range. 3 to 20 MHz, Lo Kit, Cat. No. 035105. 20 to 170 MHz, Hi Kit, Cat. No. 035106.
Specify when ordering.

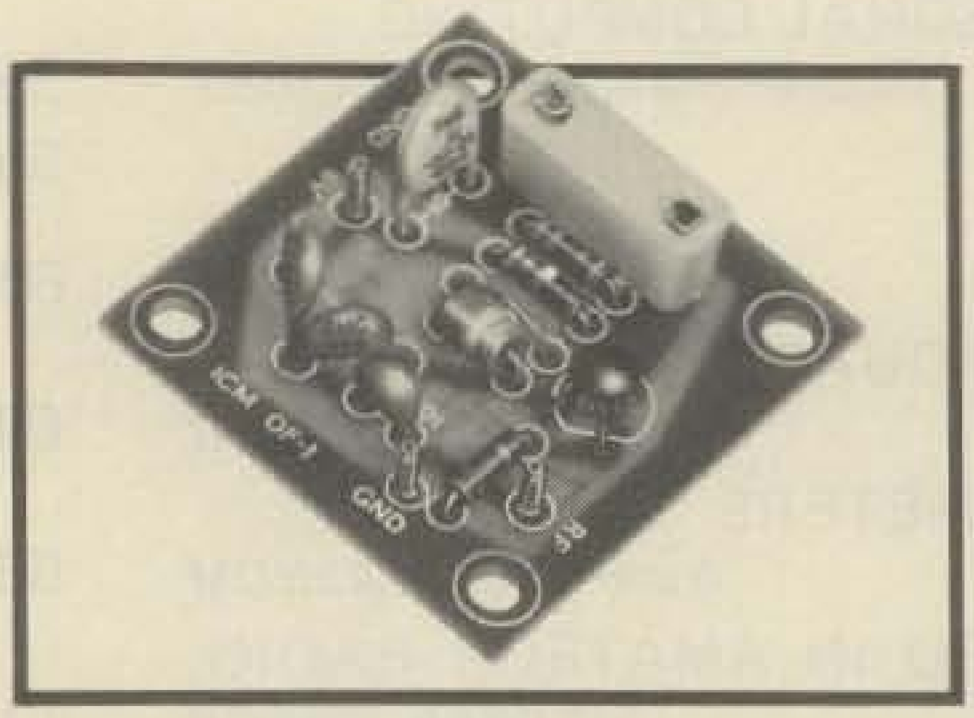
$5.50 ea.



PAX-1 TRANSISTOR RF POWER AMP

A single tuned output amplifier designed to follow the OX or OF-1 oscillator. Outputs up to 200 mw, depending on frequency and voltage. Amplifier can be amplitude modulated 3 to 30 MHz, Cat. No. 035104.
Specify when ordering.

$5.75 ea.



OF-1 OSCILLATOR

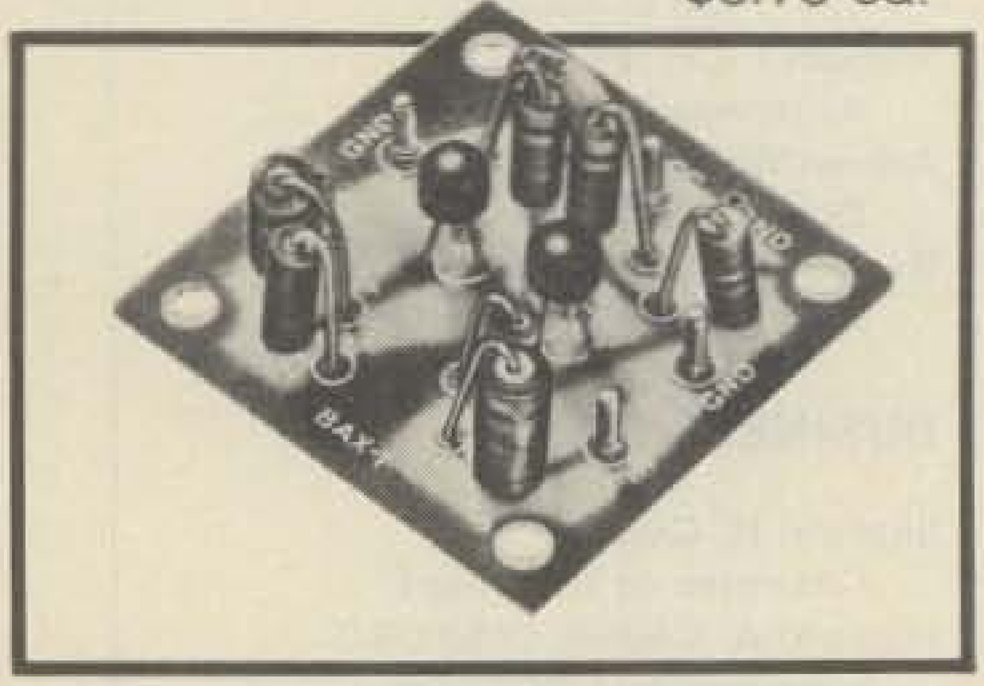
Resistor/capacitor circuit provides osc over a range of freq with the desired crystal. 2 to 22 MHz, OF-1 LO, Cat. No. 035108. 18 to 60 MHz, OF-1 HI, Cat. No. 035109.
Specify when ordering.

$4.25 ea.

SAX-1 TRANSISTOR RF AMP

A small signal amplifier to drive the MXX-1 Mixer. Single tuned input and link output. 3 to 20 MHz, Lo Kit, Cat. No. 035102. 20 to 170 MHz, Hi Kit, Cat. No. 035103.
Specify when ordering.

$5.50 ea.



BAX-1 BROADBAND AMP

General purpose amplifier which may be used as a tuned or untuned unit in RF and audio applications. 20 Hz to 150 MHz with 6 to 30 db gain. Cat. No. 035107.
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.02% Calibration Tolerance
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Shipping and postage (inside U.S., Canada and Mexico only) will be prepaid by International. Prices quoted for U.S., Canada and Mexico orders only. Orders for shipment to other countries will be quoted on request. Address orders to:
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CIRCLE 25 ON READER SERVICE CARD

Zero Bias

an editorial

By now a lot of you have realized that there is a great deal of difference between the First Amendment to the Constitution and the Communications Act of 1934. What we are guaranteed by one as a citizen of the U.S., we are restricted in by the other as amateurs. What I am referring to is the common concept of free speech; the right to speak openly and frankly on whatever crosses our minds. The First Amendment says we have it and specifically section 1464 of the Communications Act of 1934 says we *sort* of have it.

Section 1464 deals with what is called obscene, indecent and profane language. We could all conjure up words, thoughts and phrases which might fall into those categories. We might all agree in principle that such expression of thought has no place in amateur radio, and chose not to use it. But, Section 1464 legislates against the use of such language on the airwaves. It provides punishment for the transgressor. So, a philosophical and moral argument over the right to say what we please has been taken out of our hands and settled by government.

Recently, a local listner sponsored f.m. station in New York, WBAI, has sought redress to FCC action on this very principle. Several years ago they aired a record containing language which falls under Section 1464. A listener objected to having his child hear such language and complained to the FCC. In subsequent action, the FCC ruled against the radio station whereby the station appealed the decision to the Supreme Court where the case is being decided as this is written.

They, (WBAI), are in fact testing the validity of 1464 and the right of free speech with regard to the First Amendment. Part of the philosophy is that the airways belong to the people and as such should reflect what is topical in an unhampered form. They cited language used in great literature, works by Shakespeare, the Bible and other famous works as unpresentable on the airwaves because of 1464.

We, as amateurs can look at this and shrug our shoulders and say that it doesn't concern us, but actually it does. We are subject to the very same rules as commercial and public broadcasting. What the Supreme Court finally decides will in the long run affect us as much as NBC, CBS, ABC and WBAI.

If the airwaves, in fact, belong to the people, for their use in the broadest of terms, then it follows that the allocation of such airwaves could be looked at in terms of the most good. Our traditional view of ourselves in a sacrosanct position has been shaken in recent times by the CB phenomenon. We have seen the rise of CB as a hobby to the point of becoming a social necessity. We have experienced the hobby's jargon used in everyday speech. The aculturation process is complete, the *people* now view the "social necessity" as we view the telephone . . . it's there.

Amateurs traditionally have reacted to such change with anger over what "they" are getting away with and a mixed bag of frustration and I think envy over what is happening in the civilian world. We have in the past fostered the special mystique of amateur radio shrouded in examinations, Morse code and hurdles we overcame (and enjoyed) to get where we are. Well, where we are is now in a state of flux. The times are indeed "a-changin".

We as a group have been singled out to pay the price for most of the RFI and TVI problems. The people spoke, the Government listened and we pay. It's history and I won't rehash it for you here. Just keep in mind that whatever the Supreme Court decides with this case, more history is being made.

This is not a story of doom and gloom or something that can be passively accepted or rejected. It's the way things are, but not the way they could be. What WBAI is doing may or may not sit well with us or be the kind of thing we could champion. The net result will be something we will have to live with. On the other hand, it does show all of us that a relatively small organization can take on the FCC, can present their side to the Supreme Court and not arbitrarily accept being due processed to death.

We can't return to yesterday and can't rely on tomorrow being better without some help. If and when "free speech" becomes freer, it and all that it implies won't take long to filter down to us. Being angry, irate and vindictive never changed anything. Remember, you don't have to listen to any radio program or talk to any amateur you don't want to. That's "free choice", and that's another story.

73, Alan K2EEK

Announcing

• **South Haven, MI** – The Black River Amateur Radio Club will be operating a Special Event Station during the National Blueberry Festival in South Haven on July 20-23, 1978. The call of the Station will be W8IGV. The station will operate on or near the following frequencies: 3.975, 7.275, 14.275, 21.375, 28.675, 29.475 (OSCAR), and randomly throughout the Novice subbands. Any station working W8IGV during this period can receive a colorful, post-paid certificate by mailing a QSL to: The National Blueberry Festival, P.O. Box 224, South Haven, MI 49090.

• **Marshall, MO** – The Indian Foothills Amateur Radio Club's Third Annual Hamfest will be held on Sunday, July 23, 1978 at the Saline County Fairground's air-conditioned multi-purpose building in Marshall. Registration is $2.00 in advance and $2.50 at the door. Flea markets for the OM and XYL. Tables for a small charge. For additional info and advance tickets contact: Jim Little, WD0BPG, 405 East Rosehill, Marshall, MO 65340 or call (816) 886-8583.

• **Missoula, MT** – The International Glacier-Waterton Hamfest will be held on July 15-16, 1978 in the West Glacier Area. Location will be the Three Forks Campground, 10 miles east of Essex on U.S. Highway 2. Registration begins at 9:00 a.m. MST. For more info, write: The International Glacier-Waterton Hamfest, P.O. Box 2225, Missoula, MT 59806.

• **McKeesport, PA** – The 14th Annual Hamfest of the Two Rivers Radio Club is scheduled for July 23, 1978. The site will be the Green Valley Fire Department Fairgrounds off of U.S. Route 30 near East McKeesport. For more info, contact: Andrew Salitros, W3OFM, 2901 Stewart St., McKeesport, PA 15132.

• **Bowling Green, OH** – The Wood County's 14th Annual Ham-A-Rama will be held on Sunday, July 16, 1978 at the Fairgrounds in Bowling Green, (just off I-75). Gates open at 10:00 a.m. Admission and parking are free, tables available for $3.00, or an 8 foot space for $2.00, (advance table or space rental to dealers only). K8TIH talk-in on 146.52 simplex. Tickets are $1.50 in advance, $2.00 at the door. For more info, write: The Wood County Amateur Radio Club, c/o Eric Willman, 14118 Bishop Rd., Bowling Green, OH 43402.

• **Kingsford, MI** – The 30th Annual U.P. Hamfest, co-sponsored by the Great Northern Repeater Association and the Mich-A-Con ARC of Iron Mountain-Kingsford, will be held on Saturday, July 29 and Sunday, July 30, 1978 at the Dickinson County Armory on M-95 in Kingsford. Registration will begin at 9:00 a.m. on both days. Tickets are $2.50 in advance and $3.00 at the door. Plenty of free parking. Prizes galore! Talk-in will be on 146.25/85 and 3922. For more info, write: UP-HAMFEST 78, Box 2056, Kingsford, MI 49801.

• **Palmyra, IL** – The Quad-Co. Amateur Radio Club will be sponsoring the 21st Annual Hamfest of the "Breakfast Club" on Jly 15 and 16, 1978 at Terry Park, 3/4 mile east of Palmyra. Mobile talk-in on 3973 kHz, 7 52 simplex, from noon Saturday until 4 p.m. Sunday. Pre-registration until July 7 is $1.50; $2.00 at the gate. Write "HAMFEST", c/o Quad-Co. ARC, Box 81, Chatham, IL 62629.

• **Salem, OH** – The Kent State Salem Amateur Radio Club will be holding a Hamfest on July 23, 1978. The Main door prize will be the Ten-Tec no. 540 transceiver, courtesy of KenMar Industries. Doors open at 9 a.m., prize drawing at 3 p.m. Admission is $2, wives and kid under 12 free, flea market $1, and tables are $5. Talk-in on 146.10-70. For more info contact: W8JPG, 147.27, Milhoan Electronics, 1128 West State St., Salem, OH 44460.

• **Charleston, SC** – On July 8th and 9th, 1978, the 5th Annual Charles Towne Hamfest will be held at the Gaillard Municipal Auditorium. There will be displays and a swap meet on both days. For more info, contact: The Charles Towne Hamfest Committee, P.O. Box 4555, Chas. Heights, SC 29405.

• **Indianapolis, IN** – The Indianapolis Hamfest will be held on Sunday, July 9, 1978 at the Marion County Fairgrounds S.E. corner in Indianapolis. Gates open at 6:00 a.m. to 4:30 p.m. There will be professional commerical exhibiting, a covered flea market, and an unlimited outdoor flea market. For more info, write: Indianapolis Hamfest, P.O. Box 1002, Indianapolis, IN 46206.

• **Arlington, VA** – The Amateur Computing 78 Microcomputer Festival will be held on July 22-23, 1978 at the Sheraton National Motor Hotel in Arlington. For more information on Amateur Computing 78 write to: AMRAD, P.O. Box 682, McLean, VA 22101.

• **Rapid City, SD** – The Black Hills Amateur Radio Club will be holding their Annual South Dakota Hamfest on July 1-2, 1978 at the Surbeck Center on the campus of the South Dakota School of Mines and Technology in Rapid City. Technical forums, ARRL forum, flea market, and industrial tours will be featured. The grand prize will be the Kenwood TS-520S. Admission will be $5.00 at the door. For more info and/or assistance with reservations, write: The Black Hills ARC, Box 1014, Rapid City, SD 57709.

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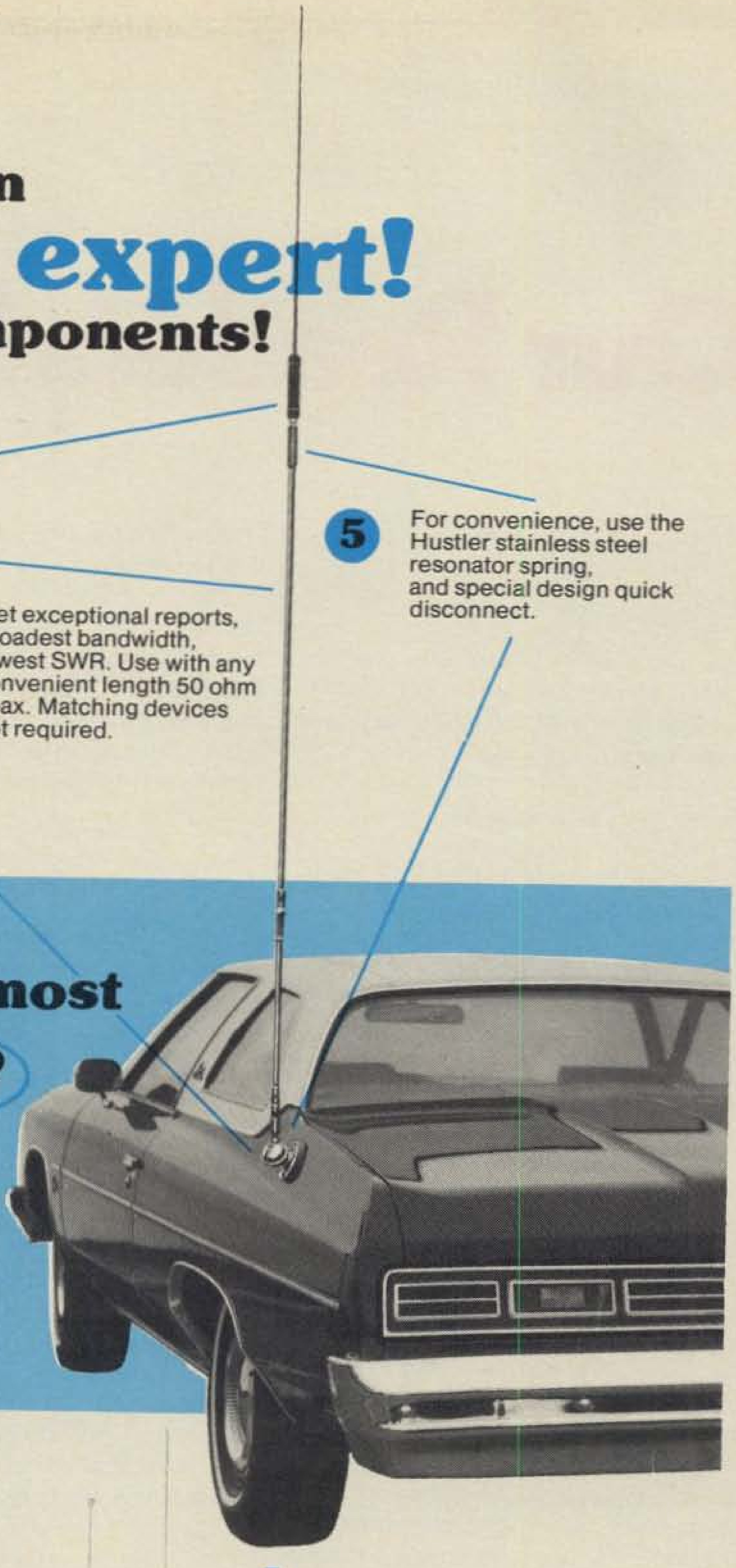

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CIRCLE 35 ON READER SERVICE CARD

Our Readers Say

Wighting A Wrong

Editor, CQ:

In response to those who read my article "Metamorphosis of CQ", which appeared in the March 1978 issue and caught the error:

Thanks to those who write
To those who wish it better
It's too late to make it right
Or blame the printer
Of course it is the Isle of Wight
It's wrong to name another
There is no isle of Wright!

Norris K. Maxwell
Stillwater, OK

Teutonic Trickery

Editor,CQ:

Having just read Professor Heisseluft's fine thesis on contest operator selection using biorhythm techniques, I did notice one small omission due, no doubt, to excessive zeal on the part of the editorial staff.

Certainly, the second paragraph should have read "Only those operators whose charts are in favorable state (e.g. MD, NY, PA, VA), (correction emphasized), are permitted to operate . . ."

Those of us west of the codfish curtain know that the best E state is worth less when propagation is via F_2.

Chip Margelli, K7JA
Tokyo, Japan

Editor, CQ:

I read the April 1978 article on Biorhythm Charts by Professor Heisseluft. I found it to be "Quatsch". As you know, "Quatsch" in German means "throwing" the bull or pure baloney". If I remember my German lessons, the Professor's name means "Hot Air". "Grossmaul-an-der-Donau" means "big mouth on the Danube". The D.O.S.E. award given to the Professor obviously was presented due to people who became "eingeschlafen" from the Professor's articles and dissertations.

"Doc", WB2IWH
Cliftom, NJ

Sets An Even Course

Editor, CQ:

I am a 48 year old bricklayer and a collector of vintage radios. I have recently discovered the pleasures of ham radio. On August 5, 1977, I received my Novice ticket and on February 24, 1978, I passed my Extra exam. With 6 months of band work and dedication to purpose, I now have the coveted Extra class.

My hope is that a ham somewhere may decide to stay in ham radio or to upgrade with the knowledge that it is possible.

I have applied for a 1 x 2 call sign and am now working 20 meter DX.

Carl Elkins, WD4KWQ
Nashville, TN

Helping Hand Needed

Editor, CQ:

First of all, I'd like to thank you for putting an excellent magazine out. It is an aid in my studies for the general license here in Canada. I'm going it alone and have found several articles that cleared the fog in rough areas.

I have a rig; a Morrow MB-560A transmitter and an MBR-5 receiver with power supply which I don't know much about. The receiver is invaluable for W1AW code practice but when I have the license, I would like to fire the rig up for at least a couple of contacts.

What I would like to know is if any readers who know anything about this unit would care to help out. Otherwise, I intend to put it on the shelve as there is enough interference on the air.

Anyway, thanks again for putting the magazine out; keep up the good work.

Bill Morrison
RR no. 3, Shelburne
Ontario Canada L0N 150

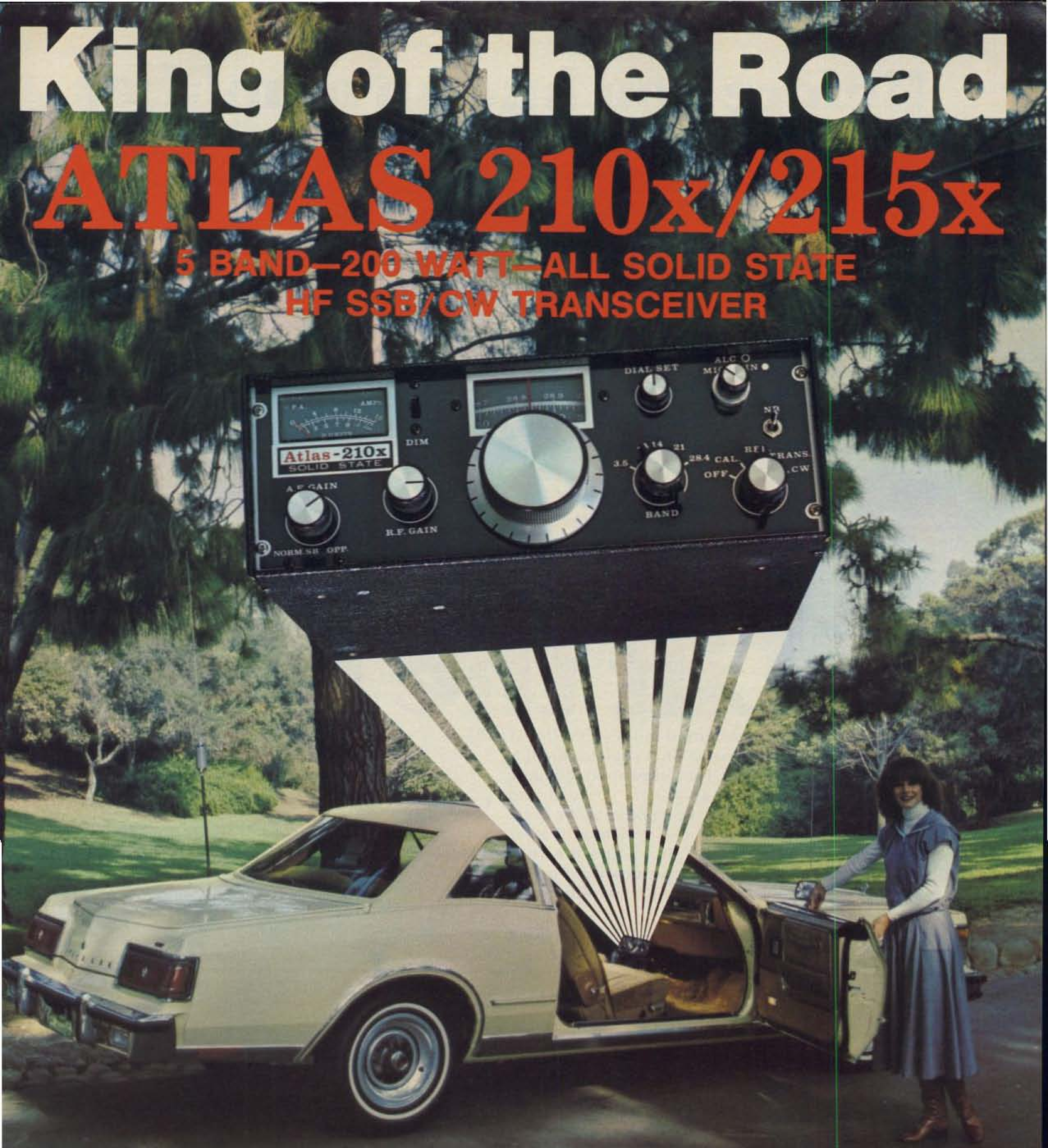
RF (you and) I

Editor, CQ:

My one year of CQ is almost up and I felt I must thank you for an enjoyable year. I am not an amateur but I really enjoy tinkering with radios. I had read different amateur literature and got the impression that amateurs were starting to hate CBers. I started out with CB at a young age with radio control boats and when I was old enough, I got a CB that had one plug-in crystal in the front and built from there. I was therefore very impressed with your articles on CB and amateur RFI. After years of CB and many nights of SWL, I have a good ear and it is not uncommon for me to hear police calls, phone calls, CW and other yet unknown QRM on my TV. Your features on RFI and the league and FCC proposals to stop it are right. They won't work until John Q. Public finds out that the sound or lines on his TV are not those CBers or amateurs again but could be the neighbors' mixer, vacuum cleaner, a passing car, or their local police.

Keep up the good work.

John C. Daenzer/KXD 1364
Jacksonville, AR



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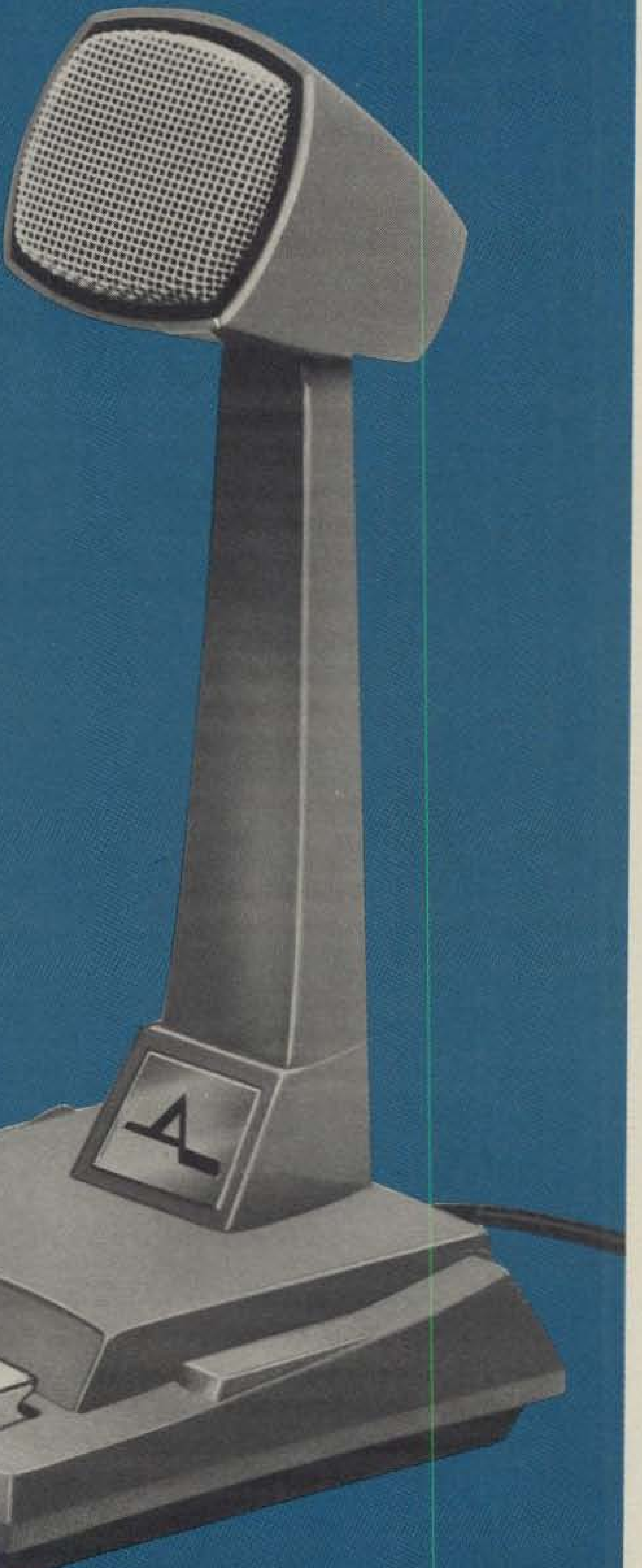

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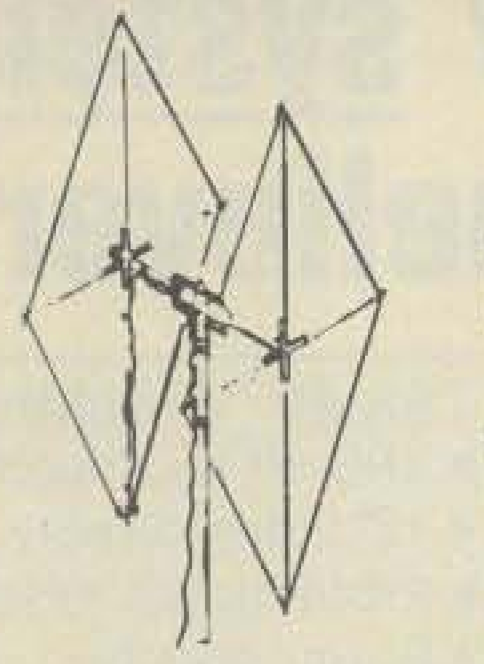

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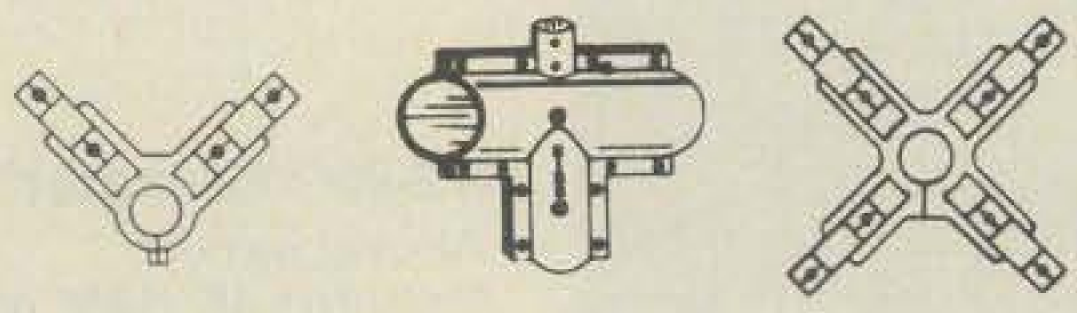

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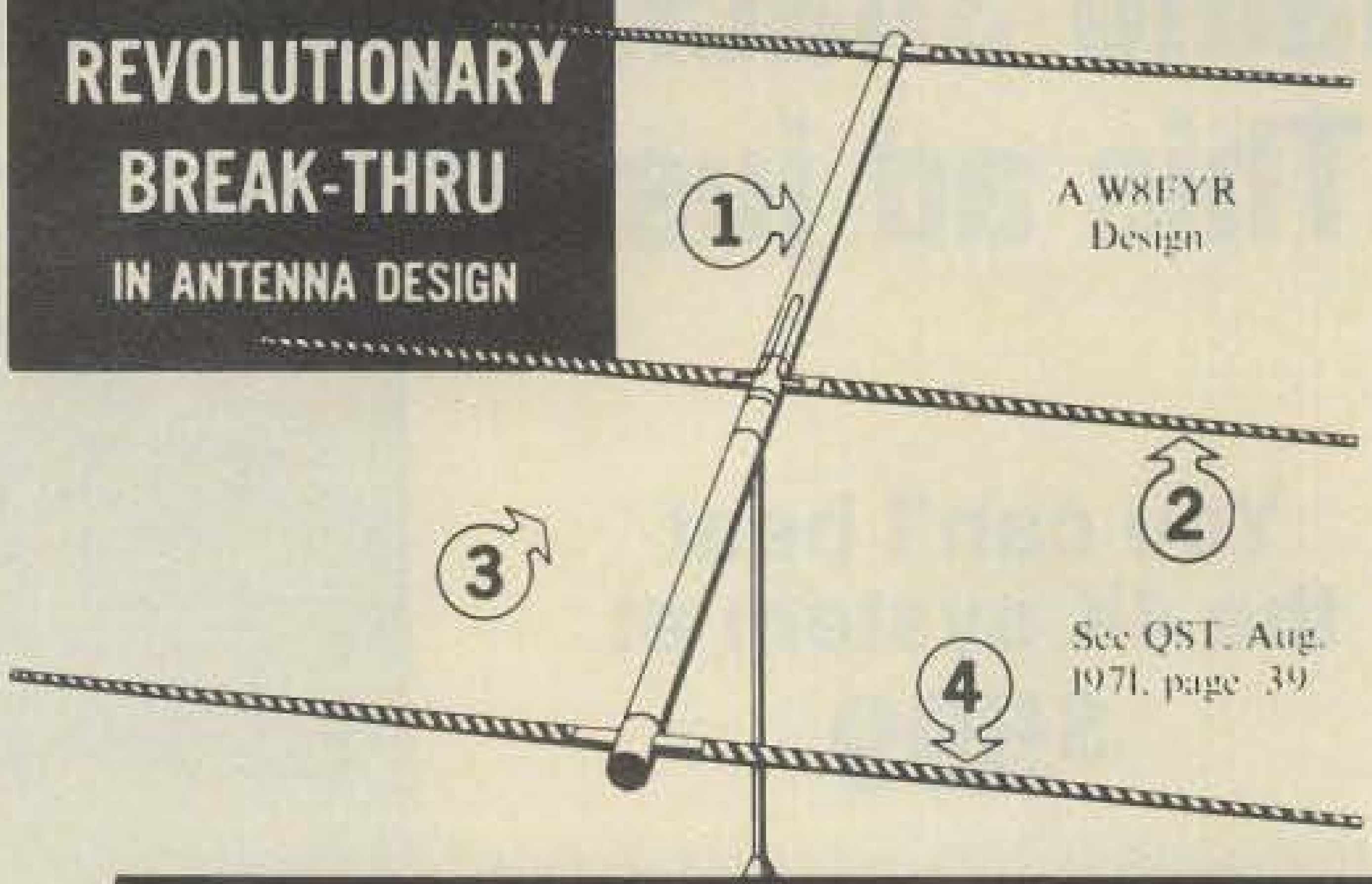

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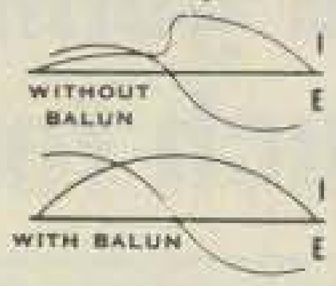

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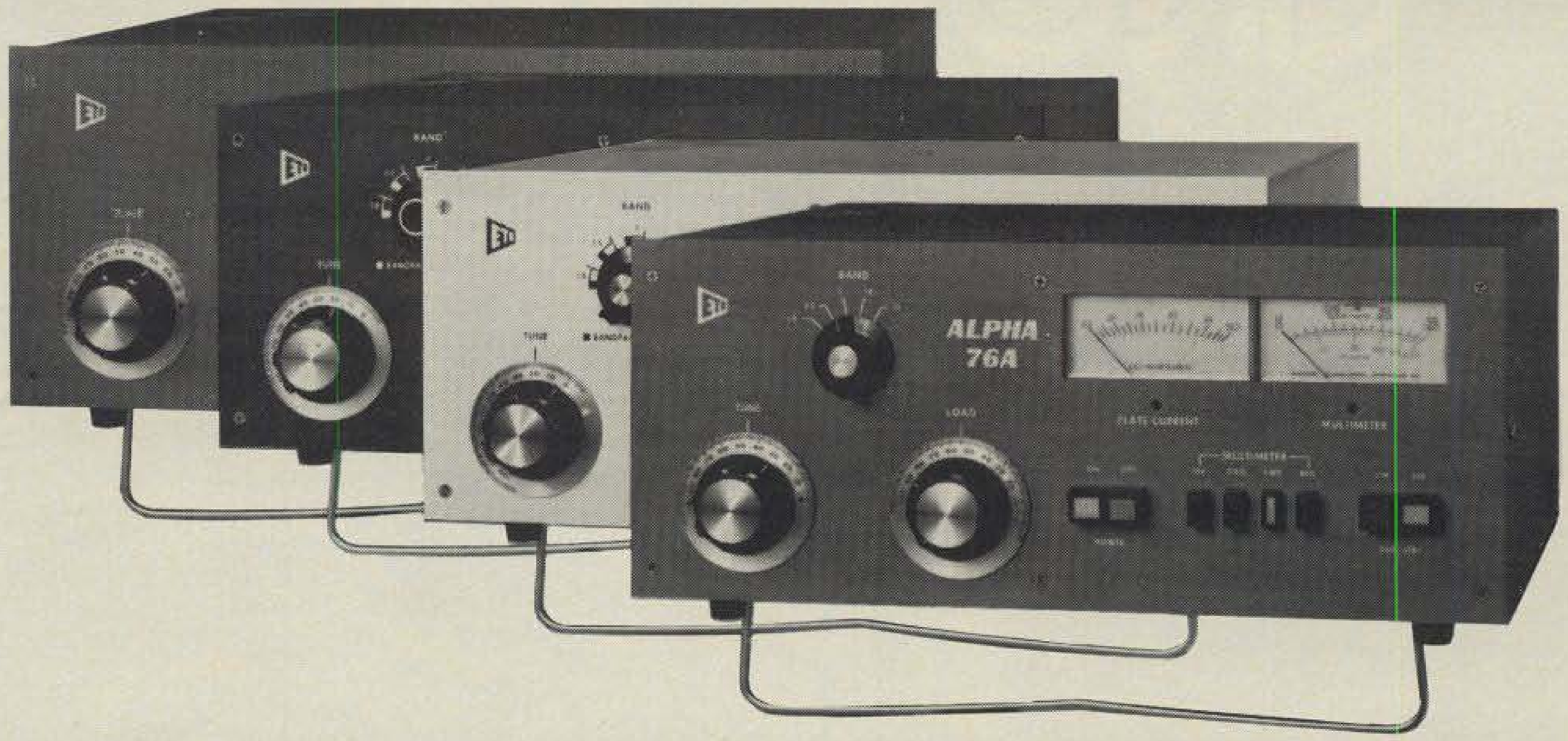

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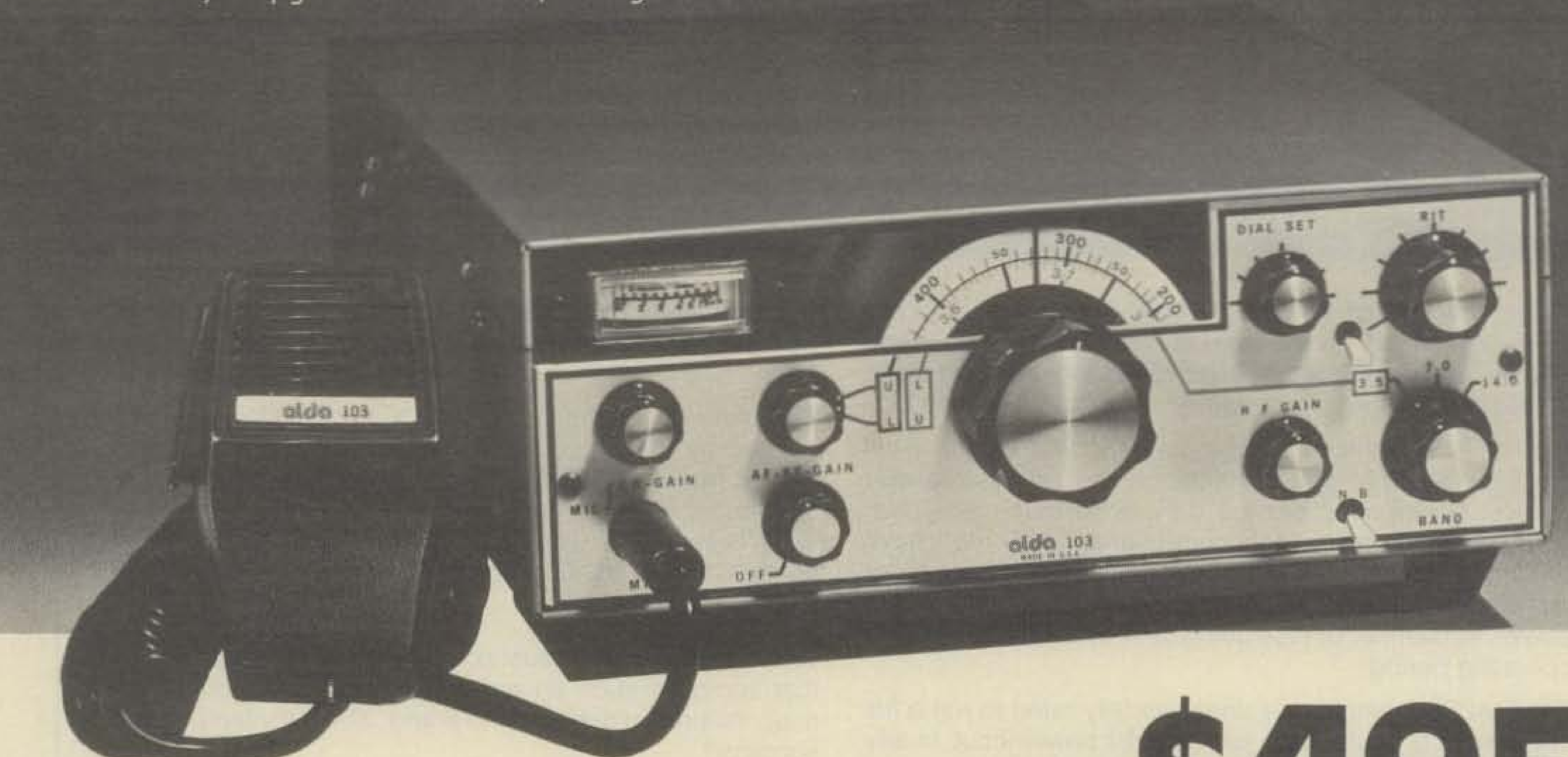

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Power Requirements:	Nominal 13.8 VDC input at 15 amps, negative ground only
Power Consumption:	Receive — 5.5 watts (includes dial and meter lamps); Transmit — 260 watts
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Weight:	8-1/4 lbs. (3.66 kg)

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Frequency Range:	80 meter band — 3.5 to 4.0 MHz 40 meter band — 7.0 to 7.5 MHz 20 meter band — 14.0 to 14.5 MHz
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RF Input Power:	SSB — 250 watts PEP nominal CW — 250 watts DC maximum (adjustable)
Transmitter:	
Antenna Impedance:	50 ohm, unbalanced
Carrier Suppression:	Better than −45 dB
Side-Band Suppression:	Better than −55 dB at 1000 Hz
Distortion Products:	Better than −26 dB
AF Response:	500 to 2500 Hz
Spurious Radiation:	Harmonics better than −45 dB below 30 MHz; better than −60 dB above 30 MHz
Frequency Stability:	Less than 100 Hz drift per hour (from a cold start at room temperature)
Microphone:	High impedance 3000 ohm
Receiver:	
Sensitivity:	Better than 0.5 watts audio output for 0.5 µV input
Signal-to-Noise Ratio:	Better than 10 dB S+N/N for 0.5 µV input
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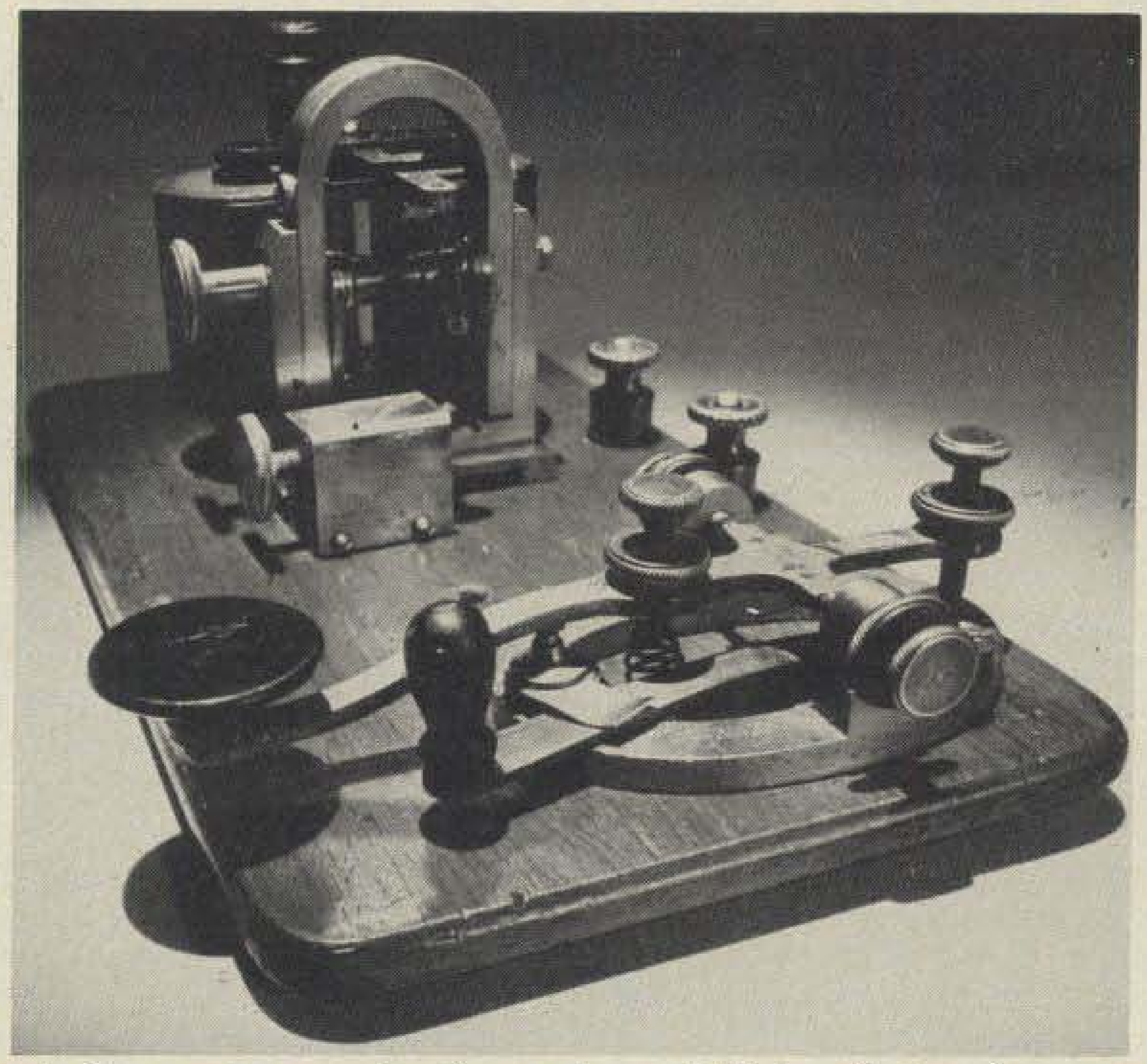
COLLECTAHOLICS*

*People who have an uncontrollable urge to collect one of everything.

By Alan M. Dorhoffer*, K2EEK



When Vail and Morse were busy devising the telegraph and Morse code, there was probably someone sifting through their trash-bin looking for something that would be worth a great deal of money in years to come. A scrap of paper, a piece of unfinished equipment a packing box, periodicals and catalogs all have intrinsic value.

Tradition is in. It has become fashionable and fun to begin collecting artifacts of many periods, and to display these as decorations in our homes. Societies and organizations spring up whose intent is to preserve a sense of history, while providing a common meeting ground for people with similar interests. Recognized experts arise in very esoteric areas, and before you know it an entire subculture exists, whose consuming passion is the preservation for antiquity of narwhal horns.

Amateur radio is no different. There is an ever-growing element of collectors garnering every gem connected with electricity and electronics. Come summer, the country-side is scoured for garage sales, flea markets and hamfests with flea markets to root out the "mint" whatever. Classified ads (including mine) abound, seeking out or selling something to enhance a collection.

Our cover this month would enhance most any collection and would certainly be a conversation piece when displayed, especially at your QTH.

The photo shows a J.H. Bunnell Co., Main Line Sounder. The New York based company manufactured the sounder after the turn of the century and it was used by the press, railroads and the military as a portable means of connecting into the main circuit. This eventually led to the elimination of relay systems, local sounders and local battery systems (many of which are on collectors shelves now).

Think of the fun you can have going through some old magazines or catalogs. Imagine what it would take to restore an old piece of equipment to working order, or the thrill of locating something brand new that was stored away in an attic years ago and forgotten; Who bought it? Who used it? Each crease, scratch and dent adds to the history and lore.

Remember, amateur radio is still basically in it's infancy. Although technology has increased tremendously in a very short time, the time span we are collecting from is relatively short. There is still material around and more to be found that is worth collecting and preserving. It's a lot of fun and a very good investment if you're careful.

The next time someone offers you Fessunden's tooth brush, think about it and if you can't use it, let me know.

*Editor, CQ

Our cover photo comes from the Collection of Canadian National, Toronto. It is reproduced with permission of "In Search" magazine, Department of Communications, Ottawa, Canada.

In this interesting article, John Nagle discusses the theory and operation of an instrument which measures Q. He also talks about some frequently seen, but not so generally understood, electronics terms.

The General Radio 821 R.F. Admittance Bridge (A Poor Man's Q-Meter) Part 1

BY JOHN J. NAGLE*, K4KJ

CQ readers are always interested in test equipment that is low in cost and which can be used around the shack for a variety of measurements. One such instrument is the General Radio 821 R.F. Admittance Bridge. This instrument complements the GR-916/1606 family of r.f. impedance bridges[1,2] in that the 916 measures low impedances (up on to 1000 ohms), while the GR-821-A measures high impedances, at least 1000 ohms and up, depending on the frequency (actually zero to 3000 μmhos conductance, as I will explain later). Under some circumstances it can directly measure some relatively low impedances such as an electrically short antenna or other high-Q circuits. Admittances outside the normal range of the instrument can usually be measured by placing a high reactance in series with the unknown device.

The merits of the 821 have gone relatively unnoticed by the amateur community as evidenced by the comparatively low price of this instrument. My own GR-821-A cost $50 several years ago in "hardly used" condition; I saw one for $35 at the Gaithersburg, Maryland Hamfest in 1975 in acceptable condition. The used test-equipment houses list this instrument from $150 to $425. Most of the prices I have seen are less than one-third to one-quarter the price for a GR-916/1606 instrument. Yet, the GR-821 is just as useful as the GR-916/1606.

One possible reason for the relatively low price is that the 821 reads in "funny units," i.e., admittance, mhos, conductance and susceptance . . . units with which the amateur community is not too familiar. While these units are perfectly valid for describing the behavior of electronic components, they are new to many amateurs who are more familiar with the terms, impedance, ohms, resistance and reactance.

This article will describe the GR-821, its operation, and some of the measurements you can make with it. Appendices will show how to use the "funny units" directly or to convert them into more common engineering terminology. Programs for doing this on a programable calculator will also be given.

*12330 Lawyers Road, Herndon VA 22070

First, what does the instrument actually measure and how do we use the data? General Radio called the instrument a "Twin-T-Impedance Measuring Circuit." The word "Impedance" is a misnomer; the 821 actually measures conductance and susceptance which are the two components of admittance. A more accurate name would be **Twin-T Admittance Measuring Circuit.** This, however, is rather long-winded so I will refer to the 821 simply as an **admittance bridge,** recognizing that the word "bridge" is not accurate either, but is shorter than *Twin-T Measuring Circuit.*

All amateurs are familiar with Ohm's law written in the form

$$E = IZ \qquad (1)$$

where E is the voltage across an impedance in volts and I is the current flowing through the impedance in in amperes. Z is the impedance in ohms and is expressed as

$$Z_s = R_s \pm jX_s \text{ ohms} \qquad (2)$$

The use of impedance the expression implies a *series* combination of a resistance and reactance as shown in fig. 1. If the reactance is inductive, it has a plus sign; if the reactance is capacitive, a negative sign is used. Mathematically speaking, equation (2) is a complex number, as evidenced by the imaginary operator j in front of the reactive terms, so that impedances must be manipulated in accordance with the laws of complex numbers. This will not pose any problem, though, in the work we will be doing.

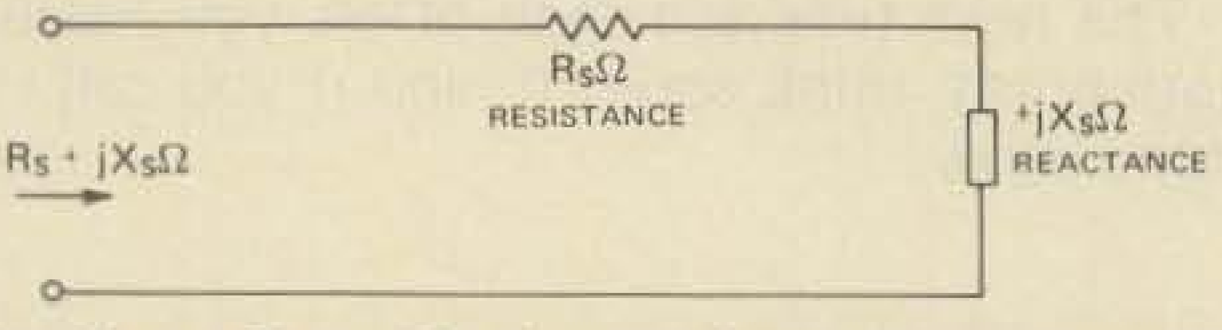


Fig. 1 – $Z_s = R_s \pm jX_s$ ohms defined series connected resistance and reactance.

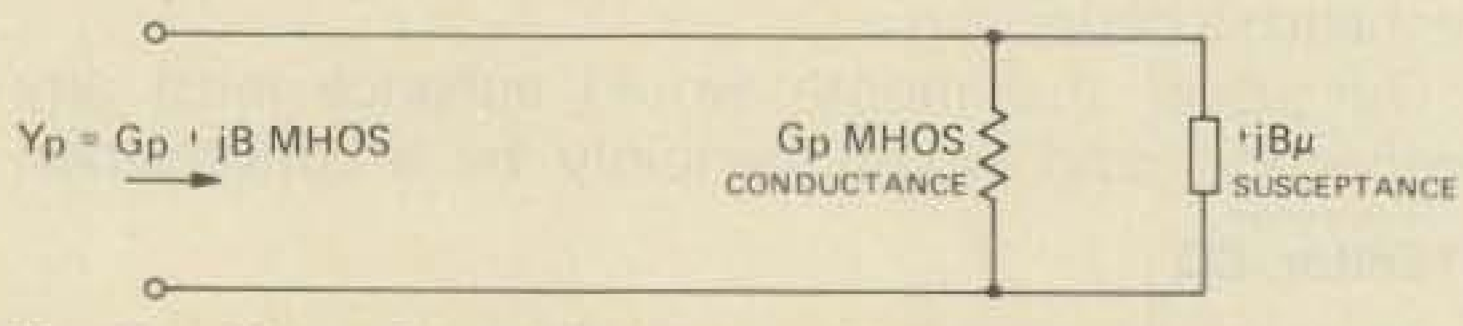


Fig. 2 – $Y_p = G_p \pm jB$ mhos defines parallel connected conductance and susceptance.

Ohm's law may also be written

$$I = EY \qquad (3)$$

where Y is the admittance in mhos and

$$Y_p = G_p \pm jB_p \text{ mhos} \qquad (4)$$

Here Y_p represents a parallel combination of conductance and susceptance, as shown in fig. 2.

The unit of admittance is **mho**—ohm spelled backwards. The conductance, G, in the admittance form is the analog of resistance (R) in the impedance form of equation (2); in the physical world they both dissipate energy. Mathematically, both terms represent the real part of a complex number. Similarly, the susceptance $\pm$ jB in equation (4) is the analog of reactance $\pm$ jX in equation (2); they both represent the imaginary part of their respective equations. There is one important difference, however: inductive reactance is positive while inductive susceptance is negative.

It is important to realize that $Z_s = R_s \pm jX_s$ mathematically describes a resistance and reactance connected in series and not in parallel. Similarly, $Y_p = G_p \pm jB_p$ describes mathematically a conductance and susceptance connected in parallel, not in series. To emphasize this, I put a subscript s for series connection, on the impedance equation and a subscript p for parallel connection, on the admittance equation. The s and p should not be necessary, so I will not continue to use them.

There are equations to transform impedance into admittance and *vice versa;* I will derive these in the Appendix. For the moment, it is enough to say that the 821 admittance instrument measures the value of the two components of admittance, as shown in fig. 2 and equation (4).

A photograph of the GR-821-A is shown in fig. 3. The *Conductance* dial is toward the upper right-hand portion of the panel. The susceptance value is determined by a precision variable capacitor which is seen just to the right of the row of push buttons along the left-hand edge of the panel. This precision variable capacitor has a range of 100 to 1100 pF and has dial indications every 0.2 pF; it can be read to 0.1 pF, although the specified accuracy is less than this. The row of pushbuttons is used to place sufficient capacity in parallel with the variable capacitor to obtain an initial balance; the two controls marked *Frequency Range* must be set to the desired positions depending on the frequency at which the measurement is to be made.

The basic schematic of the 821 is shown in figs. 4 and 5. Figs. 4(a) and 4(b) show two T-networks which are connected in parallel, as shown in fig. 5; hence, the name, *Twin-T network*. The variable capacitor C_G is the conductance dial while C_B is the precision variable capacitor used to obtain susceptance measurements. When the two T-networks are adjusted so that transmissions through them are equal in magnitude, but opposite in phase, a null will be obtained at the detector and the instrument is said to be *balanced*.

Since one side of the generator, as well as the detector and the unknown component are all at ground potential, no transformers are needed, a fact which simplifies operation and maintenance of the instrument.

Like the GR-916/1606 family, the GR-821-A uses the substitution principle in making a measurement. A null is first obtained with the "Unknown" terminals open-circuited. This is called the *initial balance*. The device to be measured is then connected to the terminals and the 821 is rebalanced. The difference in dial readings between the initial and final balances of the respective dials gives the conductance and susceptance of the device under test. As the only instrument components that are varied between the initial and final balances are two air-dielectric precision variable capacitors, and since this type of component is inherently stable (i.e., not subject to drift with time), the calibration of the instrument can be expected to remain constant. This is an obvious advantage when buying a used instrument.

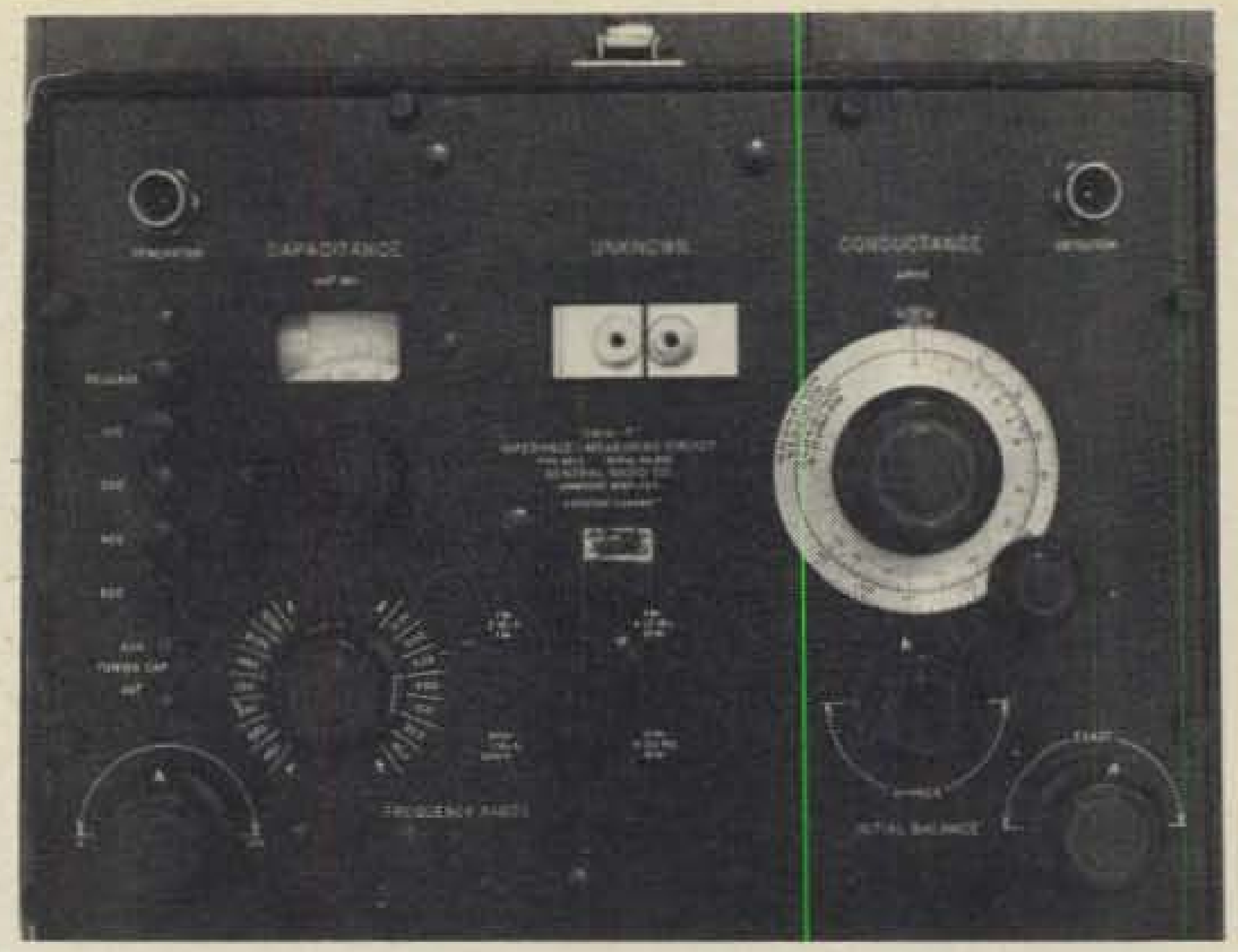


Fig. 3 – A top view of the General Radio 821-A Twin-T Impedance Measuring Set.

Those with access to a good technical library may be interested in two papers by General Radio Company engineers: Tuttle[3] discusses the bridge-T and parallel-T circuits for radio-frequency measurements; a later paper by Sinclair[4] explains the design of the 821 and why it is built the way it is. These two papers, particularly the latter, provide helpful background information for users of the 821-A, information that is not covered in the instruction manual. Both papers are very readable and should be of interest to those engaged in impedance measurements at radio frequencies.

Making measurements with the instrument is relatively straight forward: connect a signal generator and a well-shielded receiver, preferably one with a coaxial antenna terminal, to the appropriate terminals of the 821-A. A frequency counter may be connected in parallel with the signal generator when it is necessary to know the frequency accurately.

The next step is to obtain an initial balance. The initial balance controls are set to their mid-range position; the conductance dial set to zero. The two frequency range switches are set to include the desired measurement frequency.

The required capacity to obtain an initial balance at the desired frequency may be estimated from the graph in fig. 6,

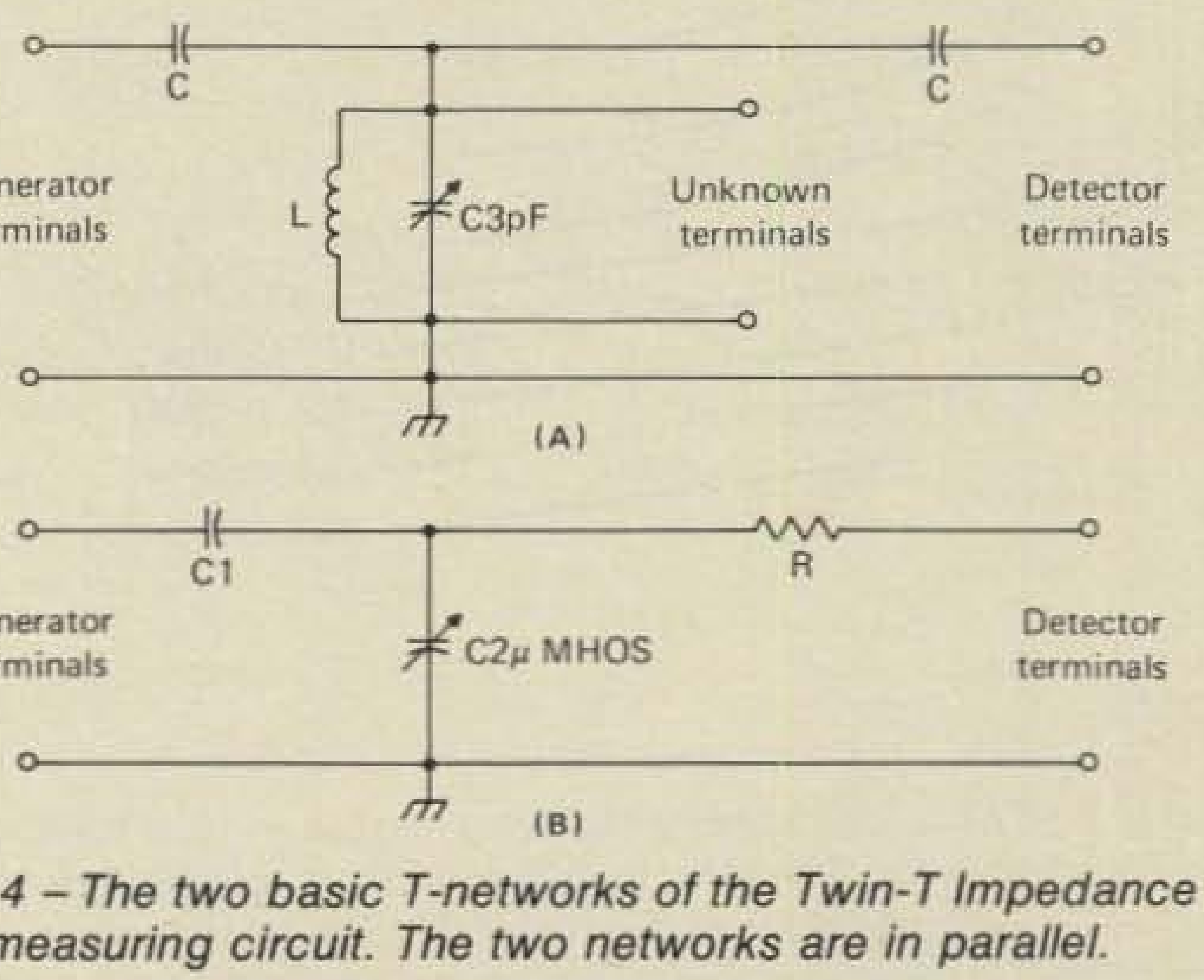


Fig. 4 – The two basic T-networks of the Twin-T Impedance measuring circuit. The two networks are in parallel.

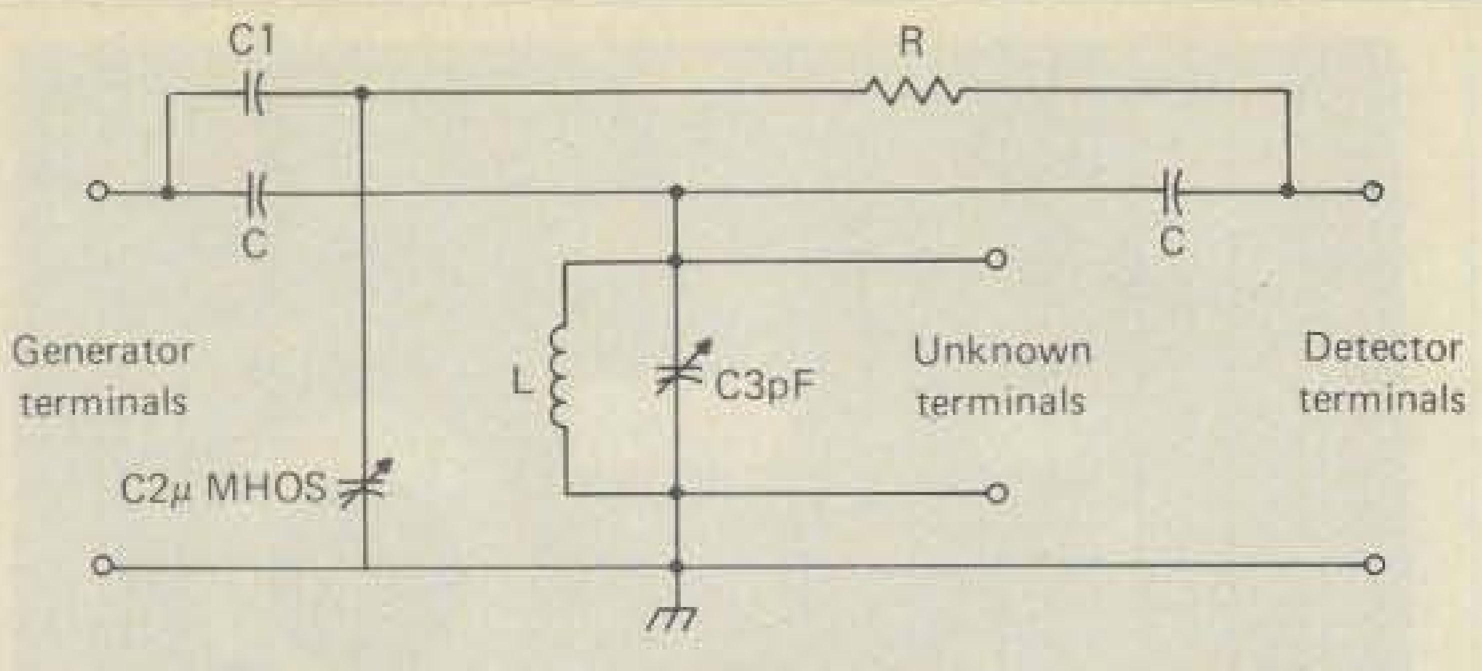


Fig. 5 – The basic circuit of the Twin-T network. Note that one terminal of the generator, detector and unknown terminals are tied to a common ground point.

which is taken from the GR-821-A operating manual. The graph gives total tuning capacity *vs.* frequency for the various switch positions of the left-hand *Frequency Range* switch. The total tuning capacity is the sum of the *Capacitance* dial reading and the pushbuttons that are depressed.

Next, slowly rotate the *Capacitance* dial and the two right-hand *Initial Balance* dials until a null is obtained. Record the dial reading of of the *Capacitance* dial. If desired, the *Capacitance* dial may be set on some convenient number, such as a multiple of ten, and the initial balance reestablished with the lower left-hand dial.

The component under test is then connected to the *Unknown* terminals and the instrument rebalanced using the *Conductance* and *Capacitance* dials only. When the final null has been obtained, the susceptance value is determined from the difference between the capacitive dial readings of initial and final balances in accordance with the equation

$$\text{Susceptance} = B = 2\pi f_t(C_i - C_f) \qquad (5)$$

Where f_t = test frequency

C_i = capacitance dial reading—initial balance

C_f = capacitance dial reading—final balance

If the susceptance of the component under test is capacitive, the final *Capacitance* dial reading (C_f) will be less than the initial reading (C_i) by an amount equal to the capacity

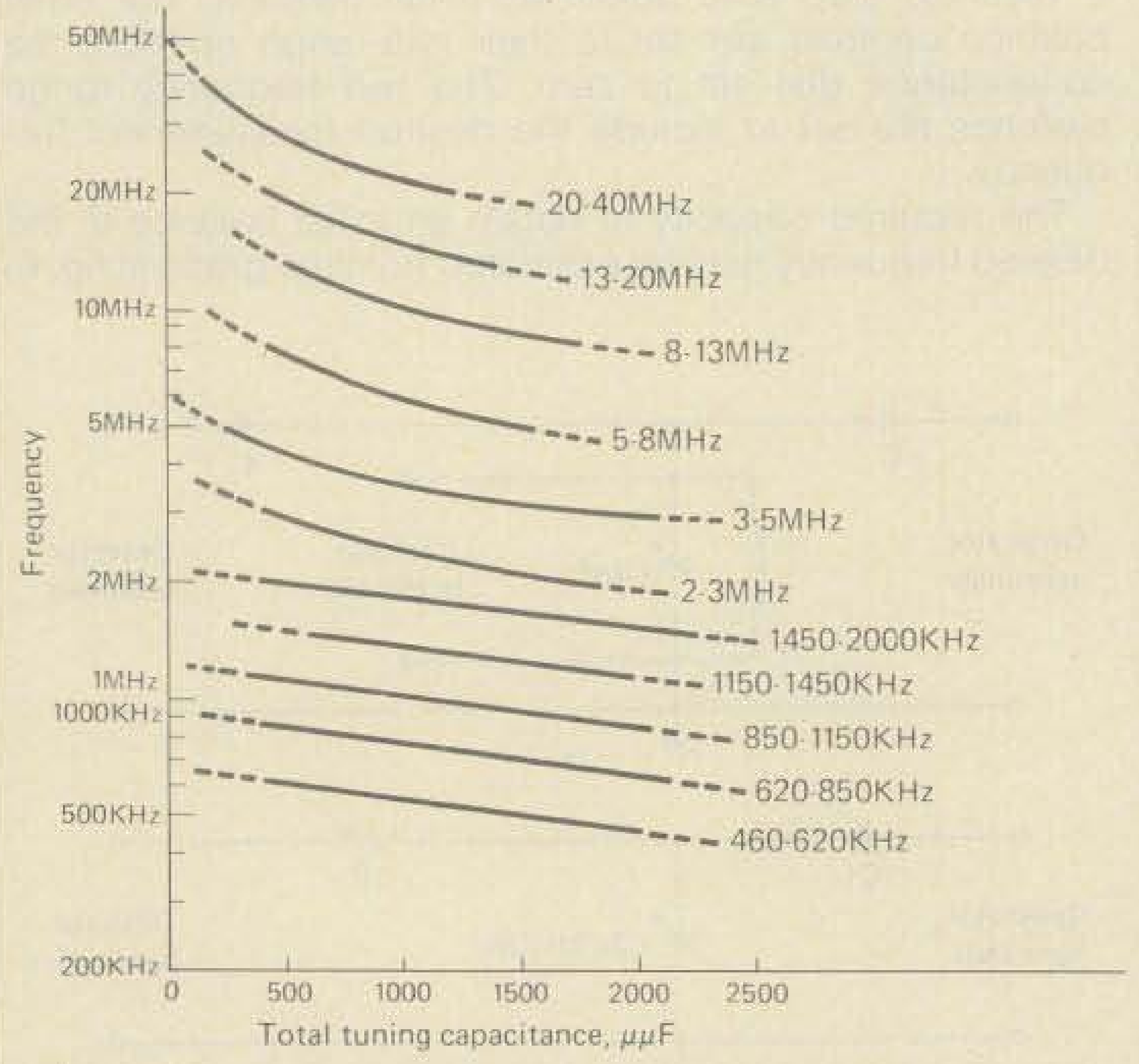


Fig. 6 – The total capacity required to obtain initial balance as a function of the left-hand frequency range switch. This graph was taken from the 821 manual.

added across the unknown terminals. The difference, $C_i - C_f$, will therefore be positive and the susceptance, as given by equation (5), will also be positive. The difference, $C_i - C_f$, is the capacity of the component under test.

If the unknown component is inductive, the capacitance dial setting must be increased to obtain the final null. The difference, $C_i - C_f$, therefore will be negative and the susceptance, as given by equation (5), will also be negative. It can thus be seen that the sign of the susceptance will take care of itself.

The difference in *Capacitance* dial readings will give the amount of capacity required to resonate the inductance at the test frequency. Frequently, this is the only information desired so that no calculations are necessary.

If the full data is required, these calculations are readily made with a slide rule or even by hand. The easiest way to reduce the data, however, is to use a programmable calculator. In Appendix 2 I will give a program for the HP-25 programmable calculator. The same program should also be usable on other HP programmable calculators, although the function numbers may be different.

The conductance component is the product of the *Conductance* dial reading and a **frequency correction coefficient.** This frequency correction term is equal to the actual test frequency, f_t, divided by the reference frequency, f_{ref}, to which the right-hand *Frequency Range* dial is set, quantity squared.

Conductance =

$$G = (\text{Conductance dial reading}) \left(\frac{f_t}{f_{ref}}\right)^2 \qquad (6)$$

Thus, if making a measurement at 14 MHz, the *Frequency Range* dial would be set to 10 MHz so that the conductive component would be

Conductance =

$$(\text{Conductance dial reading}) \times \left(\frac{14}{10}\right)^2 \qquad (7)$$

or about twice the actual dial reading. Also notice the instructions engraved on the *Conductance* dial: If the *Frequency Range* dial is set to either 1 or 3 MHz, the appropriate conductance scale is read directly. If the *Frequency Range* dial is set to 10 or 30 MHz, multiply the conductance reading by ten. This is an addition to the frequency correction term described above.

Because of the capability of the GR-821 admittance bridge to measure both the conductance and susceptance components of admittance, the 821 is useful for making many measurements. Some of these measurements can be made by other types of instruments, although not as well as with the 821 in some instances. For other types of measurements, the 821 is unique.

Of the various measurements that can be made using the 821 admittance bridge, one of the easiest and most frequent uses around the shack is that suggested by the title of this article, measuring the inductance, *Q*, and resonating capacitance for an inductance.

If only the capacitance required to resonate an unknown coil at a specified frequency is desired, all that is necessary is to operate the admittance bridge at that frequency and record the change in capacity between the initial and final balances. If the *Q* is also needed, both the conductance and susceptance must be determined from equations (5) and (6).

The Q of an inductor in terms of G and B is given by

$$Q = \frac{G}{B} \qquad (8)$$

as derived in the Appendix. The measurement of the tuning capacitance and Q of an inductor is probably the most common application of a Q meter and this is the most frequent application of my own 821. In terms of admittance bridge readings, the inductance of a coil is given by

$$L = \frac{1}{(2\pi f_i)^2(C_i - C_f)} \qquad (9)$$

where the symbols are as previously defined.

Another interesting application of the 821 is the measurement of coaxial transmission line parameters such as actual electrical length or velocity constant. It may also be used to adjust a quarter- or half-wave line to an exact frequency. The general procedure here is to adjust either the frequency or the line length until the change in capacitance between the initial and final balance is zero. That is, there is no change in the *Capacitance* dial required to establish the final balance after the coax cable is connected to the unknown terminals. The *Conductance* dial reading gives an indication of the losses in the cable.

Since the 821 can measure only high impedances, it is necessary to use either an open-circuit half-wave length or a shorted quarter-wave length. Under these conditions, when the change in capacitance between the initial and final balance is zero, the length of cable is an exact quarter- or half-wave length. If the frequency is accurately measured with a counter, the electrical and physical length of the cable can be compared to determine the velocity coefficient. I have found that a change on the order of 25 Hz in the 15 to 30 MHz range is detectable with the 821.

To cut a half-wave length line accurately, set the signal generator to the desired frequency, attach a coax line, slightly too long and with the far end open circuited, to the terminals of the instrument; keep cutting off the far end until $\Delta C = 0$. The resolution obtainable is a small fraction of an inch.

The attenuation in dB per 100 feet for a half-wave length of transmission line can be easily calculated by using the following equation which is derived in Appendix 3.

$$\text{Attenuation (in dB/100 ft.)} = \frac{G(\text{in mhos}) \times 1200 \times 8.686 \times Z_o}{\text{length (in inches)}} \qquad (10)$$

where Z_o is the characteristic impedance of the coax in ohms.

For those on the metric system, the attenuation is

$$\text{Attenuation (in dB/100 meters)} = \frac{G \times 100 \times 8.686 \times Z_o}{\text{length (in meters)}} \qquad (11)$$

The velocity coefficient of the coax can also be easily calculated. Compare the physical length of the cable with the length of a half-wavelength in free space as given by the familiar formula

$$\frac{\lambda}{2}\text{ (in feet)} = \frac{492}{f\text{ (in MHz)}} \text{ or } \frac{\lambda}{2}\text{ (in meters)} = \frac{150}{f\text{ (in MHz)}} \qquad (12)$$

As an example, I recently had a short length of RG-58 foam-type coax that fed an antenna on the side of the house. This antenna had withstood the August sun and the arctic winds for more seasons than I like to think about, and I began to have doubts about its electrical condition although its physical condition looked good.

I took it down and measured it . . . 21 feet, 1 inch (= 253 inches or 647.68 cm.). By using the frequency control on the signal generator and the conductance dial on the 821 to reach a null, I obtained the following parameters:

$$f = 17.699497 \text{ MHz}$$
$$G = 251\ \mu\text{mhos}$$
$$\Delta C = 0$$

The frequency was determined by a counter connected in parallel with the 821 at the output of the signal generator. I mentally multiplied the *Conductance* dial reading by 10 to obtain 251 μmhos. Because I adjusted the frequency to make the coax an exact half-wavelength long, the susceptance is expected to be zero. That's why $\Delta C = 0$.

As a final note of caution, always recheck the initial balance immediately before what you hope will be your final measurement.

Next determine the actual conductance from equation (6)

$$G_{act} = 251\left(\frac{17.699497}{10.0}\right)^2 = 786.31\ \mu\text{mhos.}$$

From equation (10) the attenuation in dB per 100 feet is

$$\text{Atten.} = \frac{786.31 \times 10^{-6} \times 1200 \times 8.68 \times 50}{253 \text{ inches}} = 1.62 \text{ dB/100 ft.}$$

Manufacturer's literature gives a loss of about 1.3 dB/100 ft. for this type cable at 17 MHz.

With the frequency of a half wavelength accurately known, the velocity constant of the cable can be easily calculated. In free space

$$\frac{\lambda}{2} = \frac{492}{17.699497} = 27.797 \text{ ft.} = 333.568 \text{ inches} = 8.473 \text{ meters}$$

$$k = \frac{\text{actual coax length}}{\frac{\lambda}{2}\text{ (in free space)}} = \frac{253}{333.568} = 0.7585$$

The published value of k is 0.79.

Since both of these constants are close to the manufacturer's specifications, the cable was assumed to be OK.

Measurements of this type will easily disclose transmission line deterioration, such as that due to moisture penetration, dielectric poisoning by the vinyl outer jacket or any other reason.

Simply disconnect the transmission line at the antenna. Knowing the approximate length of the line, it is not difficult to find the lowest frequency for which the admittance bridge will balance with no change in the susceptance, $\Delta C = 0$. Determine the conductance and calculate the attenuation as I did above.

If this measurement is made when an antenna is first installed and at regular intervals thereafter and the results recorded, say, in the station logbook, any deterioration in the transmission line, gradual or sudden, will be obvious.

An unusual application I had recently, and one where the 821 came through very well, was to measure the parallel resonant frequency of a quartz crystal. I had been unable to

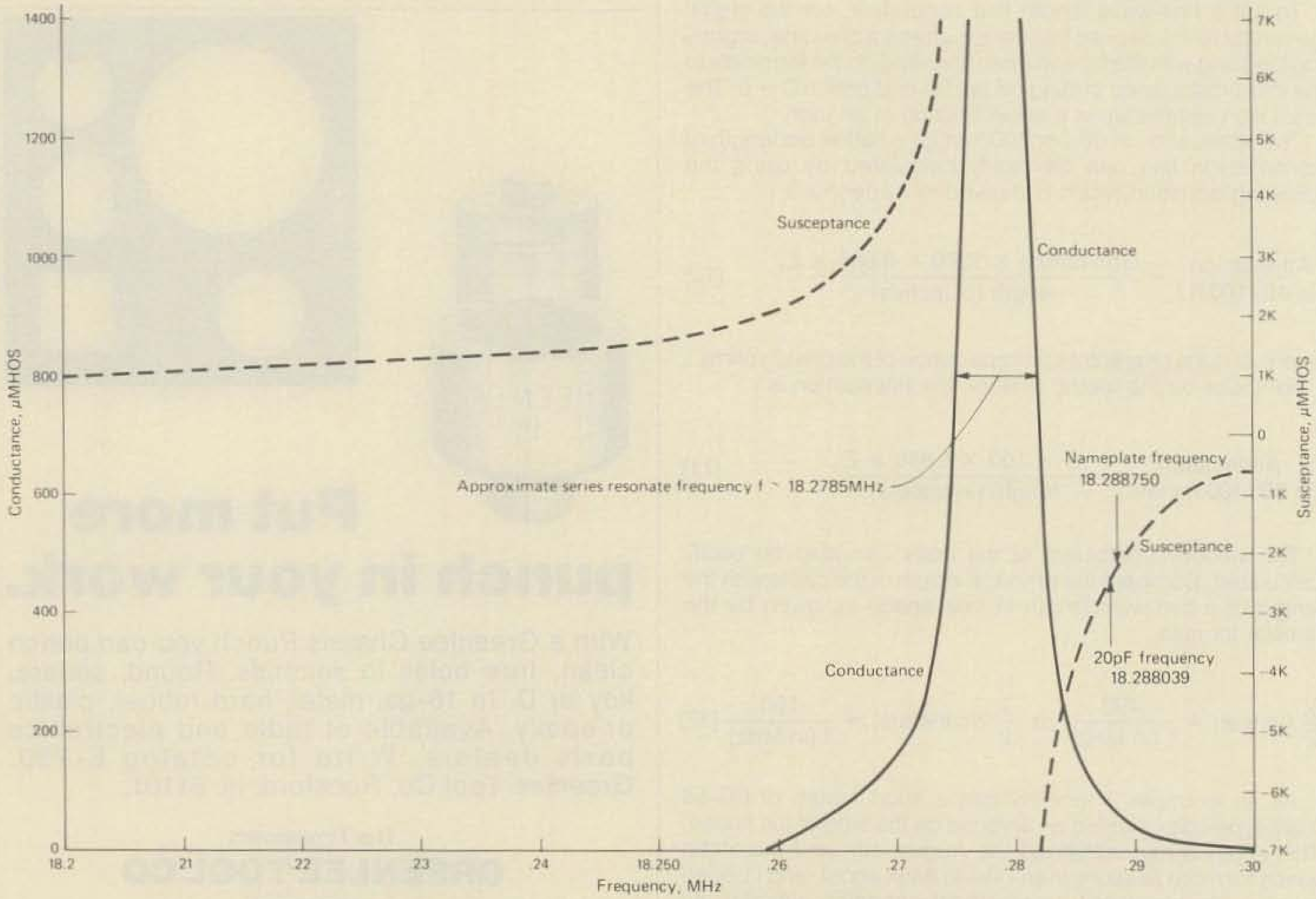


Fig. 7 – The conductance and suseptance of the 18.288750 MHz crystal.

get my two-meter rig "on frequency," and did not know whether the problem was that the crystal was off or that the oscillator was not presenting the specified capacity to the crystal—it turned out to be both!

To play this game, one must have a signal generator whose stability is at least as good as that of a crystal and that can be incremented in small steps—say, one hertz: namely a frequency synthesizer.

The procedure here is to measure the crystal admittance as the frequency is slowly incrementally tuned through series and parallel resonance. The admittance of one crystal is shown in fig. 7.

When measuring a crystal that will be used in the parallel resonant mode, there are two important points to check. First, set the synthesizer to the crystal nameplate frequency and determine the capacity required for a null. This is the capacity the oscillator must present to the crystal for the oscillator to operate at that frequency.

The second test consists of offsetting the *Capacitance* dial from the initial balance by an amount equal to the specified crystal-load capacity. Now, rebalance the bridge by varying the frequency and *Conductance* dial. This will tell you the oscillation frequency at the specified load capacity. (Note: don't forget to recheck the initial balance of the admittance bridge since it is sensitive to even small changes in frequency.)

The turned end of the adapter will fit into the series 774 connectors on the bridge. The 0.54 inch outside diameter will give a loose fit in the connector; this is done purposely since there is no spring material to compensate for wear. A tight fit can (and should) be made by placing a short piece of solder "in parallel" with the connector when it is inserted in the plug. The soft solder will be mashed down, making a tight fit without damaging either the adapter or the instrument. Since the adapters from u.h.f. to any other type of connector can be easily obtained, no further problems should be encountered. One word of caution, however: do not twist the adapter when it is being inserted or removed from the jack because the center conductor (banana plug) in the jack may be broken.

If, after considering the above, you are still interested in the instrument and have the opportunity to test the bridge, I suggest the following test to check the instrument. Take a dipped mica capacitor, 100 to 500 pF, and measure it on the 821 at a convenient frequency between 7 and 15 MHz. The measured capacity ($C_i - C_f$) should agree with the marked value (within the tolerance) and the conductance should be very low. While operating the bridge, also note whether the null is smooth and complete and whether there is any noise while adjusting the controls. Control noises can usually be eliminated by careful cleaning with contact cleaner. Since the adjustable controls are all variable capacitors, not subject to wear as is a variable resistor, control noise is not a serious problem. An incomplete null is probably caused by a poor test set-up. A null that is not smooth may be caused by variable capacitor plates shorting out.

If the unit still looks and sounds good, take it!

Before closing, a few suggestions are in order concerning the test set-up and the process of obtaining a null, as some users seem to have trouble in these areas. Two keys to accurate measurements are well-shielded instruments and good grounding.

Low leakage is probably the most important criterion for the signal generator. If there is direct leakage from the signal generator to the receiver, it will be necessary to offset the bridge from its true null position by an amount that is equal in magnitude, but opposite in sign from the leakage in order to obtain a null in the receiver. This will cause an error since the bridge will no longer be at a true null.

The generator should have a coax output connector and the lead to the bridge should be coax. Avoid using the economy grade of coax as this cable has a very loose outer

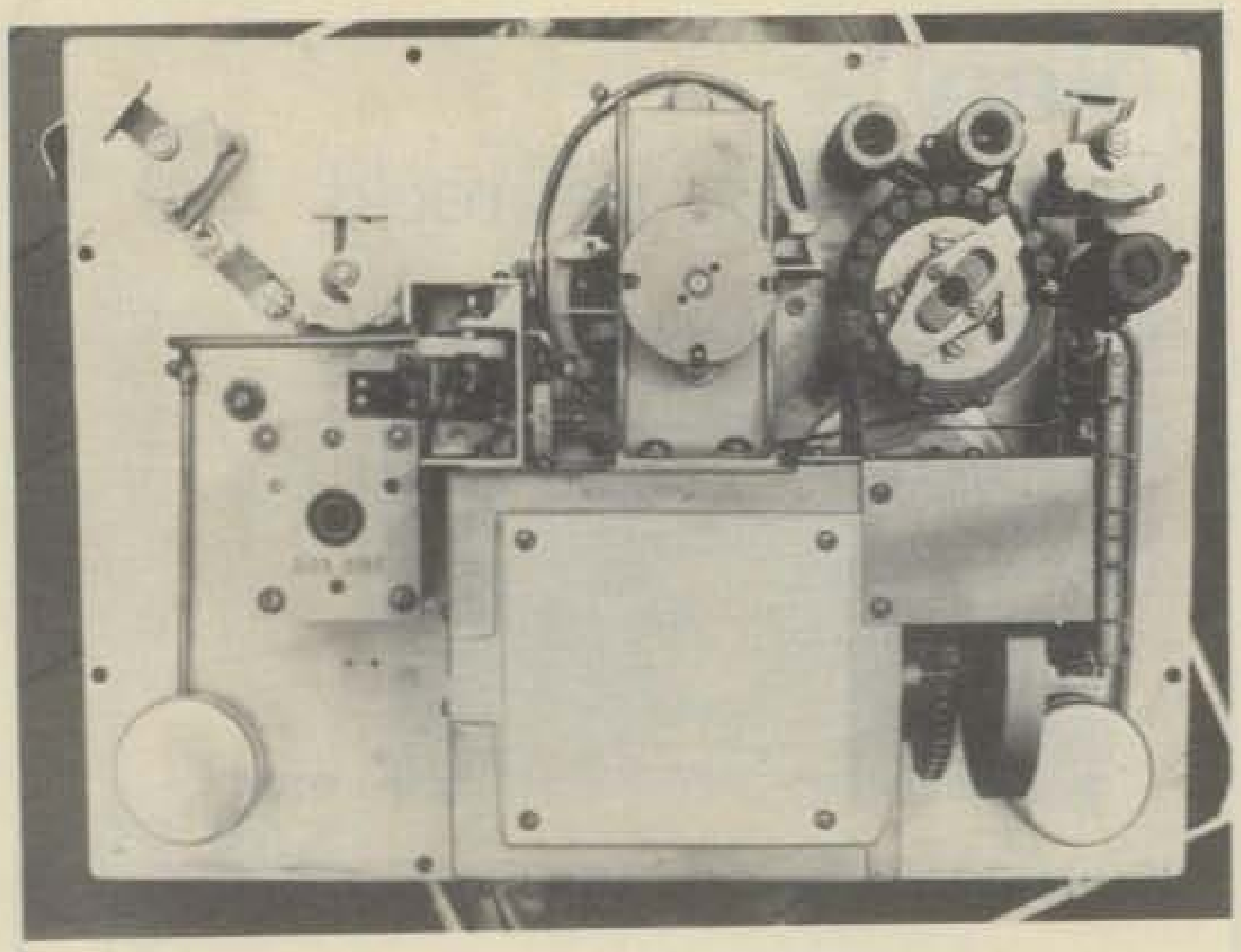


Fig. 8 – An interior view of the 821-A.

braid with large open areas which result in high leakage. Use high quality "mil-spec" cable which will have an outer conductor with a full, tight braid and consequently lower leakage, or, better yet, use double braided cable. The same holds true for the cable between the bridge and detector.

If you still have a leakage problem, cut strips of aiiminum foil about one inch wide and almost as long as the cable. Wrap these around generator lead (and detector lead, too), and ground only at the generator (or detector) end.

If a permanent set-up in the work-shop is contemplated, the bridge, detector and generator can all be mounted on a large copper sheet. The bridge has a ground clamp along the bottom edge of the front which will accept a wide copper strap soldered to the ground plate. The generator and detector can also be grounded to the same plate with copper strap. Such an elaborate ground system is not always practical for field work, however.

The series resonant frequency can not be accurately determined since it will be on the order of 10 to 50 ohms, which is far outside the range of the 821. The series resonant frequency can be estimated, however, by drawing a horizontal line between two frequencies that have the same conductance and taking the average frequency of the two intercept points. This is also shown in fig. 7.

For the crystal shown, the frequency for a 20 pF load was 18.288039 MHz while the load capacity for 18.288750 MHz (name plate frequency) was 18.45 pF.

The above are some applications to which I have put my own 821. No doubt the active experimenter will find others where measurement of high impedances at radio frequencies is desirable.

So much for a basic description of the GR-821 admittance bridge; the next question is: What does one look for and look out for when buying a used instrument? As with any other piece of equipment, the first step is a thorough inspection. Are there any signs of mechanical damage or abuse? Do the controls turn freely? Are there any parts missing? This last is an important consideration since replacement parts are no longer available from the manufacturer.

Observe, from fig. 3, that the front panel is held in the case by eight easily removable thumb screws. Not evident in the photograph is the fact that all bridge components are mounted to the front panel. It is, therefore, relatively easy to remove the bridge from its case to more carefully examine its guts. A photograph of the underside is given in fig. 8.

Electrically, the admittance bridge is a purely passive device; it has no vacuum tubes, transistors or power supplies. Also, it operates at a very low r.f. voltage so that voltage stresses on the components are for all practical purposes non-existant. Because of this, there is very little to burn out unless the instrument has been abused. Mechanically, these instruments are really built well, so that if the bridge does not show signs of abuse, either electrically or mechanically, and if there are no missing, components, they will probably work.

If the unit you are considering passes this test, you probably have a usable instrument.

The only accessories that were originally supplied are two connecting cables which are not critical and can be homemade. If they are available, however, it will make life easier. These cables are used to connect the bridge *Generator* and *Detector* terminals to the signal generator and receiver, respectively.

Early examples of the 821 instruments were equipped with the General Radio 774 series of connectors which are now obsolete. The 774 series of connectors have long since gone out of production, and adapters from this series to other types of connectors are no longer made, either. Later production runs of the 821 were equipped with the 874 series which are currently in production and create no problems.

If the instrument you are purchasing has cables with the appropriate connectors to match your bridge, you are in business. If the bridge is equipped with 774 connectors and the cables are bad, save the connectors and make up new cables with 774 connectors on one end to match the bridge, and connectors on the other end to match the receiver and signal generator you intend to use with the bridge.

If you are unable to get matching 774 series connectors, that fact should certainly be considered in arriving at a price for the bridge, but all is not lost. An adapter can be homemade as follows: In its simplest terms, the GR series 774 connectors as used on the 821's were, simply, shielded banana plugs. Fortunately, the center conductor of a u.h.f connector fits very nicely over a standard banana plug. Therefore, if you start with a UG-363/U straight adapter and turn down one end on a lathe, or otherwise, to a diameter of 0.54 inches (1.37 cm) for a distance of five-eights of an inch (1.59 cm) as shown in fig. 9, it can be inserted into a 774 series jack. A finished adapter is shown in the photograph in fig. 10.

For a signal generator, I use a Knight KG-686 which has been adequate for at least 95 percent of my work.

As a detector, I usually use either an NC-303 or an SP-600. If the work I am doing is in the amateur bands and is out in the field, I usually use the 303 as it is easier to carry than the SP-600 and also has a crystal calibrator. The 303 came with a punch-out on the rear of the chassis for a coaxial antenna connector, SO-329; if not already so equiped, one should be installed. For component testing in the work-shop, I usually use the SP-600.

In making a test I usually turn both the signal generator modulation and the receiver a.g.c. on and the b.f.o. off (a.m. mode). I have found that an S-meter is a big help in finding a null. The S-meter will start to dip down long before the null is audible in the headphones. When I have gotten a deep null with a weak signal, I sometimes find it easier to adjust the bridge for maximum noise level rather than minimum signal.

If you have difficulty obtaining a complete null, consider the

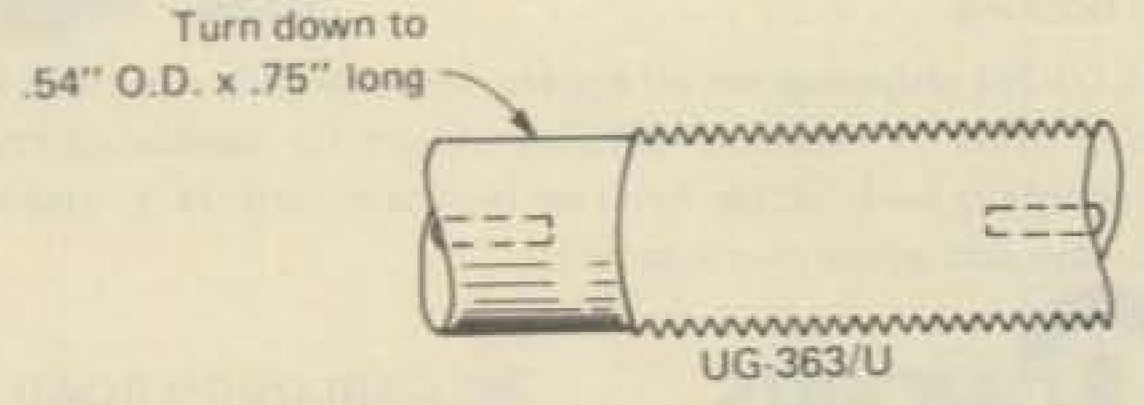


Fig. 9 – A home-made adaptor designed to join GR-774 series connectors with u.h.f. connectors.

following: Is the residual signal a harmonic of the modulation fundamental? The 821 is capable of very sharp nulls and you may null out the fundamental, but not its harmonics. Try reducing the r.f. output of the generator as well as the depth of modulation. This will sometimes help by reducing the distortion out of the signal generator. A second possibility is to turn off the generator modulation and the receiver a.g.c. and turn on the b.f.o. As you are now in a c.w. mode, you can also narrow the receiver bandwidth. This, too, may help. If all else fails and the residual is small, you may find that it makes very little difference in the dial reading. Do the best you can and ignore the rest. The data you have will be reasonably close.

(To be continued)

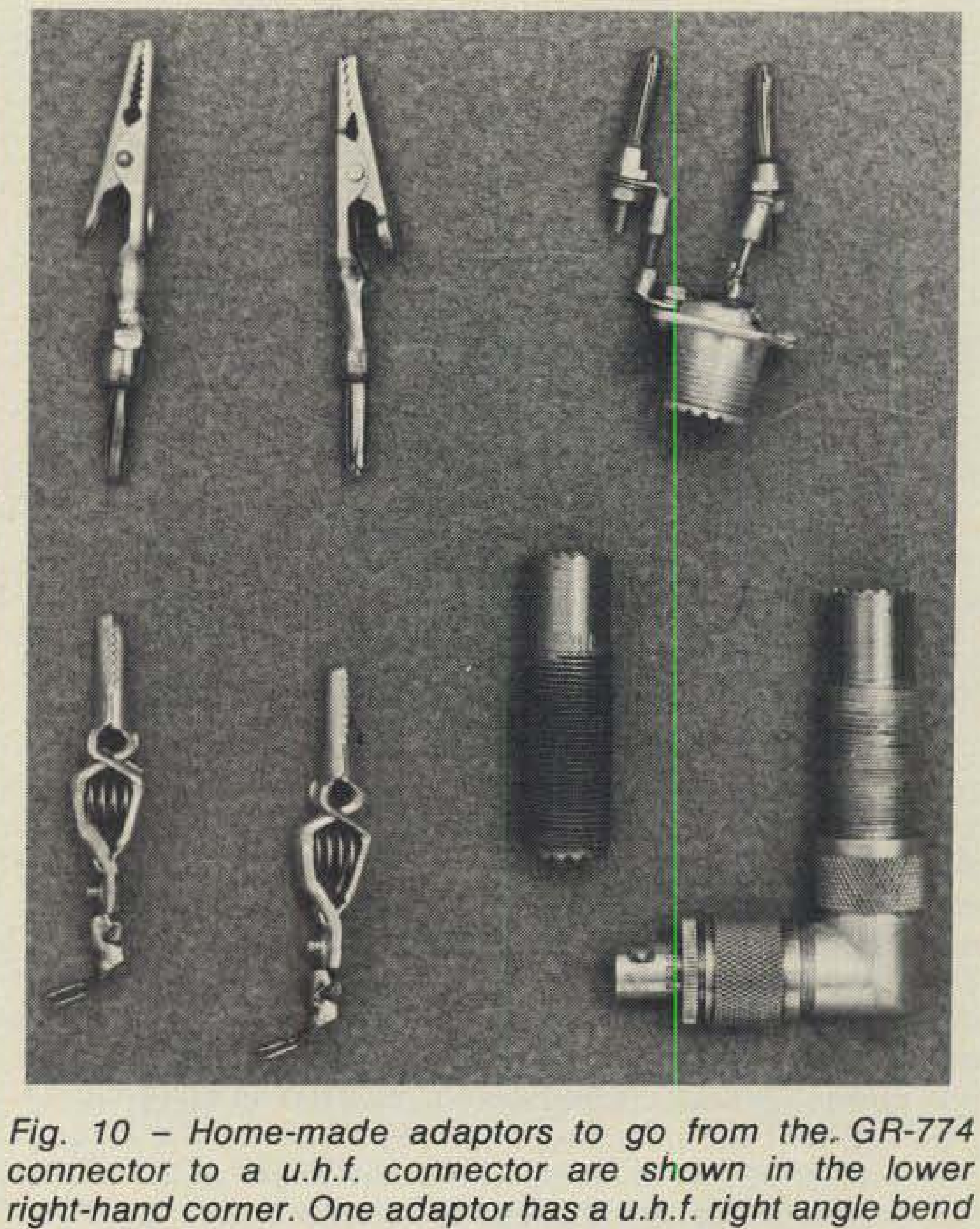


Fig. 10 – Home-made adaptors to go from the GR-774 connector to a u.h.f. connector are shown in the lower right-hand corner. One adaptor has a u.h.f. right angle bend and a BNC adaptor on it. Other convenient accessories are shown in the photograph.

Footnotes

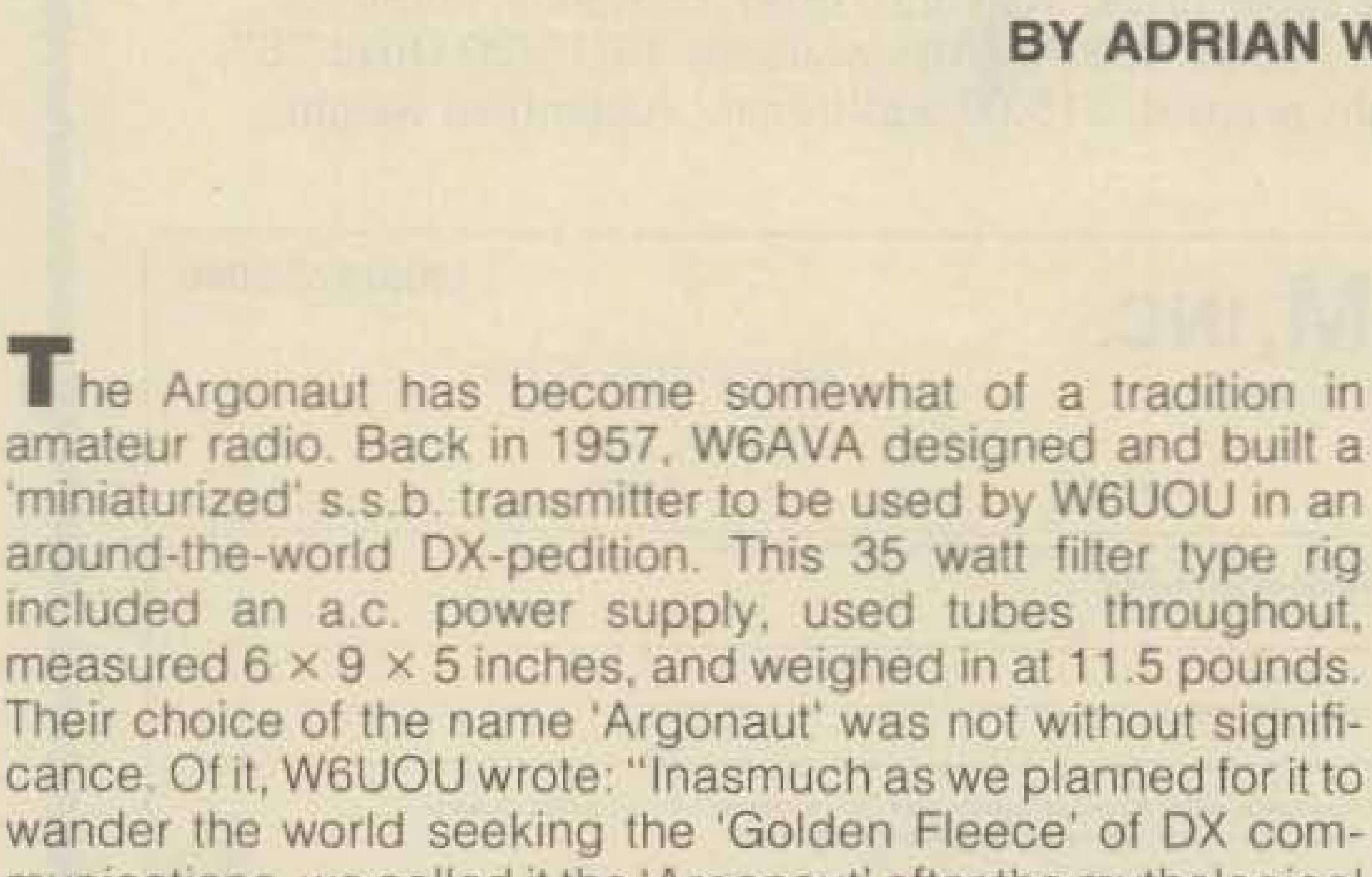
1. Nagle, John J., K4KJ, "Impedance Measurements at Radio Frequencies," *CQ*, Vol. 30, No. 11, Nov. 1974, pp. 18-24.
2. Nagle, John J., K4KJ, "R. F. Impedance Measurements (continued)," *CQ*, Vol. 31, No. 6, June 1975.
3. Tuttle, W. N., "Bridged-T and Parallel-T Null Circuits for Measurements at Radio Frequencies," *Proc. IRE*, Vol. 28, No. 1, Jan. 1940, pp. 23-29.
4. Sinclair, D. B., "The Twin-T—A New Type of Null Instrument for Measureing Impedance at Frequencies Up to 30 Megacycles," *Proc. IRE*, Vol. 28, No. 7, July 1940, pp. 310-318.

CQ Reviews: The Ten-Tec Argonaut 509 QRPp S.S.B./C.W. Transceiver

BY ADRIAN WEISS*, K8EEG

The Argonaut has become somewhat of a tradition in amateur radio. Back in 1957, W6AVA designed and built a 'miniaturized' s.s.b. transmitter to be used by W6UOU in an around-the-world DX-pedition. This 35 watt filter type rig included an a.c. power supply, used tubes throughout, measured 6 × 9 × 5 inches, and weighed in at 11.5 pounds. Their choice of the name 'Argonaut' was not without significance. Of it, W6UOU wrote: "Inasmuch as we planned for it to wander the world seeking the 'Golden Fleece' of DX communications, we called it the 'Argonaut' after the mythological gold seekers of ancient Greece. Apparently, the name was well chosen since it has figuratively struck gold in every country it has visited. And already it has wandered so far it has dwarded the puny voyages of the original Argonauts."[1] Indeed the little rig wandered the globe, putting such exotic calls as KB6, KS6, VR2, VS1, VS5, VK9, and many others on the air in the new s.s.b. mode for the first time. The various operators of the little transmitter were consistently impressed with the effectiveness of the diminutive rig.

*83 Suburban Estates, Vermillion SD 57069



Front view of the Argonaut 509 with the Model 208 c.w. filter on top. The sliderule dial shows calibration in 100 Hz increments for 28-30 MHz. The lower scale shows 100 kHz of the 80-15 meter bands that the 0-100 kHz round dial plate is registering. The spinner knob exhibits a 25 kHz per turn ratio. The combination S-meter/s.w.r. bridge meter is at the right of the dial. The controls, from left to right, are: Top - Resonate control for peaking the receiver front end, r.i.t. knob, drive control knob; Bottom - bandswitch, main tuning dial/knob, r.f. gain contronl, a.f. gain/on-off control, mode switch. All controls are easily manipulated. The speaker grill is at the rear right corner at the top. The legs are shown in their extended position. The front panel is a light cream color, and the sides and top are simulated wood grain.

In closing his article, W6UOU looked forward to the day when it would return from its voyages to "an honored spot in our radio den as a permanent reminder of our most meaningful adventure in amateur radio."

The s.s.b. Argonaut eventually did reach that spot of honor, but its memory lived on. K4DCD and K4FW resurrected the idea years later in designing and producing the original TenTec Argonaut 505, which appeared on the market in 1971. In "The Second Coming of the Argonaut," they described the result of their effort to put the adventure of the ancient Argonauts back into amateur radio (*CQ*, November, 1971). The name was the same, but what a world of difference! Instead of 11.5 pounds of tube circuitry which produced only a transmitted signal, the new Argonaut was a complete station in itself (except for key, antenna, and battery): an ultra-compact s.s.b./c.w. transceiver incorporating the most advanced solid-state technology, weighing in at 6 pounds and capable of operating for weeks from a pair of lantern batteries. And it could compete with other transceivers in every respect except power output.

The second coming of the Argonaut was indeed a welcome event in amateur radio, for many amateurs had become involved in low power as their special interest in the hobby. The Argonaut provided a monumental impetus to this already established move to low power operation. Today, nearly 2500 Model 505's are providing reliable communications from all parts of the globe. Because of its size and meager power requirements, the Argonaut has become the standard symbol of away-from-home hamming, and it has provided ordinary amateurs with the thrill formerly reserved for those with exraordinary resources.

In a typically modest fashion, TenTec raised no fanfares to introduce the Argonaut 509, although they could have with good readon. The 509 is not simply a cosmetic touch-up of the 505, but incorporates several fundamental circuit improvements, as well as considerable improvements in the mechanical area. While the receiver remains substantially the same as in the 505, the transmitter section has undergone design changes, especially in regard to shifting to a broadband two stage driver unit in place of the 505's two stage narrowband circuit.

[1] Ted Henry, W6UOU, "Adventures of the SSB Argonaut," *CQ* (May, 1960), p. 40.

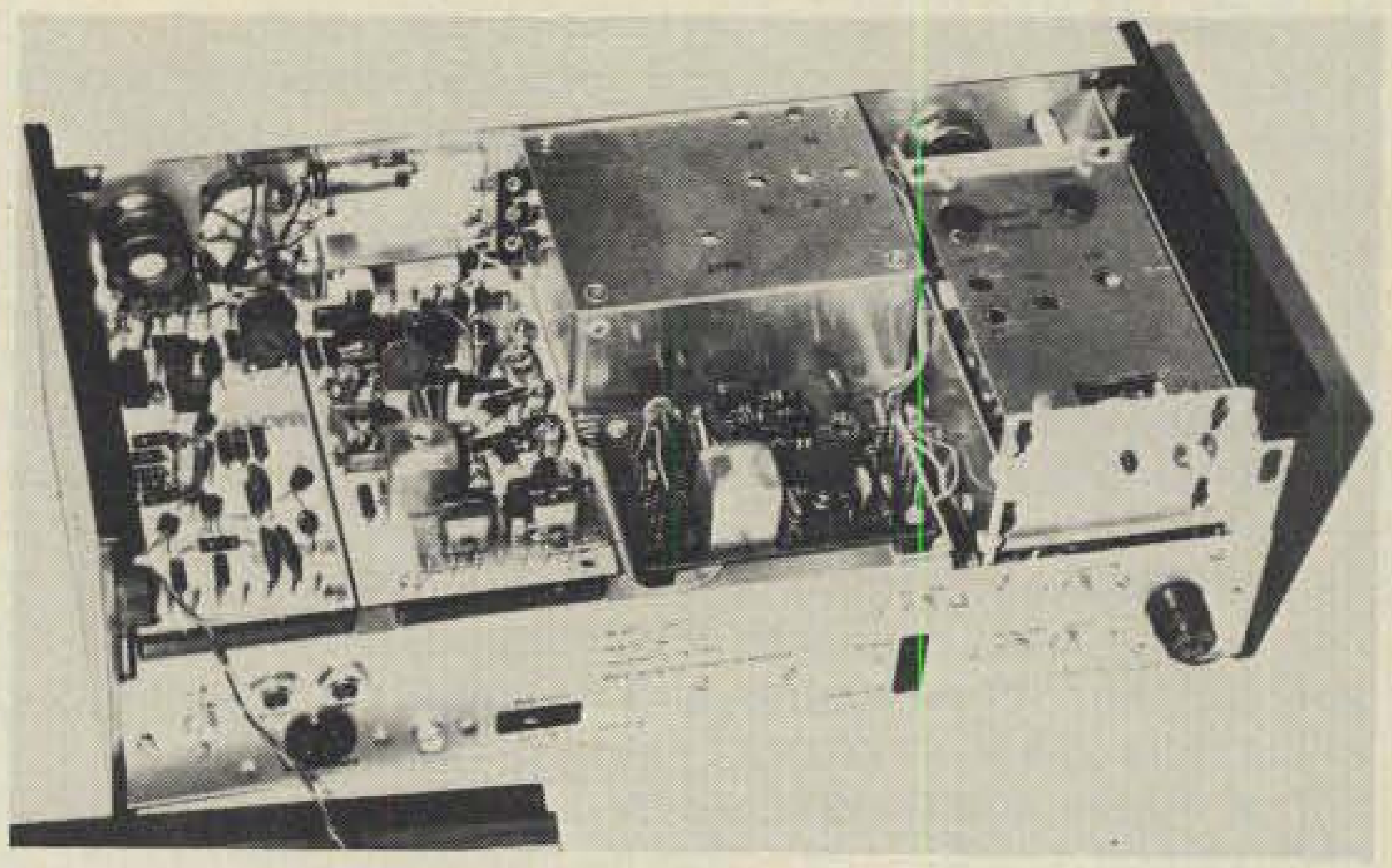
Frequency Generator System

The 509 uses a heterodyne frequency generator system, but with an innovative twist that eliminates the need for more than a single heterodyne crystal. The design was tried and proven in the 505, and is basically the same, except for a few minor improvements. The key to the Argonaut system is that, instead of operating the v.f.o. on a single frequency, and employing separate crystals to mix that v.f.o. frequency to the various amateur bands, the Argonaut v.f.o. actually operates on five different frequency ranges, all of which fall within the 5.0-7.0 MHz spectrum. Depending upon the desired amateur band, each of these basic v.f.o. ranges is taken straight through, or multiplied before mixing, in order to produce output on the desired amatuer band when mixed with the 9 MHz crystal, which serves also as the b.f.o. For example, on the 20 meter band, the basic v.f.o. range is 5.0-5.5 MHz, which, when mixed with 9 MHz crystal signal, produces a 14 MHz signal. However, in order to provide a mixing signal with a difference of 3.5 MHz for 80 meter operation, the basic v.f.o. range of 6.25-6.5 MHz is multiplied by 2 in order to produce a 12.5-13.0 MHz signal which, when mixed with the 9 MHz crystal produces a product signal at 21.5-22 MHz, and a difference signal at 3.5-4.0 MHz. A double-tuned transformer at the input to the broadband driver passes the 3.5 MHz difference signal while rejecting the 21 MHz product signal.

There are two major advantages to this approach. First the cost of seven extra crystals is eliminated. Second, since the five basic v.f.o. ranges are within a small spectrum, and overlap in several cases, careful calibration of the v.f.o. tuning inductances can produce a fairly linear spread on all bands so that a single dial plate will serve with good accuracy on all bands. 10 meters is an exception, due to the width of that band, but here again, there is a definite advantage in as much as the typical transceiver requires four crystals to cover the entire 10 meter band. So, for the full-band 10 meter coverage, the Argonaut system eliminates at least three crystals. Overall, the system eliminates the cost of about seven crystals (allowing for the 9 MHz crystal as part of the transmitter system cost, where in fact it serves also in the receiver system). The Argonaut heterodyne system is a monument of engineering ingenuity.

Basically, the Argonaut employs inductances rather than capacitances-inductances to generate the basic v.f.o. signal. A pair of series inductances L1 and L2 are selected by the bandswitch for each band of operation. L11 is the main tuning inductance and is permeability tuned (a slug is passed in and out of the coil to produce a change in inductance) through the v.f.o. tuning dial on the front panel. It is placed in parallel with the L2 inductance and correspondingly decreases the overall oscillator inductance. Any change in L11 thus produces a shift in oscillator frequency. By a careful selection of values, TenTec has managed to achieve a linearity figure of ± 5 kHz on 80-15 meters, and ± 10 kHz on 10 meters. This is quite acceptable. A planetary vernier drives the permeability tuned coil, resulting in an extremely smooth action, with a bandspread of about 25 kHz per revolution of the tuning knob. The dial plate is calibrated 0-100 kHz for 80-15 meters, and this must be multiplied by four when tuning 10 meters due to the expanded range of that band. The slide rule dial serves as a "hundreds" marker, showing which 100 kHz segment of the band the dial is registering. Calibration of the dial is quite simple. The Argonaut is tuned to a 100 kHz band edge marker, the tuning knob held firmly in place, and the dial plate rotated until an exact line-up is achieved between pointer and dial plate, 0 kHz or 100 kHz point.

The v.f.o. uses a different NPN bipolar transistor type than was used in the 505. However, the circuit is essentially the same, with two exceptions. The first buffer was capacitively coupled directly to the collector tuned circuit of the oscillator in the 505, and in the 509, it is capacitively coupled to the oscillator emitter, a point which eliminates the loading of the oscillator tuned circuit by the buffer stage. Second, the buffer stages have been changed slightly. Output from the second buffer is in the ranges shown in Table I. For 20 meter operation, v.f.o. output is taken directly from the second buffer. For the other bands, the buffer output signal is multiplied by a factor of two or three. Multiplier output is double tuned at T1 to eliminate harmonics, and to provide a relatively constant output voltage across each band. Multiplier output, as a glance at Table I reveals, is at 12 MHz, or 19 MHz, C1-C2 in parallel with T1 resonates the double tuned circuit in the 19-21.0 MHz range for 10 meter operation; trimmer capacitors are bandswitched into the circuit for resonating T1 at the other two output frequencies. Suppression of unwanted harmonics from the multiplier stage is at the level to be expected from the use of the double tuned transformer. Further elimination of undesired frequencies is achieved in the double tuned transformer in the output of the transmitter mixer.



View from the rear with the bottom plate removed. The audio board is at the right end; then the i.f. board. At the front center the v.f.o. enclosure can be seen, and inside it is the ⅛ inch aluminum box which houses the main permeability-tuned inductor L11. The s.w.r./filter board is mounted on the rear wall of the v.f.o. enclosure. The receiver front-end switch and T2 trimmers are at the upper left corner. The final is not visible, but is on the rear apron directly behind the s.w.r./low-pass filter board.

The entire v.f.o., including the v.f.o. bandswitch, is housed in a sturdy sub-assembly chassis box. The permeability tuned oscillator inductance and vernier are, furthermore, housed in a ⅛ inch aluminum enclosure which is mounted in the v.f.o. chassis box. The shaft driving the slug in the permeability tuned inductance is left floating with respect to ground (ungrounded) in order to avoid possible intermittent contacts which would cause frequency shifts. As a result, a slight "hand-capacity" effect can be noticed when touching the dial plate. It is minimal. A new type of bandswitch with silver-plated double contacts is used in the 509, and eliminates the switch contact intermittency problem which many 505's exhibited. When the 509 is bandswitched, it stays on frequency once the contacts make. The 505 was rather annoying in this respect, and I'm pleased that TenTec has eliminated the problem. Overall, the v.f.o. is very stable with no noticeable drift over long periods. But most important, the mechanical instability which plagued the 505 has been rectified. The 509 takes considerable buffeting without any noticeable effect on frequency. This is especially important to mobile operators. I took the 509 on a roadtrip the day after I received it, and it didn't budge a Hz despite a thirty-mile pot-hole detour. I was skeptical until then, and now I'm a believer.

S.S.B. Generator

The s.s.b. generator board includes the microphone amplifier, b.f.o./carrier oscillator, balanced modulator, and crystal filter. The circuits are the same as in the 505. A single 9 MHz crystal oscillator serves a dual function of beat frequency oscillator for the receiver chain, and carrier generator oscillator for the transmitter chain. Three trimmer capacitors are placed in series with the crystal in order to provide proper frequency adjustment for the u.s.b., l.s.b. and c.w. modes. Two of these trimmers are switched in and out of the circuit to move the crystal to the proper frequency for c.w. and l.s.b. modes. For u.s.b. and l.s.b., the crystal is tuned to the 15 dB points of the filter passband, and for c.w., the crystal is tuned to the approximate center of the filter passband.

The carrier signal and audio signal from a two stage microphone amplifier are fed to the balanced modulator which uses a CA3053 IC differential amplifier to insure good balance under varying conditions of supply voltage, input levels, and temperature. The 9 MHz output from the balanced modulator is coupled to the crystal filter through a single tuned transformer. In the c.w. mode, the modulator is unbalanced by application of a control voltage, allowing the passage of the c.w. carrier. The crystal filter is a four pole half-lattice type with a 6 dB passband of a 2.4 kHz, and a 1.7:1 shape factor at the 6/50 dB points. This is not the ultimate in selectivity, providing only a 30 dB sideband suppression factor and 40 dB carrier suppression, but is quite satisfactory from a practical viewpoint. It is adequate in most situations, and a drawback only in receiving situations where the unwanted sideband contains a signal vastly stronger than the desired sideband signal. This situation occurs quite infrequently.

Transmitter Mixer

The transmitter mixer shares a board with the receiver mixer, and the 509 circuit is different than the 505. In place of the 505 CA3053 mixer, a MC1496P IC is used in a double-balanced mixer configuration. The advantage of this circuit is that the fundamental driving signal and its odd harmonics are well suppressed in the output, as well as undesired products applied to the other input port from the s.s.b. generator.

Broadband Driver

The output signal from the transmitter mixer is coupled to the broadband driver through a half-wave low-pass filter on 80 meters, and through double tuned, overcoupled transformers on 40-10 meters. The transformers are adjusted for a twin-peak response at opposite ends of the band, with a slight trough in the middle, to permit a relatively constant drive level across each band. These transformers provide an additional 30-40 dB rejection of unwanted mixing products. The broadband driver section is a new addition to the Argonaut design. It eliminates complicated bandswitching associated with tuned circuits, allows superior linearity, and requires no tuning during band-changes. The two-stage driver employs broadband toroidal transformers for interstage and output coupling. The bandpass filter transformers and driver circuitry located on the front-end board and mounted in a shielded compartment.

R.F. Amplifier/Filters

The final r.f. amplifier circuit is essentially the same as in the 505, but a pair of PT3647's, which are designed for broadband applications, have been substituted for the 2N2631's used in the 505. Idle state bias current is adjusted for about 15 mA, establishing Class B conditions. The r.f. amplifier board is extremely compact, and, due to its broadband circuit, can be located in a small vacant space on the rear panel, away from the bandswitch. Minimum output is at the two watt level, although it is possible to raise the output to above four watts on several bands without deterioration in signal purity. Low-pass filters must be used in the output of any broadband r.f. amplifier, since it will amplify harmonics as well as the fundamental driving signal, and can generate its own harmonics. Unlike the 505, which included only four low-pass filters, with a single filter serving both 15 and 10 meters, the 509 has a separate half-wave filter for each band. Further, the filters in the 509 are cascaded double pi networks, where in the 505 a single pi network design was used. The double pi, of course, adds to the total suppression of harmonics in the output.

Finally, a Bruene type s.w.r. wattmeter circuit is included in the Argonaut. It allows the meter on the front panel to read forward and reflected power, as well as serving as an S-meter in the receive mode. The sensitivity of the bridge circuit is non-adjustable—a resistor selected at the factory replaces the meter sensitivity potentiometer that occupied front panel space on the 505. The sensitivity determining resistor in the unit tested permitted full scale deflection of the s.w.r. meter at a power level considerably below the maximum output to be achieved on several bands. While the s.w.r. could be accurately determined on these bands by lowering the output level by means of the drive control to produce full scale deflection of the meter in the forward position, constant monitoring of s.w.r. was not possible with the unit operating at full output. The simple expedient of replacing the factory selected sensitivity resistor will permit adjustment.

Receiver

The receiver front end r.f. amplifier uses a dual-gate, low noise MOSFET with tuned input and output tank circuits. A 9 MHz trap in the input prevents feedthrough of signals at the i.f. frequency. Fixed capacitors are switched across the input transformer, while trimmer capacitors are switched across the output transformer, to place them within the proper band. The transformers are permeability tuned by means of a rack mechanism activated from the front panel which moves the slugs in and out of the coils. The r.f. amplifier gain can be manually controlled from the front panel, or automatically through the a.g.c. circuit. The a.g.c. figure is 6 dB/100 dB input signal variation. Operation is quite smooth. No cross modulation in the presence of very strong signals has been noted on the unit reviewed.

The receiver mixer employs a MOSFET with untuned input and single tuned output lightly coupled to the crystal filter. Following the filter, a single stage of i.f. amplification utilizing a bipolar device and single tuned output transformer feeds a MOSFET product detector. The three stage audio preamplifier follows the product detector. A singular improvement in the 509 allows for access to the audio chain after one stage of preamplification. A six-prong accessory plug on the rear panel permits the insertion of an external c.w. audio filter at the proper point in the circuit prior to the a.g.c. deriving stages, where the passband of the filter controls the audio derived a.g.c. voltage. A single bipolar device produces the a.g.c. voltage, which is designed for fast-attack-slow-decay operation. The a.g.c. voltage controls r.f. amplifier, mixer, and i.f. amplifier stage gain. The audio amplifier employs an LM380N low noise integrated circuit to produce 1 watt output into 8 ohms with 2% distortion. The Argonaut audio is superb. Included on the audio amplifier board are the sidetone oscillator and muting switch. The tone and volume of the sidetone oscillator are controlled by two p.c. board trimmer potentiometers which are accessible through a hole in the bottom panel. This is convenient, especially when the Argonaut is used in environments with differing noise levels, as, for example, the quiet home station and an automobile with a noisy muffler.

The Argonaut includes an r.i.t. (receiver incremental tuning) circuit. The tuning potentiometer includes a push-pull r.i.t. defeat switch. This feature is extremely valuable in transceive operation on c.w. The offset range is too wide on some bands—as much as ±6 kHz. With this range, the task of zeroing the offset knob, or tuning a signal to a precise frequency, is very delicate and sometimes difficult. A simple modification should be able to make the offset more practical and, hence, more effective. Or the small factory-supplied r.i.t. tuning knobs may be replaced with a larger 1.5 or 2 inch knob, which aids greatly in precise tuning situations.

Layout/Mechanical

The front panel layout of the 509 is essentially the same as the 505, with all controls easily manipulated. One improvement which vastly incresases the convenience of operating the Argonaut 509 is the mounting of the c.w. Drive and Microphone Gain control on the front panel. A ganged dual potentiometer permits drive and gain adjustment without the hassle presented by the 505, in which these controls were located on the rear panel. Otherwise, an improved dial-plate, vernier, and spinner knob arrangement increase the convenience of operation. The rear panel includes phono plug jacks for B+ to accessories, a six-prong accessory plug permitting access to the audio channel, the "transmit" control voltage, and the B+ line. An external c.w. filter, such as the TenTec Model 245, which provides four stages of active filtering, can be inserted quite conveniently by means of the plug and cable. A new feature of the 509 permits using the transceiver with an external linear amplifier without complicated t/r switching. A "Receive/Transceive" switch on the rear panel allows one to connect the receiver section of the Argonaut directly to the t/r switch of the linear for full transceive operation. Finally, the 509 includes front chassis feet with spring extensions which raise the front of the Argonaut about 1.5 inches when extended, so that the front panel of the Argonaut is perpendicular to the operator's line of sight.

Defects

The Argonaut 509 unit tested by this writer performed flawlessly in all respects. The only defect encountered was that the glue holding the plexiglass dial window to the front panel failed. The plexiglass window warped inward toward the dial, causing the dial pointer to hang up, and the dial pointer string eventually slipped off a pulley. This is an admittedly minor defect. Otherwise, everything performed as it should.

Conclusions

Although the Argonaut 509 looks like the 505, it definitely feels like a different rig when operating it. As far as the operation of the Argonaut 509 is concerned, I'd have to say that the single most important improvement is the frequency stability. This is essential, not merely convenient. Second, that the other improvements certainly add to the 509's overall effectiveness. Undoubtedly I will get numerous letters asking whether I would personally recommend the Argonaut for purchase. My answer is without any qualification: *yes*, it is well worth the price. Furthermore, from all reports, with one exception, factory service is excellent. Due to the Argonaut's modular construction, many of the boards may be pulled out and shipped to the factory for servicing, eliminating the need to ship the whole transceiver back. In closing their introduction to the 505, KCD and K4FW expressed the hope that "the Argonaut will expand the horizons of amateur radio." The 505 certainly did just that for thousands of amateurs, and its spectacular beginning will be doubtless carried on by the 509.

Dr. Chalfin was there from the beginning. He shares with the readers of CQ some of his observations of the testing phase of OSCAR-8.

Pre-launch Testing of AMSAT/OSCAR-8

BY DR. NORMAN L. CHALFIN*, K6PGX

In addition to the article presented below, Dr. Chalfin sent CQ the following background letter. –K2VG

For an hour-and-a-half Booth Hartley, N6BH, piloted his Beechcraft Bonanza over Southern California on November Fifth carrying a prototype model of the A-O-D mode J transponder. Booth is a member of the JPL Amateur Radio Club. Maurice Piroumian, WA6OPB, a member of the Hughes Aircraft Company Amateur Radio Club, also aboard Booth's plane, operated an ECHO II 432/435 MHz KLM transceiver to monitor the output of the model J transponder. The flight was in preparation for the full-scale all-day test flight to be held on December 3, 1977. The December 3rd flight will cover all of the state of California, starting from Van Nuys Airport early in the morning. It will go on to San Diego, then north to Palo Alto where the fliers will stop for luncheon and refueling. After lunch they will continue to Sacramento and then return south through the inland valleys to Van Nuys Airport.

Just before the flight on November the fifth, tests were made on the ground with Skip Reymann W6PAJ (JPLARC), and Gene Halaas WB6GSP, of Van Nuys, transmitting s.s.b. signals on 2 meters through the transponder. Norm Chalfin, K6PGX operated f.m. through the transponder transmitting on 2 meters from a new WE 800 Wilson. The transponder output was received on an inexpensive battery operated portable tuned down from its nominal 450-470MHz commercial band operation.

The Jamsat transponder beacon was keyed by prom operated keyer putting out "Hi, Hi, Hi, Hi, de WA3NDS AA 4." The keyer was built by Dick Ulrich K6KCY. Dick was to have been aboard the plane also, but was grounded by a strep throat. He did manage, however, to complete the equipment modifications necessary for the flight despite his discomfort. Dick is a member of the JPL Club.

At the QTH of N6IC, Don Bostrom, on November fifth, there were three ground stations set up:

John Dessel WA6JML operated the Downlink position, receiving signals in the 435.125-.140 MHz band from the airborne transponder on a Kenwood TS820 equipped with a Hamtronics 435 MHz converter.

Elliot Oseas, WA6KGN operated the uplink position using a Kenwood TS-700-A for transmissions in the 145.890-145.905 MHz range.

Dick Handlen WA6SLB maintained ground-to-air and air-to-ground communication via a 220 MHz repeater WR6AJI on Mr. Wilson using the Midland 13-509.

Don, John, Elliot and Dick are members of the Hughes Club. Tom McInnes WB6ZEB, President of the HAC Club, and Sam Weise, another member, set up and maintained ground station antenna facilities which included beams, ground planes and vertical units.

John Swancara WA6LOD, and John Gerlach K6BRD also of the Hughes Club, also participated with the operations.

Dr. Sandra Bostrom (Don's XYL) provided a delightful buffet. Also in the wings was Mrs. Nancy Reymann, Skip's XYL.

About 10 calls were heard in the narrow pass-band during the very short flight. On the ground tests of the mode J transponder at the airport, Skip reported that the band width was 18KHz.

Calls heard were:

WB6GSP	*(SSB)*
W6PAJ	*(SSB)*
K6PGX	*(FM)*
W6LO	*(SSB)*
W6TCQ	*(SSB)*
W6XT	*(CW)*
N6IC	*(SSB)*

There were no interferring signals heard about the aircraft or on the ground, and no interference was reported from the transponder to other amateur services

(Signed) Norm Chalfin

Two test flights were made of the 2-meter-to-70-centimeter transponder to be incorporated as the Mode J unit of the A-O-D amateur communications spacecraft. A-O-D is scheduled to be launched on March 5, 1978** from the NASA Western Test Range at Vandenberg AFB, near Lompoc CA. The A-O-D will become AMSAT/OSCAR-8, unless the long expected Russian RS satellite is launched first.***

The flight tests were designed to provide West Coast amateurs an opportunity to check out their gear in the 2 meter to 70 centimeter range. A second purpose of the test was to determine what interference problems, if any, might develop with the fast scan TV operators using the 432-435 MHz band. The JAMSAT transponder call sign was WA3NDS.

Booth Harley was the pilot of his Beechcraft Bonanza which carried the transponder. Maurice Piroumian, WA6OPB, was the co-pilot and communicator. Dick Ulrich, K6KCY, was the technician who set up the equipment for operation aboard the plane. He designed and built the IC beacon identifier which put out the signal "HI HI HI DE WA3NDS AMSAT AA4."

The flight test demonstrated that the JAMSAT transponder might interfere with fast scan TV, at least at the 15-20 kHz bandwidth level of the prototype model carried on the test aircraft. This model had been built by the Japan AMSAT organization for local tests in Japan. It was situated on Mount Fuji. The Japanese equivalent of our F.C.C. required the

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**It was—successfully.

***It wasn't.

Gene Halaas, WB6GSP, shows Dick Ulrich, K6KCY, the operation of his 2 meter ICOM s.s.b. unit. Dick carried the ICOM aloft during the December 3 flight test of the JAMSAT 2 meter to 435.1 MHz translator. (K6PGX photo)

limited bandwidth. The actual flight equipment will have a bandwidth of 100 kHz and will be operating at an altitude of about 550 miles.

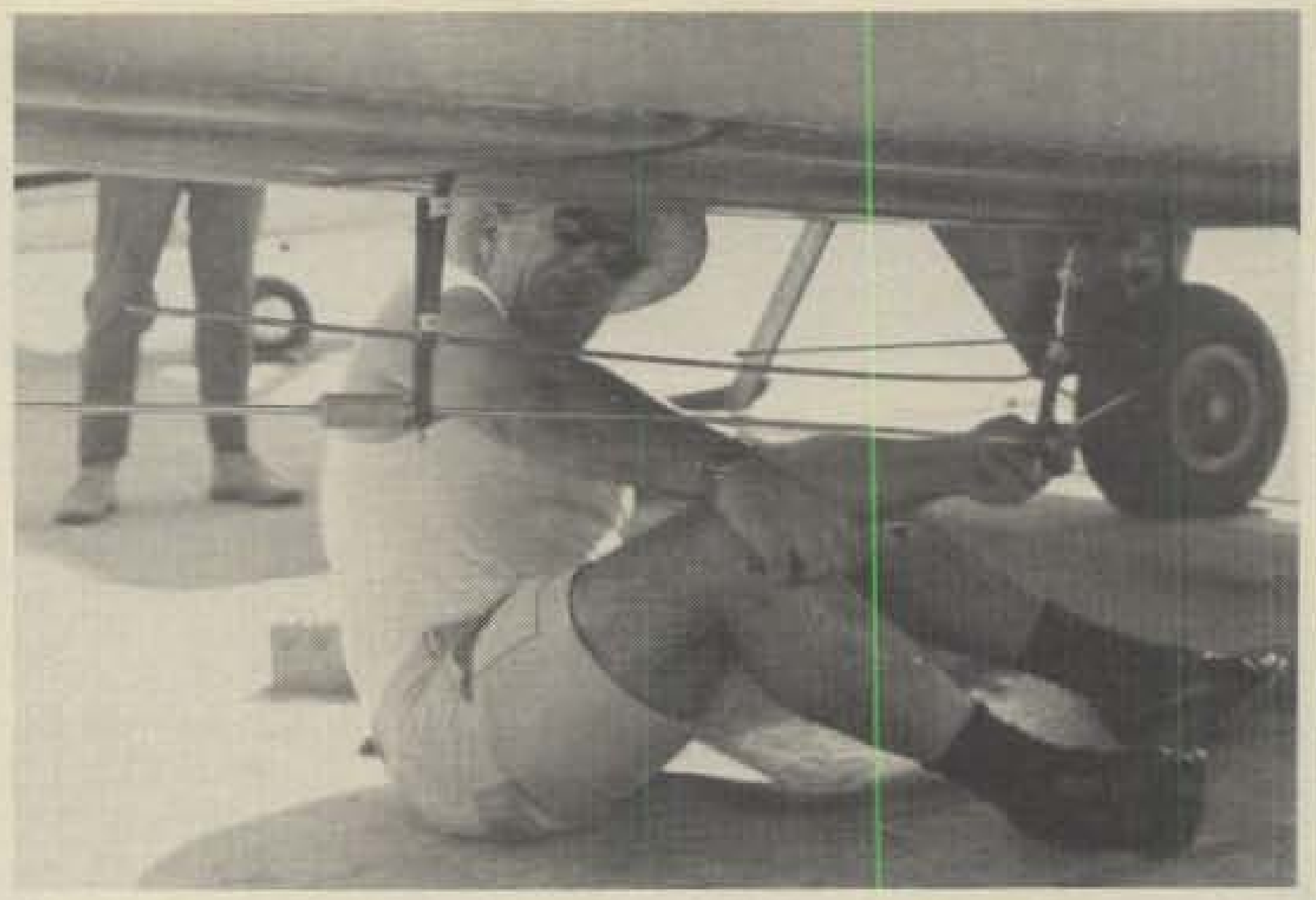
The first flight on November 5th lasted only an hour and a half covering Los Angeles County, Orange County, San Diego County and Riverside County. Several dozen reports were had from participants in this flight. No fast scan TV interference was reported.

The second flight, starting at 10:15 AM on December 3, 1977, followed essentially the same path as that of the first flight but continued northward to Palo Alto where the crew stopped for lunch and refueling. They were met there by W6BD, WA2VBD, W6KN, W6JZU and W6HDO.

Then they continued over the Bay Area and on to Sacramento. Turning south, the flight continued through the Valley on the Eastern Slopes of the Sierras back to the Van Nuys Airport (their starting point) at 6:00 PM. Several hundred reports were received of access to the transponder and of 2-way contacts. Fast scan TV interference was observed by one operator.

The A-O-D space craft will include the JAMSAT 2 meter-to-70 cm transponder built by the Japan AMSAT group, and a 2 meter-to-10 meter transponder built by the AMSAT group in Washington, D.C. The latter will replace the capability lost when AMSAT/OSCAR-6 ceased operation last summer, and

Jan King, W3GEY, makes an adjustment of the release mechanism of the AMSAT/OSCAR-8 spacecraft during testing at the NASA test facility in Lompeo, CA. Dick Daniels, WA4DGU, left, and Lance Ginner, K6GSJ, are getting a kick out of holding the spacecraft so that Jan can get at the mechanism. (K6PGX photo)



Maurice Piroumian, WA60PB, installing the loaded 10 meter antenna under the belly of N6BH's Bonanza *in preparation for the flight test of AMSAT/OSCAR-6's 2 meter to 10 meter transponder in 1971. Maurice again participated as co-pilot and in a technical capacity on the December 3, 1977 test flight of the mode-J 2 meter to 70 cm transponder for the A-O-D spacecraft which will become OSCAR-8 when in orbit. (K6PGX photo)*

AMSAT/OSCAR-8 was launched March 5, 1978 aboard a Delta rocket carrying the LANDSAT-C NASA Earth Resources Technology Satellite. The launch took place at the NASA Western Test Range at Lompoc, CA. Another secondary payload on the rocket was the PIX (Plasma Interaction Experiment) from Lewis Research Center which is designed to study corona effects in high voltage solar cell applications for future space missions. (Photo by USAF/NASA).

Dick Ulrich, K6KCY, examines the connections for the JAMSAT 2 meter to 435.1 MHz translator just prior to take-off for the December 3 test flight over California. (K6PGX photo)

help to continue the educational activity on the 2-to-10 meter link.

The tests were carried out as a joint effort of AMSAT with the JPL Amateur Radio Club, The Lockheed (Southern California) Radio Club, the Lockheed (Sunnyvale) Amateur Radio Club, and Hughes Aircraft Company Amateur Radio Club. The JPL club had operated the AA-2 test of OSCAR-6 and the AA-3 test of OSCAR-7 previously.

There were ground control/communications stations at the home of N6IC, Don Bostrum, and also at the home of WB6ZEB, Tom MacInnes, both of these in Southern California. Tom is the president of the Hughes club.

In Northern California, W6UM, Dr. Charles Weir at San Luis Obispo, maintained a midway communications monitoring point. At Lockheed in Sunnydale Cliff Buttschardt, W6HDO, maintained constant communications on 40 meters with N6IC through the Lockheed Club station, W6GFY.

Direct air-to-ground communication was maintained on 220 MHz via both the JPL repeaters WR6APS and WR6AJI in Southern California, and through WR6ABH in San Jose.

Skip Reymann, W6PAJ, was project organizer for the tests. He was unable to be with the group during the second test so that the author was pressed into service as *honcho* for the December 3rd test. Merv MacMedan, N6NO, provided the Northern and Southern California liaison which resulted in the successful coordination responsible for the happy outcome of the flight test.

Other participants at the various ground stations included:

WA6SLB, Dick Handlen	220 Ground to Air
WA6LOD, John Swancara	2m-70cm operations
K6BRD, John Gerlach	2m-70cm operations
WA6KGN, Elliott Oseas	2m uplink
WA6JML, John Dessel	70cm downlink
WB6QWR, Randy	Ground support 40m/220Mhz
WB6GSP, Gene Halaas	Ground tests before flight

Multiple-crystal, diode-switched filters can make reception of amateur communications more reliable. W4FA describes a few simple filter circuits, and discusses their application.

Economical Diode-switched Crystal Filters

BY JOHN J. SCHULTZ*, W4FA

Deficient selectivity is a problem that plagues many transceivers or receivers, particularly older equipment. Deficient selectivity can have several aspects to it. The bandwidth of the signal passband may be larger than desired for a particular mode of operation or for certain QRM conditions. Another possibility is that the basic passband may be satisfactory but the sides or skirts of the passband broaden out too rapidly (poor shape factor) and do not provide "clean" reception under crowded band conditions.

There are all sorts of cures, of course, for the selectivity problem. Outboard audio devices can do a great deal to help and are easy to install. But, better results are invariably obtained if one can attack the selectivity problem in the i.f. chain.

Commercial crystal filters can be expensive and are not available in all desired bandwidths to suit all i.f. frequencies. However, individual crystals are not very expensive. In fact, if one can tolerate the old fashioned FT-243 crystals, one might even say they are inexpensive (as low as $2.00 cut to specific frequencies in the h.f. range!). Also, they are available for practically any i.f. frequency up to 9 MHz (see Jan Crystals catalog flyer). Building one's own crystal filter need not be expensive, therefore, although it may require a bit of patience to get it adjusted correctly.

This article deals with two simple crystal filter circuits that are suitable for practically any i.f. frequency up to 9 MHz. The circuits can be used alone or in cascade for better skirt selectivity at a given bandwidth. Their application depends on the needs of a particular piece of equipment. The simple two-crystal circuit might be all that is needed to obtain adequate c.w. selectivity if a transceiver already has a good s.s.b. filter. The four-crystal circuit can replace many s.s.b. filters directly in older pieces of equipment which have 3 or 4 kHz wide filters. The filters both use a diode switching arrangement so one can vary the bandwidth over as wide or as narrow a range as desired by switching in different sets of crystals. This capability also provides an economical approach. If one initially used some crystals which, it ends up,

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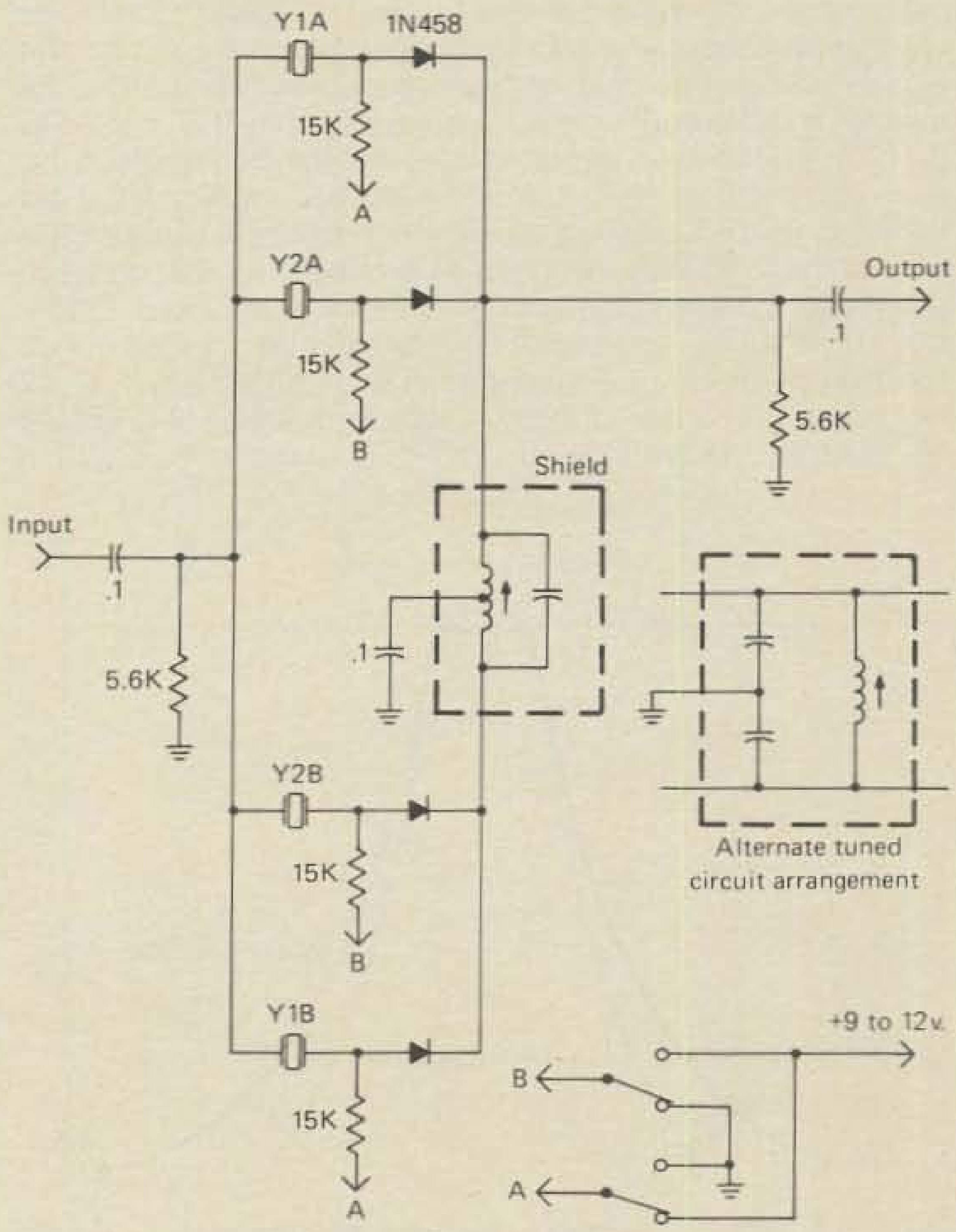

Fig. 1 – Filter circuit using single crystal pair for each degree of selectivity. With the switch as shown, Y1A and Y1B are active. The frequency spacing between the crystals in a pair can be estimated from fig. 2. For example, for a 455 kHz i.f., if a 500 Hz bandwidth were desired, the spacing would be 300 Hz. Y1A would be 455.150 and Y1B would be 454.850.

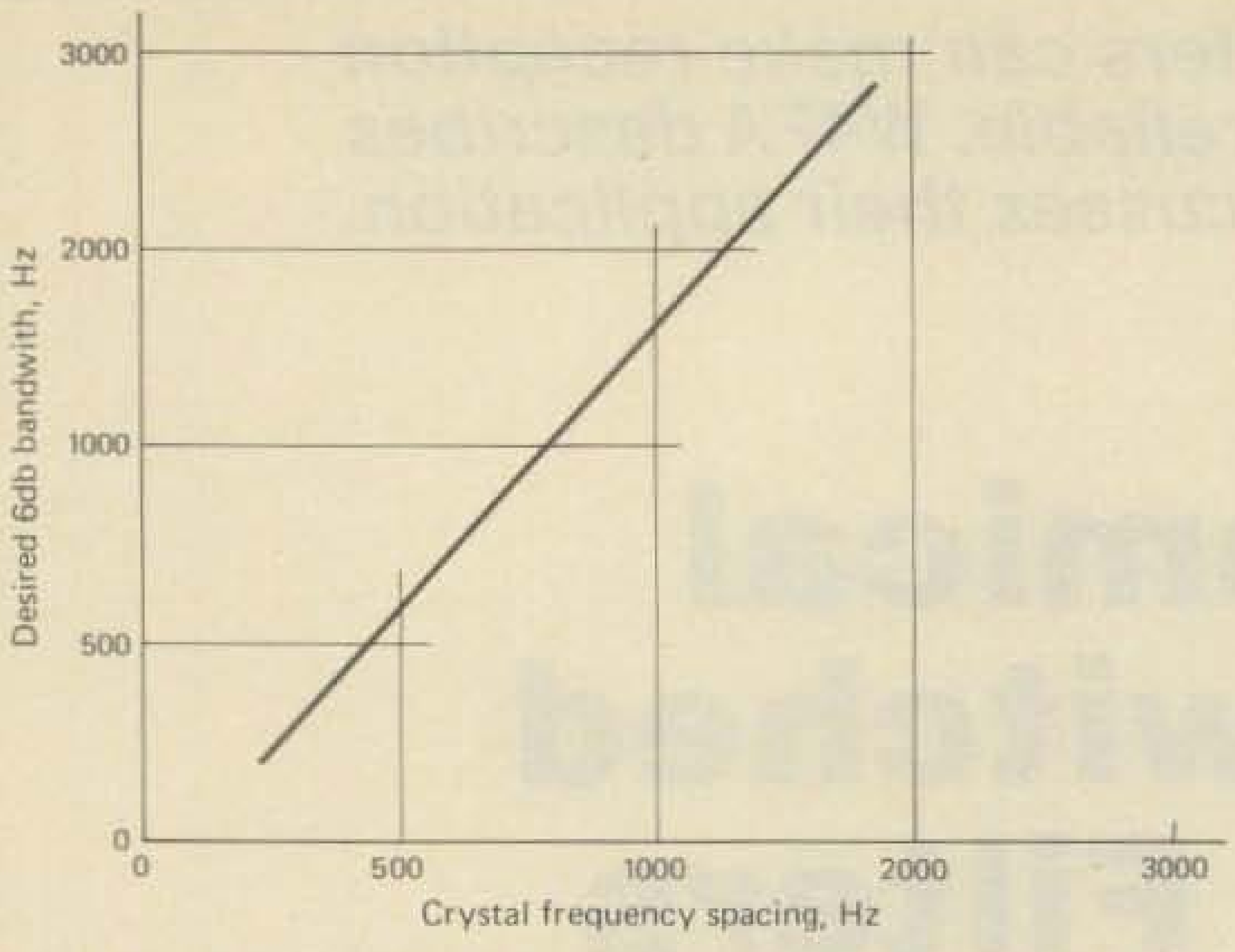

Fig. 2 – Approximate frequency spacing of crystals used in the circuit of fig. 1. The graph is used to obtain various filter bandwidths.

did not quite provide the results desired, it is possible in many cases to purchase just one or two more crystals to try out another bandwidth rather then having to purchase a complete set of two or four more crystals. The relationship of the b.f.o. frequency to the i.f. passband frequencies determines whether this is possible or not as discussed later.

Fig. 1 shows the two-crystal filter circuit. The diode switching arrangements shows only two pairs of crystals being used but this can be expanded as desired. 1N458 diodes are used as switches. When forward biased from the + line, the diodes switch "in" the applicable crystal. Note the 5.6k resistor at the output side of the tuned circuit. This is used to develop a positive voltage to ensure that the diodes which are associated with the crystals switched "out" of the circuit are definitely reverse biased in conjunction with having the anode side of those diodes switched to ground. The tuned circuit resonates at the particular i.f. frequency being used. Often, one can obtain a replacement i.f. transformer or tuned circuit for a given piece of equipment to use. About any form of home-brew resonant circuit will also work although it should be shielded. If one cannot obtain a tuned circuit with a center-tapped indicator, the alternative circuit shown in the diagram can be used. The only criteria is to choose the component values so a resonant circuit is formed at the i.f. frequency.

The individual crystal frequencies are chosen on the basis of the bandwidth desired. For c.w. usage a 500 Hz bandwidth at 6 dB is often used. In this case, the crystals would be chosen 300 Hz apart in frequency (that is, one being 150 Hz above and one 150 Hz below the i.f. center frequency). For a resultant 2.7 kHz s.s.b. bandwidth, the crystals are spaced 1.8 kHz in frequency and for a 2.1 kHz s.s.b. bandwidth, the crystals are spaced 1.25 kHz in frequency. The reason, of course, that the bandwidth is larger than the crystal frequency spacing is that the skirts or sides of the crystal filter bandpass shape are not vertical but flare out. The crystal frequency spacing for other bandwidths is shown approximately by the graph of fig. 2. Fig. 3 shows a typical bandpass shape for the crystal filter.

Fig. 4 shows a four-crystal filter circuit. Diode switching is used again and it can be expanded to as many sets of crystals as desired for different bandwidths. The same com-

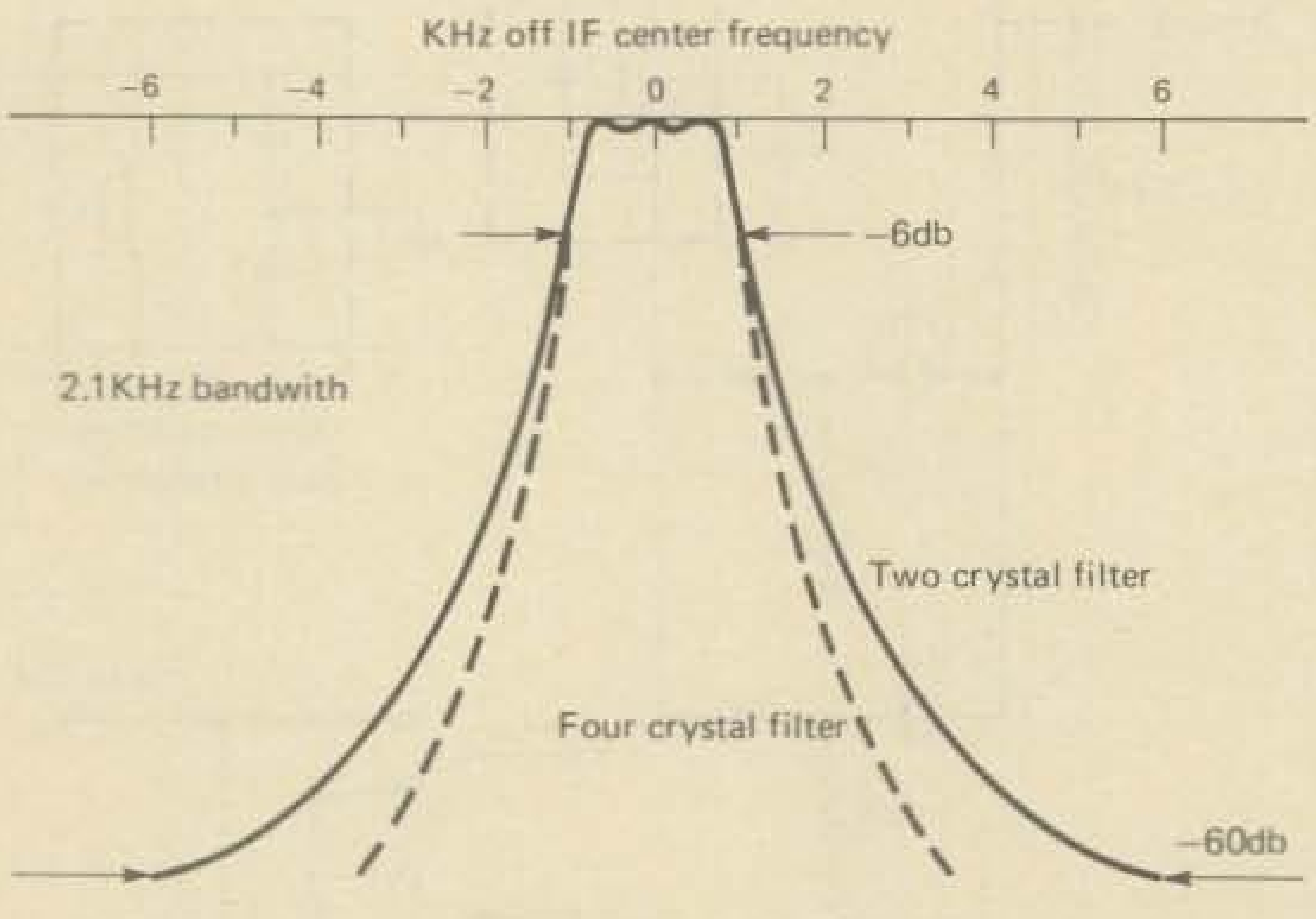

Fig. 3 – These curves give an approximation of the bandpass shape of the filters using either two or four crystals for each selectivity position. The actual shapes will be somewhat more uneven. If filter stages are cascaded (with suitable isolation amplifiers), the steepness of the skirts will improve since the attenuation provided by the filters at frequencies off the center frequency are additive.

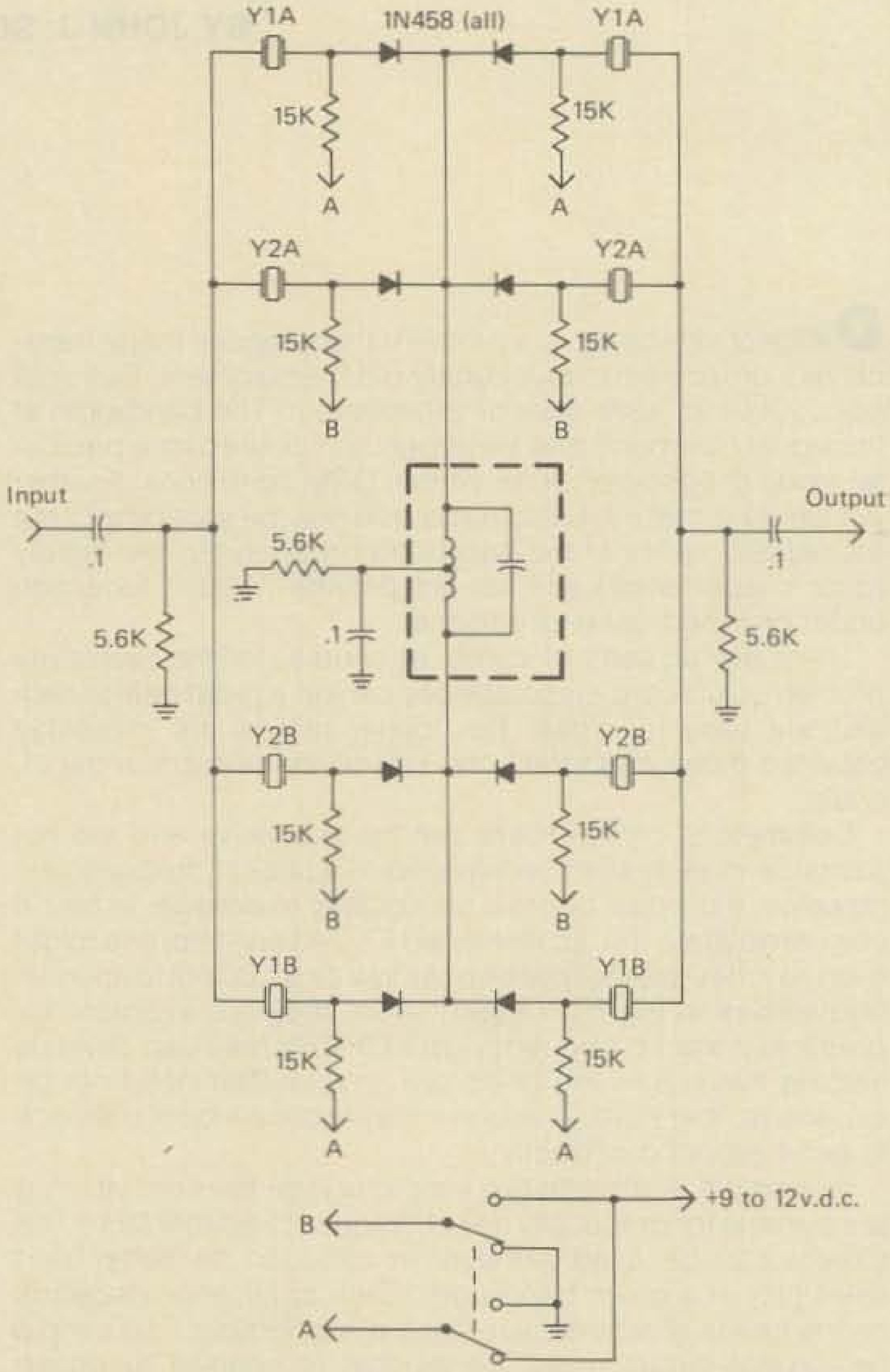

Fig. 4 – The four crystal filter circuit (two pairs of crystals for each selectivity position) is a simple expansion of the circuit of fig. 1. The diode switching shown could be further simplified but the parts cost saving would be minor and the circuit as shown does allow those who like to experiment to independently switch in crystals by controlling each diode separately. This would be done by connecting each 15k resistor to a separate switch. Sometimes, depending on the crystal frequencies involved, useful additional selectivity options can be obtained.

ments apply for the tuned LC circuit as for the circuit of fig. 1. The crystal frequency spacing is also approximately the same with a pair of spaced frequency crystals being placed on each side of the tuned circuit. As is readily apparent, the circuit of fig. 1 can be easily expanded to that of fig. 4 if the former circuit does not deliver the performance needed and one allows for this expansion in the method of construction used. The advantage of the four-crystal circuit is greatly increased skirt sharpness as shown in fig. 3.

The method of construction used will depend, of course, on the piece of equipment being modified. P.c. board construction is generally most applicable. The only precautions necessary are those common with any r.f. construction—keeping lead lengths short and arranging components to separate the input/output portions of the circuit so a signal cannot leak around the filter and thereby negate its effectiveness.

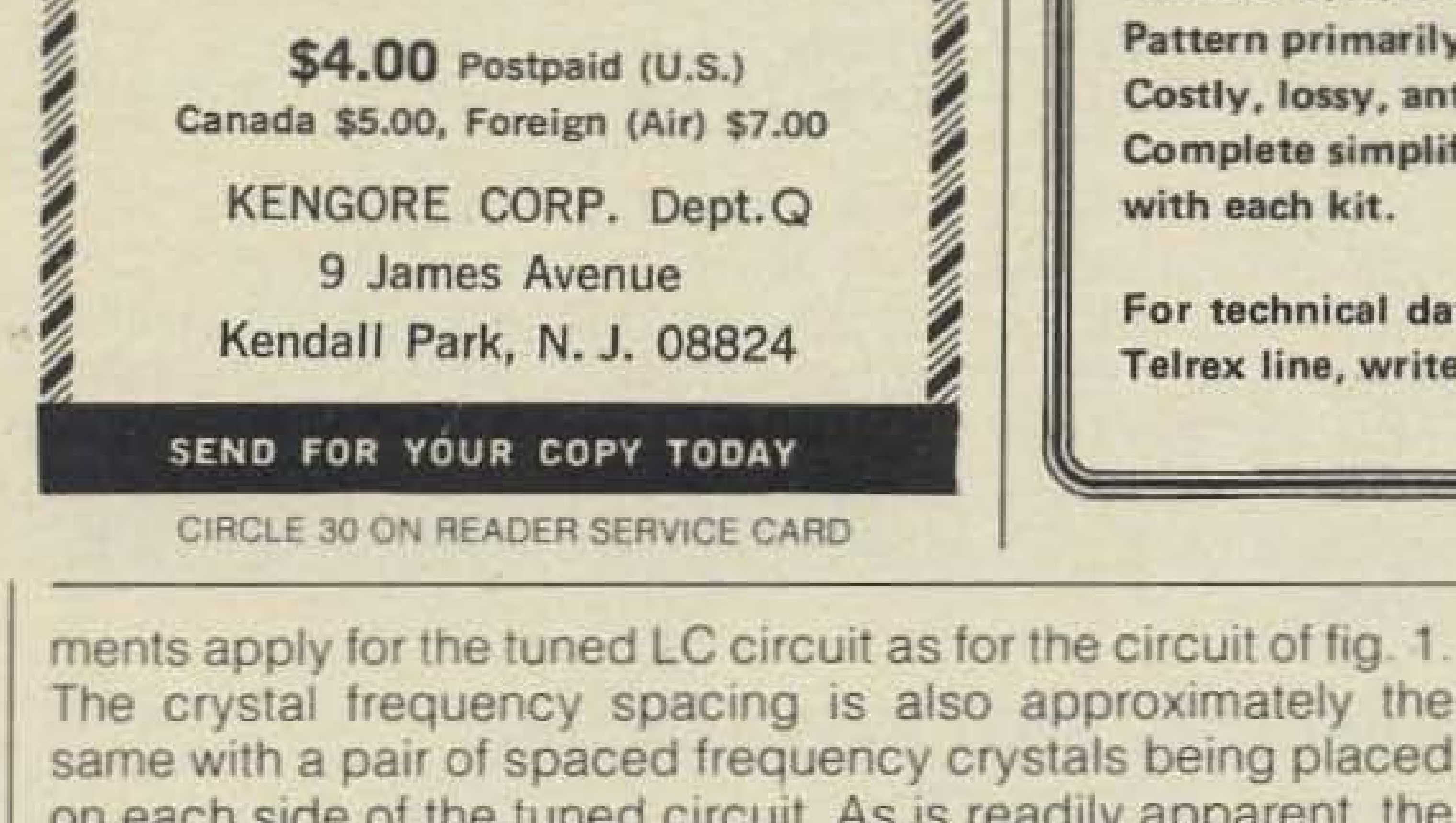

Fig. 5 – Simple in/out amplifier for a filter in case the filter attenuation needs to be compensated for by additional i.f. amplification. It is assumed that there would be some tuned circuits at the input and output associated with the normal i.f. circuitry in a piece of equipment. If not, a simple tuned, parallel circuit at the input may be necessary to get the desired gain.

The filters do have a certain amount of insertion loss. If they are used to replace the existing filter in a piece of equipment either temporarily by a switching arrangement or permanently, no additional i.f. amplification usually is necessary. In other cases, when an added crystal filter is switched in the i.f. chain to supplement an existing filter, the loss introduced by the crystal filter may have to be made up by suitable added amplification. A duplicate of any i.f. amplifier used in the piece of equipment will generally suffice or the simple input/output amplifier shown in fig. 5 can be used. I.f. selectivity should take place as early as possible in the i.f. amplification chain. This is also true for any added selectivity so one should place the crystal filter in the i.f. chain in the stage where the major i.f. filter is presently used or in the first i.f. stage after the mixer stage.

Adjustment of the crystal filter requires first that the tuned circuit associated with it be peaked at the i.f. frequency. This can be done using a signal generator or just the signal from a calibrator. In any case, one should take care that the signal going through the i.f. chain is at the center frequency of the i.f. bandpass. For the circuit of fig. 1, one of the upper crystals can be temporarily shorted and its associated lower crystal temporarily removed from the circuit to peak the tuned circuit. The same is true for the circuit of fig. 4, except that both upper and both lower crystals are involved.

In most cases, no further adjustment is needed. However, it is possible to maximize the skirt symmetry about the i.f. center

(Continued on page 91)

This part of the series will get you on the air. In addition to instructions for building a frequency shift keyer, on-the-air procedure is discussed.

AN RTTY PRIMER PART V

BY IRWIN SCHWARTZ*, K2VG

The greatest concern in receiving RTTY is that of isolating and processing two audio tones which are separated by a given number of hertz. The major objective of transmitting RTTY is generating those tones.

The signal requirements are quite strict. First, the signal must consist of two radio frequencies separated by (let us agree) 170 Hz. Second, the accuracy of these tones must adhere to close tolerances — for if not, the converter on the receiving end will not respond to them. Third, the change from one frequency to the other must be effected instantaneously. And fourth, the stability of the transmitted radio frequencies must lie within proscribed limits.

In short, the transmission of a RTTY signal must lie hand-in-glove with its reception.

The terminal unit is designed to respond to two tones with a given frequency separation. The **frequency shift keyer** is designed to cause that separation.

This article will discuss the theory of frequency shift keying (f.s.k.) and will describe the construction of a frequency shift keyer using one of the two methods.

Frequency Shift Keying

The basic technique used for shifting the frequency of a transmitted signal is found through analysis of the relationship between the resonant frequency, f_r, of a tuned circuit and the values of the components in that circuit.

Consider fig. 1, which is a diagram of a parallel tuned circuit. The resonant frequency of the circuit is a function of the values of the capacitor, C, measured in farads and the inductor, L, measured in henries. The resonant frequency is given by

$$f_r = \frac{1}{2\pi\sqrt{LC}},$$

where f_r is measured in hertz. See inset 1 for a derivation of the formula; see inset 2 for an example of using the formula.

*Technical Editor, *CQ*

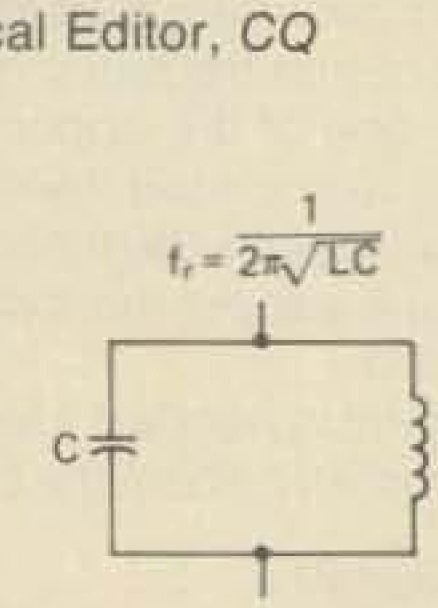

Fig. 1 – A parallel-tuned resonance circuit.

By changing either the value of L or the value of C in the tuned circuit of fig. 1 a corresponding change in its resonant frequency can be realized. For example, if the resonant frequency of the circuit in inset 2 were changed from 14.085000 MHz to 14.085170 MHz the seed of 170 Hz shift RTTY would be sown.

The simplest and, hence, most common method is to introduce a reactive change by varying the capacitance in the circuit.

Referring to fig. 2, note that a capacitor, C_p, has been placed in parallel with the tuned circuit. Upon doing this, the capacitance in the circuit increases (capacitances in parallel *add)* and the resonant frequency of the tank is thus lowered.

The capacitor can be switched, albeit manually, in and out of the circuit, as shown in fig. 3. When the capacitor is switched in f_r is lowered; when it is switched out f_r returns to its original value.

Frequency Shift Keyer Circuits

The foregoing discussion puts the reader in the position of being able to consider frequency shift circuits which are practical and in actual use. The simplest of these appears in fig. 4. A radio frequency choke (RFC), a trimmer capacitor (C_1) and a diode (D_1) are the only necessary components.

D_1 is normally reverse biased by the mark (positive) potential from the keyboard (+V is loop supply voltage). Under this condition there is no conduction through the diode and capacitor C_1 is switched out of the circuit. On transmission of a space pulse (–V), D_1 becomes forward biased and C_1 is introduced into the tank circuit C_2-L. This increases the capacitance and, thus, lowers the frequency of transmission.

C_1 is switched into the circuit in *parall*' with the tank when D_1 conducts. A special note is made of this fact for, if not for the existance of a current return confusion in the analysis of the circuit might result. The capacitances of C_1 and C_2 *add*. This condition makes it relatively simple to find an appropriate value for the trimmer.

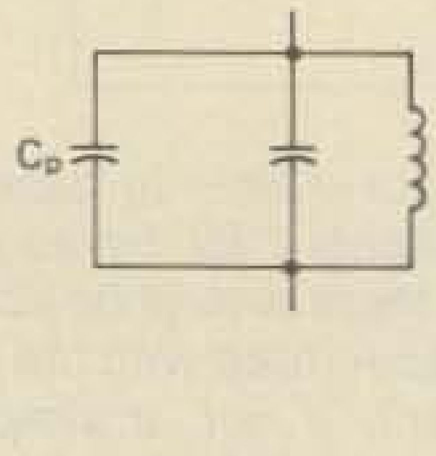

Fig. 2 – Changing the resonant frequency of a parallel-tuned circuit by placing a capacitor in parallel with it. The two capacitances add, thus lowering the resonant frequency.

A Component System for RTTY

ST-5000 RVD-1005 DKB-2010

Active amateur, short wave listener, beginner, or old-timer—you'll enjoy RTTY with the HAL component system. Shown above are our ST-5000 Demodulator, RVD-1005 Visual Display Unit, and DKB-2010 Dual-mode Keyboard. The RVD-1005 is a time-proven display generator that converts BAUDOT coded RTTY pulses into a video display. It receives the 4 standard RTTY speeds (60,66,75, and 100 words per minute) and generates a 25 line, 40 characters per line display. The low-bandwidth video output can drive either a TV monitor or a modified TV Set (power transformer and video connection required). The DKB-2010 will transmit these same four RTTY speeds as well as MORSE code at 8 to 60 wpm. The DKB also features N-key rollover, adjustable CW weight, HERE IS message, and internal CW side-tone oscillator. The 3-key standard buffer can be extended to 128 keys with the EMO-128 buffer option. The ST-5000 is the newest of HAL's line of RTTY equipment, offering 2-shift operation with high-performance active filter circuitry. It also has built-in AFSK oscillator and loop supply and can be factory tuned for either the "High" or "Low" frequency tone pairs. Autostart and printer control circuitry make the ST-5000 ideal for both electronic and mechanical RTTY terminals. For a high-performance and cost-effective RTTY station, the RVD-1005/DKB-2010/ST-5000 combination is hard to beat!

ST-5000

- 170 and 850 Hz Shift
- Low or High Tones
- Integral Tone Keyer
- Active Filters
- Autostart
- Meter Tuning Indicator
- Internal Loop Supply
- Attractive, Small Cabinet
- High-gain, Wide-bandwidth Limiter
- For either HF or VHF operation
- 120/240V, 50/60 Hz Power

ST-5000 .... $275.00
(Specify High or Low Tones)

RVD-1005

- 4 RTTY Speeds (60, 66, 75, 100 wpm)
- Crystal Controlled
- Baudot RTTY Code
- Unshift-on-Space (Switch Selectable)
- Loop or RS-232 Input
- 40 Character Lines 25 Line Display
- Table or Rack Cabinet
- Use with modified TV Set
- 120/240V, 50/60 Hz Power

RVD-1005 .... $395.00
(Specify Table or Rack Cabinet)

RVD-2110 Quasar TV $150.00
(Shown above)

DKB-2010

- Baudot RTTY & Morse Codes
- 4 RTTY Speeds (60,66,75,100 wpm)
- Crystal Controlled
- 8 to 60 wpm Morse Code
- Programmable HERE IS message
- N-Key Rollover
- 3-Key Buffer Standard (128 Key with 128 EMO option)
- Quick Brown Fox test message
- Automatic FIGS/LTRS for RTTY
- Internal CW Sidetone Oscillator
- 120/240V, 50/60 Hz Power

DKB-2010 .... $395.00
(Specify HERE IS message)

EMO-128 Buffer Option .... $ 85.00

Write for our new catalog and RTTY guide.

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Note further that when a *space* is transmitted in the circuit of fig. 4 the diode is switched on and C_1 is switched in. The fact that the capacitor is switched in *lowers* the resonant frequency. When the diode does not conduct, the diode is switched off, the trimmer is not in the circuit and the resonant frequency is *raised*. These facts are in agreement with the convention among amateur RTTY-ers of low tone for space and high tone for mark. (Incidentally, there is a cute little mnemonic device for remembering the relationship between mark, space, low tone and high tone. It goes like this: LS/MFT — **L**ow **S**pace **M**eans **F**ine **T**eleprinting)

DERIVATION OF THE RESONANCE FORMULA

Capacitive reactance (measured in ohms) is given by

$$X_C = \frac{1}{2\pi fC}, \qquad (1)$$

where f is the frequency in hertz and C is the capacitance in farads.

Inductive reactance (measured in ohms) is given by

$$X_L = 2\pi fL, \qquad (2)$$

where f is the frequency in hertz and L is the inductance in henries.

A state of **resonance** exists when the capacitive reactance is equal to the inductive reactance, i.e., when $X_C = X_L$.

Thus, resonance appears when

$$\frac{1}{2\pi fC} = 2\pi fL \qquad (3)$$

Multiplying both sides of equation (3) by $2\pi fC$ gives

$$\pi^2 f^2 LC = 1 \qquad (4)$$

from which

$$f^2 = f_r^2 = \frac{1}{4\pi^2 LC} \qquad (5)$$

Thus,

$$f = f_r = \frac{1}{2\pi\sqrt{LC}} \qquad (6)$$

Inset 1

Keying the Keyer

The discussion now turns to the question of keying the keyer at the right time and in the right sequence for Murray encodement.

The switch used in a RTTY system for changing the frequency is the keyboard of the teleprinter. Refer to fig. 5. When a particular "arrow" (i.e., a keyboard contact) touches the upper line, the capacitor will be switched into the tuned circuit.

On the other hand, if an arrow is not touching the upper line the capacitance is switched out.

Therefore, if the arrows, moving in turn, from, say, left to right, make contact at the right time in accord with the Murray encodement of a particular character, that character will now be transmuted into its "high tone/low tone" representative. Since the teleprinter keyboard is designed to make and break contact within and during a prescribed amount of time (22 ms for 60 w.p.m. and instantaneous make and break) the mechanism of the teleprinter will take care of the switching requirements. This is basically how RTTY is transmitted. See fig. 6 for a diagram of how the letter "F" (M/S/M/M/S) is transmitted.

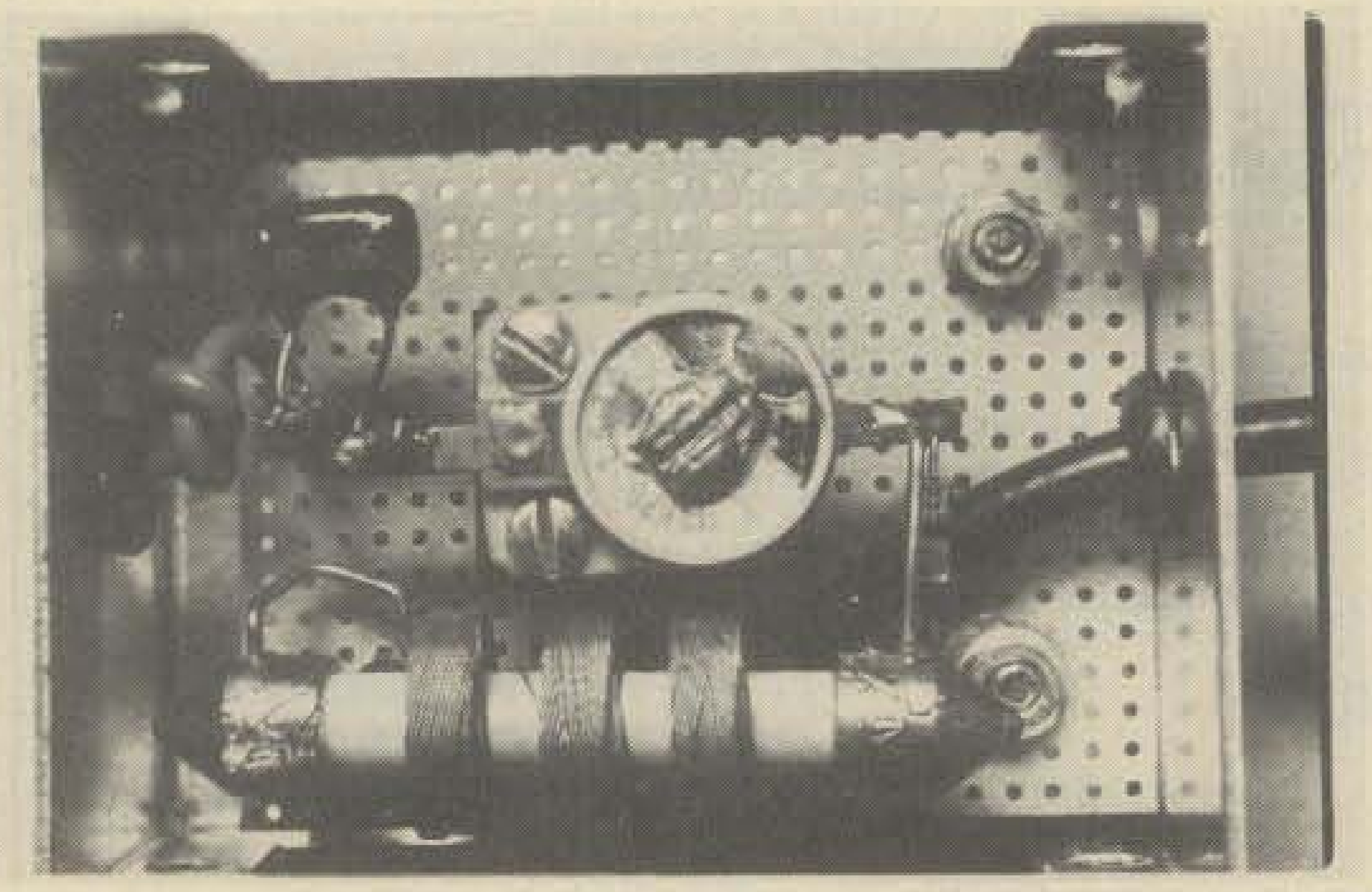
Moving sequentially from the encodement of element 1 (mark) to the encodement of element 5 (space), capacitor C_1 can be visualized as being switched in and out in accordance with the appearance of the marks and spaces for the letter "F." To make the diagram complete the timing sequency has been included, *viz.*, each pulse has a duration of 22 ms and the change from pulse to pulse (element to element) is instantaneous. The actual switching, of course, takes place inside the keyboard mechanism.

Note that throughout all of this the transmitter is sending a constant carrier. That is, the transmitter is operating under a continuous (100%) duty cycle. In that regard, it is *imperative* to note that, when transmitting RTTY, *the transmitter is always on*. If the transmitter is used in this way it is very easy to cause harm to the final tube(s). To be on the safe side **never run your transmitter so that the input power exceeds twice the plate dissipation of its final tubes(s).** The dissipation rating can be found in the specifications for your particular tube.

Construction of a Frequency Shift Keyer

A slight variation of the f.s.k.-er in fig. 4, and the circuit that will be used in the construction project, appears in fig. 7. This circuit is called a **saturated-diode** frequency shift keyer. It works on the same principle described earlier.

A pictorial representation of the finished product appears in fig. 8. Use the figure as a guide to construction.



A closeup view of the finished 170 Hz shift keyer.

The keyer next to a pack of cigarettes for size comparison.

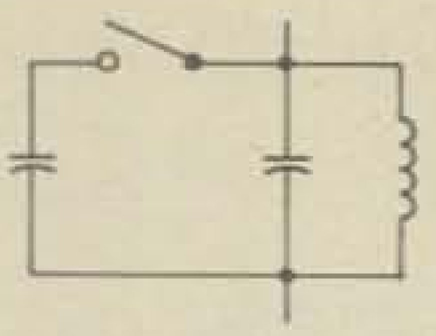


Fig. 3 – Switching a capacitor in and out of a tank circuit.

The shift keyer is designed for use with 170 Hz shift only. If you are interested in using both 170 Hz and 850 Hz shifts, simply tack on another keyer as shown in fig. 9.

The 500 ohm potentiometer is used to adjust the shift for c.w. identification. The shift for c.w. identification is usually set for about 100 Hz.

The output of the frequency shift keyer can be connected to the oscillator of the transmitter in one of the following ways:

(1) To the cathode of the oscillator tube. This method is very common. The output lead is wrapped around the cathode pin of the tube and the tube is inserted in its socket.
(2) To the control grid of the oscillator tube. The method of connection is the same as above.
(3) To the base of the oscillator transistor. Here, the output wire must be soldered directly to the transistor.
(4) Directly to the tank of the oscillator.

There are other methods. These can be found by referring to the bibliography of Part IV in this series.

The keyer should be housed in a metal mini-box for maximum sheilding against r.f. It should then be mounted as close to the oscillator (or tank) as possible. The wire going from the keyer to the keyboard should be sheilded cable. The idea is to make the keyer as r.f. immune as possible.

Of course, the keyer will have to be adjusted so that it shifts the transmitter's frequency 170 Hz. If you have a frequency counter, you are in luck. Simply key the transmitter with the keyer in and out of the circuit so that the space frequency is 170 Hz lower than the mark frequency.

If you do not have a counter, you may have to resort to subterfuge in the following manner. Use a harmonica!

An octave above E above middle C has a frequency of 659.2 Hz; an octave above G# above middle C has a frequency of 830.5. It is significant that the frequency difference between these two notes is 171.3 Hz — close enough for the purpose of setting the shift.

Zero-beat the space signal on your receiver with the E; then generate a mark and zero-beat with the G# by adjusting the trimmer.

Sometimes it is impossible to get the proper shift regardless of the position of the trimmer adjustment. In that case you might need more or less capacitance than that of the trimmer. If you look closely at the photographs of my keyer you will see that there is a 10 pF capacitor in series with the trimmer. I needed less capacitance so the solution took the form of a series capacitor. You may also have to experiment a bit.

Audio Frequency Shift Keying (A.F.S.K.)

Frequency shift keying (f.s.k.) effects a change in the r.f. frequency of the transmitter. The signal is sent over the air, following which it is processed by the distant receiver into two audio tones. These audio tones are then fed into the converter. With f.s.k. what ultimately becomes two audio tones originates in the oscillator of the transmitter.

There is another method of generating a shifted signal. With this method two tones of appropriate audio frequency are generated by a device (an **audio frequency shift keyer,** or a.f.s. keyer) whereupon the tones are fed into the microphone jack of the transmitter. The two audio tones modulate a steady carrier in exactly the same way one's voice would. The carrier and one sideband (usually the upper) are supressed at the transmitting end, to be later reinserted at the receiver. In this way the receiver of the signal treats a.f.s.k.'ed signal as an s.s.b. signal. The properly tuned audio tones are then introduced into the demodulator.

Note that, regardless of the shift method, f.s.k. or a.f.s.k., the converter is electronically ignorant of any difference. All the TU responds to are two audio tones. It cares not of their roots.

In order for a.f.s.k. to be legal on the h.f. amateur bands the carrier and upper sideband must be supressed to a very great degree — in the order of 45 dB down. Many contemporary rigs meet this standard. Many older rigs do not. Watch that supression or the F.C.C. will get you!

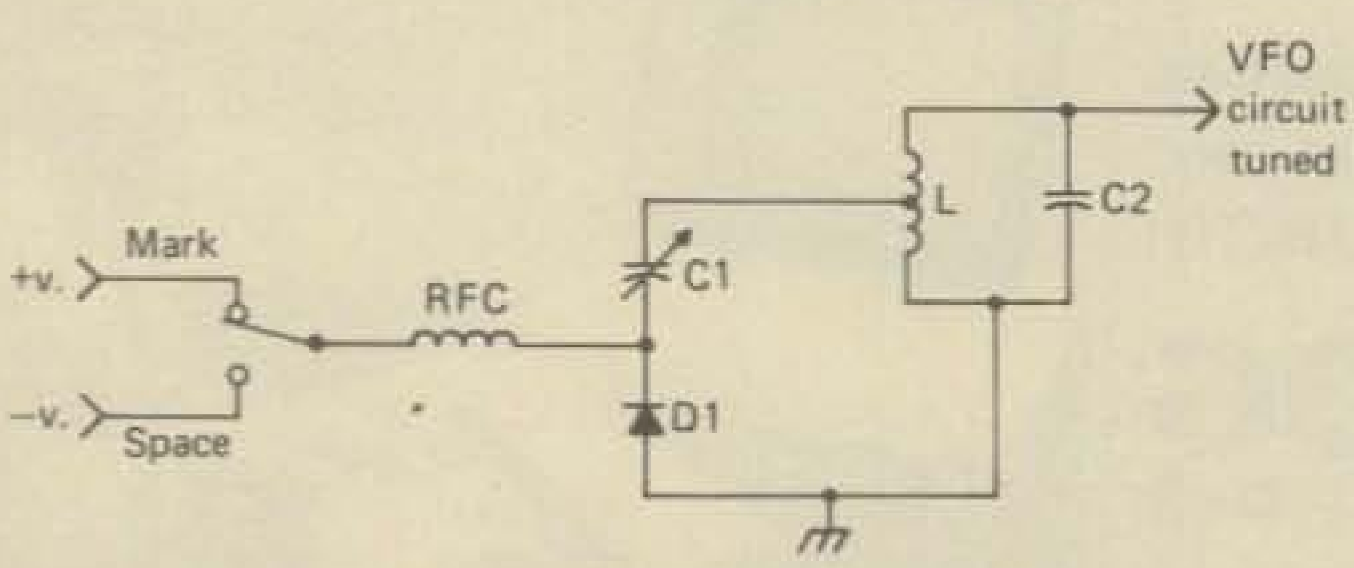
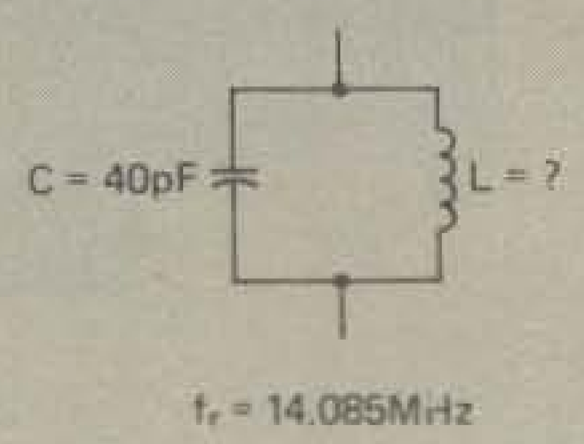


Fig. 4 – A simple frequency shift keyer.

USING THE RESONANCE FORMULA

Problem: Assume an operating frequency of 14.085 MHz (this is in the "RTTY portion" of the twenty meter band). Given a capacitance of 40 pF (40×10^{-12} F), find the inductance necessary for the circuit to resonate at the operating frequency.



Solution: $f_r = 14.085 \times 10^6$ Hz
$C = 40 \times 10^{-12}$
$L = ?$

From

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

it follows that

$$L = \frac{1}{4\pi^2 f_r^2 C}.$$

Substituting the given values of f_r and C, we get

$$L = \frac{1}{4(3.14)^2(14.085 \times 10^6)^2(40 \times 10^{-12})};$$

whence,

$$L = 0.0000031 \text{ H}$$

or

$$L = 3.1\ uH.$$

Inset 2

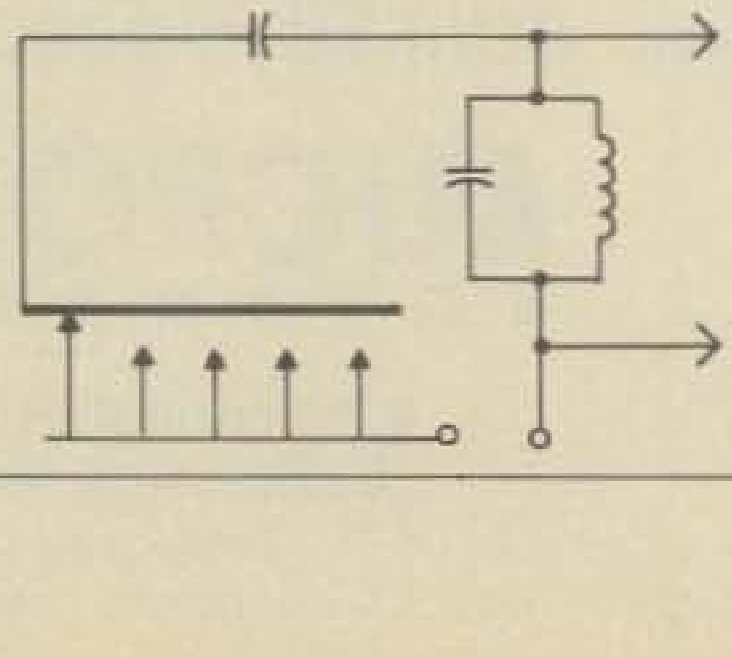


Fig. 5 – Using the keyboard of a teleprinter to switch a capacitor in and out of a tuned circuit.

On-the-Air Procedure

If you have been following this series faithfully you should now have in your possession a complete RTTY station.

The next step is getting on the air.

Although there are many similarities between operating c.w. or 'phone and RTTY, there are several differences in procedure and regulations that must be borne in mind.

First, not only must you identify every ten minutes, but you must identify *every time* you turn your rig on and off, *even if the transmission lasted but one-half minute*. Furthermore, identification must be made either by narrow shift "c.w." or by real

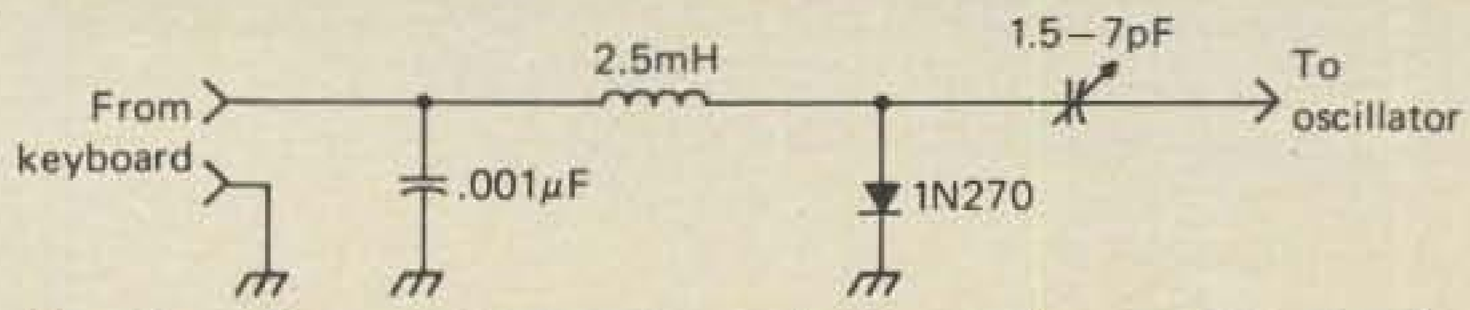


Fig. 7 – A practical saturated diode keyer. This is the schematic diagram for the construction project.

c.w. Identification *via* the keyboard is the usual procedure during a QSO but the F.C.C. requires c.w. identification. Strangely, they do not require printed identification.

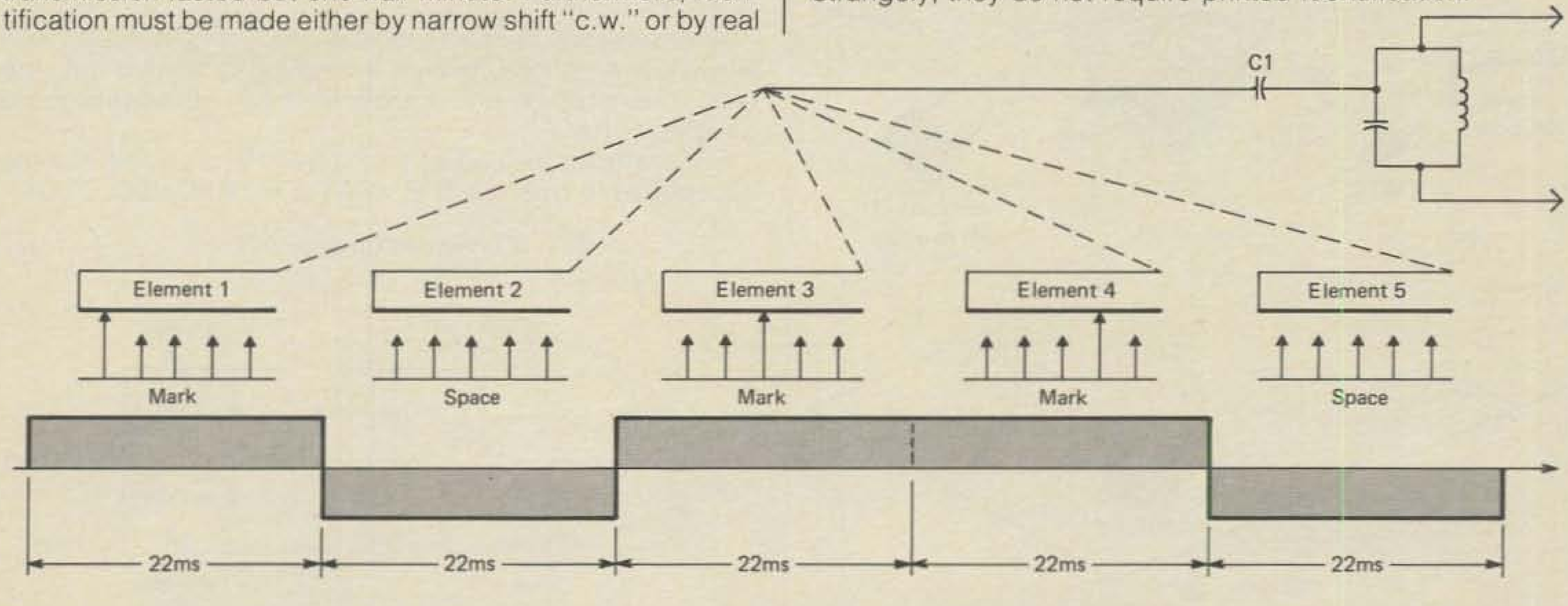


Fig. 6 – Illustration of how the letter "F" is transmitted by use of a keyboard and a frequency shift keyer. The marks and spaces are encoded as a function of whether the keyboard contacts are open or closed, respectively. Each keyboard contact is open or closed for 22 ms and the change from open to closed is instantaneous.

Call "CQ" in essentially the same way you would on c.w. You have, however, the option of adding a bit of personal data. Following is an example of a typical "CQ" as sent over RTTY.

(C.w. identification: K2VG)
CQ CQ CQ CQ CQ CQ CQ CQ DE K2VG K2VG K2VG
CQ CQ CQ CQ CQ CQ CQ CQ DE K2VG K2VG K2VG
CQ CQ CQ CQ CQ CQ CQ CQ DE K2VG K2VG K2VG
IRWIN IN NYC IRWIN IN NYC IRWIN IN NYC
K K K K (c.w. identification: K2VG)

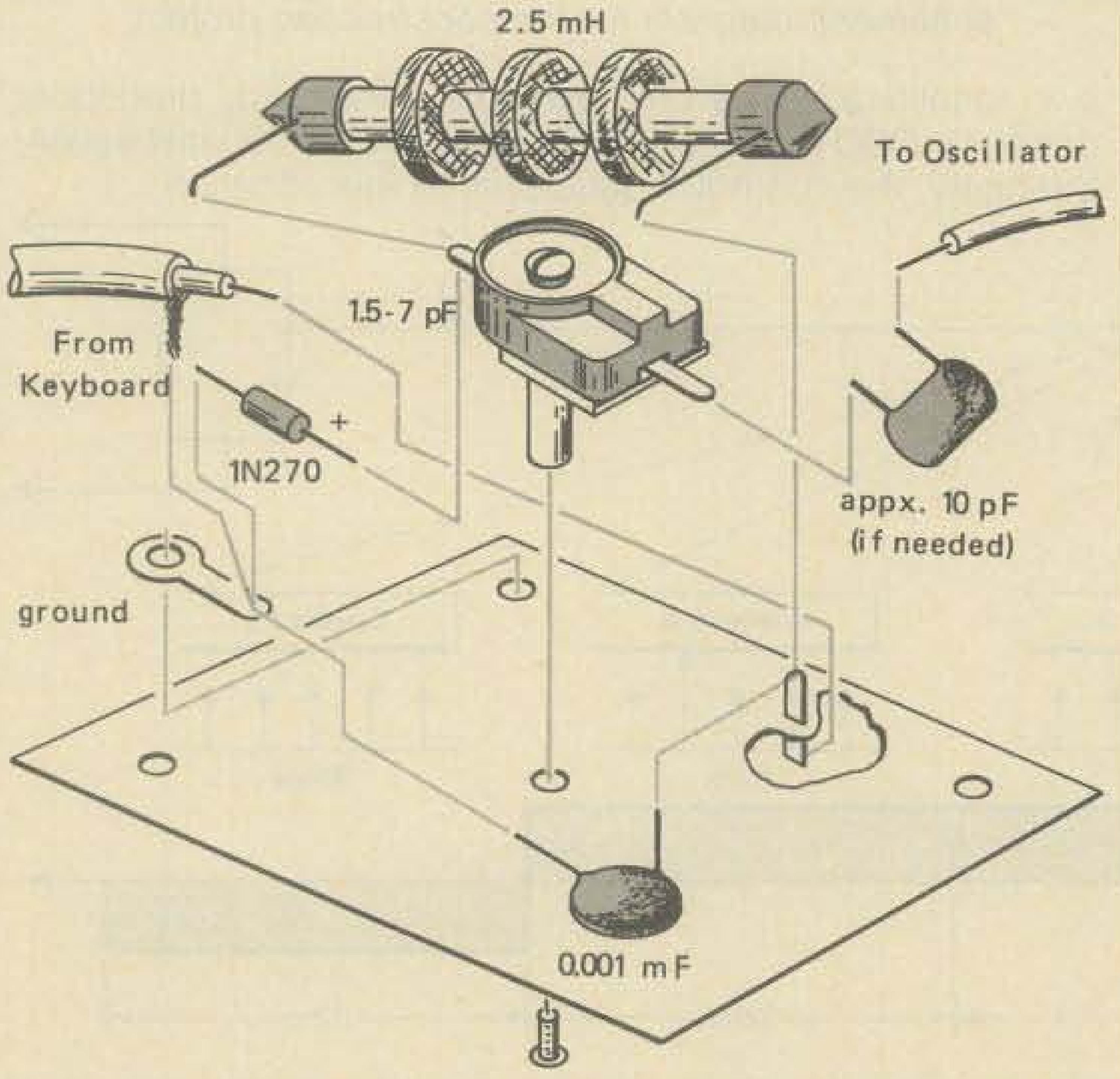
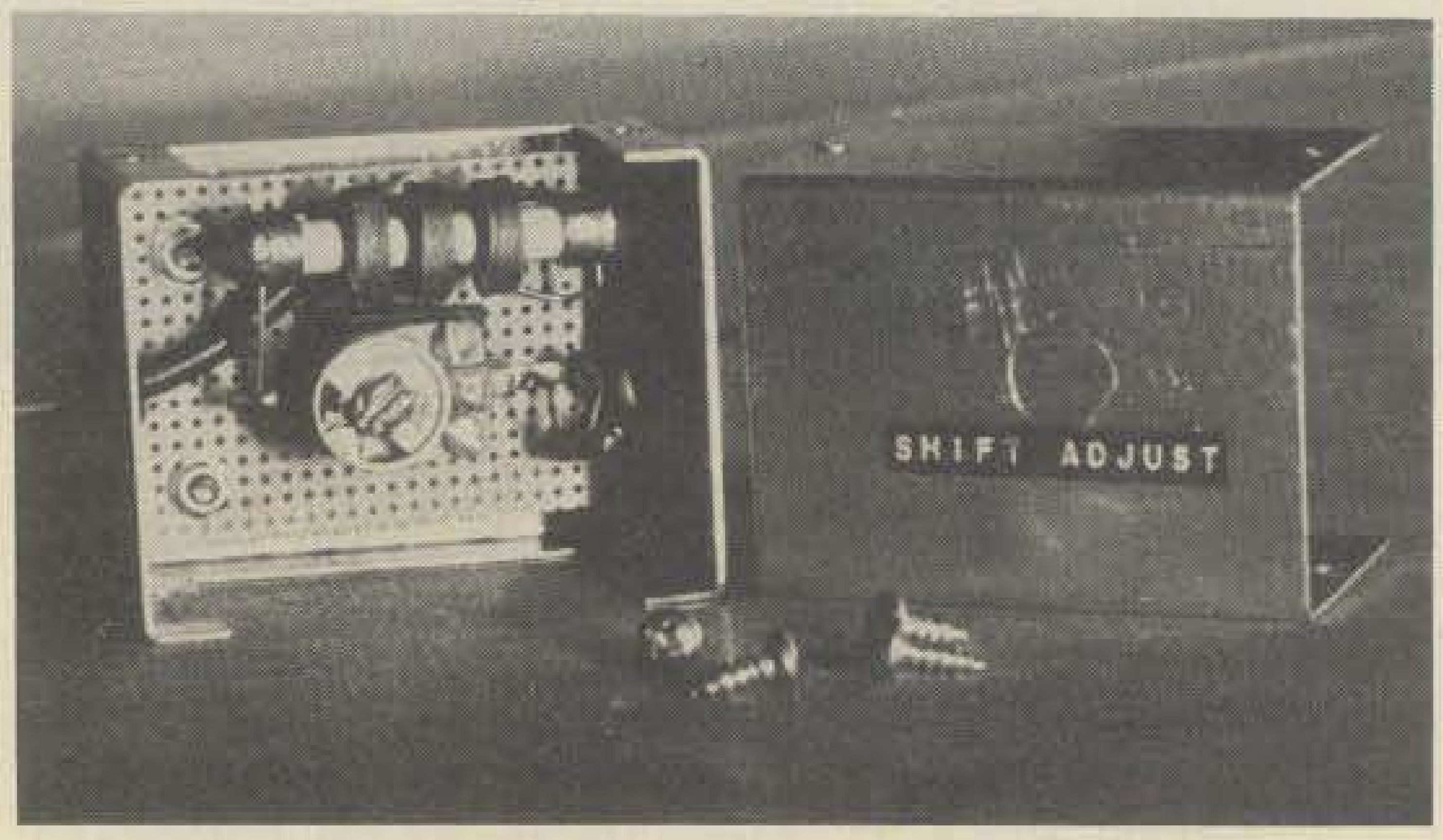


Fig. 8 – Pictorial diagram of the frequency shift keyer. Use this as a guide to construction along with the photographs of the keyer.



The keyer and its cabinet.

And that's it! Don't make it longer than that or you will be labeled as a lid.

After someone calls you, the QSO runs almost exactly as it would run on *phone*, except everything is printed out. The reason I emphasize 'phone is because c.w. abbreviations are gauche on RTTY.

For example, instead of typing WX HR CLDY, it is more acceptable to type out THE WEATHER HERE IS CLOUDY.

(Continued on page 90)

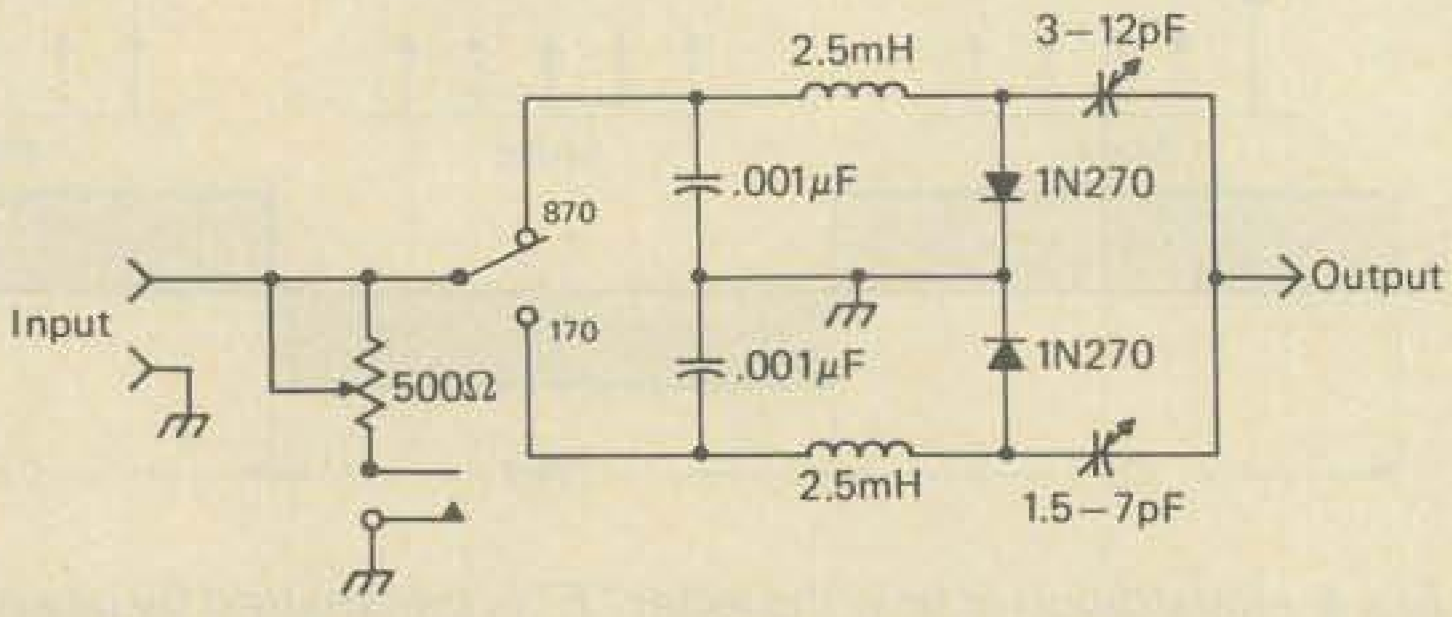


Fig. 9 – A frequency shift keyer switchable for 170 Hz or 850 Hz.

Bill Ziegenfus presents CQ readers with special methods for healing special circuits.

Troubleshooting Techniques for Solid-State Circuitry

BY BILL ZIEGENFUS*, K3MOM

The use of transistors, operational amplifiers, IC's (integrated circuits), FET's (field effect transistors) and other solid-state devices in amateur radio equipment is constantly increasing. Successful repair and maintenance of equipment using solid-state circuitry has raised many questions concerning servicing procedures and troubleshooting practices that previously have been used in electron-tube circuitry.

Transistors Vs Electron Tubes

Comparison of a given transistor and electron tube shows that there is great similarity between the functions of a transistor and those of an electron tube. Therefore, any knowledge picked up in working on electron-tube equipment will be useful in the servicing of transistorized circuits. However, there are great differences between a transistor and an electron tube from the standpoint of servicing. For instance, the reliance placed on the senses of sight, touch and smell in the visual inspection of electron tube circuits is not feasible in the case of transistor circuits. Many transistors develop so very little heat that nothing can be learned by feeling them. High-frequency transistors hardly get warm. Usually, if a transistor is hot enough to be noticeable, it has been damaged beyond use (except special or high-power transistors).

It is important to remember that because transistors and other solid-state devices are small and have many features and characteristics which differ from those of the electron tube, servicing of solid-state equipment requires a modification of some presently used and familiar techniques. The main difference between transistors and electron tubes is that transistors are current-operated devices and electron tubes are voltage-operated devices.

Use Of Test Equipment

Most good-quality test equipment used for electron tube circuit troubleshooting may also be used for solid-state circuit troubleshooting. However, before employing any test equipment, make sure that it meets the requirements given in the following paragraphs.

Signal generators, both r.f. and audio, may be used if the power supply in these equipments is isolated from the power line by a tranformer. Before any tests are made with a signal generator, a common ground wire should be connected from the chassis of the equipment to be tested to the chassis of the signal generator before any other connections are made.

Signal tracers may be used with solid-state circuits if the precautions concerning the power supplies in signal generators are observed. Many signal tracers use transformerless power supplies; therefore, to prevent damage to the transistor, an isolation transformer must be used.

Multimeters that are used for voltage measurements in electron tube equipment or transistor circuits have a high ohms-per-volt sensitivity to provide an accurate reading. A 20,000 ohm-per-volt meter or an electronic voltmeter with an input resistance of 11 megohms or higher on all voltage ranges is preferred on transistor circuits.

Ohmmeter circuits which pass a current of more than 1 mA through the circuit under test cannot be used safely in testing transistor circuits. Therefore, before using any ohmmeter on a solid-state circuit, check the current it passes on all ranges. DO NOT use any range that passes more than 1 mA. When in doubt never use a range lower than R×100.

Conventional test prods, when used in the closely confined areas of a solid-state circuit, often are the cause of

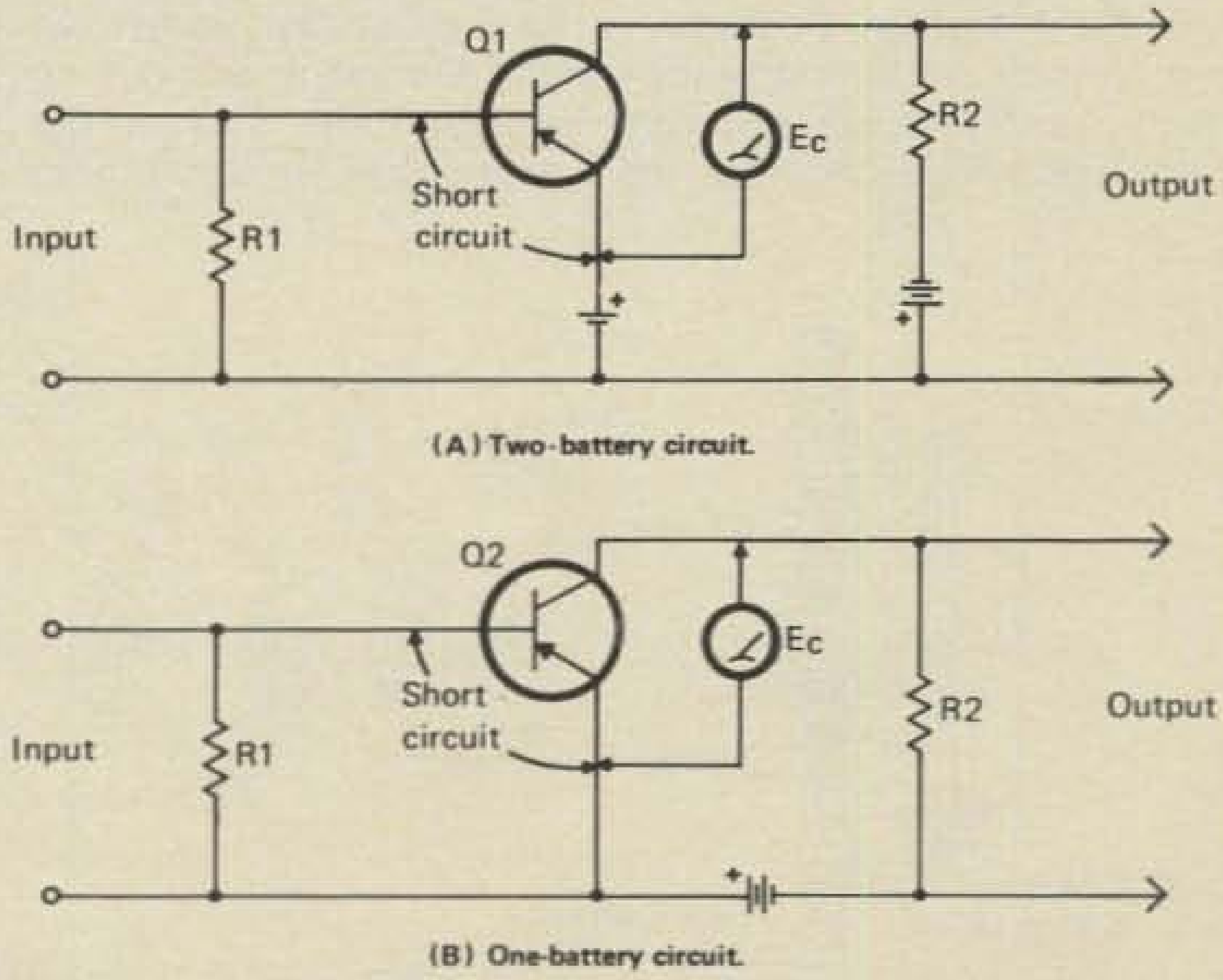


Fig. 1—E_c normally jumps if the transmitter is not defective.

*Royal Avenue, North Wales, PA 19454

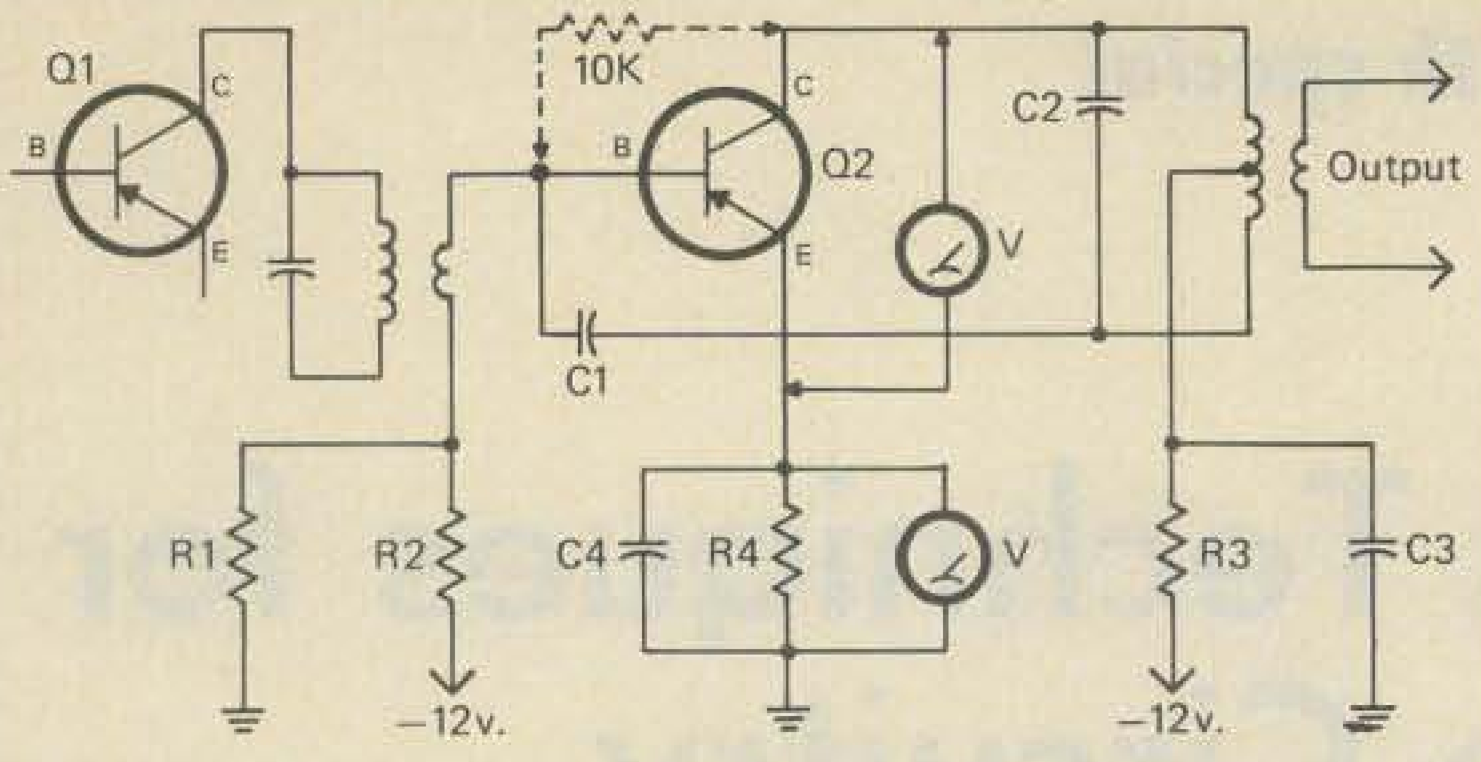


Fig. 2—In-circuit transmitter test with a 10k bias resistor.

accidental shorts between adjacent terminals. In electron tube circuits the momentary short caused by test prods rarely results in damage, but in solid-state circuits this momentary short can ruin a transistor.

An in-circuit capacitor tester is a useful auxiliary instrument since the practice of checking an electrolytic capacitor by shunting with another electrolytic capacitor should be avoided in solid-state circuits. The resulting surges can be destructive to the device. However, the instrument must be designed to apply comparatively small test voltages across electrolytic capacitors since these capacitors normally have a comparatively low value of working voltage in solid-state circuits.

Fault Isolation

The first step in troubleshooting solid-state circuitry, as in the troubleshooting of electron tube circuitry, is a visual inspection of the entire equipment. Loose connections, broken leads, and any other visible damage should be repaired before undertaking the next step of the troubleshooting procedure. A careful visual inspection will frequently shorten what could otherwise be a lengthy service job.

When any visual defects have been corrected, experience has shown that it is more efficient to determine the defective stage by means of a signal substitution or signal tracing method and then to carefully analyze that stage for defective components.

Since the transistor is probably one of the most reliable components, it should be the last to be suspected as defective. This is contrary to the long-established practice used in electron tube equipment, where the tubes normally are checked first. Because of their reliability, transistors are generally soldered in the circuit. Removing and testing each transistor will not only unnecessarily subject the transistor to heating, but may also result in damage to some other component, particularly in the case of a printed circuit board. Therefore, do not use your soldering iron indiscriminately.

An in-circuit transistor tester may be used to test transistors without removing them from the circuit. However, before attempting an in-circuit test, refer to the applicable literature to determine the in-circuit impedance limitations of the tester. Most in-circuit transistor testers will provide a satisfactory check for transistors having externally connected components with values as low as 500 ohms impedance between the transistor elements. The schematic diagram of the transistor circuit should be checked to determine whether the shunting impedance values are within the testing limitations of the tester.

If a transistor tester is not available, there is a simple in-circuit transistor test than can usually be made and which is very informative. Merely short-circuit the base and emitter terminals; this causes zero-bias operation. If the transistor is good, the collector voltage will jump to the supply voltage. However, if the collector voltage remains unchanged in the short-circuit condition, the transistor may be defective. The test is illustrated in fig. 1. Note that a good transistor could seem to test bad in a circuit that has a leaky capacitor.

In-circuit transistor tests can also be made even when the collector voltage happens to be the same as the supply voltage in normal operation. To make a test in this situation, shunt a 10,000-ohm resistor from collector to base, instead of short-circuiting the emitter to the base (fig. 2). If the collector voltage drops to a lower value, we know that the transistor is workable. Note that the resistor "turns on" the transistor because the base-bias volage always has the same polarity as the collector voltage. If the collector voltage remains unchanged in this test, one or both of the junctions is either burned out or shorted.

Checking transistors which have been removed from the circuit with a multimeter (ohmmeter circuit) is an alternate check. However, it must first be determined if the internal battery of the ohmmeter may be of a high enough voltage to damage the transistor. If in doubt, use a vtvm. Check emitter-to-collector junctions (the most popular cause of trouble) by shorting the base lead to the emitter and connect the vtvm common lead and probe in such a manner to back-bias the junction. Back-bias condition may be established as follows: for PNP type transistors connect the negative lead to emitter; for NPN type transistors, connect the negative lead to collector. Check the ohmmeter voltage source to determine if the black or the red test lead has negative polarity. The forward-to-reverse resistance ratios vary depending upon the type of transistor, particular junction measured and ohmmeter range used; a value of 100 to 1 is about average.

Since transistors are very sensitive to improper bias voltages, the practice of troubleshooting by shorting various points to ground and listening for a click must be avoided. In electron tube circuits, momentary shorts may occasionally cause a component to burn out, although they rarely affect tubes. In a transistor circuit, the transistor is usually the weakest link, and it becomes the victim.

Replacing Parts

Careless replacement of parts often creates new troubles. When it becomes necessary to replace a transistor or other solid-state device, observe the precautions given in the following paragraphs.

Before a part is unsoldered, note the position of the leads. If a part, such as a transistor, has a number of con-

(Continued on page 90)

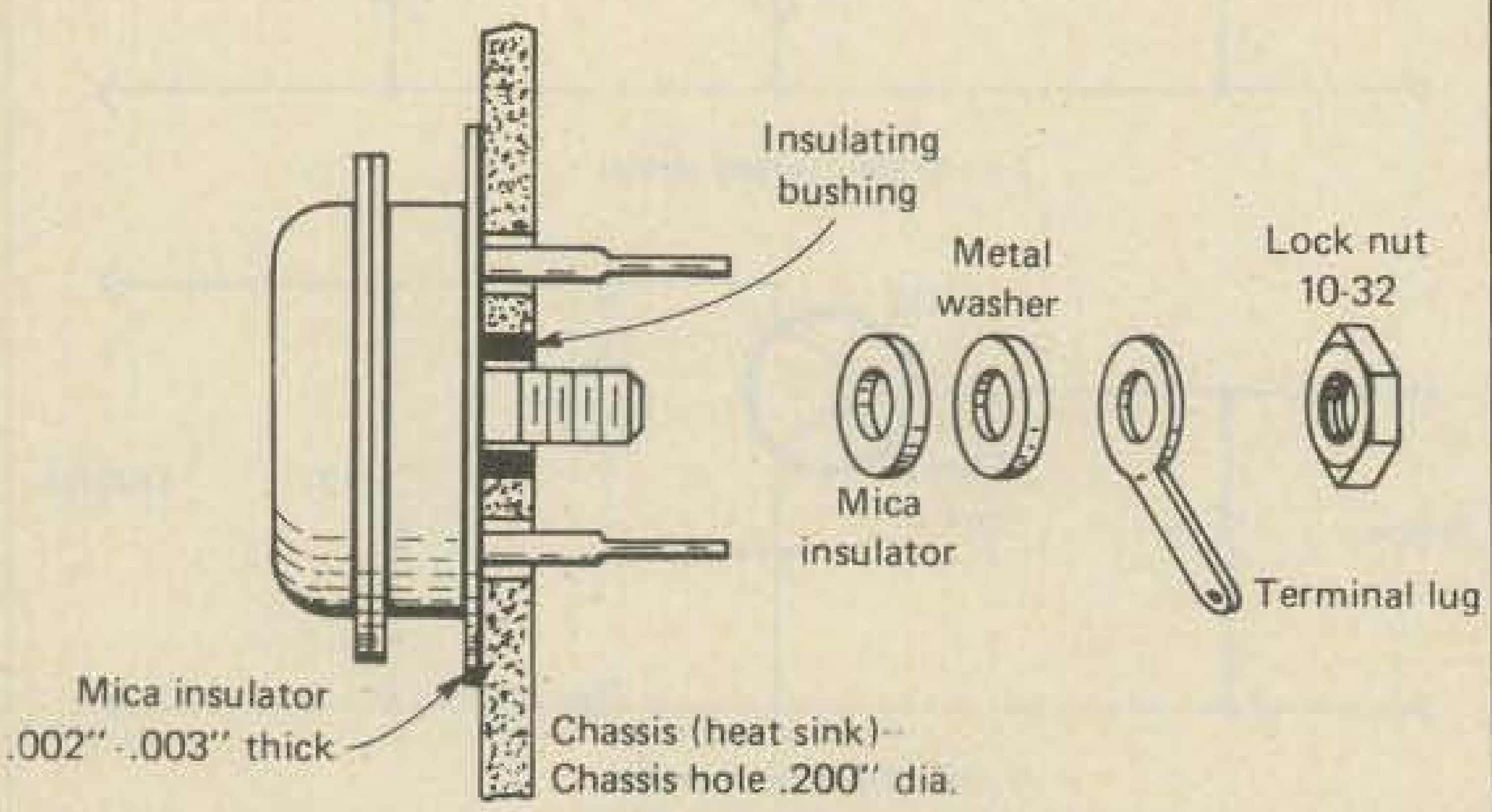


Fig. 3—Typical mounting arrangement for power transistor on a heat sink.

Viktor Melnikov, UV0EX, is a prime example that home-brewing is alive and well in amateur radio.

Home-Brewing — Soviet Style

BY ALAN M. DORHOFFER*, K2EEK

This is the story of a Soviet amateur, his transceiver and a close friend of his.

About four months ago the Editorial offices at *CQ* received some photographs of what appeared to be nothing more than another addition to the wide market of amateur radio transceivers. The staff looked at the photos and remarked that the unit was quite well physically designed. However, we were interested also in its electronics. Since no schematic was available for the transceiver, we wrote to the owner for one.

We received a letter from Viktor Melnikov, UV0EX, along with the schematic which had been published in the November 1974 issue of *Radio* magazine. In addition, we learned that the transceiver was built by Viktor. *That* piqued our interest.

We wrote back to Viktor for more information. He suggested that, since he was not well-versed in English, we might write to a friend of his, Yuzo "Tuk" Tsukui, JRIWYB, for further information.

We did just that.

Tuk sent us two letters. In them was specific data on the transceiver and biographical data on its builder.

It seems that Tuk and Viktor met about three years ago. Not surprisingly, the meeting took place on the air. Since Tuk speaks Russian(!) they were able to communicate without any trouble.

Viktor lives on Sakhilin Island. He is very active on twenty meter s.s.b. and enjoys speaking with both Japanese and stateside amateurs. He is also quite prolific in terms of awards. Viktor has both the Bicentennial WAS and JCC-400. In all he has about 60 awards. In 1976, he won second prize in *CQ*'s Worldwide DX contest.

Viktor lived in Svendovsk, in western Siberia, until 1968. At that time his call was UW9CE. Now he lives in Kholmsk City, in the southwestern part of Sakhilin Island.

He is a vice-captain of a ship (*Sakhilin II*) by trade. He sails regularly between Kholmsk and Port Vanino. He is married to a woman named Margarita who is interested in amateur radio but not licensed.

Tuk and Viktor met, in person, for the first time, in August 1976 when Tuk visited Siberia and the Far East. Tuk writes, "As he always spoke loud and cheerful, I thought he was about thirty. But as it turned out, he was over two and one-half times older than I! (Then I was 19)."

They spoke in both Russian and English and filled in the conversation with Q-codes. "Then I felt that amateur radio greatly helped us to understand each other. I hope that all amateurs would be more interested in talking with foreign friends."

*Editor, *CQ*

Tuk wrote about Viktor's transceiver in his next letter to *CQ*.

"The transceiver he (Viktor) uses is called the *UW3DI*, being named after its designer Yuri Kudryatsev (UW3DI), a radio engineer who lives in Moscow. There are two models of the transceiver. One is a tube-type; the other is solid-state.

"The UW3DI transceiver is very popular not only in the U.S.S.R. but also in Eastern Europe and Mongolia. Most of the Russians who operate s.s.b. use it. It is not a kit. However, it is built as if it were one. There are patterns for the circuit boards, a parts list and a detailed construction manual available.

"Here are some of the transceiver's specifications:

Power: about 60 watts d.c. input
Sensitivity: o.5 uV or less at S/N 10 dB
First i.f.: 6 to 6.5 MHz
Second i.f.: 500 kHz
V.f.o. frequency: 5.5 to 6 MHz

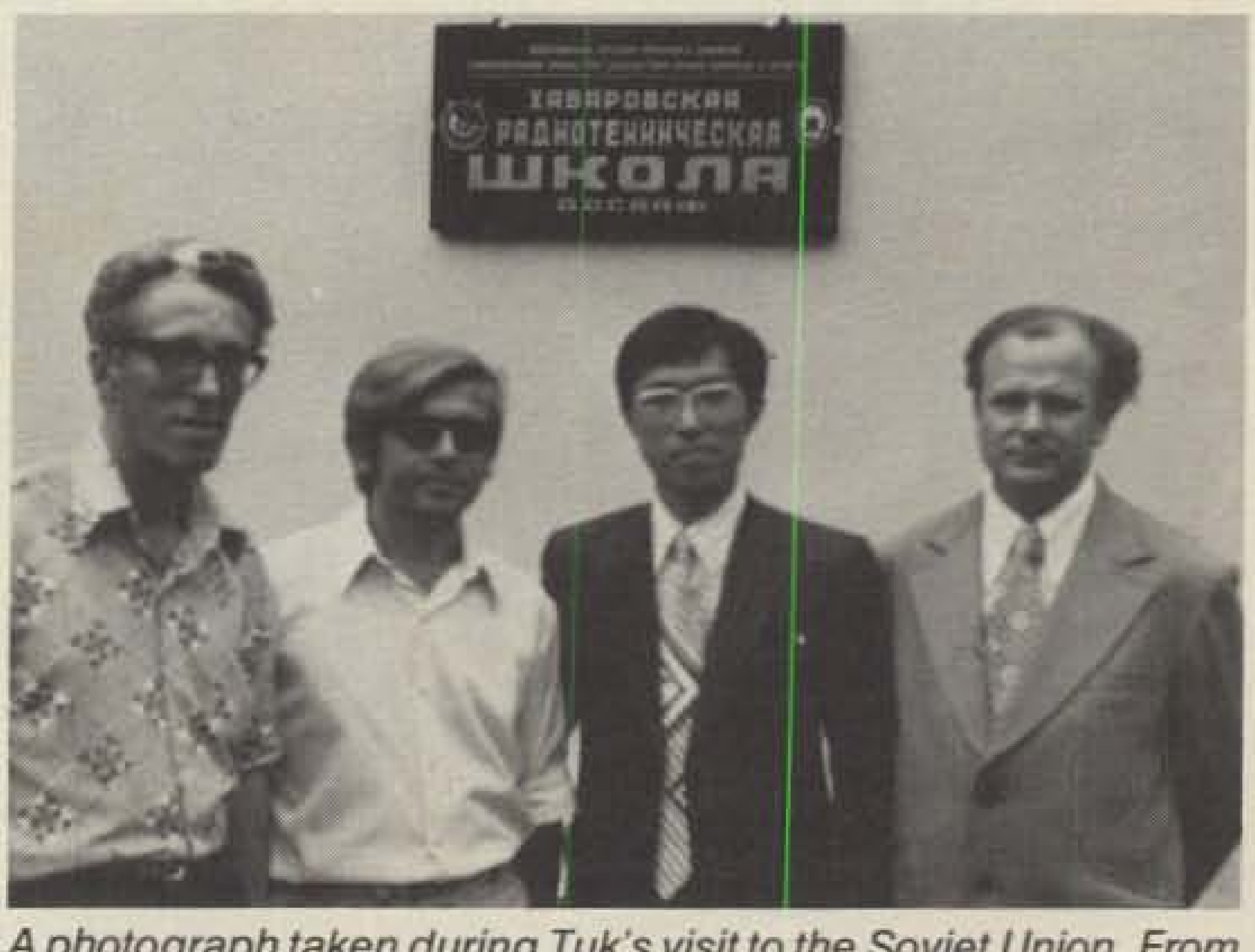
"The i.f. filter is a (Collins-like) mechanical one. The final tube (RY-19) is similar to a 5894. The tube can be used up to 500 MHz."

And that's that.

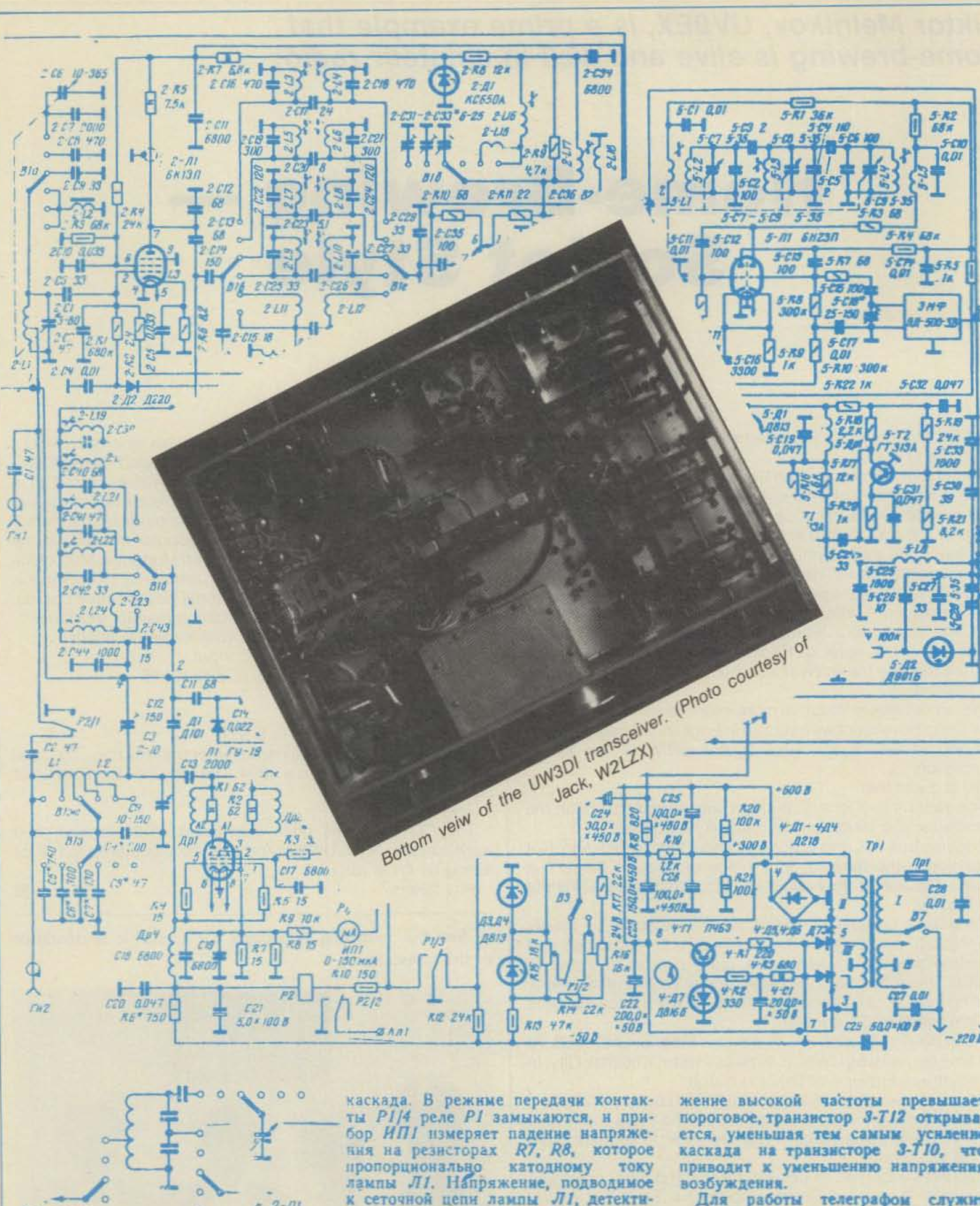
The *CQ* staff was quite impressed at the design and workmanship of the UW3DI transceiver. Our thanks to Tuk for letting us know about it.

Any takers?

See the following two pages for a graphic presentation of the transceiver.

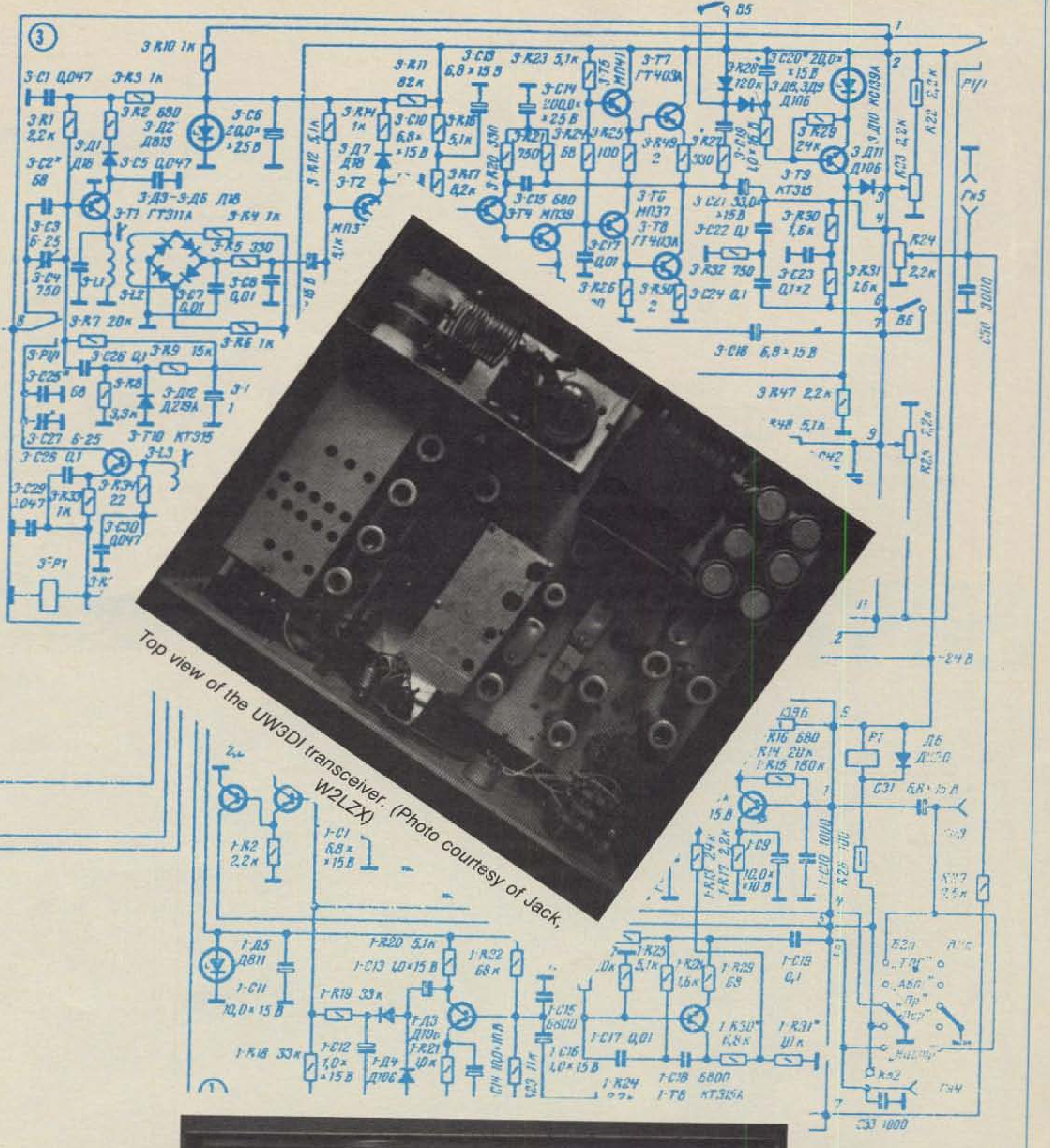


A photograph taken during Tuk's visit to the Soviet Union. From left to right: UA0CAF, UA0CCR, JR1WYB (Tuk) and UV0EX (Viktor). (Photo courtesy of Jack, W2LZX)



Bottom veiw of the UW3DI transceiver. (Photo courtesy of Jack, W2LZX)

The background for these two pages is a schematic diagram of the UW3DI transceiver. The schematic, along with a description of the transceiver, was published in the November 1974 issue of Radio Magazine. The schematic is courtesy of Tuk, JR1WYB.



Top view of the UW3DI transceiver. (Photo courtesy of Jack, W2LZX)

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Front panel view of the UW3DI transceiver. (Photo courtesy of Jack, W2LZX)

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KENWOOD

...pacesetter in amateur radio

IT'S NEW... IT'S UNIQUE... AND IT'S TRULY USEFUL. IT'S KENWOOD'S SM-220 STATION MONITOR. THE SM-220'S UNEXCELLED VERSATILITY ALLOWS YOU TO MONITOR YOUR TRANSMISSIONS, MONITOR INCOMING SIGNALS, AND MONITOR THE AMOUNT AND STRENGTH OF BAND ACTIVITY* AND PERFORMS AS A GENERAL-PURPOSE 10 MHz OSCILLOSCOPE, AS WELL.

Kenwood offers this totally unique unit as a perfect compliment to your TS-820S or TS-520S station.** The SM-220, based on a wideband oscilloscope (2 Hz to 10 MHz), permits you to monitor your transmitted signals, thus assuring optimum linearity and maximum performance. With the addition of the BS-5 or BS-8 Pan Display option you will be able to determine visually the location and strength of adjacent signals without tuning your receiver off frequency. The choice of options allows you to adapt the SM-220 to either the TS-820S or TS-520S.

The SM-220 has a built-in two-tone audio generator with full provisions for tuning your exciter and linear amplifier (160 m through 2 m).

All this costs little more than a general-purpose oscilloscope. And, of course, it's pure Kenwood quality.

*With BS-5 or BS-8 option

**For other models check with appropriate manufacturer for compatibility.

SM-220

Function: Selects operation mode: OSC/RTTY: General testing of station equipment, experimental design of new equipment, or troubleshooting; display of receiver IF output allows you to give "signal quality reports".

Power ON indicator.

Power switch.

Intensity: Controls brightness of scope display.

Band Scope: (Pan Display) With BS-5 or BS-8 option, allows you to "see" the signals on both sides of your operating frequency without tuning your receiver off frequency. Useful for determining "band conditions", band crowding, source of interference from adjacent stations ... a visual display of what you would hear if you tuned across the band, without having to touch your receiver's dial.

Focus: Controls sharpness of scope display.

Vertical Attenuator: Precision step attenuator (gain control) switch adjusts vertical input level.

Vertical Input: Accepts IF input, RTTY input or oscilloscope input.

Vertical Gain: Potentiometer to fine-adjust vertical input level.

▲▼ Adjusts display along vertical axis.

◄► Adjusts display along horizontal axis.

Sweep Range: Step switch controls sweep band width or switches horizontal input/external sync terminal "ON".

RF Attenuator: Level control used in MONI/TRAP mode.

Tone: Step switch selects Wien bridge tone generators: 1000 Hz, 1575 Hz or both tones simultaneously.

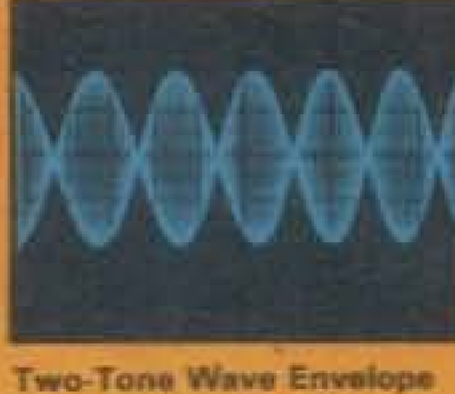
Out: Output of the audio generator can be connected to the transceiver's microphone input for "two-tone test". Also for trapezoidal test of transceiver linear amplifier.

Synchronization Marker: Selects internal or external sync (similar to horizontal hold on TV. Turns On or Off the built-in marker which shows operator where his receiver is actually tuned.

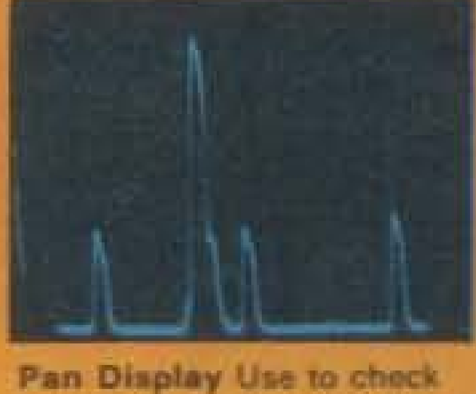
Scan Width: Selects width of "window" or receive band display when using the Pan Display option. (100 kHz or 20 kHz)

Variable sweep control/External gain: Controls (1) sweep speed of display in any sweep range, (2) optional Pan Display (Band Scope) speed of display, (3) level of horizontal input/external syncronization input when sweep range is in RTTY/Ext or Trap.

Horizontal Input/External Sync: Accepts either (1) RTTY input for tuning, (2) external sync input for test (oscilloscope functions), (3) external oscillator for Lissajous display.



Two-Tone Wave Envelope For "performance" tune-ups or checking proper tranceiver operation.

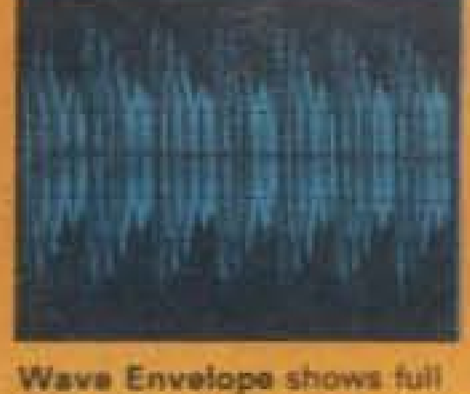


Pan Display Use to check source of interference during "QSO" without moving off-frequency. Also determines location and strength of adjacent frequencies. (Requires BS-5 or BS-8 option)

Keyed Waveform Shows detail of CW keying. Use to monitor the quality of your CW note. (Photo shows ideal waveform produced by TS-820S.)

Oscilloscope Operation (1 kHz) Oscillator function allows Sine, square wave, Lissajous patterns for testing or design work.

Trapezoid (TS-820S w/ TL-922) Shows linearity of power amplifier. Used primarily for testing.



Wave Envelope shows full SSB voice modulation, with processor on (full compression), and "clean signal" at full power.

Reliable prediction of sunspot activity has historically been of great concern to amateurs. Ted Cohen presents the latest contribution to this effort.

A New Sunspot Prediction for Cycle 21

BY THEODORE J. COHEN*, N4XX.

Recently, H.H. Sargent III presented a paper wherein he predicted that solar Cycle 21 will exhibit a maximum smoothed sunspot number of 154. If true, Cycle 21 will be equivalent to, or will be greater than, the second highest sunspot cycle observed in the last 100 years. Because Sargent's work has attracted so much attention, we have asked another recognized expert on solar predictions, Dr. Cohen, to review briefly the work of Sargent. —K2EEK

Sargent (1978), using a modification of Ohl's method, recently produced a prediction for solar Cycle 21 which suggests that this cycle will peak with a 12-month running smoothed sunspot number of 154 ± 50. This brief article is presented as a review of Sargent's work, and as an introduction to Ohl's method.

Ohl's Method

Ohl (1976) proposed a method for predicting solar activity which is based on an apparent correlation between geomagnetic activity in the years immediately preceeding a solar minimum, and the solar maximum for the succeeding cycle. More specifically, Ohl suggested that the geomagnetic activity which accompanies each cycle has two components: a "sporadic" component and a "recurrent" component (fig. 1). It is the activity of the recurrent component which appears to be related to the following solar cycle, and in fact, to be correlated with the maximum count of the succeeding sunspot cycle.

*8603 Conover Pl., Alexandria VA 22308

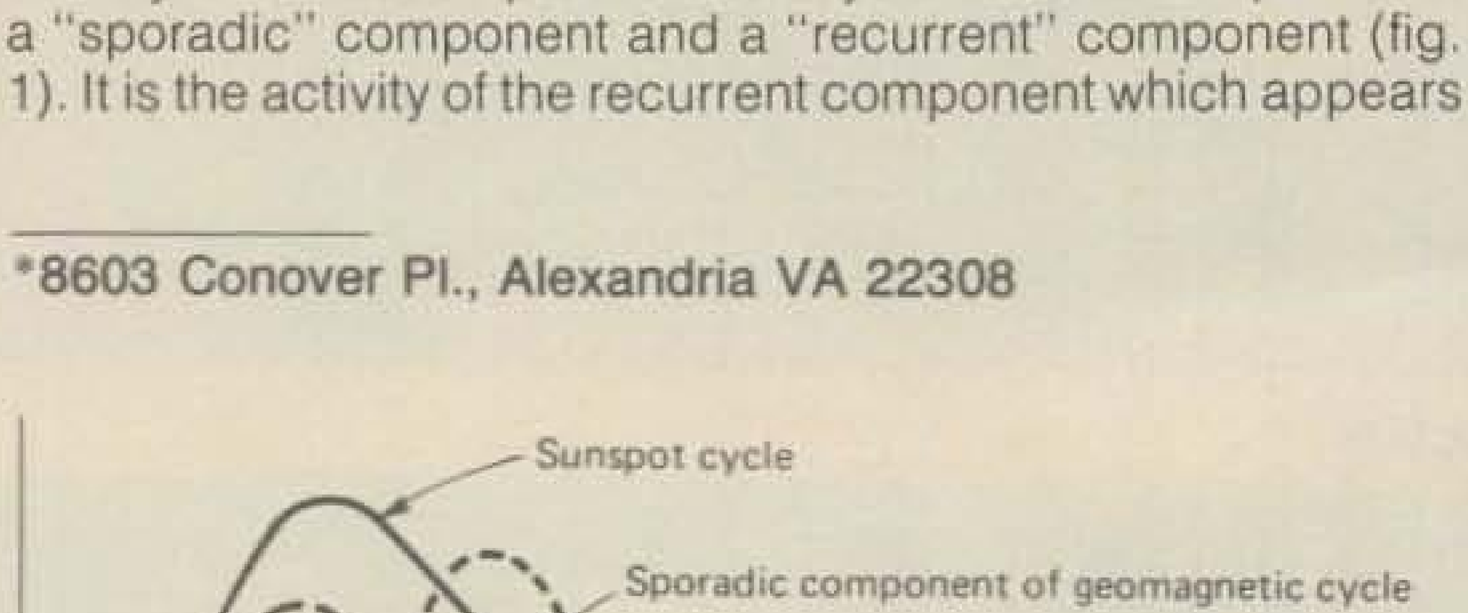


Fig. 1—A sporadic and a recurrent component of geomagnetic activity are thought to be associated with each solar cycle. (Modifed after Sargent, 1978).

Sargent modified Ohl's method by correcting for the contamination of the recurrent geomagnetic-activity component by the sporadic geomagnetic-activity component. He did this by multiplying the value of the 12-month running smoothed sunspot number at solar minimum by a constant, and then, by subtracting this factor from the geomagnetic activity indices used in the study. The geomagnetic indices so obtained were then used in a multiple regression analysis to yield the best predictive equation for the maximum smoothed value of the succeeding sunspot cycle ($R_{max\,(n+1)}$).

Sargent's Analysis

In performing his multiple regression analysis, Sargent used a linear combination of two variables:

X_1: the average value of the monthly *aa*-indices (see Mayaud 1973) for the 36-month period preceeding a sunspot minimum;

X_2: the smoothed sunspot number at sunspot minimum, ($R_{min(n)}$; from Waldmeier (1961), with updates from the Solar-Geophysical Data Bulletin of the U.S. Department of Commerce.

Using solar and geomagnetic activity for the previous nine cycles (Cycles 12 through 20, inclusive; see fig. 2), the regression equation obtain by Sargent is given as follows:

$$R_{max\,(n+1)} = 3.91 + 8.56(X_1 - 9.92X_2) \quad (1)$$

Equation (1) may be rewritten as follows:

$$R_{max\,(n+1)} = 3.91 + 2.85\,(3X_1 - 2.75X_2) \quad (2)$$

In equation (2), the quantity in parentheses is (approximately) the average of the geomagnetic activity over the three-year period prior to the solar minimum, adjusted by the sunspot value at the minimum. Hence, this quantity is a measure of recurrent geomagnetic activity.

For the three years prior to the recent solar minimum in March 1976, the average *aa*-index value was 28.7. Further, the smoothed sunpsot value at the minimum was 12.2, and so, using equation (2), the predicted, maximum sunspot value for Cycle 21 is 154. The 95% confidence interval for this determination, by the way, extends from 104 to 204, a consequence of the limited data base used. Finally, based on a rise time of 4.1 years for the average solar cycle, Sargent believes that Cycle 21 will peak in early 1980.

Comments

It was stated by Sargent that the regression equation he developed ". . . would have predicted the past three sunspot cycles within 5%." Unfortunately, without the data for Cycles 18, 19 and 20, there would have been no objective way to derive Sargent's regression equation prior to the start of Cycle 18. In fact, if only the data for Cycles 12 through 17, inclusive, are used to derive a regression equation for predicting the maximum of Cycle 18, reference to fig. 2 readily indicates that such an equation would have underestimated the actual maximum sunspot value for Cycle 18 by roughly 32 counts, or 21%.

Regardless, what Sargent was referring to, in the comment quoted above, was that the data of fig. 2 do indeed cluster well about the regression line. In fact, there is less than one chance in a thousand that the data would behave in this way by pure chance.

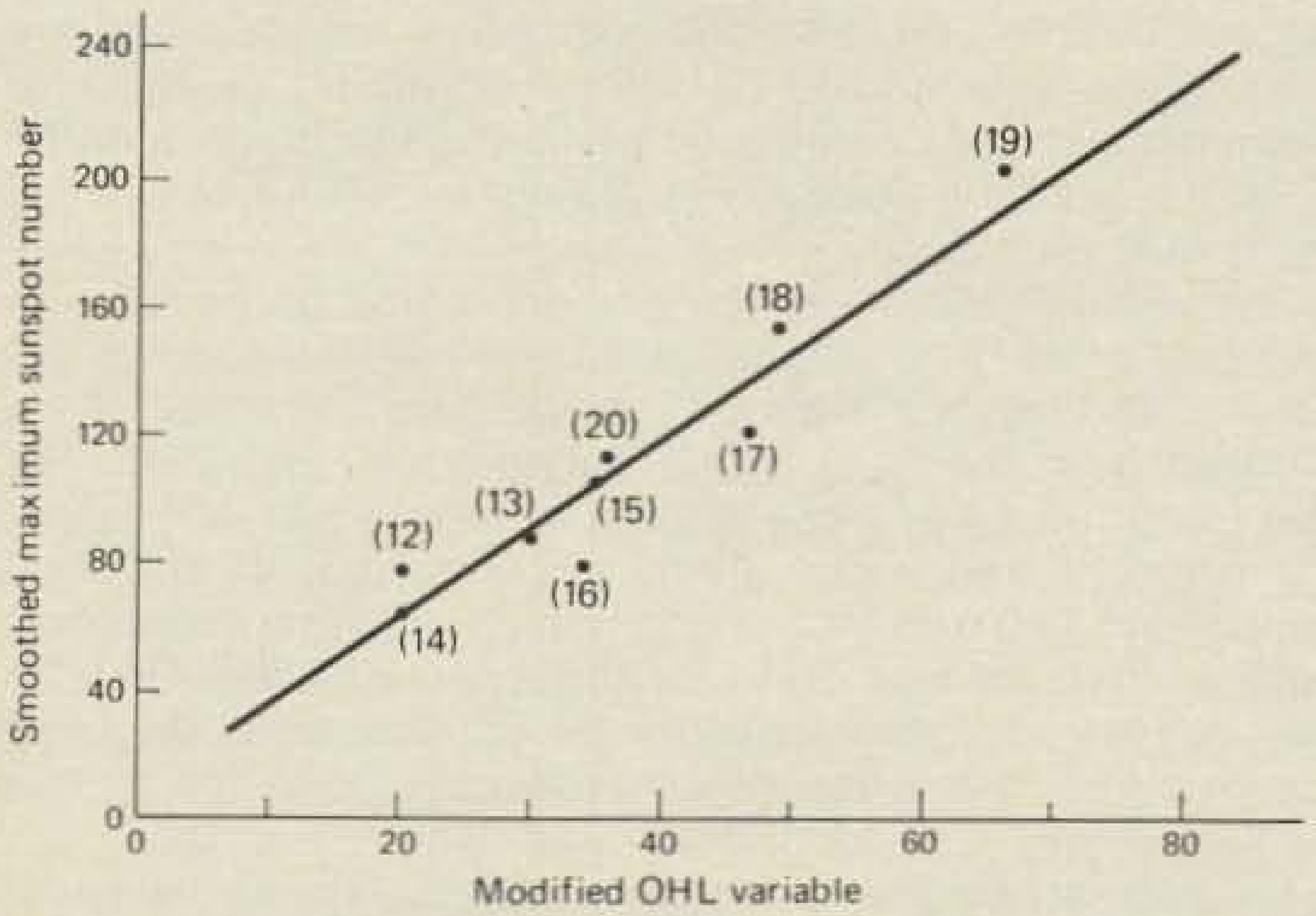


Fig. 2 – A plot showing the relationship between maximum smoothed sunspot numbers and values for the modified Ohl variable. Cycle numbers are shown in parentheses. The regression line determined by Sargent predicts a maximum sunspot count of 154. (Modifed after Sargent, 1978).

This lends credence to the results obtained and suggests that Cycle 21 just might become the second highest sunspot cycle to be observed in the last hundred years. If this happens, conditions on the 20, 15, 10 and even 6 meter bands will surpass anything observed in the last twenty years.

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In this article Richard Klinman shows Heathkit owners how to add QSK to their rigs.

Incorporation of the Vacuum Relay QSK Into a Commercially Equipped Station Part II—The Heathkit SB400/401

BY RICHARD KLINMAN*, W3RJ

Introduction

The vacuum relay QSK unit described in an earlier issue of CQ, has helped many hams achieve true break-in operation. A subsequent article was written to assist those owning the Collins S-Line to properly incorporate the QSK. Many of us use the Heathkit SB-Line, and I was requested to show how to use the QSK with that equipment. What follows is a brief discussion of the principles and a step-by-step procedure to convert the SB400/401 for QSK. It is recommended that those contemplating incorporating these changes, for break-in either with the vacuum relay QSK or any other QSK scheme, carefully review the previous articles. Modification of the SB400/401 is done in such a way that one external jumper on the rear panel restores the transmitter to its original "factory" operating state in both c.w. and s.s.b.

*RD 1, Flint Hill Rd., Coopersburg, PA 18036

[1]Klinman, R., "A Vacuum Relay TTL QSK Antenna Switch". *CQ*, July 1976.

[2]Klinman, R., "Incorporation of the Vacuum Relay QSK Into A Commercially Equipped Station". Part I, *CQ*, December 1977.

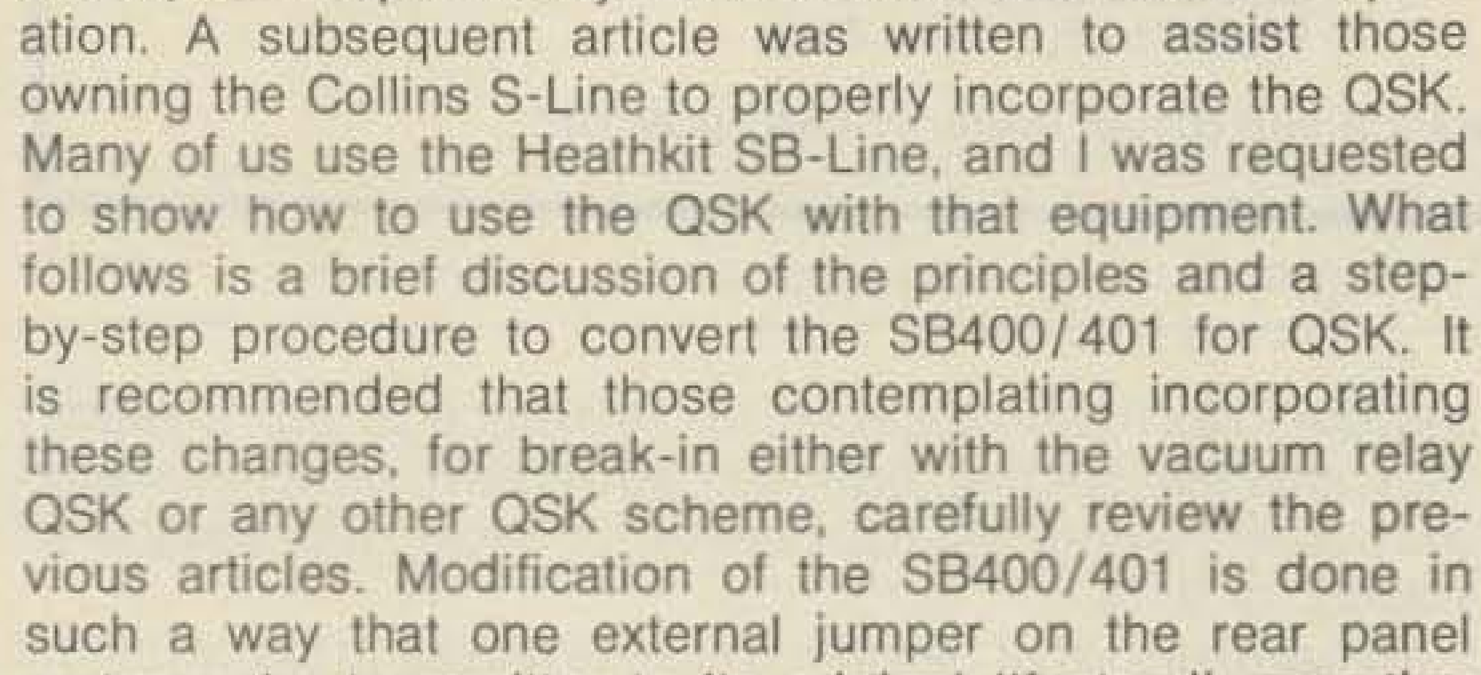


*Fig. 1—Addition of rear panel "PTT" control line. *denotes added parts.*

Break-In with the Heathkit SB400/401 Transmitter

All modifications of the SB400/401 serve to simultaneously "arm" the transmitter continuously while in the c.w. mode and eliminate the back-wave while in the key-up state. These modifications are accomplished so that one external jumper restores the transmitter to the factory state. In this way the transmitter can always be used without the QSK unit in the "VOX" or "PTT" modes.

Break-in requires the VOX relay and antenna relay, internal to the transmitter, to be in the transmit state continuously. To close these relays in c.w., the push-to-talk (PTT) line is brought out to the rear panel. It is shorted to ground by the QSK unit while in the c.w. mode, and may be shorted by a foot switch or other PTT device in s.s.b. Elimination of the backwave is accomplished by keying the isolation amplifier, V3, the LMO mixer, V4, and the c.w. carrier generator, V2B. Normally, keying the carrier crystal oscillator may not seem like a smart thing to do, and it usually is not. However, to eliminate the last vestige of backwave on 10 meters with all transceive cables connected between receiver and transmitter required that the carrier oscillator had to be turned off during receive. No detectable chirp is introduced by keying this stage with the QSK because the oscillator is always turned on before the transmitter is actually keyed.

While these three low level stages could be keyed with the grid block key voltage, as in the modifications in the Heath SB-Line, the bias for the isolation amplifier, V3, is derived from the ALC circuit during s.s.b. operation. For the Heath SB-Line, these stages are simply cathode keyed by ordinary transistors. Plate idling current of the final amplifiers, V10 and V11 is controlled by keying the screen grid voltage, as was done for the Collins S-Line. Drive to the cathode keying transistors for the low level stages is derived from the keyed screen voltage.

The timing functions generated within the QSK unit assures that the screen voltage, idling current, the isolation amplifier, the LMO mixer, and the carrier generator are all turned on prior to actuation of the transmitter grid block key line and are turned off only after all transmitter output has disappeared. In this way, the keying characteristics of the transmitter are unaltered. Exact timing can be seen in reference 1. I would like to add that the keying on the SB400/401, while not quite having clicks, is much too hard. The correct characteristic may be obtained by altering the values of C211, connected to V5, for the "make" and C304, connected to V9, for the "break."

The PTT and screen keying modifications require only a single additional phono-jack on the rear panel, and the cathode keying components are contained on a 1" x 3" circuit board that fits neatly in the transmitter chassis.

Modification of the SB400/401 Transmitter

Locate the spare phono-jack beneath the "RCVR MUTE" jack. Label this spare jack "PTT" for push-to-talk. By-pass the jack to ground with a .01 uF, 1kv. disc capacitor. Solder a wire from the function switch MS1R, pin 10, to the "PTT" jack just installed. Route this wire along the cable harness to the back panel and tie it to the harness in several places with lacing cord. If all wires are run with existing harnesses, as above, a very neat and professional job will result. The modified PTT circuit is shown in fig. 1.

PARTS LIST

QTY	TYPE
3	.01 uF, 1 kv disc capacitor
6	.001 uF, 1 kv disc capacitor
1	68k, 1 w. resistor
3	100k, 1/2 w. resistor
3	330k, 1/2 w. resistor
7	1N914 silicon diode or equivalent
3	2N1711 silicon transistors or equivalent
1	phono jack

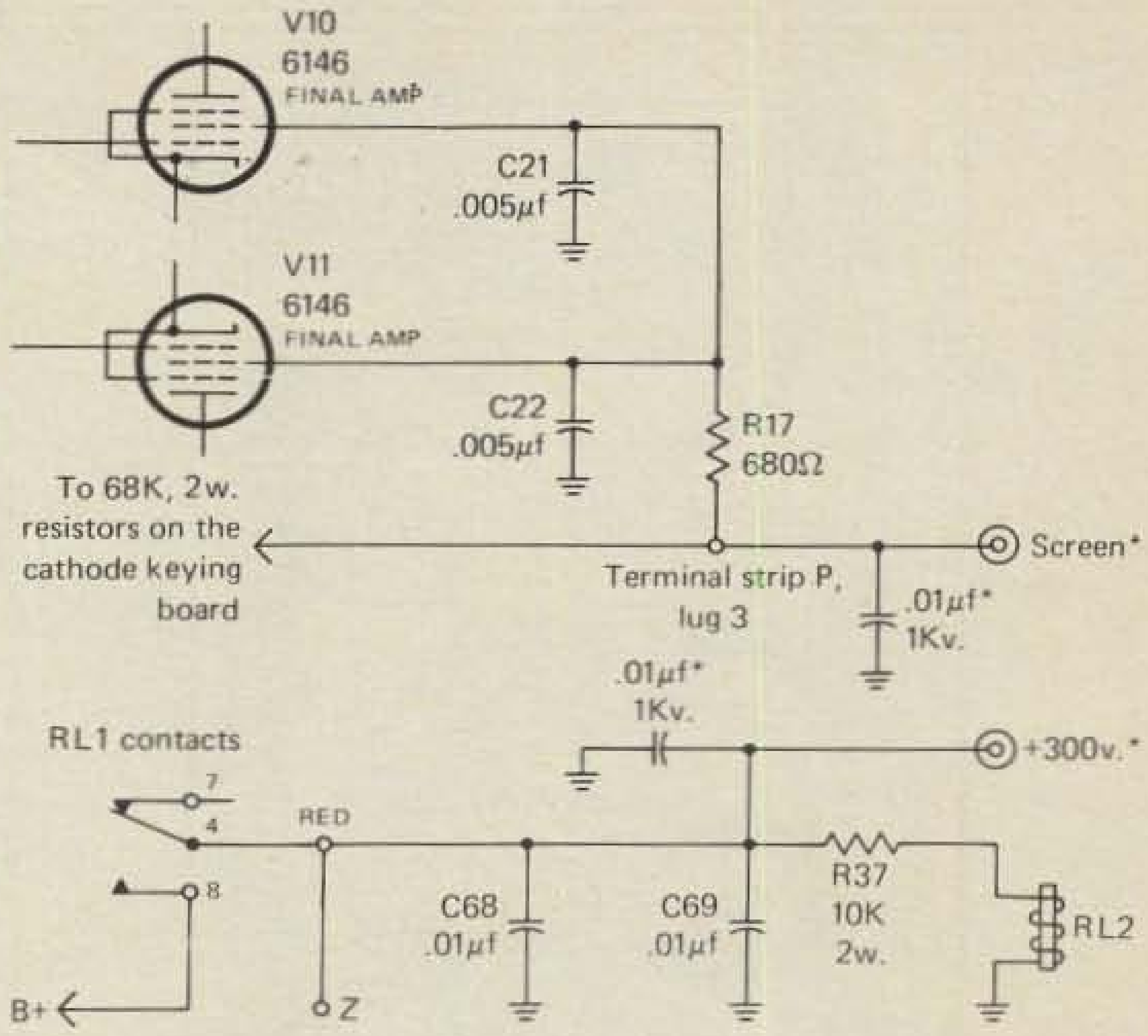


*Fig. 2—Screen keying the final amplifier. *denotes added parts.*

Mount a new phono-jack along side the spare phono jack in the final amplifier compartment. This spare is located next to the receiver antenna jack. The type of jack that mounts in a single 1/4" hole must be used. There is little but adequate space between the spare and the edge

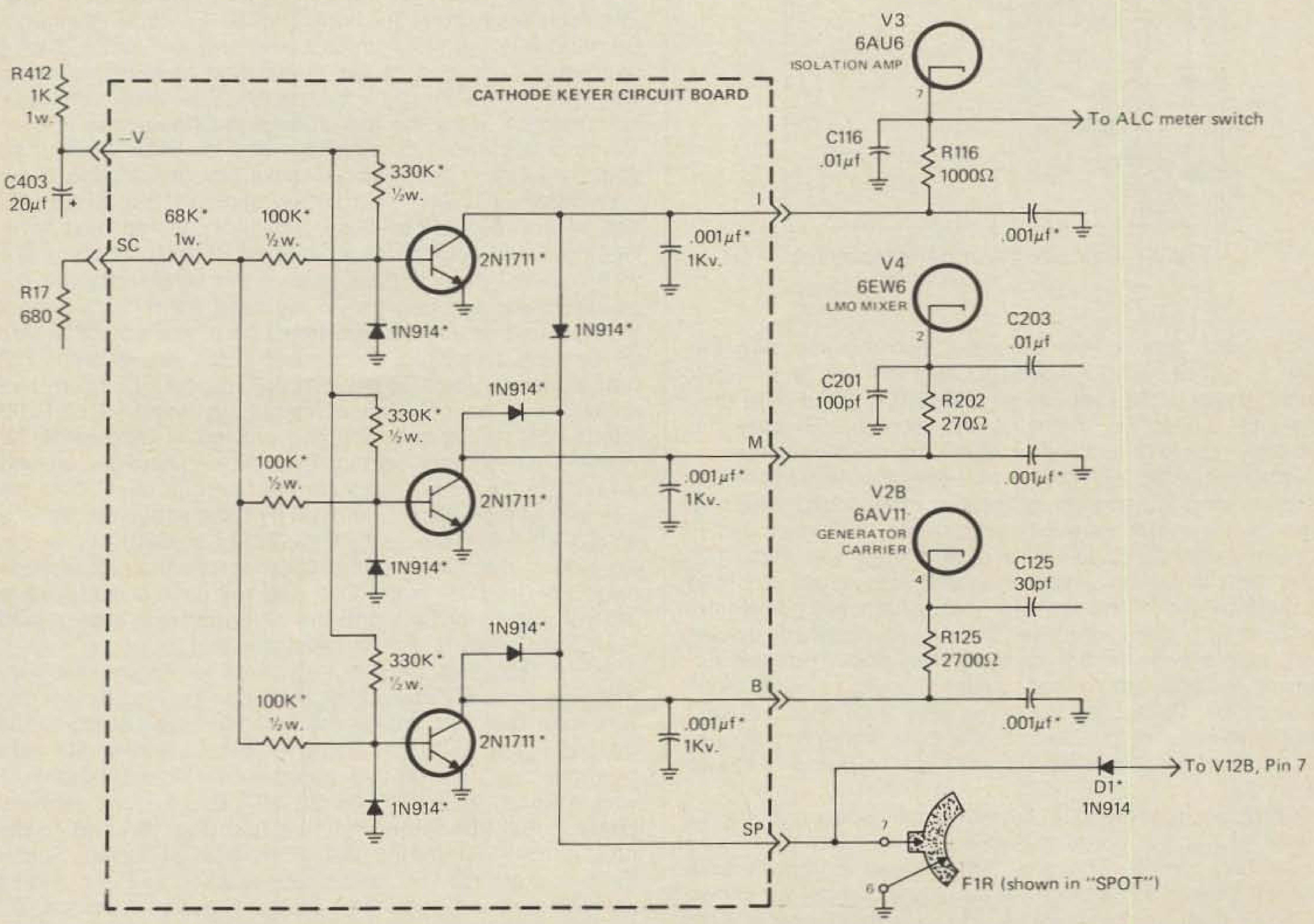


*Fig. 3—Modified circuit for cathode keying of the isolation amplifier, LMO mixer and BFO. *denotes added parts.*

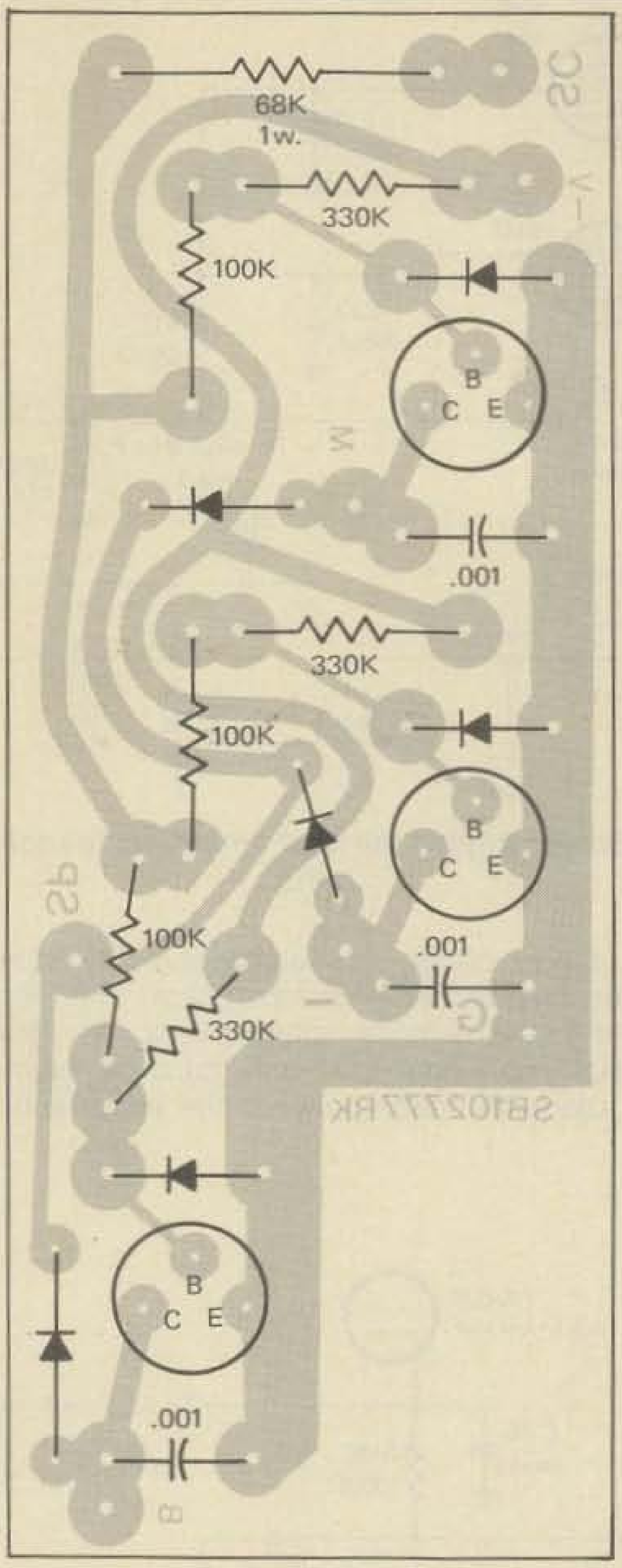


Fig. 5—Cathode keyer parts location.

of the case. Check your selected jack location with the case on before the hole is drilled! Label this new jack "+300 volts." By-pass the jacks to ground with a .01 uF, 1kv disc capacitor. Label the original spare "screen." By-pass the "screen" jack to ground with a .01 uF, 1kv disc capacitor.

Either unsolder or cut the red wire that is soldered to terminal strip lug number 3, located next to V10. This red wire carries the screen voltage from the VOX relay and is originally connected to the end of R17, a 680 ohm, 1/2 watt resistor. Solder a new insulated wire about 12" long to the free end of the red wire just unsoldered. Cover the junction with good insulation tubing, or spaghetti insulation, heat shrink tubing, or electrical tape. Trim the extension wire to length and solder it to the "+300 volt" phono-jack. Solder an insulated wire from the "screen" jack to terminal strip P, lug number 3, to which R17 is connected. The modified final amplifier screen circuit is shown in fig. 2.

Construct the cathode keying circuit shown in fig. 3, either on the p.c. board shown in figures 4 and 5, or on a small breadboard. The p.c. board mask is shown from the foil side in fig. 4, and the parts are located as shown in fig. 5 from the component side. Solder insulated wires about 12" long to the -V, SC, G, B, M, I, and SP pads of

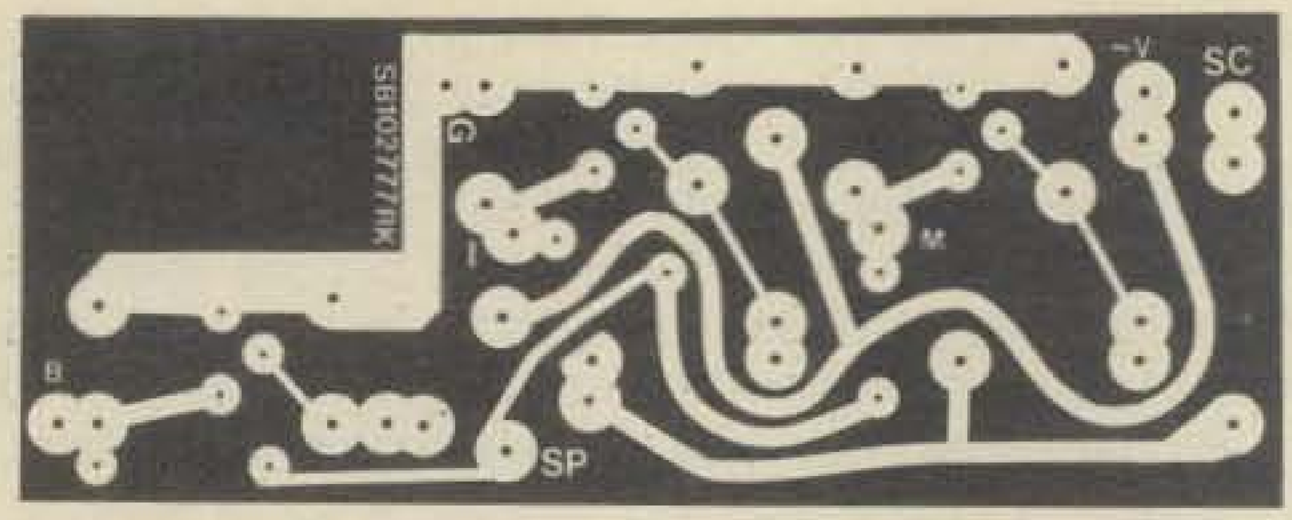


Fig. 4—Cathode keyer circuit board mask-foil side.

the completed board. Remove the screw holding the ground lug and terminal board 2, located next to the carrier generator crystals. Mount the circuit board under the ground lug and hold it in place by replacing the ground lug and screw. Be sure that the ground lug is directly under and securely touching the screw head. Tighten the screw.

Remove cathode resistor R125, a 2700 ohm, 1/2 watt resistor from the u.s.b./c.w. carrier generator, V2B. Remove cathode resistor R116, a 1000 ohm, 1/2 watt resistor, from the isolation amplifier, V3. Remove the cathode resistor/by-pass capacitor combination R202, a 270 ohm, 1/2 watt resistor, and C201, a 100pF mica or disc capacitor, from the LMO mixer, V4. Save these parts. Cut the leads of three .001 uF, 1kv disc capacitors to about 1/4" long. Bend the leads down parallel to the disc body. Invert and solder from the foil side of the transmitter circuit boards one end of each capacitor in the holes and pads previously used for the ground end of R125, R116, and R202. Cut off excess lead length on the component side of the board. The remaining capacitor leads should be sticking straight up and away from the circuit board and will be used as a support for one end of the re-installed cathode resistors. Re-insert and solder one end of R125, a 2700 ohm, 1/2 watt resistor, from the foil side of the board into the remaining hole and pad originally used for R125. Insert it so that the body of the resistor sticks straight up and away from the board. Connect the free end of R125 to the free end of the .001 uF by-pass capacitor located next to it. Re-insert and solder one end of R116, a 1000 ohm, 1/2 watt resistor, from the foil side of the board into the remaining hole and pad previously used for R116. Connect the free end of R116 to the free end of the adjacent .001 uF by-pass capacitor. Disconnect R202, a 270 ohm, 1/2 watt resistor, from C201, a 100pF capacitor. Insert and solder from the foil side of the board one end of R202 into the remaining hole and pad previously used for R202. Position the resistor so that it is sticking straight up and away from the board. Connect the free end of R202 to the free end of the adjacent .001 uF by-pass capacitor. Bend a small "L" into each end of the leads of C201. From the foil side of the board, solder C201 across the pair of pads originally used for R202. One pad will have a lead from a .001 uF capacitor in it, and the other pad will have a lead from a 270 ohm, 1/2 watt resistor in it.

In the following steps cut all wires to length after they have been neatly routed to their destination. Solder the wire from the "G" pad on the cathode keyer board to the ground lug holding the board in place. Solder the wire from the "−V" pad to the junction of R412, a 1000 ohm, 1 watt resistor, and C403, a 20 uF capacitor, on terminal board 2, pin 26. Solder the wire from the "B" pad to the junction of R125 and its .001 uF by-pass capacitor. Solder the wire from the "M" pad to the junction of R202 and its .001 uF by-pass capacitor. Solder the wire from the "I"

(Continued on page 90)

WA2DHF's curiosity about the computer hiatus turned him into an active hobbyist. Steve Mendelsohn recounts his odyssey through the world of computers.

An Unabashed Look at Personal Computing

BY STEPHEN MENDELSOHN*, WA2DHF

The world of personal computing has followed in the footsteps of its older relation, amateur radio. First the small group of avid experimenters plugging away in their attics and basements, large boxes with resident miles of small wires looking like a fantastic spider web, tortured shouts when things go wrong, followed by gallons of consumed beer and happy smiles when you finally get the box working. Such were the first years. Now, however, the box has come out of the basement and takes its respectable place on the desk with the small decorator designed transceiver and its smaller brother, the calculator.

Stuffing More Power Into Smaller Boxes

I guess it was going to have to come to pass that the manufacturers would have gotten all of those great electrons in that little bitty can. My first thoughts of personal computing were visions of large black boxes humming away in the racks I would have to put up to hold them. I was happy to see that it was not so. In the last two or three years the need for all of the big boxes has gone the way of more efficient integrated circuits, and the decision to service the novice like myself.

I am a rather ordinary amateur. I live in a small apartment in a large city (New York) which makes towers and beams a bit impractical. I have managed to work about 200 countries, WAS, and that sort of thing, and found myself getting involved in radio teletype two years ago. But it seemed that this was only a half-way measure as I added more and more automated devices. My Kenwood Twins were perking along with circuits now designed to sign my callsign automatically every ten minutes, record any incoming messages, and answer back automatically, and I was even starting to think that I might be able to take off for vacation and let the station work the next contest automatically. Depression set in. The station was written up in a local amateur magazine, and given an operating award. I was not even mentioned! It started to growl when I came near it. I had to go somewhere else.

I am an audio engineer at CBS, Inc. I work with sound at the network level. However, we also have a computer facility that does all of the internal switching of various programs to all of the stations out there on the other side of the Hudson river. This facility is watched over by a group that includes Dr. Byte, or David Minott, WA2EXP. Dave is also an active amateur who has managed to combine his work and two hobbies into one. He also uses a computer for many phases of amateur radio, such as log keeping and data retrieval. But Dave was light-years ahead as he explained that all you had to do was get an output port to turn on and off at a serial rate for c.w. and dump in ASCII for RTTY. Serial rate? I eat a bowl a day. Output port? Something on the New York City shore for handling containerized cargo? ASCII? Dave said to read some books before I continued to ASCII (pronounced AS-Key) anymore questions. Within a week I was bewitched, bewildered, and totally lost. Maybe golf or building skyscrapers would be an easier hobby. I had the interest, but the boxes were so big and the language, called computer jargon, almost as bad as a DXCC meeting. At this point I realized that I was in a boat with many, many amateurs who felt that although the technology of amateur radio skirted the fringe of computers, getting in itself. Not so. The computer manufacturers, finally coming from the lab into the sales domain themselves, have recognized our needs. At last the need for hundreds of boards in a large box with a 30 amp. power supply were being done away with. Simple incentive, large volume of sales to people with a small need for computers, and not the large need to tinker. The day of the appliance operator in the computer world had come. Now here I make a disclaimer. I am talking about the world of personal computing, and not the world of business computing. IBM, and Data General we novices don't want to be. But we have also felt the need to be able to tinker with the box itself, getting involved in the concepts, rather than the machinery.

A Look Into The Bigger Box

What makes the large computer system so big? My first investigations showed that inside was a huge power supply,

WA2DHF's computer - the Ohio Scientific Instruments' Challenger IIP.

*144-25 33rd Ave., Flushing NY 11354

or two, and the need for a 100 pin bus. This is not something run by New York City transport, but a series of rails along which the signals ride from one board to another. This need makes for large connectors, and usually lots of them. The cards themselves usually come in sets. First you needed a card with the micro-processor itself and its support chips on it. This is the brain which does all of the thinking. It may also have some read-only memory, or ROM on it. ROM is like a book. It comes with preprinted pages which cannot be written on. Another board has some random-access memory, or RAM, which is like a chalk board. You can write on it and erase it. With ROM it is written into once, and that's that. The main program, or instruction set for the processor is written in ROM.

The main program usually tells the processor to start at zero and go up in its actions. When somebody said these things were stupid, they were not kidding. A look at the next board down the line showed that it was a input/output port. Fancy name for a device which tells the computer that it is getting some information from the outside world, and then after calculations, tells the outside world what the genius in the box came up with. All of this now meant that you could hook up your keyboard, if you remembered to buy or build one, and type into the computer. Of course you now had to have a way of getting the information out of the computer. This meant that you had to decide if you wanted video, or hard copy. This is already too complex for a hobby. You wound up with a large box, and lots of boards connected by a set of trailing wires to a keyboard, and some sort of output device. Oh boy! An engineer's idea of Heaven maybe, but not for the novice.

After about six disheartening months, I came across an ad for a computer in a box. One box. Of course you have to add your own video monitor, or get a small r.f. modulator to put the thing on your television (these things can be found in all of those discarded TV games that you bought for Christmas two years ago), but it was small enough to fit under my arm, had its own keyboard, and if I wanted to keep programs, all I had to use was my own cassette recorder, a $39.00 model. I started to think excitedly, but caution held me back. I knew nothing about programming. No need to worry, the ad said. This computer comes with BASIC built in. Just plug it in, turn it on, type two "return"s and it would be ready to go.

Into The World Of Languages

Seemed like a good idea but what of this BASIC language thing? It seems that computers only think in binary, you know, ones and zeros. Things called assemblers then put together codes to say something to the machine like *and*, *or*, and *output*. I guess that to the dedicated computerist this makes lots of sense, but to a novice, it is like a steel door. So a super assembler was developed that allowed the use of English words. This was called **BASIC**, or **B**eginners **A**ll-purpose **S**ymbolic **I**nstruction **C**ode. Now if you want to have the computer print a number called X in the program you say "PRINT X" and not 85, 71, A5, FF. It's a lot easier. There are quite a few of these simple English languages around, but for the starter, this BASIC stuff is really grand. An investment of another $5.95 in a self teaching text had me working with the language in about a week of evenings at an hour or so an evening. So far so good.

The Big Decision

A quick look at the ads in September 1977 showed that three manufacturers produced the complete machine with keybeard, BASIC, cassette storage system, video output, 4 kilobits of RAM for storing programs, and an affordable price for me. These were Ohio Scientific Instruments, Radio Shack, and Commodore. The OSI machine is called the "CHALLENGER IIP", the Radio Shack is the "TRS-80", and the Commodore is the "Personal Electronic Transactor 2001", or PET.

In September of that year, Radio Shack was just starting to show the computer, as was Commodore, so I chose the readily available Challenger IIP. A check to Johnson Computer, of Madina, Ohio brought an instant response. I must add here that the folks who run the Johnson Computer store really believe in service to the customer! At my request they airfreighted the computer after going to the factory to make sure that it was working correctly in all areas. You have to go some to beat Phil and Kevin Johnson when it comes to customer service.

The Box Arrives

From here on the story is one of pleasure. After unwrapping the computer and plugging in the video display, I remembered the book stored in the same carton that OSI sends with the CIIP and decided it was time for lunch and some reading. One half hour later, two peanut butter and jelly sandwiches downed, I turned on the bat handled switch in the rear. As per the manual I hit return twice, and sure enough the screen announced that there were 3.2 kilobytes available for my use. Why not the full 4kbytes? Well, remember that some of the memory is needed for simple housekeeping like remembering that it has to look to the keyboard for input information, and send the answers out to the screen. Takes about 700 bytes. But it was well worth it.

With a tentative touch I typed the instructions to print my name. Hit return, and there was my name. Gang-busters. Next a simple 3 line program to tell the computer to list all of the numbers from 1 to 1000. It takes about 2 seconds. Can you write that fast?

Where Do You Get Programs?

Well you have the machine going, now what do you do? First take a trip down to your local computer store. There are lots of them springing up. If no store appears in your area, try writing to Kilobaud Magazine in Peterburough, NH. They publish the best monthly magazine for a beginner, and an advanced computerist as well. Look at ads. They will give you an idea of what software (jargon for programs) is available. The main computerist magazines, KB, Byte, also in Peterburough, Interface Age (business oriented), and Creative Computing of Morristown, NJ (lots of software for the novice here) are the best places for free programs. They are free with the subscription. There are lots of good games, practical household programs, and some business programs.

OK. I Have The Box. Now What?

You have purchased a computer for various reasons including learning about computing, learning programming, playing games, doing practical things with a super data retrieval unit, and also satisfy your curiosity. You don't have to know what a computer does inside anymore than you have to know how your engine works to be a good driver. What you can do with it is limited only by your ability to learn the BASIC language, or as you deepen your field of knowledge use machine codes to make the computer do whatever you desire.

A Word About Game Playing

The first thing that you will probably do when you get your machine is play games on it. Those who are really into computers in a big way will look down their noses at you as wasting a valuable resource. Don't believe it for a moment! Game playing is an excellent way to get to know how your computer makes decisions. And when your first questioner asks what you do with the thing, ask him if he has a hobby, and if so what practical use are his golf clubs, or guns. A hobby is by definition something that you enjoy. If you enjoy your computer, no matter what you do with it, you are participating in your hobby, and that needs no other rewards. Just enjoy it!

Deeper Into Wonderland

As you get to know your machine abilities you will be able to use the free programs, or go out and buy a book of BASIC programs and use the machine for bookkeeping around the house (checks and recipes), to amuse your first born (math practice, and learning word structure with games such as "hangman"), amuse yourself (do a IRS 1040A shortform in about 3 minutes), and if you are an amateur radio operator, send the best code, or smoothest radioteletype around. If you enjoy designing circuits, but don't enjoy the math, you will find out about CAD. This is the acronym for Computer Aided Design. If you have filters to do, just punch in the design parameters, and out comes waveshapes, skirt sizes, and forms. The computer is really the device for people from 4 to 99!

Folk You Will Meet

A bit of caution when shopping. The personal computer business is rather new. You can't yet go to your local store and get one from a rack. As a result you will meet some pretty strange people. Up to now it has been an engineer's and programmer's world. They speak in a social code that sometimes frustrates newcomers. If, after talking to a salesman, you feel like you have been told where to go because you don't understand the jargon, don't be bitter. Just explain to the man that your engineering degree expired about 10 years ago, and since then you have learned to speak English instead. If you still can't get through to him, and he is not salesman enough to realize that he is just turning you off, forget him, and try another store, or another salesman.

The personal computing businesses were almost all started by engineers. They do not make the best salesmen.

As many firms realize that volume sales make for big paychecks, more and more salesman are finding their way into the field. This is a key thought for both consumer and supplier to keep in mind. The field must be getting bigger, for quite a few major firms are devoting millions of dollars to advertising and sales, and not just production/engineering. It is a field coming of age rapidly.

Customer Service

Unless you are rich enough to afford a new machine each time the fuse blows, or engineer enough to fix it yourself, better think about customer service. Ask the salesman at the store if they do their own service, or ship it back to the manufacturer. If you consider buying from the manufacturer consider giving them a telephone call and asking. It may be an investment for later. In the case of the Ohio Scientific Instruments machine, OSI is a company getting larger by the day, and their company policy of having both hardware, and software services available to the purchaser makes them attractive. Likewise, the put it under your arm, with the cassette machine around your shoulder, and video display in the other hand method of transportation makes the OSI Challanger IIP right for my needs. The case, by the way, is made of good sheet steel, and not plastic. Very important over the long run.

Computers are very interesting to even the layman, in addition to the amateur who may want to expand his or her horizons. There is no limit to where you can go. A floppy disk

(Continued on page 90)

Finally! An easy, easy, easy way to put two wires together in a solid electrical connection that'll stay together. Connect radios, power supplies, stereo speakers, auto fog lights and anything else needing a fast, simple hook-up.

It's a snap!

Whew! It's a real pain in the neck. Twisting those loose wires together, wrapping them in black electrical tape, hoping they stay in connection. Now you don't have to go to the trouble anymore. Just pop a set of *It's a snap!* connectors on the ends of your wires and your installation is neat and tidy in seconds, ready to stand up to thousands of rugged miles of abuse.

In fact, *It's a snap* connectors not only are top-notch mobile power and speaker connectors but they work fine around the house.

These handy new plugs let you hook up stereo receivers and tape decks and speakers and even printed circuit boards for your one-night projects

Connector kit contains everything you need in a high-impact-resistant plastic case. The convenient storage compartments house an all-purpose crimping tool, the special insertion tool for use with the connectors and a total of 64 assorted connector housings and contacts. Contacts come in both 15 and 30 amp capabilities to fit most popular wire sizes. There's even a complete instruction manual for those who formerly were all thumbs when it came to connecting wires.

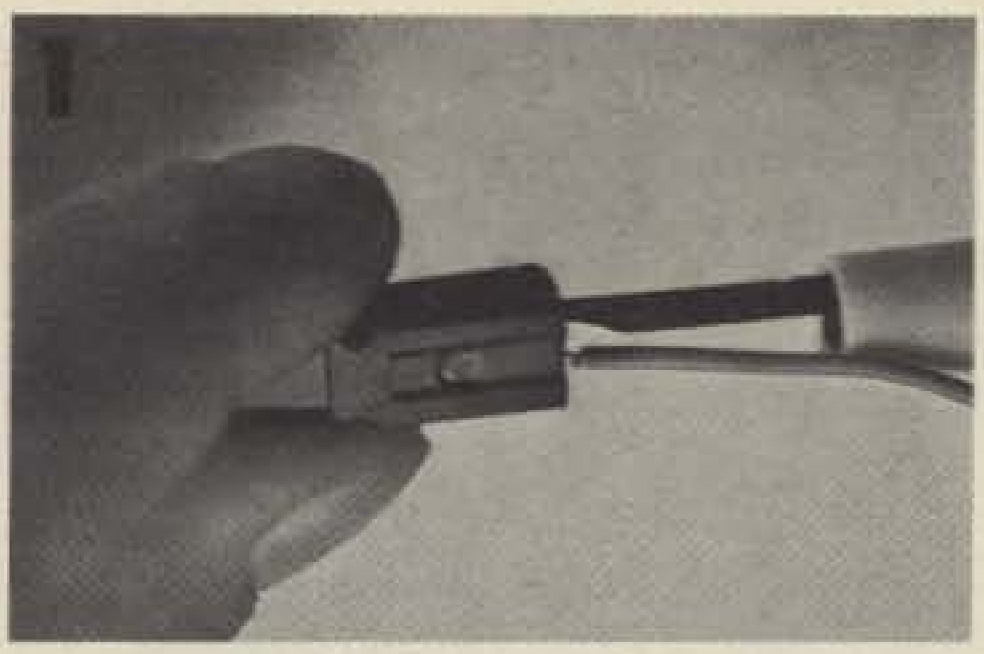
Got a boat? Use the new-style connectors to hook up your deck compass light or a bilge pump or even mast lighting. In your van, they'll connect power to your CB or ham rig, tie speakers to a tape deck or fix fog lights to the wiring.

The *It's a snap!* connectors are, well, um, what the heck, we're not afraid to say it: they're a snap to use. Here's a step-by-step guide to using these easy plug togethers.

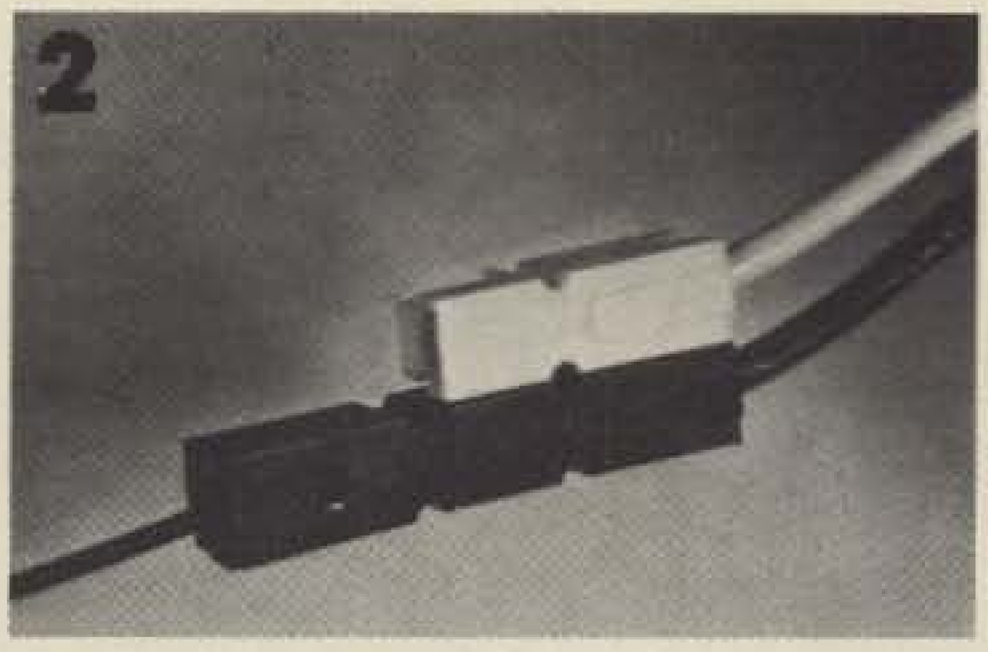
■ Determine the amount of current you expect the *It's a snap!* connector to carry. Smaller contacts are rated good up to 15 amps. Larger are good to 30 amps, according to the manufacturer.

■ Select a wire size to match the current-carrying capacity of the metal *It's a snap!* contacts.

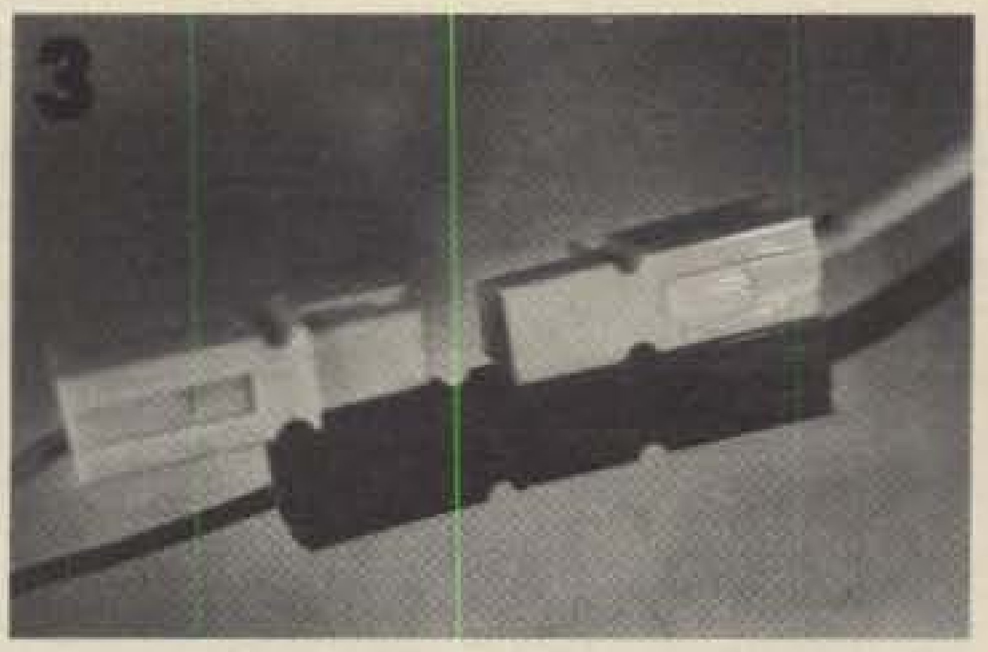
■ Use the *It's a snap!* crimp tool to strip away insulation from the end of



It's easy to use the special tool to insert a contact into a connector housing.



Align the contacts and the housings and they just snap right together. Easy as one, two, three!



Housings stack up for complex connections. They have snap-in dovetails which allow modular stacking.

the wire to which you will attach the new-style connector.

■ Pick the housing color suited to your work. For instance, color code wires which will carry positive or plus voltages with a red connector cover. Negative or minus voltages should be black. Housings of other colors can be used for codings where voltage polarities are not important.

■ The custom-made insertion tool, designed specifically for the *It's a snap!* line, will allow you to place the contacts inside the colored housing with ease.

■ Choose the proper metal contact to place inside the housing. Smaller contacts are good for up to 15 amps current-carrying capacity, according to the manufacturer. Larger contacts are useful up to 30 amperes. Now that you've selected the wire size, proper contact and proper color-coded housing, you're ready to put them together into a finished connector.

■ Finish the ends of as many wires as you need with *It's a snap* connectors. Then snap all your connectors together into one solid bundle.

Suppose you want to wire up a 12 volt dc power supply in your house to power the CB radio from your car.

Determine how many volts your CB requires to operate and how much current it will drain from the power source. Most need 12 volts dc and draw up to three amps or less. Let's figure your CB needs a power supply providing three amps at 12 volts dc.

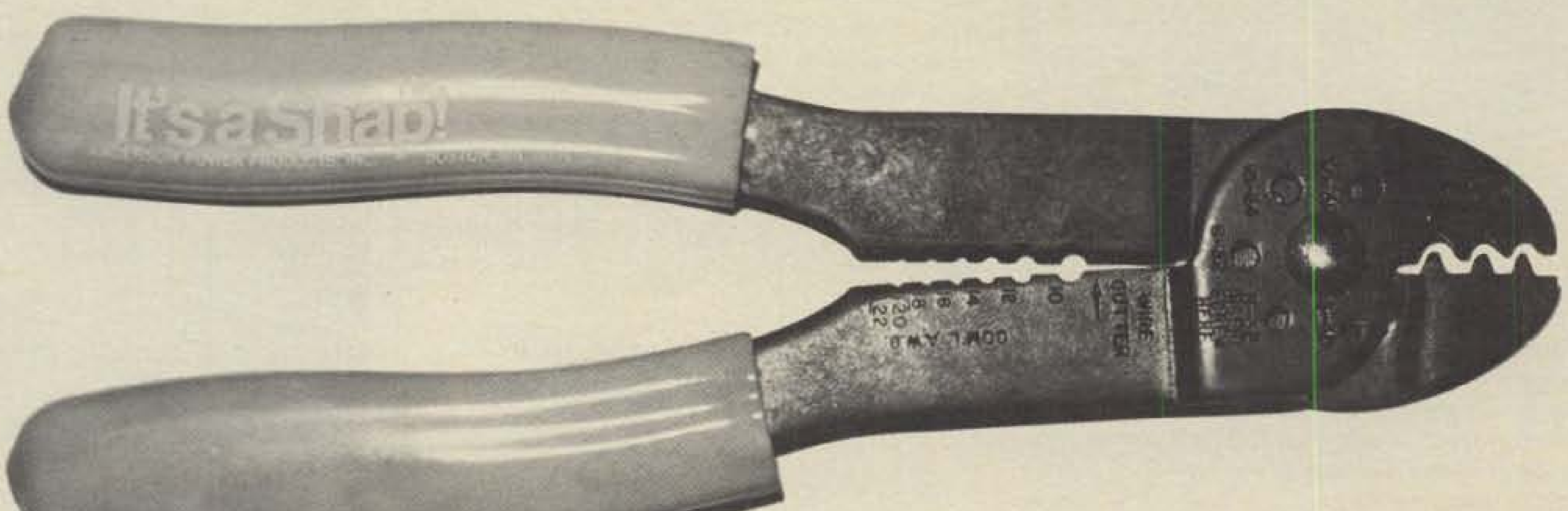
The power supply will have two output wires. One delivering 12 volts positive or plus and the other giving 12 volts negative or minus. Be sure to unplug the power supply from your ac house power. Strip the insulation from near the tips of the wires and install a red *It's a snap!* connector on the plus wire. Put a black connector on the minus wire.

Similarly, your radio will have two power input wires. One will be for plus 12 volts dc in and the other for minus 12 volts dc. Place a red *It's a snap* on the plus 12v lead and a black connector on the minus 12v wire. Now you have color coded the power supply and the radio wires so they always can be hooked, unhooked, rehooked in the proper connection.

The same sort of polarized connecting can be done with other types of electrical connections for CB, ham, stereo, home computers, burglar alarms, marine electronics and so on.

The *It's a snap!* connectors are easy to use and hard to beat. And they're handy to keep around the workshop, car or boat for quick fixes when somebody else's wiring gives out. Try 'em. You'll like the way they go together.

It's a snap! connectors are available from Concepts Unlimited, 36C Carlough Road, Bohemia, NY 11716. Or, for more information, circle 100 on our reader-service card.



Crimping tool

a monthly feature by

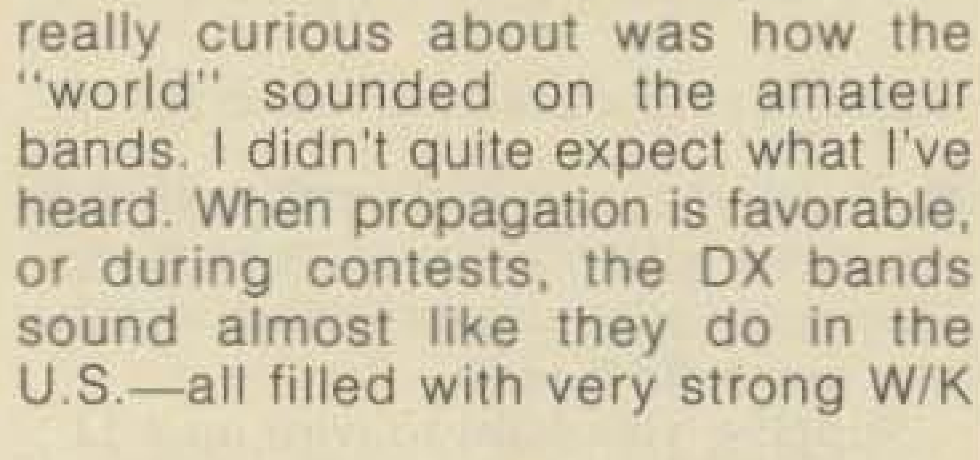
ADRIAN WEISS, K8EEG

QRP

The art of very low power operating

Greetings, to all of you, from merry old England! I managed to make it across the pond to London, and it's unlike any U.S. city I've been in. Several differences. Since London is like a group of villages and small cities, it is quite charming, with many parks scattered about and the grass in them is green! There are very few tall buildings (above six stories), so you can see the sky everywhere. Not that this is much of an advantage, since it is usually cloudy. The sun does come out, and we've had some very nice spring-like weather. It is usually cloudy, which makes navigating quite difficult, since one can't get a "fix" on the sun. Londoners are very friendly and courteous people, and the usual "hustle-bustle" of American cities is encountered only at the heart of the business district—Oxford Circus. So many cultural events are happening here, that a weekly magazine, the size of *Newsweek*, is needed to list all the concerts, plays, movies, operas, dance concerts, etc. Museums and art galleries are everywhere. Antique shops—*real* antiques—are also everywhere and most specialize in one item, such as chandeliers, or grandfather clocks, etc. There is just too much here to mention. What I was really curious about was how the "world" sounded on the amateur bands. I didn't quite expect what I've heard. When propagation is favorable, or during contests, the DX bands sound almost like they do in the U.S.—all filled with very strong W/K stations. Few European stations seem able to compete. It is unbelievable. After about an hour of listening, I wondered if I was really in Europe. It isn't all due to KW's either. In fact, a goodly percentage of the strong U.S. stations I've monitored were in the 200 watt and under class. However, they all use good antennas. I'm convinced, more than ever now, that the antenna, and not the power level, is the crucial factor in working DX. I'll try to come up with some detailed observations later—but for now, believe it or not, some mail has managed to catch up with me, so it's time to share it with our readers. First off, an old QRPp standby, who contributes regularly to this column has sent a story about a "first" and "last" operation—Bicentennial Celebration operation with a /76 call. QRPper Ben Saylor, K6TG, writes:

*83 Suburban Estates, Vermillion, SD 57069



A.R.R.L. BICENTENNIAL CELEBRATION

24 - 25 JULY 1976

AD6TG/76

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ANT. IN WASHOE CO., NEV., & SIERRA CO., CALIFORNIA

— FIVE WATTS BATTERY POWER —

The second searching trip for a Bicentennial Celebration site. The car is in Esmeralda County, Nevada. A 100 ft. wire (average height: 4 ft.) was run from the open door to a tall fence post in the background in Mono, County, Calif. There was a direct connection to the antenna terminal of the HW-8 rig. Three QSOs were made on 40m. c.w. here in one hour, just ten days before the site far to the north was used to operate in the A.R.R.L. Bicentennial Celebration.

The real "76" station in the bicentennial celebration

"It is very doubtful that even one of us will be around for the next centennial celebration. So, you might say, that the A.R.R.L. bicentennial celebration of 1976 was our one-time event—once only for you and me. But it was a great event that we can look back upon and remember for its uniqueness.

"There was in our bicentennial celebration only one real "76" station. It was also a QRPp station.

"In 1976, it was an F.C.C. regulation to use a slant and a numeral after the call letters of all portable stations to indicate what call area was being operated in. So if portable operation were in Nevada, "/7" had to be added to the call letters to show that the station was in the 7th call area, and likewise "/6" for portable operation in California. Obviously if you were right on the Nevada-California state line, "/76" would have to be added to your call letters in order to be legal.

"The idea of using the "76" suffix for a 1976 Bicentennial operation came up during a conversation between K6TG and W6JTH, the mountaineer, QRP ham, so later when the A.R.R.L. announced the bicentennial celebration, that seemed the ideal and most appropriate event for a "/76" operation. With the special bicentennial year prefix authorized by the F.C.C. plus the "76" suffix, plain K6TG could become AD6TG/76! Why not give everybody a chance to work a real "76" station in 1976!

After K6TG made two trips to several points on the Nevada-

The AD6TG/76 car parked upon arrival near the site of operation. Now ready to try to locate the exact border line between Nevada and California.

California border looking for a suitable location, he decided to operate QRPp c.w. with five watts input of battery power and one antenna positioned in both Washoe County, Nevada, and the rare Sierra County, California, though the precise location was not decided upon, because of trouble locating exactly the Nevada-California state line.

Friday, July 23rd, five hours before the bicentennial celebration started, K6TG and his loaded Volkswagen Beetle, with antenna poles on top, arrived at the Highway 395 crossing of the Nevada-California border, 16 miles north of Reno, Nevada.

Nearby residents, and border agricultural inspection officials could only indicate the general location of the state line. Then good luck: while scouting a small, nearby hill, a brass plate set in concrete was found. It was an official border marker.

The car was worked up the hill through the sage brush to the side of the marker. And though it was raining and developing into a thunderstorm, a 100 ft. antenna wire was put up on a 25 ft. pole, held up by the car (in California) and run across the state line to the top of a giant billboard in Nevada.

With the station set up on a table where one front seat had been removed, operation was ready to begin, except the Argonaut transceiver seemed to be in bad trouble, also the thunderstorm was going full force. While investigating the impossible fact that the Argonaut continued its rapid popping, even after being turned off, K6TG inadvertently touched the antenna—WHAPPO! OUCH! The popping noise was static electricity arcing across the small, series variable capacitor in the little "Ultimate Transmatch"—that much static in a heavy rainstorm?!

15 meters was hot, and stations could be copied even with the steady arcing in the capacitor. WN5SZL was called and worked until the fire really began jumping in the transmatch, and nothing but a terrible noise was coming from the receiver. Great sheets of lightning were flashing in the mountains to the east and west. It was like an artillery duel between two armies with AD6TG/76 in the middle. But the bicentennial celebration was starting without the real "76" station, so a toroid was connected between antenna and car body. That changed the tuning some in the transmatch, left weird noises in the receiver, but got rid of the arcing.

On the air and working them! The storm died down as contacts were logged. A big thrill came 55 QSOs later when the five watts got through on 20 for a complete QSO with SM5AYY.

W6OWP was heard on sked at noon Saturday and copied, but the QRPp couldn't get through to him. AB6UAV joined in and helped by acting as a relay to set up a new sked for Sunday.

Several fine QSOs developed after sending the required exchanges, one with W6SE/R2, southwest of Clipperton Island, another with K7WPC/M, and others. Quite a few would pause and then ask, "Are you on the border?"

But all day Saturday it was sadly evident that contacts were coming too slowly to attain the 200-QSOs Award that was so greatly desired—well, just do the best you can and have fun. Then Saturday night conditions changed, and the log began to fill up.

Sunday afternoon conditions again made contacts hard to come by, but

Looking southwest at the foothills of the Sierra Nevada Range in Calif. The border marker is between the base of the pole and the food chest. The car is in California. The cable coming out of the little window goes to a storage battery under the rear fender. The antenna is end fed and the car body is the ground system. All sleeping was done on the back seat.

when the celebration was over AD6TG/76 had worked 39 states and 4 continents. KH, SM, VE, VP, and ZL were worked on 20; JA and KL were worked on both 20 and 40. There were 202 valid QSOs, 8 on 15, 154 on 20, and 40 on 40.

Special QSL cards were sent to all QSOs. And now, at this date, 109 QSLs have arrived, including one from SM5AYY, and the special Bicentennial Award for 200 QSOs has been received for this once in a lifetime event!

By now, many of you should recognize Ben's VW and portable antenna hookups, since we've seen

Looking east into Nevada. The car is in California. The antenna goes 25 ft. up the pole and 75 ft. toward the top of the billboard in Nevada. A dry alkali bed, of an ancient lake, is in the distance.

them in a variety of FD locations.

My comments concerning the Milliwatt Field Day Trophy hit home with at least one reader, who responded this way:

"I read your article about the Field Day Trophy in the QRP Section of CQ Magazine and I enjoyed it thoroughly. I intend to take the trophy, hands down, this year, but in order to do so I would appreciate it if you could send me a date in which the field day is to be conducted. I will be completely portable, (In an abandoned fire lookout in the Cascade Wilderness), I am building a small portable c.w. station with a tuned long wire antenna. So much with the boring story of my planned victory. (Oh by the way, thats the 1978 Milli-watt field day.) Thank you."

73, Richard Wilson
17600 S.E. Forest Hill Dr.
Clachamas, OR 97015

Hopefully, Dick will have succeeded in his effort.

I've been planning to devote a column to the very interesting QRPp

Looking west into California. All foreground is in Nevada. The car is hardly visible to the right of the billboard and on the crest of the hill. The billboard is for Harrah's Club in Reno, Nevada.

work currently underway on the 1750 meter band in the U.S. Although few amateurs are aware of it, 1750 meter experimenters have formed the *Longwave Club of America* which publishes a very useful newsletter entitled, *The Lowdown* which gathers and publishes excellent information regarding operation and equipment for 1750 meters, active stations, frequencies, beacon "signature", antennas, as well as listings of commercial station and locations found within the band. My efforts to put a column together based on the material found in the back issues of *The Lowdown*, provided by the publisher, were underway when the following letter alerting me to the current state of 1750 meter affairs reached me W.R. McIntosh, Publisher of *The Lowdown*, writes:

I have no idea whether or not this letter will ever catch up with you in your perambulations, which I hope are pleasant.

"Quite some time ago, you wrote to me for some introductory material on 1750 meter QRP operations. I do not know, of course, whether or not you continued with this project. I'm certain that you have many worthwhile projects in mind. However, just on the off chance that you were planning something along these lines, I am writing to warn you that matters on the 1750 meter band are in a bit of a bind right now. Personnel at the FCC have changed in the years, since a "gentlemen's agreement" was reached between the FCC and the 1750 meter experimenters, and the new personnel are taking a rather different interpretation of certain sections of Part 15. The matters under consideration concern the antenna, its loading, and tuning—rather basic you might say.

"Therefore, if your interest in this band remains, I would respectfully suggest that you hold off on any article until the FCC either clarifies this matter or issues amended Rules and Regulations for Part 15 that changes the present operating procedures used by most of the active experimenters."

Hopefully, this unfortunate situation will have been resolved by the time this appears in print. Mr. McIntosh indicates that, at present, the club has 470 members, and that a "wild guess" suggests that about 40 are actually on the air, and about 200 have had beacons on the air, at one time or another. This can be a long and lonely operation, much more difficult than QRPp on the amateur bands, and many individuals have become disenchanted because of failure to be heard or work 2-way. I do feel that some publicity in *CQ* can have an important effect on experimentation on 1750 meters, so, space will be available in the future when the FCC problem is resolved.

QRPp Net Revitalized

It has been about 3 years since QRPp Net activity was organized and publicized. Two regular QNI's from the old net have attempted to resurrect activity this past winter, and hopefully, will do so in the Fall-Spring period of 1978-79. Pike, W8MGF (ex-K4COE) and Bill, K8IF (ex-WB2TEN), have sent the following information:

"K8IF and myself have been attempting to resurrect the old 7040 kHz QRPp Net at 1800z on Saturdays. QNI's haven't been that terrific because we haven't been able to get the word out. We call "CQ QRP Net" on the above frequency and time. The purpose of the net is to exchange ideas on QRPp operation, and engage in some good ragchewing with other QRPp stations. We will certainly appreciate whatever publicity you can provide us."

(Continued on page 88)

a monthly feature by

WILLIAM I. ORR, W6SAI

Antennas

Design, construction, fact, and even some fiction

"Now that DX conditions are on the rise, fellows are really getting interested in antennas", I remarked, "My mail is full of questions on the Yagi and the Quad. And some fellows are thinking about some really big beams".

Pendergast put down the stack of QSL cards he had just received from the Bureau and smiled. "Yes", he replied, "I guess a bunch of fellows had second thoughts after calling the Clipperton DX-pedition for three or four days with no resilts."

"Did you work them?", I asked.

"Certainly. The easiest contact was on 2 meters via the Oscar satellite. One call and they came right back!"

"There's going to be a lot more satellite DX as the years go on", I replied. "You had better prepare for it. And so should I", I added as an afterthought.

Pendergast tossed an envelope across the desk to me. "Here's a note from Don, K5DUT, the terror of 'Cow Town'—Fort Worth, Texas. He sent me some pictures of the antenna at VK3MO. Don swears Ian has the biggest signal from Australia. And no wonder! Look at fig. 1. This is the top four element Quad for a *stacked* Quad array! There's Ian at the 120 foot level!"

*48 Campbell Lane, Menlo Park, CA 94025

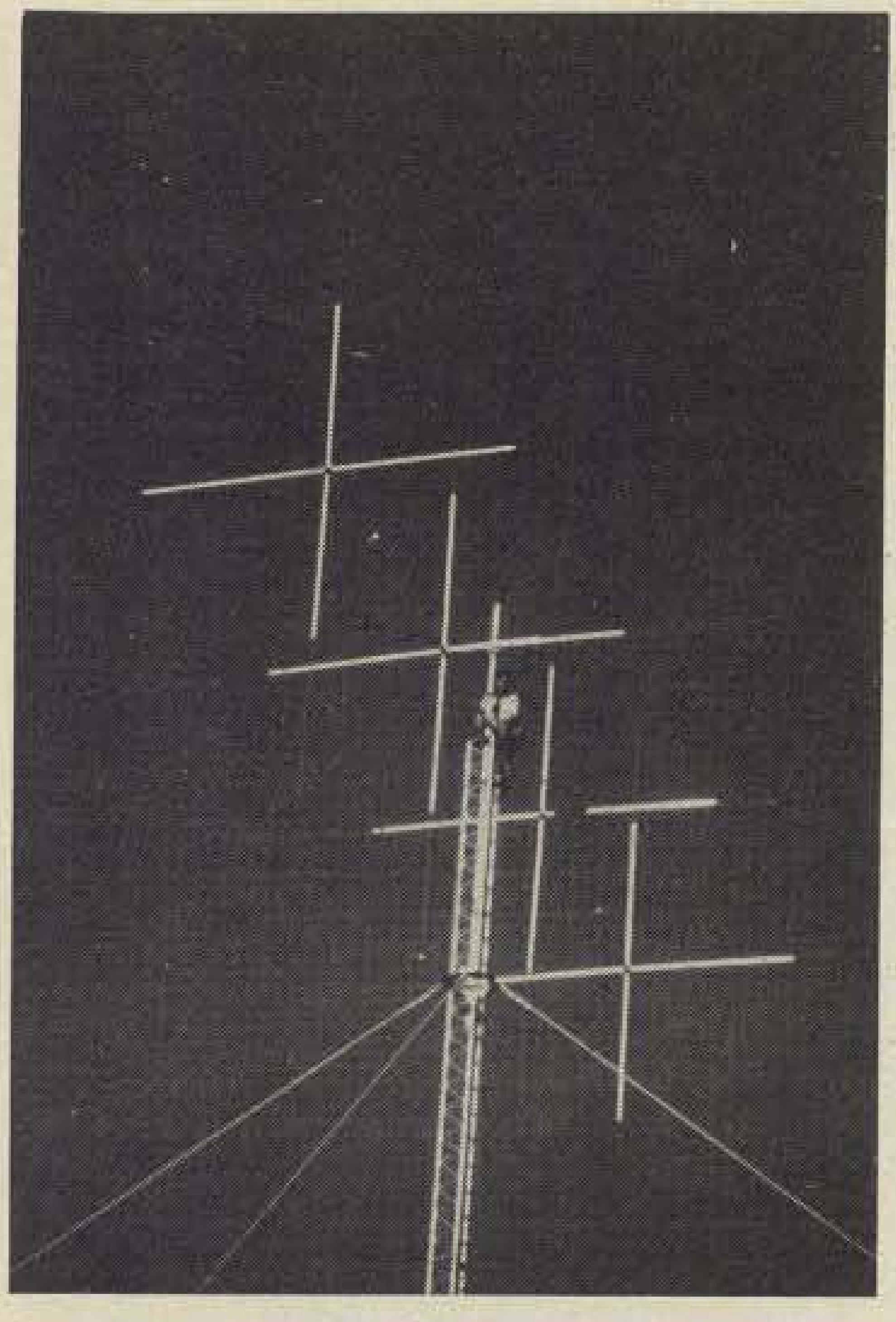


Fig. 1 – Ian, VK3MO at the 120 foot level of his tower. This is a four element stacked Quad array. The whole tower rotates in a large bearing, which is about twenty feet below where Ian is standing.

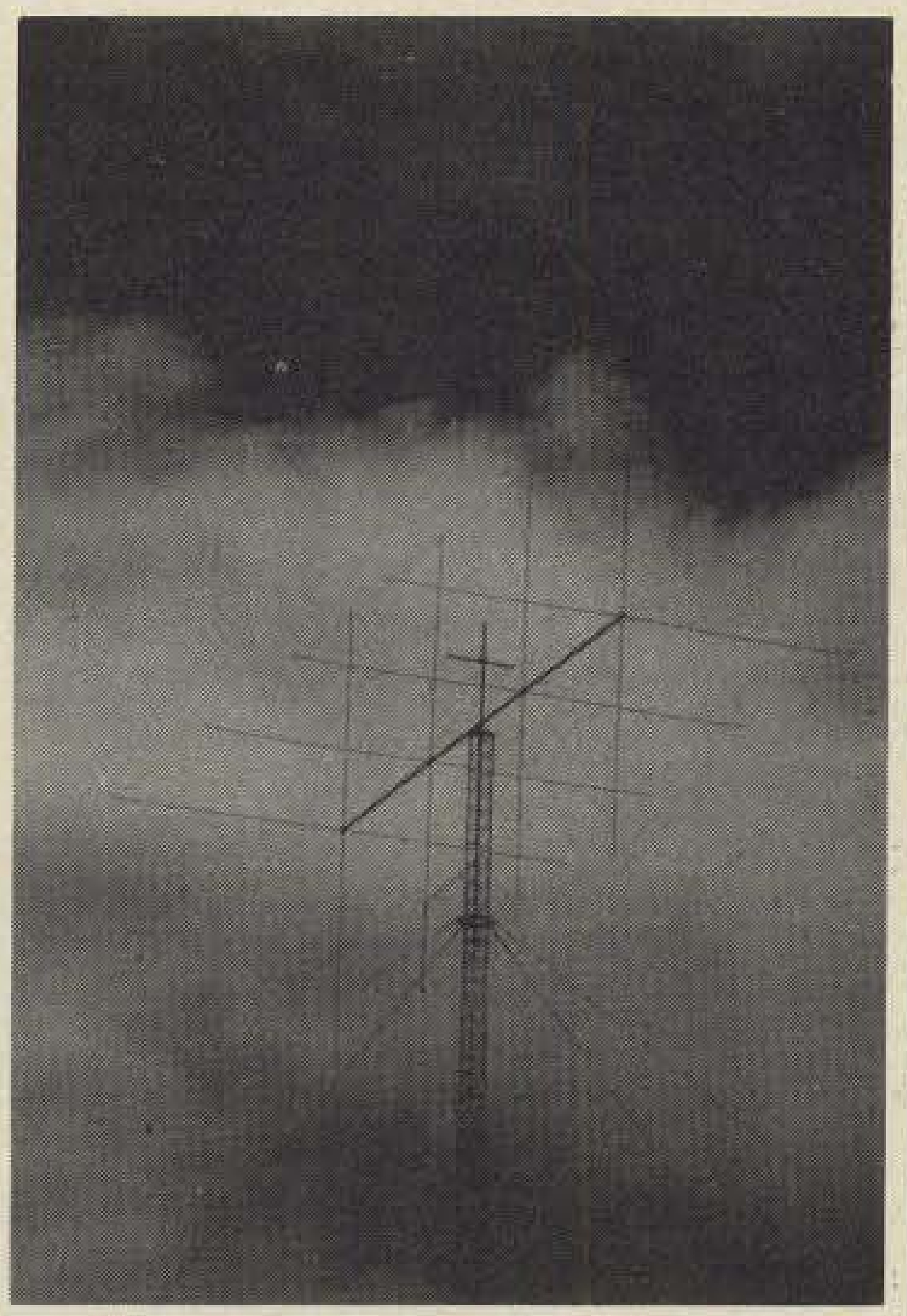


Fig. 2 – Another view of the top Quad of VK3MO's stacked array. The Quad boom is strengthened by use of top guys to a center post.

"I'd get a nosebleed if I climbed that high", I said.

Pendergast ignored the remark and handed me a second picture. "This is a second shot of the top Quad (fig. 2). Note that the Quad boom is trussed by top guys and that the tower has a slip ring about twenty feet below the Quad. That means the whole tower rotates. Everything looks ship-shape".

He handed me the last picture (fig. 3). "And here's a view of the complete array of two stacked 20 meter four element Quads. The bottom one is at 47 feet. It looks as if the rotary tower is set inside a shorter, base tower—perhaps 30 feet high. And the rotor is at ground level, right?"

"It looks that way to me", I admitted. "And Ian has a clear shot in all directions. It makes one sort of humble to see an antenna installation like that!"

With a flourish Pendergast handed me the last photograph.

"Don, K5DUT, told me that he got a chuckle out of the March, 1978 antenna column describing the K5JA Monster Quad. Don says that to qualify as a Monster Quad in 'Cow Town', the boom must be at least 50 feet long, at a minimum. Thus, the K5JA Quad is *too small* to qualify for this classification. As another example of a small Quad that doesn't qualify, Don enclosed a shot of the installation at WA5FWC. This tiny antenna (fig. 4) has two elements on 40 and four elements on 20, 15 and 10 meters. Too bad, the boom is only about 35 feet long! Finally, Don says that 'Cow Town' is the Monster Quad capitol of the World, as there are more big Quad antennas there than in any other area. And more are going up every day".

"Bet they are all CBers", I said.

Pendergast turned a slightly pink color. "I wouldn't know about that", he replied shortly.

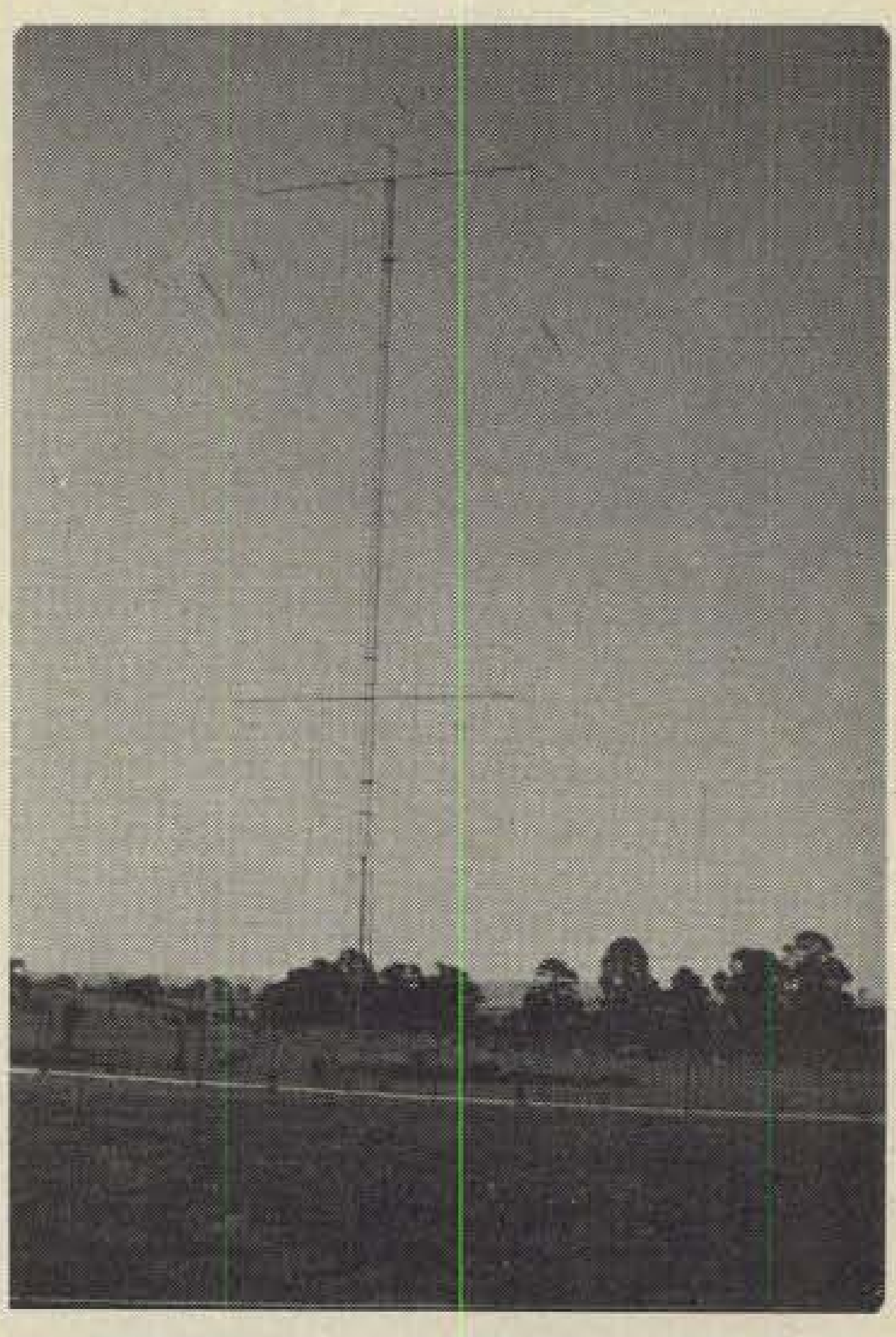


Fig. 3 – The Stacked Quad array of VK3MO built around a 120 foot, rotatable tower. The bottom Quad is 47 feet above the ground. Listen for the blockbuster of VK3MO on 20 meters.

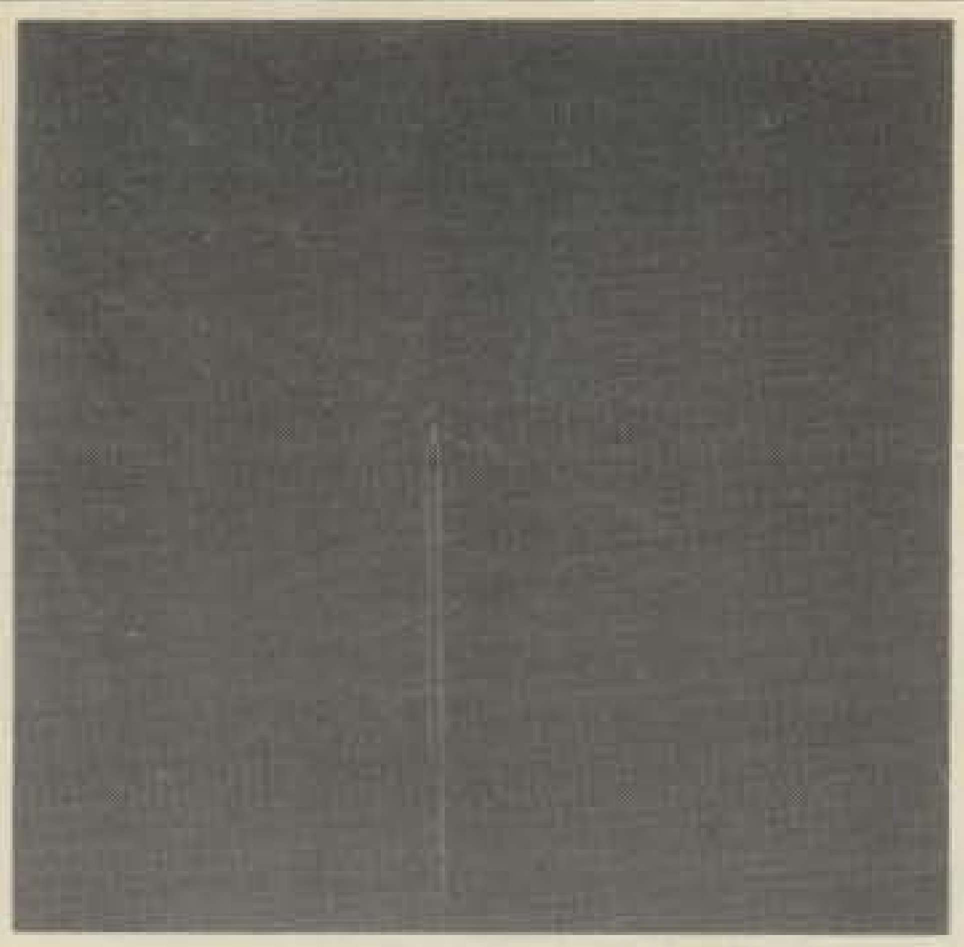


Fig. 4 – The Monster Quad at WA5FWC doesn't really qualify, as the boom is only about 35 feet long! The Antenna works on 40, 20, 15 and 10 meters with an outstanding signal.

I didn't let him off the hook that easily. "I read in *QST* a few months ago that forty-four percent of the amateurs are licensed CBers. Do you have a CB license, good Buddy?"

"Certainly", said Pendergast in a too-rapid voice. "And you do too, don't you?"

"Mine lapsed a few years ago", I said regretfully. "You know how it is".

Pendergast grinned and pulled a newspaper out of his pocket.

"Not to change the subject abruptly, but I wonder if you saw the article in *Worldradio News* recently by K6WG? It seems that he has been making gain measurements on various Quad designs. He ran his tests on 168 MHz; where one inch in wavelength is equal to one foot in wavelength at 14 MHz. Thus a direct scale (12:1) comparison in dimensions could be easily made. fig. 5 shows his gain measurements for a two element Quad. It shows that the design using a reflector provides better gain than the design with a director. Maximum gain was about 6 dB over a dipole".

"That's pretty close to my gain figure of 7 dB for a two element Quad", I remarked. I won't argue one decibel".

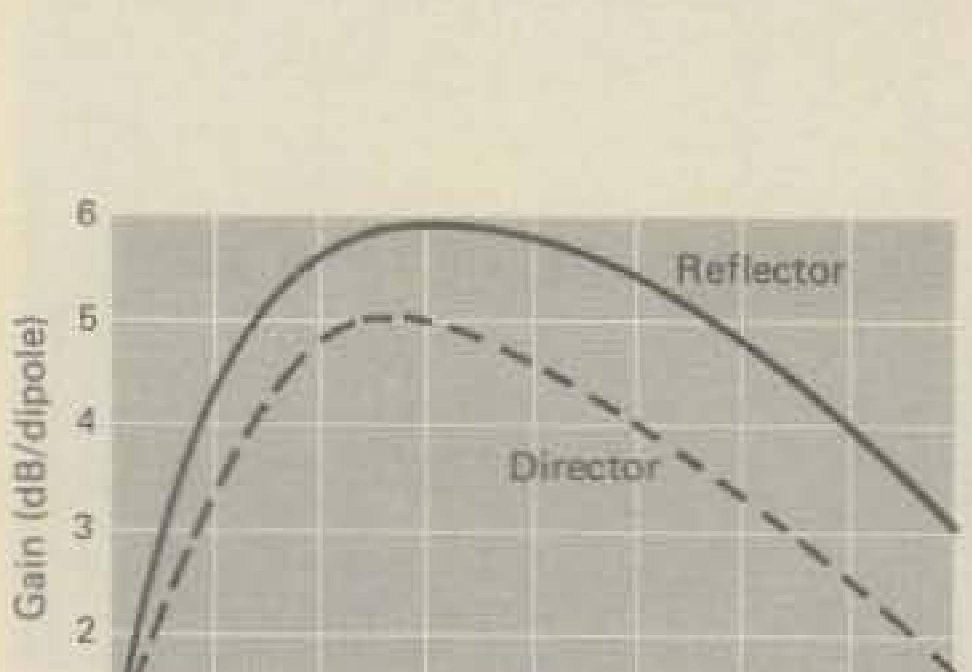


Fig. 5 – Gain measurements for a two element Quad as a factor of boom length. Reflector arrangement provides greatest gain.

"Look at fig. 6," said my friend. "That shows power gain for a three element Quad. With reflector spacing of 0.15 wavelength, forward gain peaked at about 8.5 dB over a dipole for a director spacing of 0.3 wavelength".

"Very interesting", I remarked. "That's the first time I've seen definitive gain figures for a three element Quad".

"Keith says that additional directors also show a characteristic gain peak at a spacing of 0.3 wavelength, so a four element job would have an overall boom length of 0.75 wavelength. At 20 meters, that's about 52 feet. And the gain over a dipole under these conditions is about 10 dB".

"Well, according to this data, a four element Quad for 20 meters with a 30 foot boom has a gain figure of about 9.5 dB. That seems a little low to me, but still in the ball-park", I remarked.

"Here's a summary of dimensions for the K6WG Quad design", said Pendergast (fig. 7).

"It looks like good information", I remarked. "I'm pleased to see it. And while we're on the subject of Quads, you might be interested in some data also published in *Worldradio News*. This is a Quad article by Cliff, WØMBP. It concerns the construction of a four-bay Quad for 2 meter work by WBØTEQ and himself. Fig. 8 is a good shot of Terry, WBØTEQ atop the mast, with the Quad just over his head.

"Now, the interesting point is that this is an array of Delta Quads. I can't see that there is any great difference between the operation of a Delta Quad or a Square Quad. I would think that results achieved with one could be duplicated with the other. But I'm not *sure* on that point. I've seen enough unusual things happen in the world of antennas that nothing surprises me anymore.

"In a note to me, Cliff and Terry say; 'For reasons not entirely clear, Quad elements can be effectively spaced *closer together* on a boom than Yagi elements, possibly because the Quad element is low-Q and permits closer coupling. On long boom antennas, adding elements to a Quad seems to produce less gain than adding Yagi elements, again probably due to the higher Q of Yagi elements. But the Quad-Delta design is hard to beat on a short boom antenna.' "

"This makes my head whirl", admitted Pendergast. "What spacing does this array have between elements?"

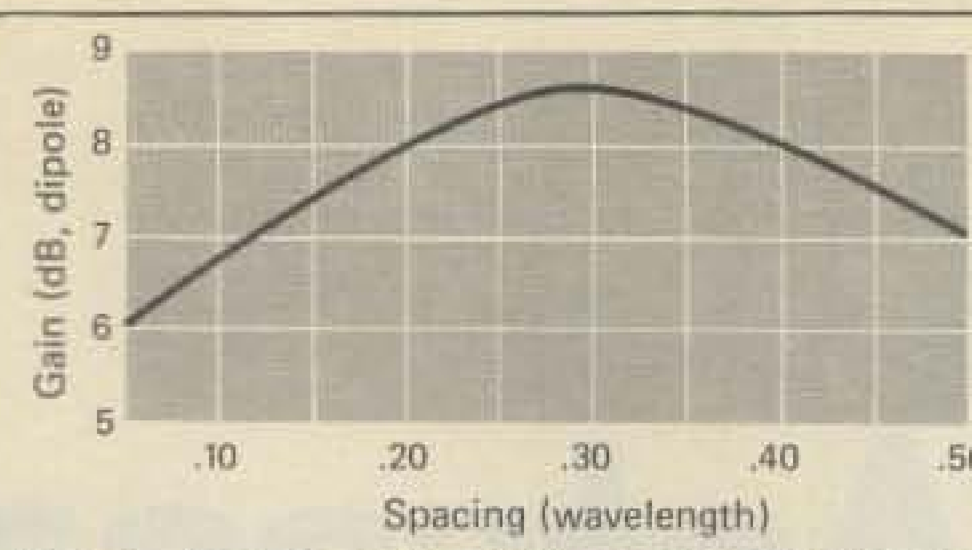


Fig. 6 – Power gain versus boom length for a three element Quad. (Data derived by K6WG.)

"Ten inches", I replied. "That works out to about ten feet on 20 meters. So a four element Quad of this design would have a 30 foot boom. . ."

"That's right, if you merely scale up the design", remarked my friend. "However, you are cutting the number of elements down from a total of eight in one Delta Quad for 2 meters to four for a similar 20 meter design. Would the element spacing change when you drop from eight to four elements?"

"I'm not sure", I replied. "You would have to work that one out on an antenna measuring range".

"Well, here's the information on this Delta-Four Super Quad. Each beam is built on a six foot boom made of 1-⅞" diameter aluminum tubing. The included angle of the Delta at the boom is

BAND	DESIGN FREQ	ELEMENT LENGTH D.E.	R	D*	SPACING DE-R	DE-D1	D1-2-3
10	28.5	35'3"	37'0"	33'10"	5'2"	10'4"	10'4"
15	21.2	47'4"	49'9"	45'7"	7'0"	14'0"	14'0"
20	14.2	70'8"	74'3"	68'0"	10'5"	20'10"	20'10"

Fig. 7 – Antenna dimensions for K6WG's multi-element Quad design.

Fig. 8 – A four-bay Delta Quad built by WBØTEQ and WØMBP. Terry, WBØTEQ atop the tower. A total of 32 elements in this array.

75 degrees. The V-arms are each two pieces of aluminum tubing. One is ½-inch in diameter and it telescopes into a ⅝-inch diameter length. Both pieces are 15" long. The arms are heliarced to an aluminum boom gripper made of 2-inch diameter tubing, 2 inches long, split to make an open ring that slides over the boom. It is held in position with radiator hose clamps. Number 14 wire completes the loop, attached by bolts and flat washers to holes drilled in the tubing ends.

"The Deltas are horizontally spaced 92 inches apart, with vertical stacking spaced 68 inches between upper and lower stacking booms—all spacings measured center-to-center".

I handed Pendergast a small chart (fig. 9). "These are the element dimensions. By the way, I mis-spoke. The spacing from the reflector to the driven element is 9-½ inches, not 10 inches.

"How is each antenna array driven?", asked Pendergast. He took out his laboratory notebook and prepared to copy the drawings in it.

"Each array has a gamma match on it. The match is a ½-inch diameter rod, 7 inches long, spaced ⅜-inch from the driven element. It has a ¼ inch copper rod inserted inside it. This rod is about 4 inches long and is soldered to a short

Element	Rod	Rod
Reflector	25¼"	25¼"
Driven	24¼"	24¼"
Dir. #1	23⁹⁄₁₆"	23⁹⁄₁₆"
Dir. #2	23½"	23½"
Dir. #3	23½"	23½"
Dir. #4	23⁷⁄₁₆"	23⁷⁄₁₆"
Dir. #5	23⅜"	23⅜"
Dir. #6	23⅜"	23⅜"

Wire	Space	Total
31½"	1"	83"
30½"	1"	80"
39⅝"	1"	77¾"
29⅝"	1"	77⅝"
29½"	1"	77½"
29½"	1"	77⅜"
29½"	1"	77¼"
29⅜"	1"	77⅛"

Fig. 9 – Element dimensions for the 2 meter Delta Quad array.

wire which is in turn soldered to the center of the coaxial receptacle. The insulating material between the two tubes is a valve stem of the water closet mechanism on a toilet".

"A distinct touch", murmured Pendergast, as he sketched the design in his notebook.

"The phasing harness between the two upper or two lower Quads is 66 inches of 75 ohm *Belden 8238* coaxial line run to the "T-fitting" from each Quad, with upper and lower pairs, connected by 40 inches of the same line to the center "T" of the array".

"The whole thing sounds great", exclaimed my friend. "I'd really like to get some more information on it".

"Well, I may be wrong, but I understand if you send 50¢ to cover postage and mailing, you can get additional information on the Delta Four Quad from the Sand Hills Amateur Radio Club, Box 811, Garden City, KS 67846. It looks like a very interesting antenna design".

I pointed to the K6WG Quad material. "This is a classic case of two separate antenna investigations. Each had a different goal and used a different method of approach to the problem. And each one came up with a different answer.

"That's what makes antenna experimenting so interesting. There's not much the amateur can build these days unless he wants to go the solid-state, circuit board route. But as far as antennas go, the sky's the limit. All that is required is some space in the back yard, some wire, tubing and cable and a good s.w.r. meter. One of these days, we'll have some definitive answers as to Quad spacing and gain. The two designs shown here are a good step in the right direction".

a monthly feature by

IRWIN MATH, WA2NDM

Math's Notes

A look at the technical side of things

This month we would like to return to a very popular topic with our readers, the digital voltmeter. Many people have asked us for more information on the construction of these devices and, as new chips make the job easier, we will pass along the information.

National Semiconductor has a very nice device that is now available and it is one that makes construction of a d.v.m. ultra-simple. The IC we are talking about is their DS8700 or ADD2500 as it is also called. This is a 24 pin DIP that, with a handful of additional parts, forms a 0 ± 1.99 volt, 1% d.v.m. that will operate from 0 to 70°C. Furthermore, battery operation may be employed if desired. This unit can easily be the heart of a multi-range instrument or digital readout for a specific product, and will cost about as much as a "name brand" moving coil meter of the same range.

The complete circuit of the 2½ digit d.v.m. is shown in fig. 1. Note that the a.c. supply or batteries can be used as desired. Construction is not critical and p.c. boards or terminal boards can be used. The only point to watch is that the common or ground point be essentially a single connection. Ground loops will upset the accuracy of the finished d.v.m.

Once the unit is assembled, check the wiring over a couple of times, and apply power. A random reading will result. To calibrate the d.v.m., an accurate v.o.m. and source of 1.9 volts is necessary.

With the meter between the common input and pin 6, adjust the 20K pot for approximately −3 volts. Now connect the high and common leads together and adjust the 100K pot for a reading of zero. Apply 1.90 volts to the input and readjust the 20K pot for a reading of 1.90. Alternately vary the input between zero (shorted together) and 1.90 volts and adjust the 100K and 20K pots respectively until the two readings are as accurate as possible.

This completes adjustment of the d.v.m. If the circuit is to be used in a multi-range instrument, a suggested modification of the input is shown in fig. 2. This results in a 20,000 ohms/volt circuit which simulates most popular v.o.m. input circuitry. Current can be measured by sensing the voltage across a resistor through which the current is flowing, although 2 volts would have to be dropped which would limit the usefulness. Similarly, ohms could be measured by use of a separate battery in the way that conventional v.o.m.'s operate. The major intention of this circuit however, is as a 2 volt meter and it is in this application that it really shines. To measure a.c., by the way, requires only a series diode, capacitor and resistor as in fig. 3. Adjustment of the values will be necessary to achieve other ranges.

If you do plan to build this simple d.v.m., we suggest that you write to National Semiconductor at 2900 Semiconductor Drive, Santa Clara, CA 95057, and ask for the data sheet and applications information for the DS8700 (ADD2500).

In the January 4, 1978 issue of *ELECTRONIC DESIGN* magazine, there appeared an item that we immediately thought would be of interest to our readers. This item concerned work done by the Royal Military College of Science at Shrivenhami, England on applying ferrite rods to v.h.f. antennas.

In the short announcement, a drawing was given (see fig. 4) describing the fabrication of such a v.h.f. ferrite antenna. As can be seen from the diagram, alternate clockwise and counterclockwise turns act to form a quarter wave resonator. A 200mm (8 inch) long rod has a bandwidth of 5MHz at 80MHz while a 130mm rod has the same bandwidth at 95MHz according to the article. Tuning is accomplished by varying the number of turns on the rod.

The gain of these antennas is much less than that of a whip when used over a large ground plane, as might be expected. When used on portable equipment, however, without a ground plane, the gain approaches that of a conventional whip. The benefit, of course, is a much shorter antenna.

We would appreciate hearing from anyone who does any work in this area as the lack of time, unfortunately, does not allow us to conduct any actual experiments at present. We will be happy to report results on this technique—both favorable and otherwise.

In the meanwhile, 73 until next month

Irwin, WA2NDM

*5 Melville Lane, Great Neck, N.Y. 11020

This month by

ROD LINKOUS, W7OM

DX

News of communications around the world

This is John Kanode, N4MM, with his WPX Award of Excellence plaque and other awards. John is a member of the CQ DX Awards Advisory Committee and was recently put on the ARRL's DX Committee.

As we pass mid year, it appears 1978 will be the year the big ones fell. The Clipperton operation will satisfy many for awhile. The operation from Iraq appears to be only the beginning of a wave of the future. Licensing for a Bouvet operation if firming up to come off this fall. A spark of good news is what seems to be the legal club operaton of BYØSA in China—now the quest for confirmations.

*5632 47th Ave. S.W., Seattle, Washington 98136

John Attaway, K4IIF (left) is caught in the act of dining Japanese style with three of Japan's top DXers. (Left to Right) John, K4IIF; Kiyoshi Mizoguchi, JA1BK; Nob Itah, JA1KSO; and Nao Akiyama, JH1VRQ. The occasion-one of John's recent trips to Tokoyo. (Photo by K7JA.)

DX QSLing

Enough has been printed on QSLing and QSL cards to fill a book. Yet, many newcomers to DXing have not acquired the expertise of the Honor Rollers in getting the rare paper. So, for those just starting, and for some of the fold, a short recap on QSLing:

The comments of Forrest Gehrke, K2BT, in last November's DX column pointed out the problems of a QSL manager. Taking his points to heart will increase everyone's yield and speed of delivery.

It has been a long time since the days of "Dollar Danny", yet there lies a lesson in history worth reporting. The "Green Stamp" or a one dollar bill gets results! With the high cost of postage and IRC's, the $1 gets lost in the noise. After a semi-rare DX station sends out 20,000 or so cards, at his own expense, that token green stamp is a shot in the arm. Most managers I've talked to sort cards when they arrive and respond to donations first. The rest build up—first in, first out. The other side to this coin— it appears to be *buying* a QSL. To some degree, that is true. But one green stamp is still cheaper than 3 IRC's and the IRC's are not valid everywhere.

A cost savings at the same time you are QSling is to use standard inexpensive QSL cards for QSL managers and multi-QSO DX stations. Those fancy photo and multi-color cards are just another card amongst the multitude. Yet to a foreign DX station receiving your card direct, the personalized expensive cards get results. So, a few good cards and the less expensive cards are a good and cost effective mix.

When sending cards direct there are several points to be made. First is timeliness. Many DX stations are on for a short time, then the operator moves to another location. So, your delay might miss him. The comments you made about the need for a card on the air are soon forgotten, so get that card there while the DXers memory is fresh. When a DX station has a manager, sending direct just isn't smart.

A quick point—on the cards you use the most: MAKE THEM SIMPLE. One sided is a must. The critical data must be obvious. Preferably the data should be in date, time (both in UTC/GMT), frequency or band, and mode sequence. The mode must show *two-way* in order to be valid on MOST awards including DXCC, WAZ and the CQ DX Awards.

The WAZ Program
Single Band WAZ
20 Meter C.W.

40 . . . I1YRL
41 . . . YU2QZ
42 . . . YU1OCV

40 Meter C.W.

6 . . . JA8DWR

20 Meter Phone

101 . . . WØSR	105 . . . W4MWT
102 . . . KL7GRP	106 . . . JA1EMX
103 . . . W1LQQ	107 . . . W4PZV
104 . . . N4KE	

All Band WAZ
S.S.B.

1447 . . . KP4AM	1452 . . . W9CTY
1448 . . . OZ1IF	1453 . . . W2MIG
1449 . . . KØSVX	1454 . . . W4CZU
1450 . . . WA1GUZ	1455 . . . WB2VFT
1451 . . . W5DRW	

C.W. Phone

4230 . . . JA4NA	4237 . . . K4PHE
4231 . . . DK5VP	4238 . . . K5LP
4232 . . . DJ9EG	4239 . . . N4XZ
4233 . . . HB9AAH	4240 . . . HC5EE
4234 . . . ISØFPH	4241 . . . VE6HT
4235 . . . K9ARZ	4242 . . . JA1WXP
4236 . . . W1HQO	4243 . . . JA1ISA
	4244 . . . KH6HC

Phone

539 . . . OZ1IF	541 . . . W6CPL
540 . . . K9RN	

The complete rules for all WAZ awards are found in the May, 1976 issue of CQ. Application blanks and reprints of the rules may be obtained by sending a self-addressed, stamped envelope to the "WAZ Awards Manager", 1044 S.E. 43rd Street, Cape Coral, Florida 33904 U.S.A.

Some other QSLing tips are listed in recent CQ DX columns of January, May, August and November 1977.

We would like to cover in a future column the use of mint stamps to obtain QSL cards direct. If you have some personal experience in the use of mint stamps and would like to share them with the readers, please drop us a note.

QSL manager directories are now starting to become available again. A couple of note are:

Gary Yarus WB0MSZ Directory
$1 U.S. + SASE)
921 North Clay
St. Louis, Missouri 63122

QSL Manager Directory
($4 U.S.)
Franz Langner DJ9ZB
C Kistnerstr 19
7800 Frieburg Breisgau, West Germany

The QSL Bible
($5 U.S)
Via JH1HWM
5-2236-33 Iriya
Zama-city, Japan

These directories do not claim to be complete. They are computer products undergoing constant update. The DX club QSL manager file still remains the best source of QSL manager data today. Also asking someone who already has the card is effective.

One of Czechoslovakia's most active DXers is Pavel Kupilik, OK1MP. Pavel gained the DX Honor Roll running this station from his home in Domazlice.

New Countries

The rumors are too numerous to repeat, yet a new country off of Puerto Rico seems likely. It fits in the same class as Sable (VE1) and St Paul (VE1). Seems strange though, as the Pribeloffs are in the same class too and the ARRL turned it down. Work them, log them and then worry about them, seems to be good advice. (Sure will be great to get WARC '79 behind us so that the politics get reasonable again.

DX Awards Program

With the demise of portable operation identification in the U.S., the requirement to work all DX within a 150 mile radius of your QTH is revoked. It is no longer possible to insure compliance. Therefore, operations from anywhere within a single country will be honored toward the *CQ* DX awards. DXCC made the same announcement earlier.

An interesting letter from Herb Schoenbohm, KV4FZ, on this subject makes an interesting point or two. "The announced concern by the ARRL on our international image, which resulted in the determination of the DXCC countries list, has been noticed with great interest. It is my observation that the present Rule 9, which was recently 'liberalized', is now extremely punitive to those who live in small countries. I believe it was the wish of the board to modernize this requirement for a mobile society. However, while the ARRL directors giveth, the HQ staff taketh! The 150 mile provision which we had learned to live with has now disappeared, to where those that live in micro-states (half the world population) have little. This could be construed as accomodating the Yanks at the expense of the rest of the world. USA amateurs now have 3,000 miles to move about, but the poor amateur in St.

One of the big signals on all bands, both c.w. and s.s.b., is Tony Smaker, KL7AF, from Kodiak, Alaska. With Ron Wenstrom, KL7RW, Tony is in the throws of organizing the Alaska DX Association. They have about 30 KL7's in tow and meet daily on 3895 kHz at 0430Z. Watch for the club score to grow in the DX contest results in the future.

Tage Axelson, SM7RS, is one of Sweden's s.s.b. DXers. Operating from Helsingborg, Tage has over 150 on 2Xs.s.b. Like many, he has more countries confirmed but the QSL's read as if one-way s.s.b. Tage was first licensed in 1926 as SMXN.

The Arizona DXer Award for DXer of 1977 went to Al Koblinski, W7XA. Of the DXCC or WAZ holders considered, Al was chosen for his skill, contribution to amateur radio, cooperation and service. (Photo via W7IR.)

Martin can move his rig a few city blocks to the French side, and is wiped out."

DX Extras

DE WP4BDL $\overline{\text{BT}}$ I just received my old (1961) call back as a secondary station license. The normal prefix for all classes of licenses in Puerto Rico is KP4. $\overline{\text{AR}}$

DXers worldwide are always pleased to hear a rare station say "QSL to . . .", and recognize a call known for their service. One of the better known teams is Ferne and Rubin Hughes WA6AHF. Ferne is a stamp collector and QSLer par excellence. Note the license plates. On behalf of the thousands who've receive a rare card from the Hughes', THANKS! Rubin is also a DX Honor Roller.

Work Dave soon as secondary calls in the U.S. appear to be on their way out, and WP4 is indeed a rare prefix today.

DE VK3AOK $\overline{\text{BT}}$ Now home from VKØAC operation. Upgraded my license, so have a new call. The VKØAC card requests are gigantic; Mt. Rainier is small in comparison. Patience please. $\overline{\text{AR}}$ That pile of QSL requests represents a year of Macquaire operation.

Tricks of the DX Trade

The Northern California DX Club's great publication, The DXer, provides several excellent hints on better DX-ing. Those who contribute to the tricks of the DX trade, receive a copy of past Hints and Rules.

Hint 12. Pileups. The guys with the biggest signals, shortest calls and quickest reflexes are the ones who get through the pileups first, right? Not always! A good signal is always an advantage, but not call letters or reflexes. First, QSB will take even the biggest signal out of the picture. Send your call slowly and clearly. If the other station can't understand you, what good is it if you're the loudest? The FCC requires full callsigns, but you can begin your call as the DX station is turning it back; since he doesn't really need your prefix. Don't bother with phonetics for your prefix on phone, unless requested, and try waiting a second or two after the pileup begins. While the quick ones are catching their breath for a second call, you can often pop in unmolested. Most operators will jump right in and then pause to see if the DX station has come back, leaving a moment of relative silence when QRPpers can jump in. One of two calls is enough. After that the QRM builds to a constant level as everyone begins calling at random. By that point a good DX operator will either have several calls picked out or will QRT because nobody is listening. (Thanks *The DXer*/WB6RIU) (ed. *He has been on both ends of the pileup and knows of what he writes.)*

Peter Schaffer, SL3NU, operates this impressive station from his Gortenhauserweg home. Peter operates all modes including SSTV. His c.w. skills are supplemented with keyboard capability.

Hint 13.5 Should you get up early tomorrow morning? Do you wonder this evening what the propagation conditions on 20 meters will be like tomorrow morning—say at 0700? You can tell with pretty fair accuracy by listening on c.w. beaming to the same north latitude as ours, and the longitude (time zone) that is 0700 there. If you hear stations in that area, then you know there is a propagation path between you. Next, figure out the reciprocal path heading, which is your beam heading subtracted from 360 degrees. If propa-

The WPX Program

Mixed

640 . . . DF7FH	645 . . . WA6EGL/VQ9
641 . . . OE1BFW	646 . . . KL7AF
642 . . . F6CUK	647 . . . I7PXV
643 . . . DJ9ER	648 . . . K4YOE
644 . . . YU2REO	

S.S.B.

1032 . . . EL3A	1038 . . . DF2SU
1033 . . . OY1A	1039 . . . UA6JAD
1034 . . . JI1TDX	1040 . . . VE1RY
1035 . . . K3IXD	1041 . . . WAØLMK
1036 . . . IØOU	1042 . . . OE1BFW
1037 . . . I6COC	

C.W.

1676 . . . F6COU	1682 . . . UA4PAV
1677 . . . N6FX	1683 . . . UB5GCG
1678 . . . W4YE	1684 . . . UY5TE
1679 . . . YU1ECD	1685 . . . UB5KAW
1680 . . . UA1AAU	1686 . . . UP2BB
1681 . . . UA6AJE	

WPNX

111 . . . WD4BMP	113 . . . WBØUBN
112 . . . WB3DNA	

VPX

133 . . . DL-121/148440	136 . . . DL-ØØ5/1616978
134 . . . DM-6721/G	137 . . . UA9-145-197
135 . . . DL-R18-6767	

Endorsements

Mixed: 400 WA6EGL/VQ9, KL7AF, I7PXV, K4YOE. 450 W1YK, YU2REO. 500 F6CUK, W1YK. 550 DJ9ER. 600 K6GO, I4BFY. 800 PY2ELV. 900 K7NHG, KØJN. 950 N2AC. 1150 N2AC. 1200 K5UR.

SSB: 300 EL3A, OY1A, JI1TDX, K3IXD, DF2SU, WAØLMK. 350 IØOU, I6COC. 450 VE1RY. 500 WA4QMQ. 550 QE1BFW. 600 LU9DM. 650 N2AC. 750 W2NC. 1050 K2VV. 1500 W4UG.

CW: 300 F6COU. 350 N6FX. 450 W4YE, YU1ECD. 500 KØJN, N4WX. 600 G3HB. 700 K9IT, KH6HC. 900 K2VV. 950 K5UR, N2AC. 1000 N4MM. 1050 W9DWQ. 1250 W2NC.

10 meters: UA6JAD

15 meters: JI1TDX, UK4WAC

20 meters: I6COC, WA6EGL/VQ9, UA4PAV

80 meters: G3XPO

Africa: KØJN, K5GO

Asia: G3XPO, DF2ME, WA6EGL/VQ9, K5GO

Europe: G3XPO, W3OGY, I6COC, WA6EGL/VQ9, K5GO, UA6JAD, WA5ALB

No. Amer.: DF2ME, K3IXD, K5GO

Oceania: G2GM, K5GO, JR1TNE, WA5ALB

So. Amer.: WA6EGL/VQ9

Complete rules for WPX can be found in the May 1976 issue of CQ Magazine. Application forms may be obtained by sending a business-size, self-addressed, stamped envelope to "CQ WPX Awards", 5014 Mindora Dr., Torrance, Ca 90505. U.S.A.

gation conditions hold, and they most likely will, that reciprocal path beam heading should be open to you at 0700 tomorrow. Furthermore, if those stations are working into other areas of the world, the chances are that you will have similar propagation paths too. Did you QSL that? (Simplified, if you are a W6 hearing England at midnight, you should hear Japan at 0700 tomorrow morning.)

Also, if you are wondering what propagation paths will be open 3 hours from now, merely listen to what the east coast is working (that is, if you live on the west coast) and figure the DX station's reciprocal path headings, as above. It works.

If you're curious to know what you missed 3 hours ago (and you're a W6) listen to the KH6's. (Thanks *The DXer*)

Hint 13.8. Is that band really dead? All of us have tuned across the band at one time or another and not heard a single signal. But is that band really dead? Try swinging the beam around while listening to the background hiss. Does it change? If it does, chances are the band is not dead and a "CQ DX" is in order. Point the beam toward the loudest hiss, because that portion of the world has propagation. Who knows—your "CQ DX" might raise some guy in a rare spot that was doing just what you were doing, combing a "dead" band.

An avid DX'er, Ron Wenstrom, KL7RW, (ex-KL7HCN) shown here taking a breather from those "Pile-Ups" for that much sought after "KL7" QSO. When not DX'ing, Ron works as an Air Traffic Control Supervisor with the F.A.A., QSL info:- P.O. Box #94, Cold Bay, Alaska, 99571 (Photo courtesy, Jack, W2LZX)

I recall, back in the late 1940's when Larry Barton, W6OCH (famous pianist) raised the FIRST Tibet station ever on the air, by calling "CQ DX" on 20 meter phone to a dead band one morning, and raised a guy in a camel caravan in Tibet. We all doubted that one—until he got his QSL card. So, try a "CQ DX" 2 or even 3 times on that "dead" band. You might raise a camel caravan on some other exotic place, like Afghanistan, or Iraq, or Burma—maybe one that QSLs too. (Thanks *The DXer*/N6GG)

Hint 13.9. Which way do you point your beam? Sometimes the beam heading doesn't add up. Sometimes, in the morning on 20 meters, a W6 can hear India coming in due West. Swing the beam to short path (330 degrees) and he fades out. Bootlegger? Not at all. That West heading happened to be the best propagation path at that moment for that part of the world. Some theories say that the F2 layer tilts as it changes height, and 2 or 3 of these tilts add up to produce the best multi-hop path. It's best to trust your ears more than your beam indicator when you are trying for very long distances. Don't be too rigid about what the beam settings should be, because, in the final analysis the propagation path ends up being a reciprocal path. Where you hear them best is where

Carl, C5ABC (on the left) and Keith, C5ABK (on the right) shown here making sure that they each receive their respective QSL cards. QSL's for C5ABC may be sent to his home QTH at WB4ZNH, (SASE PSE.) (Photo courtesy Jack, W2LZX)

Don't let the serene look fool you. That's Bill Bennett, W7PHO with the awards. The occasion is presentation of the Formosan medal to Bill by Howard Lorenzen, W7BI, on behalf of Tim Chen, BV2A/BV2B, and the Chinese Radio Association. The award was presented to Bill for his efforts in helping make BV2 (Formosa) available for so many on 14.225. (Photo by K7RI.)

Maritime mobile is common place these days, yet Dick Livingston, WB5NDV/KL7 has got to take the prize. The oil drilling platform was Dick's diving and operating platform when it is in place for drilling off the Alaskan coast.

you will transmit strongest (Thanks *The DXer*/N6GG)

DX Club 1978 Style

As the USA DX contest season draws to a close, the DX club contest chairman breathes a sigh of relief. The club competition among the worlds top DX clubs is almost over. The aim to unseat the big clubs is still fresh in everyone's mind-but now comes the hard part—getting the logs into the contest scores on time.

Even with everyone churned up to give it a real go, the final paper work is by far the biggest challenge. Here are some techniques used by a few of the top scoring clubs.

Intra club competition heads the list. Breaking the club into competitive teams is one method. It is a mathematical fact, the more multi operator stations means a higher club score. The top *CQ* World Wide DX club winning entry will contain three or more multi-multi and another ten multi operator entries. Even with those, their contest chairman will work to get as many single operator entries as possible.

Martha (WN4FVU), C5AAF, very capably handling the "Pile-Up's" on 10 Meters, where she and her O.M. (WB4ZNH/C5ABC) were very busy giving many of the DX'ers a new country. QSL via their home QTH to WB4ZNH (Photo courtesy Jack, W2LZX)

CQ DX Honor Roll

The CQ DX Honor Roll recognizes those DXers who have submitted proof of confirmation with 275 or more countries for the mode indicated. The top SSTV DXers are also listed. The ARRL DXCC Country List, LESS DELETED COUNTRIES, is used as the country standard. Total number of current countries on the DXCC list as of this listing is 318*. Honor Roll listing is automatic when submitting application or endorsement for 275 or more countries. To remain on the CQ DX Honor Roll, annual updates are required. Honor Roll updates may be submitted anytime. Updates indicating "no change" will be accepted.

C.W.

W6PT 318	W6ID 313	W2GT 306	K6JG 302	N6FX 296
K6EC 315	DL7AA 312	N6AV 303	W4BQY 301	K9MM 291
ON4QX 313	W8KPL 309	W9DWQ 303	W6ISQ 300	WA8DXA 291

S.S.B.

W2PT 317	W9JT 312	W6YMV 308	N4MM 298	N6AW 282
I0AMU 316	F9RM 311	F2MO 307	W9OHH 298	OK1MP 282
WA2RAU 316	K6YRA 311	K6EC 307	W0SD 298	W7JYX 282
DL9OH 315	SM6CKS 311	K9MM 307	HP1JC 295	WA4WTG 281
G3FKM 315	W2QK 311	OE2EGL 307	DL6KG 294	WB2RLK 281
W4EEE 314	K6WR 310	W4DPS 307	JH1EIG 294	VE7HP 280
XE1AE 314	WA2EOQ 310	I4ZSQ 305	DJ9ZB 293	W7OM 280
W3NKM 313	I8YRK 309	VE2WY 303	K8PYD 292	W9QQ 280
W4SSU 313	I0ZV 309	EA4LH 302	VE7CE 291	9H4G 280
W9DWQ 313	K4RTA 309	K9LKA 300	W6FET 291	N2SS 279
I8KDB 312	K6JG 309	W3GG 300	G3WW 289	W8ILC 279
K4MQG 312	W9QLD 309	WB6DXU 300	OE1FF 289	K4SB 278
VE3MJ 312	ZL3NS 309	XE1KS 300	SP5BSV 288	I6PLN 275
VE3MR 312	K8DYZ 308	I5WT 299	OE3WWB 285	JH1VRQ 275
W3AZD 312	OZ3SK 308	VE3GCO 299	N6FX 284	K4LSP 275
W6EL 312	SM5SB 308	YV1KZ 299	K3EH 283	K8LJG 275
W6EUF 312	SM5CWK 308	....	....	....

SSTV

W8YEK 108	G3IAD 100	....	....	....

* Geyser Reef deleted effective this listing

The CQ DX Awards Program

S.S.B.

548 . . . I2SYG	556 . . . IT9TGO
549 . . . N4UF	557 . . . WA4HDD
550 . . . DK4MI	558 . . . KL7AF
551 . . . WB4UFF	559 . . . K9PPY
552 . . . WA4TLI	560 . . . TG8NE
553 . . . W1AGA	561 . . . EL3A
554 . . . I5BDE	562 . . . WB9YHP
555 . . . I8KCI	. . .

C.W.

306 . . . W8FEM	310 . . . UW1YY
307 . . . UA6PK	311 . . . UK5IAZ
308 . . . UT5LF	312 . . . UC2CX
309 . . . UA6LBO	. . .

S.S.B. Endorsements

310 . . . K6WR/310	275 . . . JH1VRQ/275
300 . . . OZ3SK/308	250 . . . K9PPY/270
300 . . . W6YMV/308	200 . . . I5BDE/224
275 . . . YV1KZ/299	150 . . . IT9TGO/182
275 . . . DL6KG/294	150 . . . W1AGA/175
275 . . . WB2RLK/281	150 . . . WA4HDD/162
275 . . . 9H4G/280	3.5/7 MHz . . . ZL1BOQ

C.W. Endorsements

300 . . . W4BQY/301	150 . . . OK1DVK/150
275 . . . K9MM/291	. . .

Complete rules and application forms for the CQ DX Awards Program can be obtained by sending a business size, No. 10 envelope, self-addressed and stamped to: "CQ DX Awards", 5632 47th Avenue S. W., Seattle, Washington 98136 U.S.A.

A few years back, the difference between top positions in the club competition was less than 10,000 points. The little scores make the tight competitions. Without the casual entry, the race can be lost.

One California club has certificates and plaques for their members to try for without regard to the normal contest prizes. The intra club competition is fierce, for being able to take on a peer equalizes the band conditions and multiplier syndrome.

Dividing the club into groups is somewhat obvious. But some classes that bring others out is to make a class for everyone. One club category is interesting: class G—operator/owner must be a general class, power less than 200 watts, antenna up less than 40 feet with operating time less than 24 hours. Class H—same as class G except there is an operating time of 24 or more hours. Another pair of similar classes for advanced class. With this approach even the little guy gets a chance.

(Continued on page 87)

Colin Richards, currently 9M2CR, from Port Dickson, Malaysia is no newcomer to DX. He was originally GW3JET. Most will remember his operation as AP2CR and mobiling from the Kyber Pass. He was also S21CR, 5A2CR, 9K2CR and 9V1CR. (Photo via W7PHO.)

a monthly feature by

BILL WELSH, W6DDB

Novice

"How to" for the newcomer to Amateur radio

How to get started in amateur radio–Part I

This two-part column provides introductory material that should be useful to aspiring amateur radio operators who don't know how to get started in the Amateur Radio Service. It is hoped that readers who are licensed amateurs will bring these simple facts to the attention of people who need help getting into amateur radio.

It is not unusual to receive a request from someone seeking basic facts about getting started in amateur radio. These letters often contain the same questions, and I have devoted these two novice columns to answering the ones which are most frequently asked. Typical questions are repeated as paragraph headings and the associated response follows each question.

Who is eligible to hold an amateur radio operator's license, issued by the Federal Communications Commission (FCC)?

There is no age restriction; we have had licensed amateurs as young as five and others more than 100 years of age. It is no longer necessary to be an American citizen to be licensed in this country. All amateur licenses are valid for a maximum of five years and are renewable. Novice licenses were originally valid just one year and were valid two years until recently.

What classes of operator licenses exist in the amateur radio service?

The Novice license requires one to have knowledge of basic FCC rules and regulations, reasonable understanding of electronic/communications fundamentals, and a working knowledge of the International Morse Code. The Novice license is available to anyone who does not hold a valid amateur license of any class, including those who have previously held Novice, Technician, Conditional, General, Advanced, or Extra class licenses. Novice licensing examinations are conducted by unrelated amateur radio operators holding a General (or higher) license and serving as volunteer examiners.

*2814 Empire Ave., Burbank, CA 91520

Technician exams are no longer conducted by volunteer examiners (amateurs); they are now administered at FCC examining offices. The code test is just 5 words per minute for Technician license applicants, the same as for Novice license applicants. The Technician theory test is the same as the theory test given to applicants for the General license. It is more difficult than the Novice written exam.

Conditional licensees were all recently grandfathered to General privileges and Conditional licenses are no longer available.

The General class license exam includes a written examination at the same degree of difficulty as is used in the Technician written exam. One must have a slightly better knowledge of FCC rules and regulations than is needed to pass the Novice written exam. The General license applicant must have a much better understanding of radio/electronic theory and operating information than is needed to pass the Novice written exam. The General class amateur radio operator's exam also includes code receiving and sending tests at 13 w.p.m. as compared to the 5 w.p.m. Novice and Technician code requirement. General examinations are normally conducted only by FCC personnel at FCC offices.

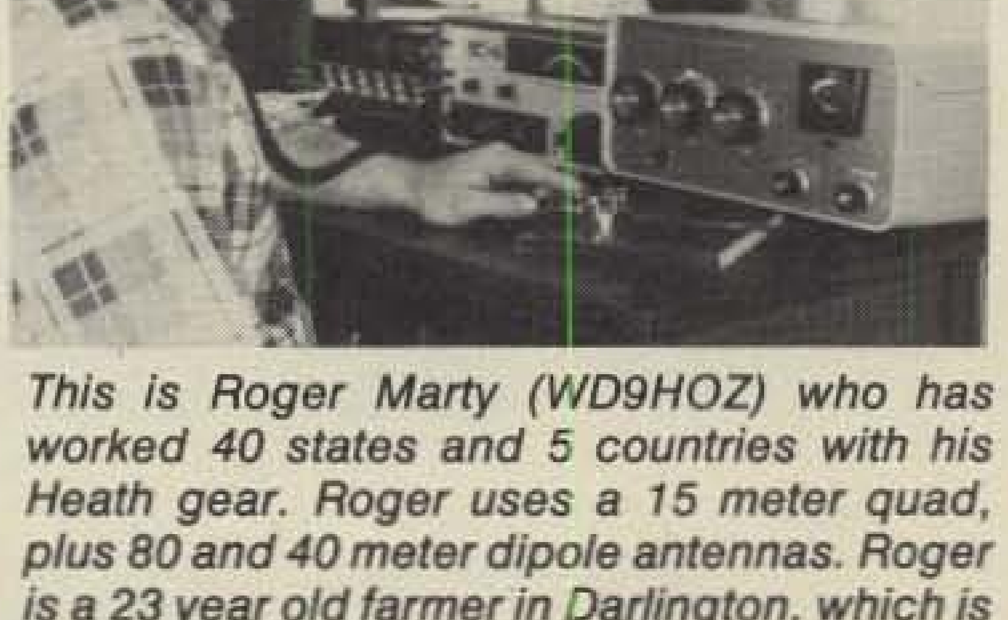
The Advanced code test is 13 w.p.m. the same as for the General license. The advanced written exam requires a more thorough knowledge of electronic and radio theory than is needed to pass Technician and General written exams. The Extra class code test is 20 w.p.m. and the theory test is the most difficult used in the amteur written examinations.

What is in an FCC Novice exam?

There are 20 questions, with five on each of four pages. Each question is followed by five possible answers. There is just one completely correct answer in each group. The selected answers are not written by the student directly on the exam papers containing the questions. Selected replies are indicated on a separate answer sheet, taking care to match replies to corresponding question numbers. As an example, if your exam questions are numbered 41 thru 60, start marking the answer sheet at 41, not 1. It is important to indicate all selected answers by a dark mark. Use a soft lead pencil to leave a substantial graphite deposit at each point on the answer sheet. If you change an answer (which is usually a mistake) erase the previous mark completely. One must answer 15 (or more) questions correctly to pass the written exam; the Novice passing grade is 75, not 74 percent.

Do I have to know a lot of math to get a novice license?

One does not have to be a math expert to get any amateur license. I just use 13 basic formulae in the General class licensing courses I instruct, and Novices just need to know four of them. Anyone who wants a free copy of the formula reference sheet I prepared for our students, should supply the usual s.a.s.e. with their request for this aid. There are just a couple of questions in the Novice



This is Roger Marty (WD9HOZ) who has worked 40 states and 5 countries with his Heath gear. Roger uses a 15 meter quad, plus 80 and 40 meter dipole antennas. Roger is a 23 year old farmer in Darlington, which is in the Southwest corner of Wisconsin.

exam that requires formula familiarity and math.

Electronics is really mathematics put to practical use. One can pass amateur exams with little or no knowledge of formulae. However, it is natural to develop an interest in math as one gets more involved in electroncis and radio. It is satisfying to be able to determine such things as the exact length of an antenna, the current flowing in a circuit, and the value of a required dropping resistor. Math is essential.

What should one do to get started?

Decide how you are going to progress in the first license, which is usually the Novice ticket. After you have determined whether you are going to attend a formal course, complete a correspondence course, or hack it on your own, you should set a date when you plan to take the FCC Novice exam. I usually have my students pass the Novice code tests (receiving and sending at five words per minute) within a few weeks after they begin a course. It takes several weeks for the Novice written exam to be received and the student can prepare to pass that part of the exam while waiting for it to arrive in the mail. If possible, study and practice with a friend or someone else in your family.

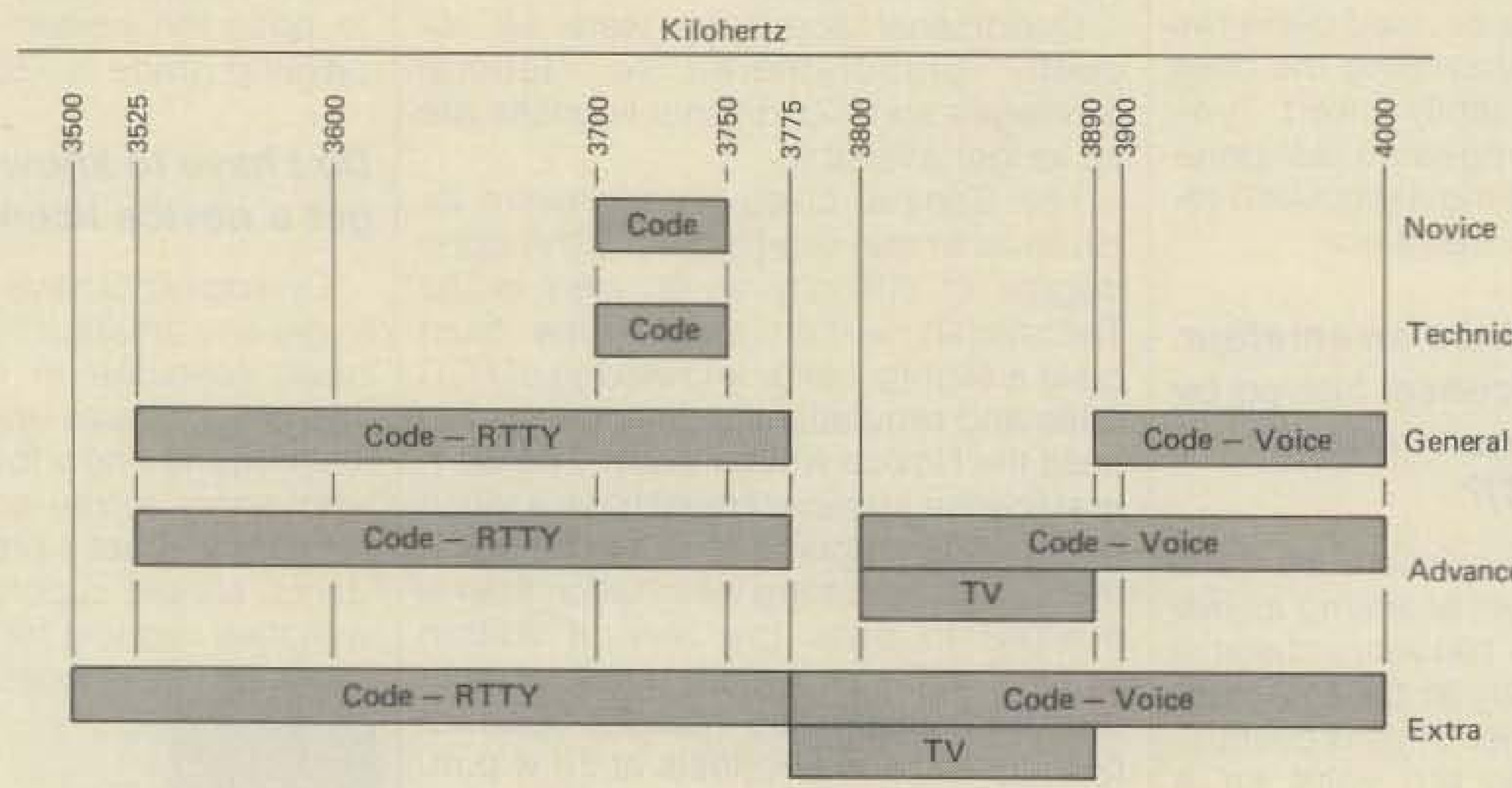
What are the privileges for each class of license?

Most of the amateurs who have become licensed since 1951 have first held a Novice license. The Novice license provides code (only) communication opportunities on four bands. The 80, 40, 15, and 10 meter Novice bands are 3700 - 3750, 7100 - 7150, 21,100 - 21,200, and 28,100 - 28,200 kilohertz, respectively. Novices have worldwide communication opportunities during daytime operation on their 10 and 15 meter bands. The 10 and 15 meter bands close down at night and become useful only for very short range contacts (under 20 miles). However, the 40 and 80 meter bands become good long distance bands at night, whereas they are usually just good for a few hundred miles during the daytime.

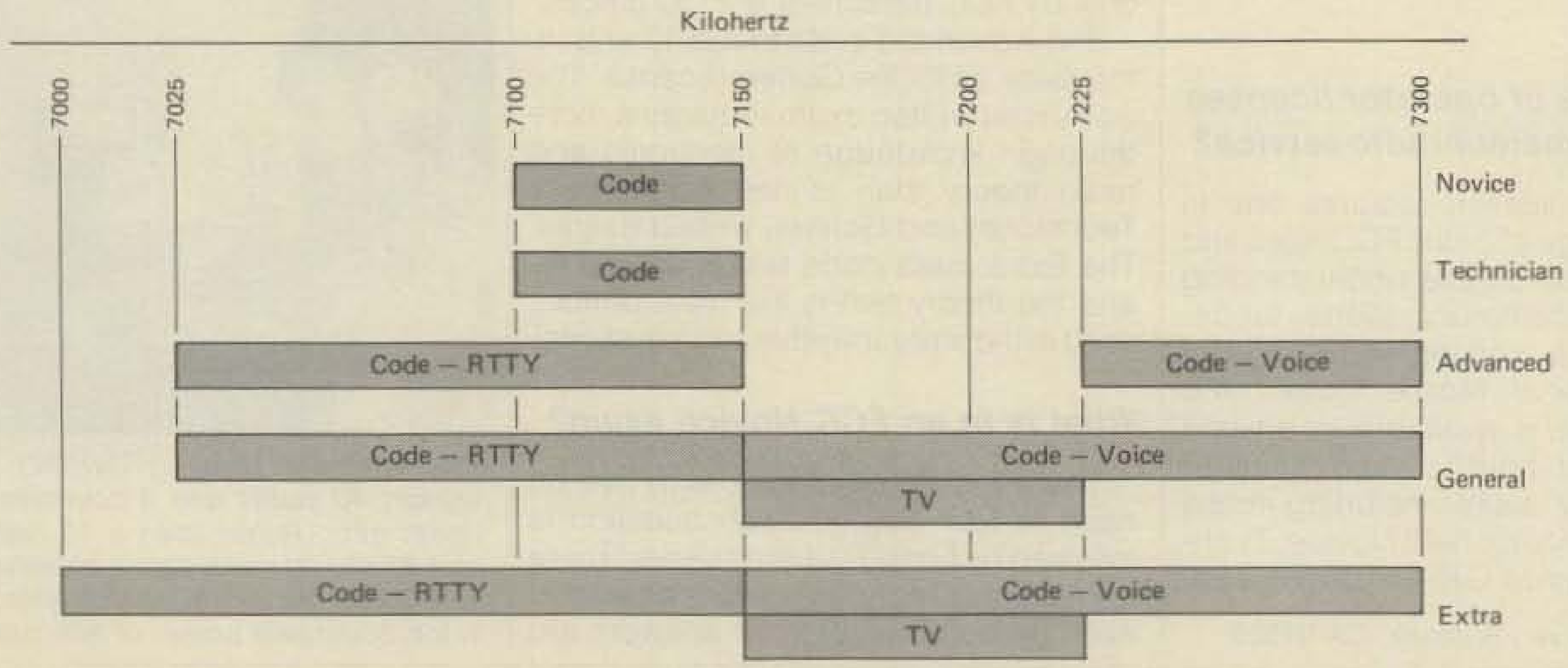
The Technician has full use of the Novice code bands, plus code (A1), voice (A3, F3, a.m., f.m., s.s.b.), radioteletype (F1 - RTTY), and television (A5, F5, TV) operating privileges. As the following charts show, operating privileges increase as one upgrades in license. If one can operate two modes of emission on a particular frequency spectrum, that is twice as much operating privileges as just having the right to make one type of emission on that spectrum. Using the preceding basis, the operating privileges for each class of amateur licensee is as follows for the frequency segments shown on the following bar charts:

License Grade	Megahertz-Mode Privileges
Novice	0.3
Technician	167.6
General	178.37
Advanced	179.23
Extra	179.565

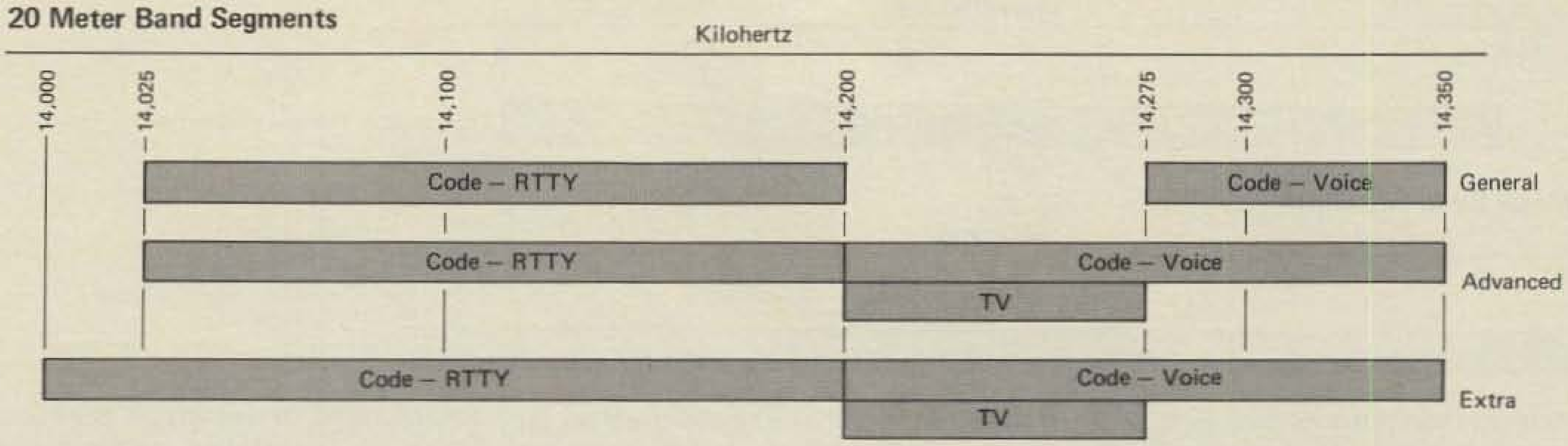
80 Meter Band Segments



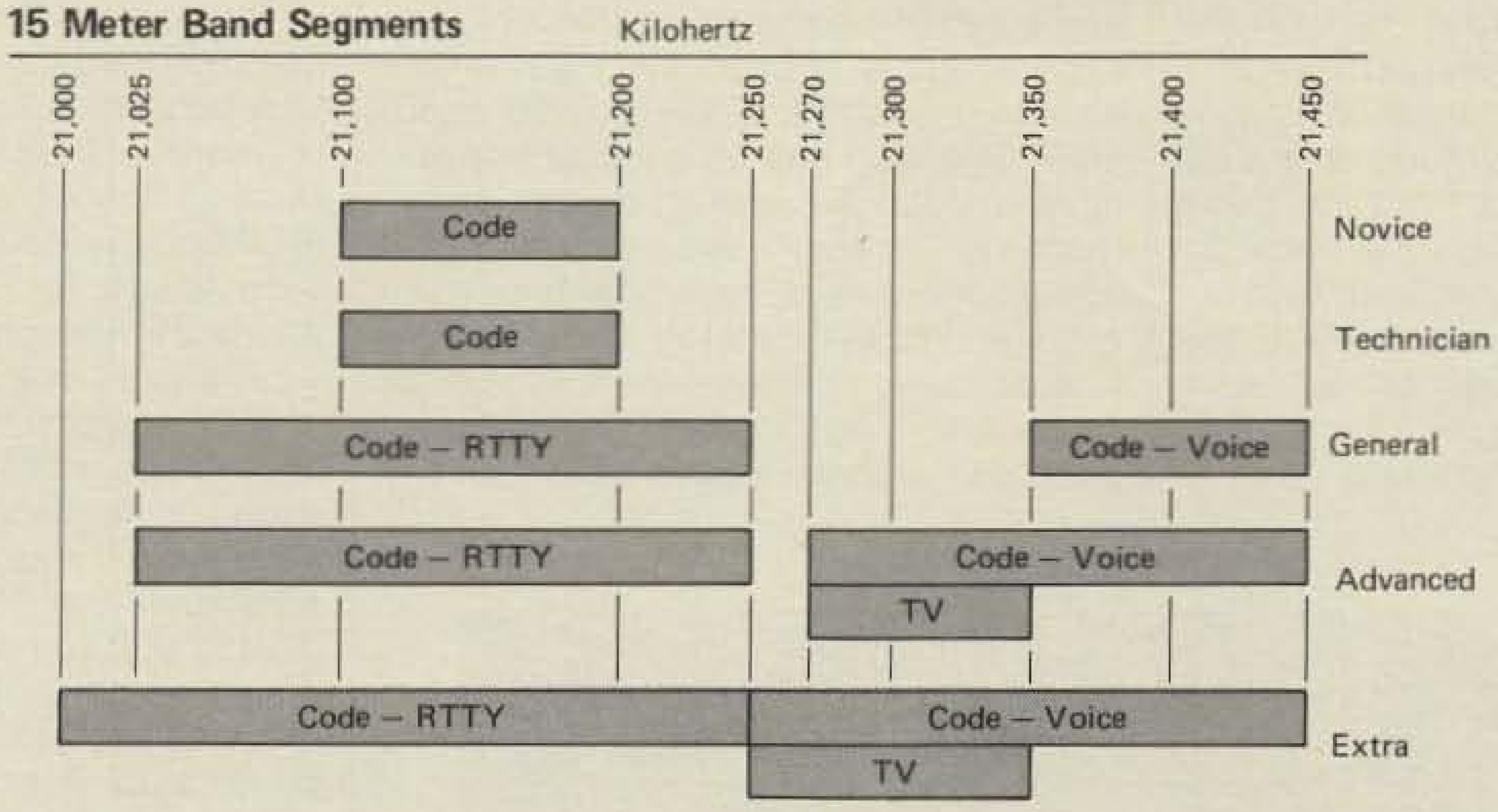
40 Meter Band Segments



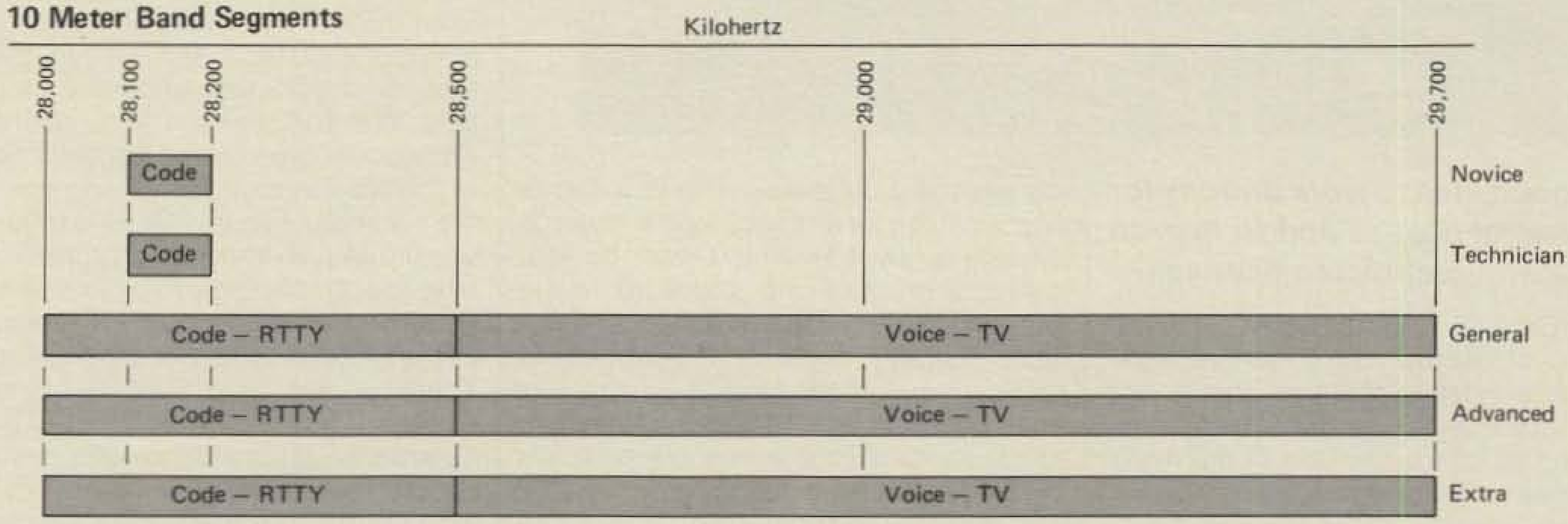
20 Meter Band Segments



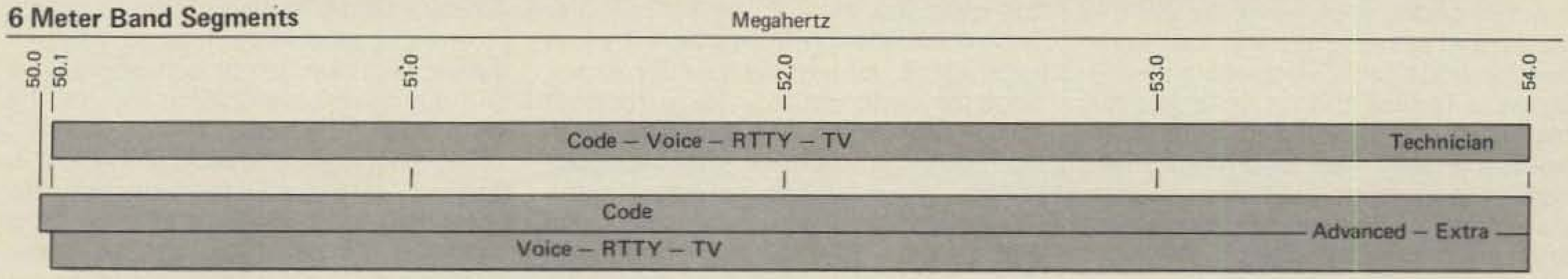
15 Meter Band Segments



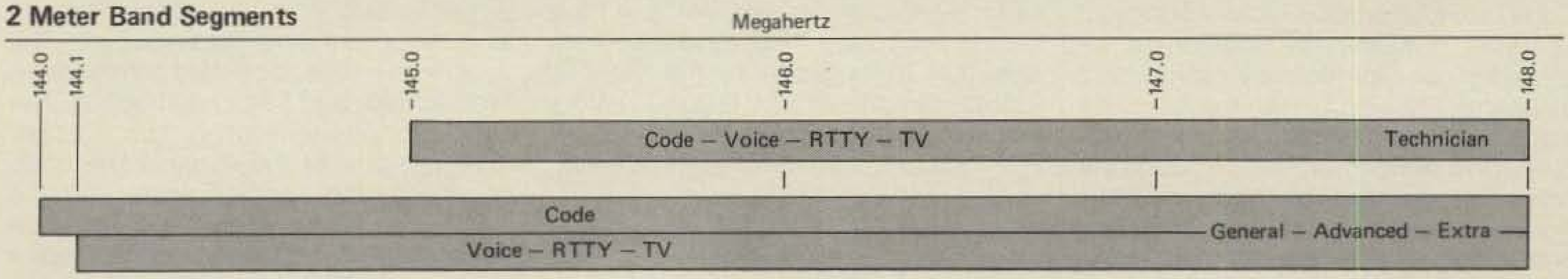
10 Meter Band Segments



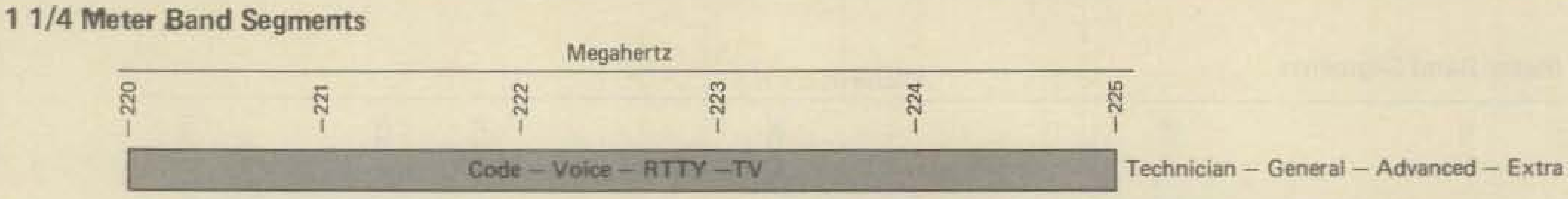
6 Meter Band Segments



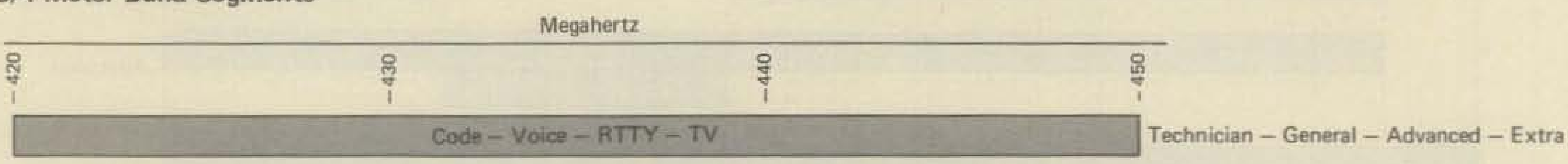
2 Meter Band Segments



1 1/4 Meter Band Segments



3/4 Meter Band Segments



Amateurs have frequencies available above and below those shown on these band segment bar charts. The high frequency range is presently considered of utmost importance by most amateurs, and the HF megahertz-mode operating privileges summarized from the band segment bar charts show the major increase in privileges associated with upgrading from Technician to General. The relative operating privileges are summarized in the following figure in a manner that is easy to understand.

HF MEGAHERTZ – MODE PRIVILEGES

License	80λ	40λ	20λ	15λ	10λ	Total	Percentage of maximum operating privileges
Novice	0.050	0.050	0.000	0.10	0.1	0.300	4
Technician	0.050	0.050	0.000	0.10	0.1	0.300	4
General	0.720	0.400	0.500	0.65	3.4	5.670	81
Advanced	0.990	0.625	0.725	0.89	3.4	6.630	95
Extra	1.115	0.675	0.775	1.00	3.4	6.965	100

Is it a good idea to work directly for the general license and to bypass novice and technician licenses?

The General class license is the first major goal for most new amateurs. However, this goal is reached faster and more pleasantly by first becoming licensed as a Novice. One of the major obstacles one must overcome to become a General class licensee is the 13 w.p.m. code requirement. Simply stated, it is easier and a lot more fun to develop code proficiency while operating as a Novice than it is to get this capability by practicing with code tapes, magnetic tape recordings, inked paper tapes, perforated paper tapes, records, on-the-air code reception, or any other code practice system that does not involve on-the-air code operation. Code proficiency rises rapidly if one just operates regularly. In addition to increasing code proficiency rapidly and pleasantly, Novice band operation has many side benefits that may not be apparent to a newcomer. Novice bands are primarily operated by new amateurs who are much more tolerant of sending and procedural errors than operators outside the Novice bands. Advice is freely exchanged on the Novice bands and the spirit of friendship is greatest on these bands. I sincerely feel sorry for any amateur who has missed the Novice experience; it is often the most enjoyable part of one's amateur radio exposure. One also has an excellent opportunity to become familiar with equipment (receivers, transmitters, transceivers), accessories (keys, keyers, antenna tuners, s.w.r./power meters), and antennas. Novice band operation permits one to gradually learn the procedures, phrases, abbreviations, and special signals used on the air. The QSL cards one receives as a Novice apply towards operating awards which can be obtained even after one upgrades to the Technician, General, Advanced, or Extra class license. Now that Technicians have full use of the Novice bands, it is advisable to progress from the Novice to the Technician license before attaining the General license. This is now a natural and reasonable progression. Once one has obtained the Novice license, the Technician license is available by just passing the General class written exam, since the code test is 5 w.p.m. for both Novice and Technician licenses. When the Technician license has been obtained, one just has to operate the Novice code bands to increase code proficiency to the 13 w.p.m. General class code requirement. If you have your valid Technician license, you just have to pass the 13 w.p.m. code comprehension test to upgrade to the General license. Simply stated, it is good to progress from the Novice to the Technician, and then to the General class license.

How does one take a novice test?

Since Novice tests are administered by General (or higher) licensees serving as volunteer examiners, it is necessary to locate a qualified amateur who is willing to provide this service. It is now common for amateur radio clubs to regularly conduct licensing courses and one (or more) of their instructors will be conducting Novice exams. A visit to your local electronics store will probably provide leads to clubs and individual amateurs who provide this type of service. If you have an antenna installation in your area which leads you to believe a neighbor is an amateur, there is nothing wrong with going to that residence to seek help. If your neighbor is a licensed amateur, he/she will probably be very glad to help you directly, or by telling you where you can go to have a Novice exam. If you are going to be examined by a club licensing instructor, they probably have a supply of the necessary form (610) on hand. If some other amateur is going to serve as your volunteer examiner, you should obtain the FCC form 610 yourself and have it with you when you go to take the code portion of the Novice exam. If you do not know the address of your local FCC office, it is usually easy to find in your nearest major city telephone directory; just look for Federal Communications Commission in the United States Government listing. There is usually a Regional Services Division listed under FCC with an Operators' Examination Office shown. Simply telephone or write your request for a Form 610 Application for Individual Amateur Radio Station and/or Operator License. If all else fails, send your request (with the usual self-addressed and stamped envelope) to me and I'll send a Form 610 to you.

The Novice examination procedure is simple. Once you have obtained the Form 610 Application and located a volunteer examiner, arrange an examination date, time, and location that are suitable and mutually satisfactory to both your examiner and yourself. The examination site should be comfortable, well lighted, and free of distraction. The total procedure involves two sittings. The first part of the exam is the code receiving and sending tests and the second part is the written test. The code receiving test is administered first, since there is very little possibility that anyone will fail a sending test and pass a receiving test at the same speed. Almost everyone can send code faster than they can receive it. The code receiving test is a five minute long run at 5 words per minute. Since each five letters counts as a "word", the Novice code test is actually 125 letters in five minutes. Just letters in the alphabet can be included in the Novice code receiving test and the text must be forward reading material, such as one would read in a magazine or newspaper article. The volunteer examiner can require the applicant to pass either the "one minute out of five" or the "code comprehension" type test. A passing run in the first case is simply any 25 consecutive correctly copied letters out of the 125 total letters in the test. If a "code comprehension" test is used, the applicant must correctly answer at least 8 of 10 questions related to the text material.

If one passes the code receiving test, the code sending test is administered. The code sending test includes all the numerals (one thru zero), four worksigns (AR — end of message, BT — paragraph/break, SK — end of work, and K — answer), four punctuation marks (?.,/) and all the letters of the alphabet. The applicant is required to "transmit by key" at a rate of at least 5 w.p.m. It should be noted that each numeral, worksign, and punctuation has a two-unit value, whereas each letter has a one-unit value. A passing sending test is simply any 25 consecutive correct letters sent at a rate of 5 (or more) w.p.m. during the 5 minute test run. The examiner usually takes an article from some publication and tells the applicant to send everything included in the article. The examiner usually strikes out punctuation marks which the applicant is not required to know and adds worksigns which are required but would not appear in newspaper or magazine articles. If both the receiving and sending portions of the code test are passed, the Form 610 should be dated and signed by the applicant and given to the volunteer examiner. It must be submitted to the FCC within 10 days. If the entire code test is not passed, do not date and sign the Form 610 because it does not have to be submitted to the FCC; keep it for use 30 days later. If the code tests were passed, the volunteer examiner will complete his part of the form and mail it to the Federal Communications Commission, P.O. Box 1020, Gettysburg, Pennsylvania 17325. The applicant should supply a stamped and addressed envelope for mailing the completed Form 610 to the FCC. The Form 610 is essentially an affidavit used to identify both the applicant and the volunteer examiner. In this instance, the form is also being used to advise the FCC licensing office that the applicant has passed the code element and that the "written" Novice exam is requested. The written exam is subsequently mailed to the volunteer examiner who supervises the applicant as he/she completes it. As was the case when the code tests were conducted, the written exam should be administered at a time, date, and suitable location which are mutually agreeable to both the applicant and the volunteer examiner. Do not stall taking the written exam and keep your appointment with the volunteer examiner. The examination must be returned to Gettysburg within 30 days, whether or not it is administered, and most volunteer examiners want to return completed exams as quickly as is possible. The examination sheets and the answer sheet should be filled in and signed in ink. However, the answers must be indicated in pencil on the answer sheet form. It is advisable to use a soft lead pencil to mark selected answers on the exam answer sheet. If you change an answer take care to carefully erase every bit of the previous mark. The volunteer examiner is not allowed to discuss exam questions or answers with the applicant. When the applicant has completed the written exam, he/she gives it to the volunteer examiner, who fills in (and signs) an affidavit on the reverse side of the answer sheet. The answer sheet and the written exam are mailed to the same FCC office by the volunteer examiner, with the applicant supplying the large (9 by 12 inches) stamped and addressed envelope. Your volunteer examiner cannot be a relative and must be at least 18 years old and must hold a valid General, Advance or Extra class amateur license.

No one knows how long it will take to get the written exam from the FCC after the code tests are passed and the Form 610 application has been submitted. We have received the response in less than two weeks and I recall one case where we waited more than six months. However, the FCC does respond as promptly as possible and 4 to 8 weeks is the normal waiting span to receive the written exam. You can generally assume that you will again wait about the same period of time to receive your license after the written exam has been passed and sent to the FCC. Your license is sent directly to the mailing address you list on the Form 610 application. It is common to first learn your new callsign by seeing it on address labels of companies advertising products of interest to new amateurs.

If one holds a commercial operator's license, is it still necessary to take amateur exams?

If an applicant for an amateur radio Novice, Technician, General, or Advanced class license holds (or has held within five years) a Second or First Class FCC Radiotelegraph Operator's License, he/she is not required to take the code tests. Similarly the holder of a First Class FCC Radiotelegraph Operator's License is not required to take the 20 w.p.m. code tests when applying for an Extra class license. Other than these exceptions, commercial operators are required to take all elements of amateur exams. Since only code tests are waived in these cases, it is true that all applicants for amateur licenses are required to take the written exams. This requirement is more reasonable than it might appear to be, since amateur radio rules, regulations, frequencies, and operating procedures are not the same as the commercial operator has used. Next month's Novice column will complete this two-part article intended to help newcomers get started as amateurs. I have recently had the pleasure of working the following stations on the Novice bands:

WBIFTM Rex @ Sudbury, Mass., WA2MZX Raffaele @ Larchmont, N.Y., WB3FAK Leonard @ Rockville, Md., WD4LGQ Jeff @ Virginia Beach, Va., WB5VSS Marcel @ Heavener, Okla., WA6NAK Tom @ San Jose, Calif., WB7ECH Joyce @ Everett, Wash., WD8LYI Paul @ Westland, Mich., WD9HTI Joe @ West Allis, Wisc., WDØCMT Charles @ Cedar Rapids, Iowa

73, Bill W6DDB

a monthly feature by

A. EDWARD HOPPER, W2GT

Awards

News of certificate and award collecting

The July, "Story of The Month" as told by Mike is:

M. D. "Mike" Baustian, WA0KQQ All Counties #149, 6-15-76

"I was born in Rock Rapids, Iowa in 1924 and was educated in the local schools. Served 3½ years in the Navy in WWII and 15 months during the Korean conflict. Received a BA in chemistry and mathematics from Augustana College, Sioux Falls, South Dakota in 1953.

USA-CA Honor Roll

2500		**1500**		**500**	
W0UM	257	WA6AQR	353	WB0MIX	1227
2000		W0UM	354	K6XZ	1228
WA6AQR	301	WB4MXC	355	WB0SYT	1229
W0UM	302	VE3IR	356	WB2PMO	1230
		1000		W0UM	1231
		W0UM	470	WB4MXC	1232
		WB4MXC	471	WB4WSB	1233

"I was married to my XYL, Bert, in 1949 and we have three children, Cheryl, Mark and Dale and our first grandchild, Jason Michael Baustian came 3/3/78. Mark is presently in the Air Force and the other two are still living at home.

"I have been working in the Flour Milling Industry as a quality assurance chemist for over 22 years.

"I was first exposed to amateur radio about 1938, but the particular ham was not disposed to giving any aid to me. As a result the urge to pursue ham radio was pushed into the background and surfaced from time to time until 1963 when I enrolled in a course offered by MARS at McClellan AFB in California. George, WB6EXT (All Counties #91) was a classmate.

"Due to an unfortunate move, I did not take the Novice test until 1964, and the General Examination until 1965. I was active chasing DX for most of he next four years before I became aware of County Hunting. Since then, I have been quite active in County Hunting.

"I was fortunate to have been one of the founders of MARAC and am a member of the Board of Directors. I am thankful that I can count a goodly number of the finest people in the world as my friends, both through the various Nets and the ICHN Conventions.

"Many people have traveled many miles to help us all get those rare Counties and we are all very thankful to them. I wish I could mention all that have been helpful to me, but there are just too many of them, so I will only mention a few: W4YWX, W0SJE, WA0WOB, W4GGU, W0YLN and WA0SHE. The real "Biggie" has to be Ralph, W9JR, who traveled over 5000 miles to give out my last seven Counties in Indiana, Kentucky, Nebraska and North Dakota.

"All in all, I have enjoyed the comradeship of the County Hunters and intend to remain somewhat active, and put that TS-520 in the truck from time to time in order to help out those who have been around these many years, and the newcomers to attain the goal of USA-CA".

*P.O. Box 73, Rochelle Park, NJ 07662

Awards Issued

Frank Tracy, W2MCY was happy to make them *all*, endorsed all s.s.b.

Dr. Karl Brownstein, W6PSI (center), his wife Joan, W6PSE (left), and son Harvey, WB6YNQ (right), were honored February 28, 1978, in San Diego, CA., during a gala even celebrating 4 years in business. The Brownsteins, owners of Electronics Emporiam International, Integrated Circuits Unlimited, and State of the Arts Publications, are well known for their public service contributions to the community. Two Awards were presented, a Resolution from State Senator Bob Wilson and a Certificate of Appreciation from the San Diego Police Department.

Howard Gifford, WA2WCW was sure pleased to also get them *all*.

Cecil Vincent, W0UM (ex-WA0ZOL) did a lot of paper work to get USA-CA-500 through 2000 endorsed all s.s.b. and USA-CA-2500 endorsed Mixed.

Al Churchman, WA6AQR added to his collection, USA-CA-1500 and 2000 endorsed all s.s.b., all 14, all mobiles.

Ken MacNeilage, WB4MXC (ex WA2IDH) qualified for USA-CA-500, 1000 and 1500.

Bob Rennie, VE3IR had me send him USA-CA-1500.

Special Honor Roll (All Counties)

#180—Francis D. Tracy, W2MCY 3-24-78
#181—Howard A. Gifford, WA2WCW 4-7-78

USA-CA-500 Certificates went to:

Jim Roberts, WB0MIX endorsed all s.s.b.

Robert Craig, K6XZ endorsed all A-1. Edward Bever, WB0SYT endorsed all A-1.

Larry Taylor, WB2PMO endorsed Mixed.

Ron Underwood, Jr., WB4WSB endorsed Mixed.

Awards

The New Jersey All County Award (NJAC): The Jersey Shore Amateur Radio Society is happy to sponsor this new award. It is offered for working New Jersey Counties on any band, as follows:

Seven Counties for the certificate and endorsements for each additional seven Counties for a total of 21 Counties.

Send log information plus $1.00 and two 13¢ stamps to: Wally Eichorn, K2CYX, 105 Seaside Place, Sea Girt, N.J. 08750.

The Pony Express Certificate: The Pony Express Certificate is back and is being reissued by the Missouri Valley Amateur Radio Club, Inc. The award is available to any amateur who works the h.f. bands. This certificate is not affiliated with any other organization such as 10-10 International or YL International.

To qualify U.S. amateurs (Including Alaska and Hawaii) must work 5 Missouri Valley Amateur Radio Club members, then send 5 QSLs confirming the contacts plus two 13¢ stamps or a business size s.a.s.e. DX amateurs must work 3 MVARC members, then send 3 QSLs plus 1 IRC. Be sure to wait until you have the 5 or necessary 3 QSLs before trying to apply. Apply to the certificate manager: Ernie Early, WBØLVW, P. O. Box 141, Station E, St. Joseph, Missouri 64505.

That Proud Grandpa, Mike, WAØKQQ.

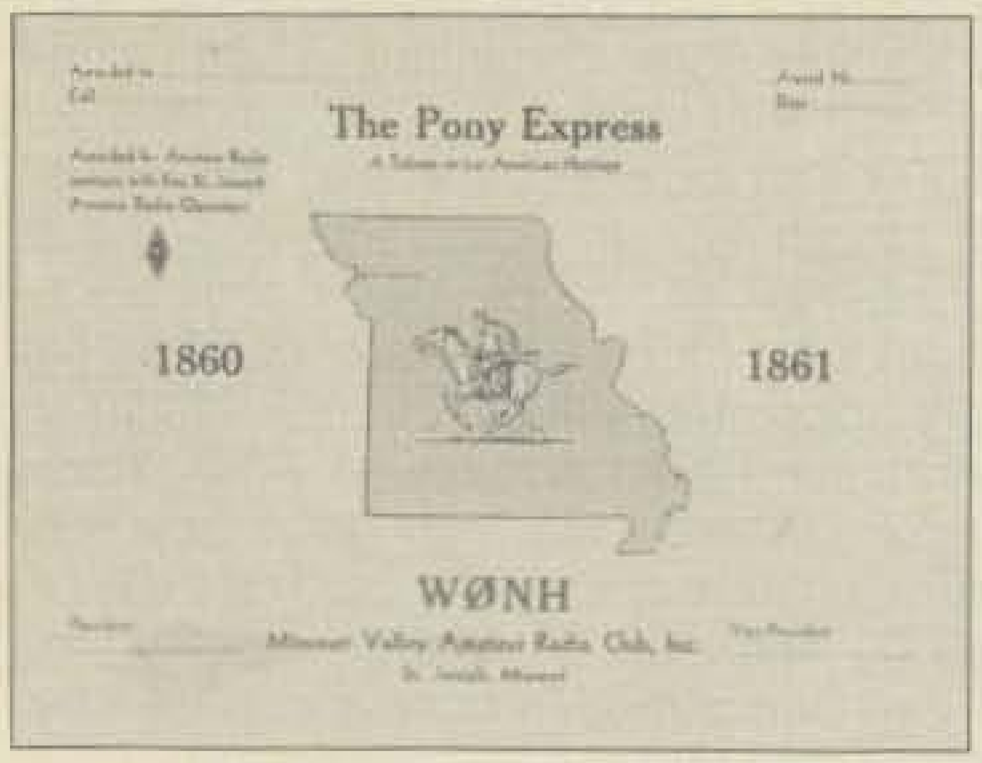
Stations to work are:

WDØBBH	KØHRL	WBØVRD
WAØCHE	WBØLVW	WAØRTT
KØCWQ	WBØMGQ	WBØWKK
KØERD	WØNUT	WBØWXD
WBØEYJ	WBØOVZ	WBØWXE
WØFXD	WBØPKJ	WØYVJ
WØFXY	WØPWH	WBØZLO
WØGC	WØQB	WBØZLP
WDØGEJ	KØUQH	KØZMZ
WDØGEK	WBØVQY	KØHRL
WBØHEF	WBØVRA	
WBØHNO	WBØVRB	

Ibaraki Prefecture Award (I.P.A.): This beautiful Japanese Award is offered by the Ibaraki Branch of J. A. R. L. for working ten (10) Ibaraki stations. Send GCR (certified) list and 7 IRCs or $2.00 to: Ibaraki Branch of JARL, c/o JR1JEG, Masami Tomiyama, 1-2-2 Motomiya-cho, Hitachi-City, Ibaraki 317, Japan. Active station in Ibaraki include: JA1KF, KG, AZR, GTF, JRK, XAF, JH1BZJ, EIG, IRC, JR1JEG, UDK. Thanks to JH1EIG for the data.

The Associazione Radiotecnica Italiana: (ARI) They have a fine Awards program. For all their Awards, address all inquiries to the A.R.I. HF Awards Manager, G. Nucciotti, I8KDB, Via Fracanzano, 31 - 80127 Napoli, Italy, together with one IRC (2 IRCs if air mail reply is desired outside Euorpe). Applications for Awards should include a letter, dated and signed with applicant's name, full QTH and call. He must certify to have complied with all rules governing Amateur Radio Service in his own country, and to have used fair play and good sportsmanship in operating toward the Award for which he is applying. Include a complete list of QSLs, with call-sign, date, frequency, reports, time and type of emission (c.w., a.m., s.s.b., RTTY). Include QSL cards for checking, although foreign applicants can avoid sending QSL cards by submitting a check list of the cards duly certified by an appointed officer of their National Amateur Radio Society. ARI HF Manager reserves the right to check, on request, one or more QSLs. Ten IRCs or $1.00 required of foreign applicants. The "Guglielmo Marconi Award" is free (only mail fee).

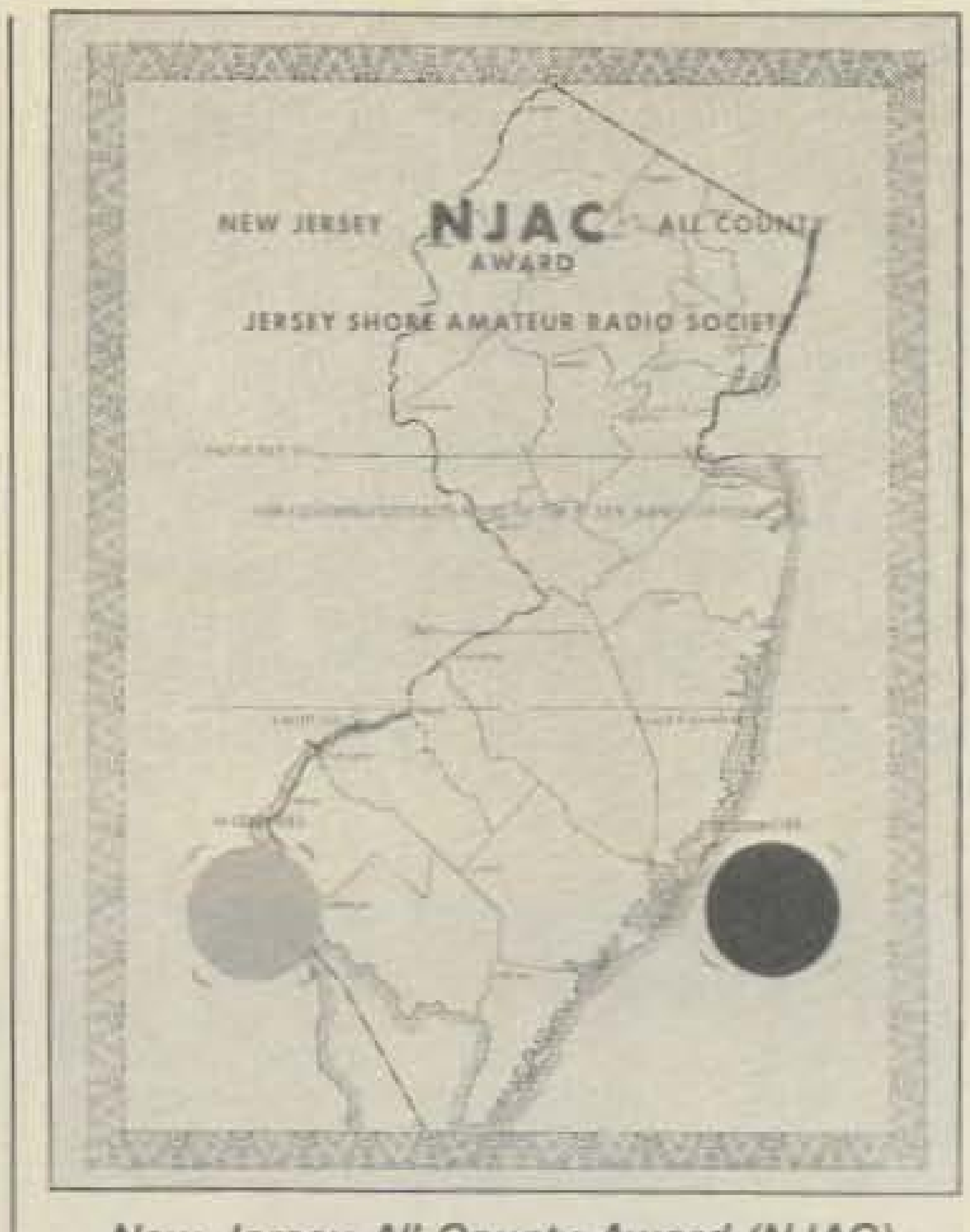
Certificato Del Mediterraneo (CDM) This is the award of the A.R.I., for confirmed two way contacts on the h.f. bands after June 1, 1952 with a fixed amateur station in at least 22 countries



The Pony Express Certificate

listed and at least 50 amateur stations of peninsular Italy (total: 72 QSLs). A station may be worked only once. The CDM is issued in two classes: Mixed and Phone only., with a minimum report of 338 or 33. The list of countries for CDM are:

Spain	France
Balearic Island	Algeria
Ceuta and Melilla	Corsica
Crete	Sardinia
Mount Athos	Sicily
Turkey	Lebanon
Morocco	Egypt



New Jersey All County Award (NJAC)

Greece	Gibraltar
Dodecanese Islands	Cyprus
Syria	Monaco
Yugoslavia	Tunisia
Albania	Israel
Malta	Libya.

NOTES

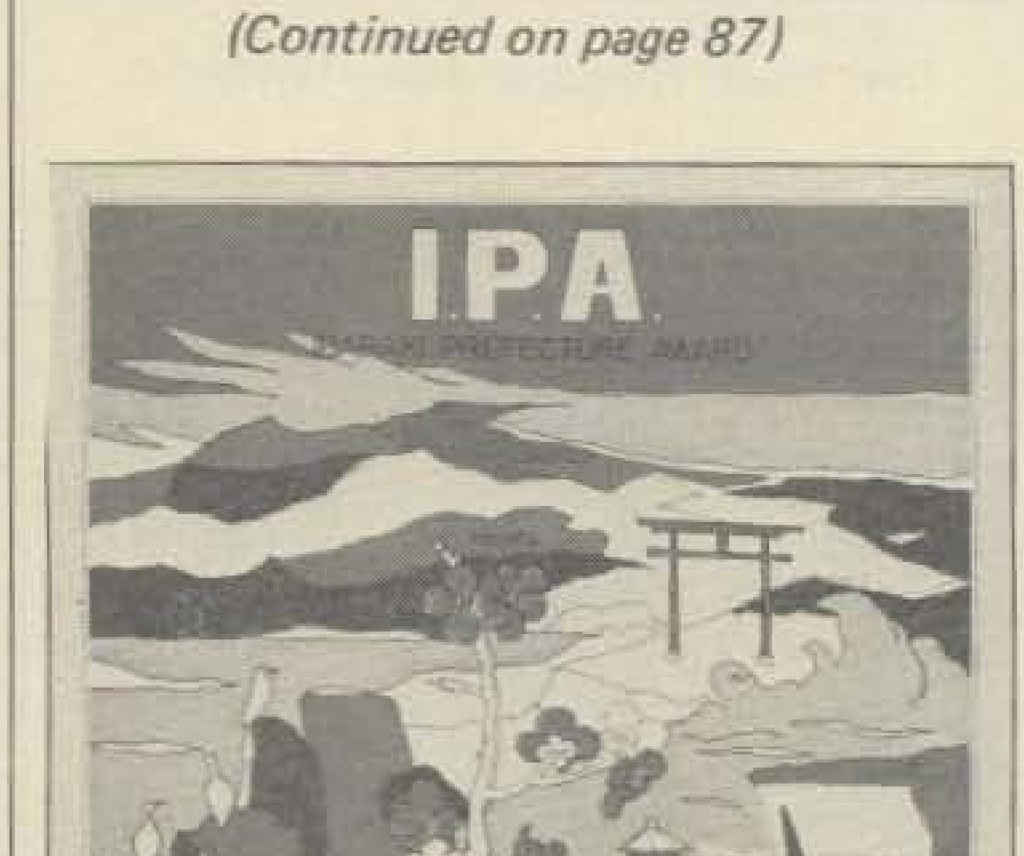
More data on other A. R. I. Awards next month.

Sad news to report passing of Herb Perry, WØGQR, All Counties #150.

County Hunter QSL manager (for County Hunters) for G2AFQ is James Whittaker, WBØTVL, 3019 O'Henry Road, Minneapolis, Minn. 55429.

Happy to report a nice surprise at a recent meeting of the North Jersey DX Association. There was a fine talk on

(Continued on page 87)



Ibaraki Prefecture Award (I.P.A.)

a monthly feature by

GEORGE JACOBS, W3ASK

Propagation

The science of predicting radio conditions

The Swiss Federal Observatory at Zurich reports a monthly mean sunspot number of 73.5 for March, 1978. Daily numbers ranged from a low of 44 on the 30th to a high of 103 on March 4th.

This results in a smoothed sunspot number of 38, centered on September, 1977, as the new cycle continues to increase at a more rapid rate. A smoothed sunspot number in the lower 60's is forecast for this month.

As a result of the accelerated increase in solar activity, both *15* and *20* meters are expected to share honors for optimum DX propagation during July.

Good-to-excellent openings are forecast for *15* meters throughout much of the daylight hours, and to some areas throughout the early evening hours as well. Conditions will favor north-south openings and openings to southern and tropical areas, but some openings will also be possible to almost all areas of the world. Peak conditions are expected during the late afternoon and early evening hours.

Twenty meters should remain open for DX to one area of the world or another, almost around-the-clock. Optimum conditions are forecast for the early evening hours, most of the hours of darkness and the sunrise period, with excellent openings possible to just about every area of the world.

Although a seasonal decrease is expected in *10* meter DX possibilities, some good openings should be possible this month, particularly on north-south paths and to tropical regions. The band should open an hour or two after sunrise and remain open until sunset, with optimum conditions expected during the late afternoon hours.

Despite seasonally higher static levels, some fairly good *40* meter DX openings are expected to most areas of the world during the hours of darkness and the sunrise period. High static levels are expected to reduce the possibility of *80* meter DX openings during July, although some fairly good ones are forecast to many parts of the world during the hours of darkness and at sunrise. Not many DX openings are expected on *160* meters during the month, because of seasonally high levels of static and summertime solar absorption.

*11307 Clara St., Silver Spring, MD 20902.

LAST MINUTE FORECAST

Day-to-Day Conditions Expected For July, *1978*

Propagation Index	*Expected Signal Quality* (4)	(3)	(2)	(1)
Above Normal: 24, 25	A	A	B	C
High Normal: 7, 11-12, 16-17, 23, 26	A	B	C	C-D
Low Normal: 1, 6, 8, 10, 13, 15, 18-20, 27, 30	B	C	D	D-E
Below Normal: 2-3, 5, 9, 14, 21-22, 28-29, 31	C	D	D-E	E
Disturbed: 4	C-E	D-E	E	E

Where *expected signal quality is:*

A—Excellent opening, exceptionally strong, steady signals greater than S9+30 dB.

B—Good opening, moderately strong signals varying between S9 and s9+30 dB., with little fading or noise.

C—Fair opening, signals between moderately strong and weak, varying between S3 and S9, with some fading and noise.

D—Poor opening, with weak signals varying between S1 and S3, and with considerable fading and noise.

E—No opening expected.

HOW TO USE THIS FORECAST

1. Find *propagation index* associated with particular band opening from Propagation Charts appearing on the following pages.
2. With the *propagation index*, use the above table to find the expected signal quality associated with the band opening for any day of the month. For example, an opening shown in the charts with a *propagation index* of 3 will be fair (C) on July 1st, poor (D) on the 2nd and 3rd, poor to no opening at all (D-E) on the 4th, and poor (D) on the 5th, etc.

For updated information dial Area Code 516-883-6223 for DIAL-A-PROP, subscribe to bi-weekly MAIL-A-PROP, P.O. Box 1714, Silver Spring, MD. 20902.

Short-Skip

This month's column contains Short-Skip Propagation Charts for July and August, 1978. DX Propagation Charts for July appeared in last month's column.

Short-skip conditions are expected to be at their best during July, mainly due to peak sporadic-E ionization, and to seasonally high nighttime F-layer ionization. During the daylight hours considerable short-skip openings are forecast for *10* and *15* meters, between distances of approximately 400 and 1300 miles, with some *10* meter, and a considerable number of *15* meter, openings extending out to as far as 2300 miles. A number of short-skip openings may also be possible on these bands during the hours of darkness. Frequent short-skip openings on *20* meters, ranging between 250 and 2300 miles, should be possible almost around-the-clock. Peak conditions should occur during the late morning hours and again during the late afternoon and early evening.

Good daytime short-skip openings are expected on *40* meters between distances of approximately 100 and 700 miles, with excellent nighttime openings between 250 and 2300 miles. Good *80* meter openings are forecast for the daylight hours over distances up to approximately 300 miles, with the range extending up to the F-layer one-hop limit of 2300 miles during the hours of darkness. While no *160* meter short-skip openings are expected during the daylight hours, some should be possible during the hours of darkness for distances up to about 1300 miles. During periods of lower than usual static levels, *160* meter nighttime short-skip openings may extend out to as far as 2300 miles.

V.h.f. Ionospheric Openings

The big v.h.f. propagation event during July should be the numeorus *6* meter and occasional *2* meter openings, that are expected as a result of the seasonal peak in sporadic-E ionization. Fairly frequent *6* meter openings should be possible over distances between approximately 500 and 1300 miles, with some multi-hop openings extending out to 2300 miles. While short-skip openings can occur at just about any time of the day or night on *6* meters, statistics indicate that they generally peak a few hours before noon and again during the early evening hours. During many of the *6* meter openings expected during July, signal levels should be exceptionally strong. Some *2* meter sporadic-E short-skip openings are also expected during July, ranging between approximately 1000 and 1300 miles.

During July, you can expect *6* meter openings on at least three out of every four days. Openings may last from a few minutes up to several hours. Considerably fewer openings are expected on *2* meters.

A good rule of thumb to remember about 6 and 2 meter short-skip openings; as the skip distance gets *shorter* on 6 meters, the MUF is *increasing*. When you hear skip stations on 6 meters as near as 600 miles, the MUF should be high enough for 2 meter openings in the same direction. Generally, when the skip distance on 6 meters falls below 600 miles, 2 meter openings should be possible between distances of about 1000 and 1300 miles.

HOW TO USE THE SHORT-SKIP CHARTS

1. In the Short-Skip Chart, the predicted times of openings can be found under the appropriate distance column of a particular Meter band (10 through 160 Meters), as shown in the left hand column of the Chart. For the Alaska and Hawaii Charts the predicted times of openings are found under the appropriate Meter band column (10 through 40 Meters) for a particular geographical region of the continental USA, as shown in the left hand column of the Charts. An * indicates the best time to listen for 80 meter openings.

2. The *propagation index* is the number that appears in ( ) after the time of each predicted opening. On the Short-Skip Chart, where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecast is made, and the second to the greater distance. The index indicates the number of *days* during the month on which the opening is expected to take place, as follows:

(4) Opening should occur on more than 22 days
(3) " " " between 14 and 22 days
(2) " " " between 7 and 13 days
(1) " " " on less than 7 days

Refer to the "Last Minute Forecast" at the beginning of this column for the actual *dates* on which an opening with a specific *propagation index* is likely to occur, and the signal quality that can be expected.

3. Times shown in the Charts are in the 24-hour system, where 00 is midnight; 12 is noon; 01 is 1 A.M.; 13 is 1 P.M., etc. On the Short-Skip Chart appropriate *daylight* time is used at the *path midpoint*. For example, on a circuit between Maine and Florida, the time shown would be EDT; on a circuit between N.Y. and Texas, the time at the midpoint would be CDT, etc. Times shown in the Hawaii Chart are in HST. To convert to daylight time in other USA time zones, *add* 3 hours in the PDT zone; 4 hours in the MDT zone; 5 hours in CDT zone, and 6 hours in the EDT zone. *Add* 10 hours to convert from HST to GMT. For example, when it is 12 noon in Honolulu, it is 15 or 3 P.M. in Los Angeles; 18 or 6 P.M. in Washington, D.C.; and 22 GMT. Time shown in the Alaska Chart is given in GMT. To convert to *daylight* time in other areas of the USA, *subtract* 7 hours in the PDT zone; 6 hours in the MDT zone; 5 hours in the CDT zone and 4 hours in the EDT zone. For example, at 20 GMT it is 16 or 4 P.M. in N.Y.C.

4. The Short-Skip Chart is based upon a transmitted power of 75 watts c.w. or 300 watts p.e.p. on sideband; the Alaska and Hawaii Charts are based upon a transmitter power of 250 watts c.w. or 1 kw p.e.p. on sideband. A dipole antenna a quarter-wavelength above ground is assumed for 160 and 80 meters, a half-wave above ground on 40 and 20 meters, and a wavelength above ground on 15 and 10 meters. For each 10 db gain above these reference levels, the *propagation index* will increase by one level; for each 10db loss, it will lower by one level.

5. Propagation data contained in the Charts has been prepared from basic data published by the Institute for Telecommunication Sciences of the U.S. Dept. of Commerce, Boulder, Colorado, 80302.

A good deal of meteor activity is expected in July, which should result in meteor-type ionospheric openings on the v.h.f. bands. A major meteor shower, the *Delta Aquarids*, should take place between July 27th and 30th, peaking at approximately 8 a.m. EDT on July 29, with a meteor count of between 20 and 30 an hour.

Not as many Trans-Equatorial (TE) openings are expected on 6 meters during July, but some should be possible. Check between 8 and 11 p.m., local daylight time for openings toward South America, with conditions favoring the southern tier states.

Some v.h.f. short-skip openings may be possible during July, as a result of auroral ionization. The best dates to look for these openings are those shown as DISTURBED or BELOW NORMAL in the "Last Minute Forecast" at the beginning of this column.

CQ Short-Skip Propagation Chart
July & August, 1978
Local Daylight Savings Time At Path Mid-Point.

Band (Meters) — *Distance Between Stations (Miles)*

	50-250	250-750	750-1300	1300-2300
10	*Nil*	08-10 (0-1)* 10-14 (0-3)* 14-18 (0-1)* 18-22 (0-2)* 22-00 (0-1)*	08-10 (1)* 10-14 (3)* 14-18 (1-2)* 18-22 (2-3)* 22-08 (1)*	08-10 (1-0)* 10-14 (3-1)* 14-18 (2-1)* 18-22 (3-1)* 22-08 (1-0)*
15	*Nil*	08-10 (0-2)* 10-14 (0-3)* 14-18 (0-2)* 18-20 (0-3)* 20-22 (0-2)* 22-08 (0-1)*	08-10 (2)* 10-14 (3)* 14-18 (2)* 18-20 (3)* 20-22 (2)* 22-00 (1-2)* 00-08 (1)*	08-10 (2-1) 10-14 (3-2) 14-18 (2-3) 18-20 (3-4) 20-21 (2-3) 20-00 (2-1) 00-08 (1-0)
20	10-01 (0-1)*	07-10 (0-2)* 10-16 (1-4)* 16-21 (1-3)* 21-01 (1-2)* 01-07 (0-1)*	07-10 (2-3)* 10-17 (4)* 17-22 (3-4)* 22-01 (2-3)* 01-07 (1-2)*	07-10 (3-2) 10-16 (4-2) 16-17 (4-3) 17-22 (4) 22-00 (3) 00-01 (3-2) 01-07 (2-1)
40	08-12 (1-2)* 12-17 (2-4)* 17-21 (3-4) 21-23 (1-2) 23-08 (0-2)*	08-10 (2-4)* 10-12 (2) 12-17 (4-2) 17-18 (4-3) 18-21 (4) 21-23 (2-4) 23-05 (2-4) 05-08 (2-3)	08-10 (4-1) 10-17 (2-1) 17-18 (3-1) 18-21 (4-3) 21-05 (4) 05-06 (3-4) 06-08 (3)	08-18 (1-0) 18-21 (3-2) 21-06 (4) 06-08 (3-1)

80	07-12 (3-4) 12-16 (4-3) 16-22 (4) 22-05 (3-4) 05-07 (4)	08-10 (4-1) 10-12 (4-0) 12-16 (3-0) 16-18 (4-1) 18-20 (4-2) 20-22 (4-3) 22-07 (4) 07-08 (4-2)	08-10 (1-0) 10-16 (0) 16-18 (1-0) 18-20 (2-1) 20-22 (3-1) 22-05 (4) 05-07 (4-3) 07-08 (2-1)	08-18 (0) 18-20 (1-0) 20-22 (1) 22-04 (4-3) 04-05 (4-2) 05-06 (3-2) 06-07 (3-1) 07-08 (1)
160	18-19 (1-0) 19-20 (1) 20-22 (3-2) 22-00 (4-3) 00-06 (4) 06-08 (3-2) 08-09 (1) 09-10 (1-0)	19-20 (1-0) 20-21 (2-0) 21-22 (2-1) 22-00 (3-2) 00-04 (4-2) 04-06 (4-3) 06-08 (2-1) 08-09 (0-1)	21-22 (1) 22-01 (2-1) 01-04 (2) 04-06 (3-2) 06-07 (1) 07-08 (1-0)	21-23 (1-0) 23-01 (1) 01-06 (2-1) 06-07 (1-0)

* Predominantly Sporadic-E Openings

HAWAII
July & August, 1978
Openings Given In Hawaiian Standard Time #

	10 Meters	15 Meters	20 Meters	40/80 Meters
Eastern USA	14-16 (1)	06-11 (1) 11-14 (2) 14-16 (3) 16-17 (2) 17-18 (1)	13-15 (1) 15-17 (2) 17-18 (3) 18-20 (4) 20-22 (3) 22-02 (2) 02-04 (3) 04-06 (2) 06-09 (1)	18-20 (1) 20-00 (2) 00-02 (1) 21-00 (1)†
Central USA	14-16 (1)	06-08 (1) 08-13 (2) 13-17 (3) 17-18 (2) 18-19 (1)	06-08 (2) 08-14 (1) 14-16 (2) 16-18 (3) 18-20 (4) 20-23 (3) 23-03 (2) 03-06 (3)	18-21 (1) 21-22 (2) 22-01 (3) 01-02 (2) 02-03 (1) 20-22 (1)† 22-00 (2)† 00-02 (1)†
Western USA	11-14 (1) 14-17 (2) 17-18 (1)	07-08 (1) 08-10 (2) 10-12 (3) 12-16 (4) 16-17 (3) 17-18 (2) 18-20 (1)	06-08 (4) 08-10 (3) 10-13 (2) 13-15 (3) 15-20 (4) 20-22 (3) 22-05 (2) 05-06 (3)	18-19 (1) 19-20 (2) 20-02 (4) 02-04 (3) 04-05 (2) 05-06 (1) 19-20 (1)† 20-22 (2)† 22-02 (3)† 02-03 (2)† 03-04 (1)†

See explanation in "How To Use Short-Skip Charts" which appears in the box at the beginning of this column.

† Indicates best time for 80 meter openings. Openings on 160 meters are most likely to occur during those times when 80 meter openings are shown with a propagation index of (2), or higher.

Note: The Alaska and Hawaii Propagation Charts are intended for distances *greater* than 1300 miles. For shorter distances, use the preceding Short-Skip Propagation Chart.

ALASKA
July & August, 1978
Openings Given In GMT#

	10 Meters	15 Meters	20 Meters	40/80 Meters
Eastern USA	*Nil*	00-02 (1)	12-15 (1) 22-01 (1) 01-04 (2) 04-06 (1)	07-10 (1)
Central USA	*Nil*	21-00 (1) 00-03 (2) 03-04 (1)	13-16 (1) 22-00 (1) 00-03 (2) 03-05 (3) 05-06 (2) 06-08 (1)	08-12 (1)
Western USA	01-04 (1)	17-22 (1) 22-00 (2) 00-03 (3) 03-04 (2) 04-05 (1)	13-14 (1) 14-15 (2) 15-19 (3) 19-01 (2) 01-03 (3) 03-05 (4) 05-07 (3) 07-09 (2) 09-11 (1)	07-09 (1) 09-12 (2) 12-13 (1) 09-12 (1)†

a monthly feature by

FRANK ANZALONE, W1WY

Contest Calendar

News/views of on-the-air competition

Our WPX SSB Contest last March was a good one, excellent conditions, loads of activity, and there will be record scores I am sure.

The much publicized Clipperton Expedition was in full swing during the contest week-end, and most everybody was anticipating that extra FO0X contest multiplier, but it did not materialize.

At the last minute, the Clipperton crew wisely decided to switch to c.w. operation only, during the contest week-end. I say wisely because it would have been utter chaos if they continued on s.s.b., and reworked all those thousands who were already in their logs.

After all, this was an expedition to make this rare spot available to as many as possible, not to run up a big contest score. I understand that they made around 8,000 c.w. contacts during that week-end, making the deserving, c.w. faithful very happy. *I know that I'm going to get some flack from Bernie, W8IMZ about this. Ed.*

Although this hardly comes under the heading of contest news, it could indirectly qualify as an Expedition, an "Eyeball QSO Tour of Japan", as it were. The Northern California DX Club is organizing this exciting tour for November 3rd to the 18th. Half a dozen club meetings have already been lined-up in Japan so you will get to meet many of those avid JA contesters.

Activity is not confined to amateur radio only, but will also include many excursions to exciting points of interest. If interested, drop a line to Bob Thompson, K6SSJ, P.O. Box 896, Los Gatos, CA 95030.

(Do you suppose I could convince Dick Cowan that he should send me on this expedition as a CQ representative? Ed.)

73 for now, Frank, WY

SEVEN Land QSO Party

Starts: 1200 GMT Saturday, July 1
Ends: 2400 GMT Sunday, July 2

This the first annual QSO Party sponsored by the NAS Whidbey Island A.R.C.

The '7' land area includes not only the eight W7 US states, but also VE7, British Columbia and KL7, Alaska.

Operating time is limited to a maximum of 30 hours out of the 36 hour contest period. The same station may be worked on each band, and contacts between '7' land stations are permitted for QSO and multiplier credit.

Exchange: RS(T) and state or province for W/VE stations, (inc. KH6 and KL7) and RS(T) plus a contact no. for DX.

Points: One point per QSO for 7 Land stations. All others, 5 points for each 7 land contact.

Multiplier: *For 7 land* - A multiplier of 1 for each of the 50 US states and 13 Canadian provinces worked on each band. *All Others* - A multiplier of 1 for each state (9) and VE province (1) in the 7 land area worked on each band.

There is also a power multiplier as follows: Less than 100 watts input, 2; 100 to 299 watts, 1.5; 300 to 499 watts, 1.25; Nil if over 500 watts.

Final Score: Total QSO points X sum of multiplier for each band X power multiplier if any.

Awards: Certificates to top scoring single operator station in each state, province and DX country. And top multi-op station in each W/VE call district.

Logs must show band, mode, date/time in GMT, station worked, exchange sent/rec'd and points. Use a separate sheet for each band and include a dupe sheet if your log contains over 100 contacts.

Make up your own log and dupe sheets, but you can obtain summary sheets from WB7BFK if you include a s.a.s.e. with your request. Also include a s.a.s.e. with your entry, mailing deadline is Aug. 1st to: NAS Whidbey Island ARC, Att: Bill Gosney, W7BFK, 4471 40th N.E. St., Oak Harbor, Wash. 98277

Calendar of Events

*July	1-2	Venezuelan Phone Contest
July	1-2	SEVEN Land QSO Party
July	2	North American C.W. Sprint
July	8-9	Radiosport Competition
July	15-16	Colombian Contest
July	15-16	VHF Space Net Contest
July	15-16	Ten-Ten Net QSO Party
July	22-24	Rhode Island QSO Party
*July	23	WAB VHF Contest
*July	29-30	Venezuelan C.W. Contest
July	29-31	County Hunters C.W.
July	29-31	New Jersey QSO Party
Aug.	19-20	Can - Am Contest
**Aug.	26-27	All Asian C.W. Contest
Sept.	10	North American C.W. Sprint
Sept.	16-18	Maryland/DC QSO Party
Sept.	16-18	Wash. State QSO Party
Sept.	23-24	Delta QSO Party
Oct.	7-8	VK/ZL/Oceania RTTY
Oct.	7-8	VK/ZL/Oceania Phone
Oct.	14-15	VK/ZL/Oceania C.W.
Oct.	14-15	RSGB 21/28 MHz Phone
Oct.	14-16	Manitoba QSO Party
Oct.	21-22	RSGB 7 MHz SSB Contest
Oct.	**28-29**	**CQ WW DX Phone Contest**
Nov.	4-5	RSGB 7 MHz C.W. Contest
Nov.	**25-26**	**CQ WW DX C.W. Contest**

*Covered last month
**See June Calendar

North American C.W. Sprint

Two Periods GMT
0100 to 0500 Sun. July 2 and again Sept. 10. (Local time Sat. night)

Organized by the National Contest Journal, this contest is a real shorty, 4 hours only in each period.

North America will be working stations on other continents as well as other North Americans. (CQ WW Contest boundries) Single operator and c.w. only. You may enter one or both, but do not combine scores.

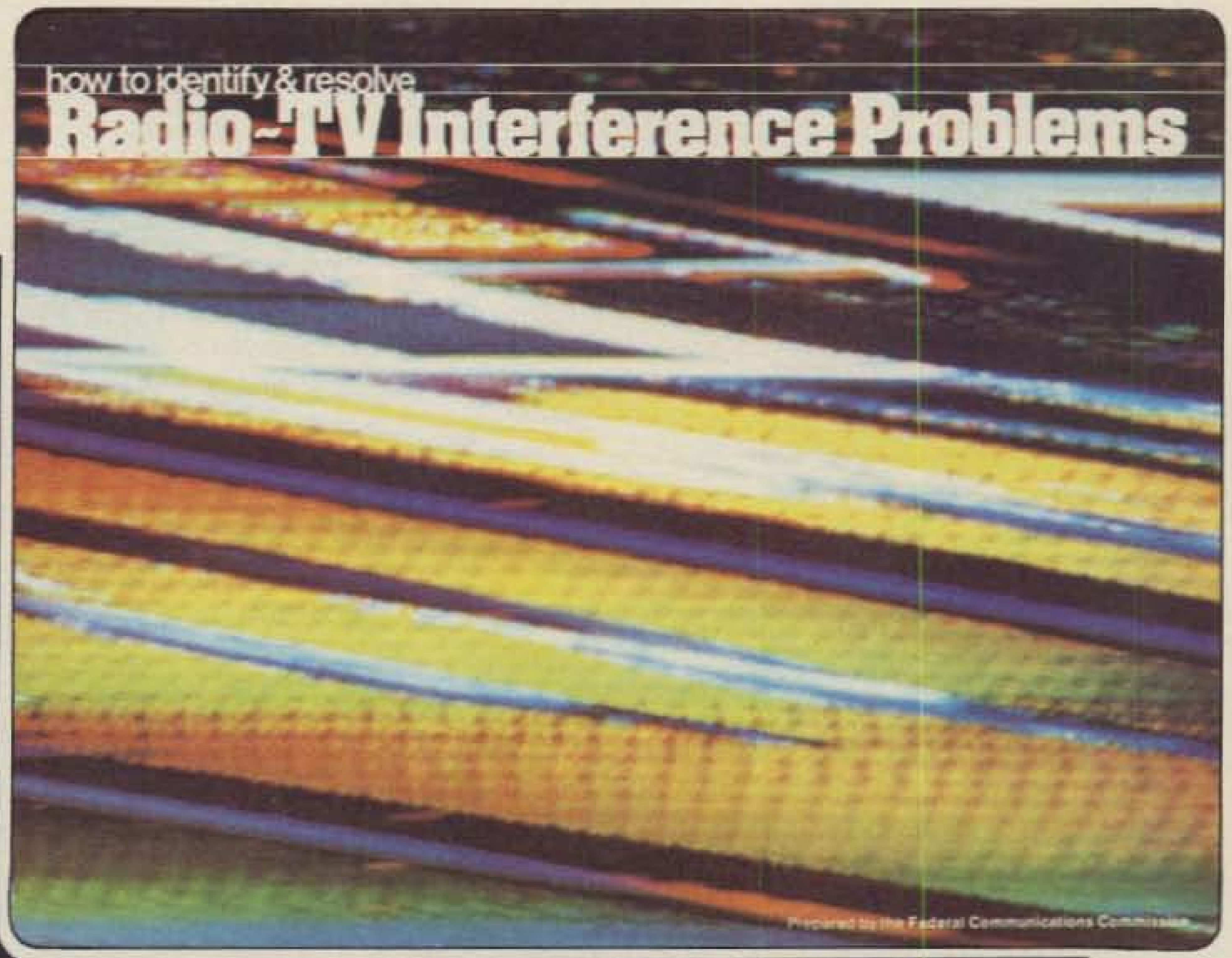
Exchange: Call, QSO no., name and QTH; (state VE province or country).

Scoring: *For No. America* - Multiply total QSOs by sum of states, provinces and countries worked. *For Others* - Multiply total QSOs by states, provinces and No. American countries worked. (USA and VE not countries, KH6 not a state.) There are 8 VE provinces, Maritime and VE2 - VE8.

Frequencies: Three bands only, 3530-3550, 7030-7050, 1430-1450. Same station may be worked once on each band.

Awards: A Trophy to the "Top Banana." Certificates to the highest scoring stations in each USA call area,

*14 Sherwood Rd., Stamford, Conn. 06905



Let the FCC's own Radio-TV Interference booklet be your club's first line of defense on the TVI front.

For the first time here's an easy-to-read guide showing all of the classic TVI symptoms and their cures.

Use it as a "handout" by the local TVI committee, defuse tricky "irate neighbor" situations, help the local TV repair shop root out RFI/TVI problems in your area.

This top-quality booklet (40 pages 10¼ x 8") is available in quantities of 12 at $9.00 plus $1.00 shipping. Single copies are available for $1.25, postpaid. Note that the FCC offers the self-same booklet for $1.50 per copy with no quantity discount.

Prepared by the Field Operations Bureau of the Federal Communications Commission and reprinted at low cost by the Publishers of CQ, the booklet offers guidelines for the amateur, non-amateur and CBer alike in dealing with RFI and TVI. A dozen full-color illustrations show most interference patterns with descriptions and solutions for each problem.

The booklet should be on your "must" list for reading and your "do" list to help eliminate the problem. Order a dozen copies today!

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Port Washington, N.Y. 11050

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Name ______ Call ______

Address ______

City ______ State ______ Zip ______

Canada and DX country. And to 10 top scores, the winning team and each operating member.

Special QSY Rule: North Americans calling CQ are permitted only one contact, as a result of that call. He must thereafter move at least 1 kHz. before working another station, or at least 5 kHz. before calling CQ again.

Club competition is limited to a total of 10 members as a single entry unit. A club may enter more than one unit. To qualify each operator in the unit must be registered with contest coordinator, N6SF, at least 24 hours before the contest.

Use a separate sheet for each band, indicate the multiplier the first time it is worked, and include a summary and check sheet with your entry. A signed declaration is also requested. The usual disqualification regulations are in effect and will be enforced.

Entries must be received no later than 30 days after each Sprint and go to: Rusty Epps, N6SF, 35 Belcher Street, San Francisco, CA 94144

IARU Radiosport Championship

Starts: 0000 GMT Saturday, July 8
Ends: 2400 GMT Sunday, July 9

This is the 2nd time around for this one. Last year's initial affair being a huge success.

It's a worldwide competition, all bands 160 thru 2 meters. Single and multi-operator. (single xmtr. only) There are three categories: c.w. only, phone only, and mixed c.w. and phone. Multi-operator entries use mixed mode only.

A maximum of 36 hours of operating time for single operator stations. Off times must be at least 30 minutes and indicated in your log. There is no time limit for multi stations, but operation must remain on the same band for at least 10 minutes.

Exchange: Signal report and your ITU zone.

Points: One point for QSOs with stations in your own ITU zone, 3 points if station is outside your zone but on same continent, and 5 points if on a different continent.

Multiplier: Sum of different ITU zones worked on each band.

Final Score: Total QSO points from all bands times the sum of the multiplier from each band.

Each station may be worked only once per band, regardless of the mode. Crossband contacts are not allowed, except via Oscar which counts as a separate band.

Awards: Certificates to the top scorers in each category, in each ARRL section, each ITU Zone, and each DX country. Additional achievement awards are available for making 250 QSOs, 1000 QSOs and/or working a total of 50 or more zones. In case of multiple award levels achieved, only the highest award will be issued.

U.S. and Canadian entries must use official log and summary sheets which may be obtained from ARRL. Also request forms CD-77, CD-175 and a ITU zone list. A large s.a.s.e. with at least 24¢ postage will get you a good supply.

All entires worldwide go to: IARU Headquarters, Box AAA, Newington, CT 06111. Mailing deadline is August 21st.

Top 10 Scores - 1978 QCWA Party

W4WKQ	304	23,104
K9CLO	293	21,090
W6UA	249	18,450
W9IB	245	18,375
N4SU/9	245	17,640
W6FQ	239	16,969
W5JC	220	15,620
W4BK	215	15,480
W5AK	219	14,892
W5OB	200	14,200

2nd column no. of QSOs.

Colombian Contest

Starts: 0001 GMT Saturday, July 15
Ends: 2359 GMT Sunday, July 16

This year's contest will be commemorating the 168th Anniversary of Colombia's Independence. Exchange will be on a world wide basis.

All bands, 3.5 thru 28 MHz., phone and c.w. Three classes, single operator, single band and all band; multi-operator single transmitter.

Exchange: RS(T) plus a 3 figure QSO number starting with 001.

Scoring: QSOs with HK's-5 points, with stations in North America-3 points, other countries-2 points, and with same country-1 point. The multiplier is determined by sum of DX countries worked on each band.

Final Score: Sum of QSO points from all bands, multiplied by sum of different countries worked on each band.

Awards: A silver cup to the overall world winner. There are nine plaques, six to the continental winners and three to the top scoring station in each category. Certificates will be issued to the top scoring station in each country.

A minimum of 50 QSOs must be shown by all award winners.

Use a separate log sheet for each band, indicate the country only the first time it is worked. Also include a summary sheet with your entry showing the scoring and a signed declaration. The usual rules of disqualification will be enforced.

Mailing deadline is September 30th to: L.C.R.A. Concurso Independencia, Apartado Postal 584, Bogota, Colombia.

VHF Space Net Contest

From 6 P.M. Saturday, July 15 to
9 P.M. Sunday, July 16. (Local Time)

Like previous v.h.f. Space Net activities, this one is also in commemoration of an event in the Space Program. This one honors the 9th Anniversary of Apollo II, "Man's first landing and walk on the Moon."

Activity will be on the 50, 144 and 220 MHz. bands, all modes but no repeater contacts.

Exchange: Signal report and zip code, P.O. location for out of country stations.

Points: Each contact is worth 2 points. The same station may be reworked in a different mode for 2 additional points. And 2 more points if worked on a different band.

Multiplier: Each different zip code and/or P.O. location worked. (Counted once only)

Score: Total QSO points multiplied by the number of zip codes and/or P.O. locations.

Awards: Plaques to each of the following categories:

I- Stations using 100 to 500 watts.
II- 25 to 100 watts input.
III- 5 to 25 watts input.
IV- 5 watts or less input
V- Using c.w. only, any power.
VI- YL only, any power.
VII- Club competition.

Also certificates to 2nd and 3rd place winners in all classifications.

Mailing deadline for logs is August 10 to: VHF Space Center, Att: A.W. Slapkowski, K4AWS, P.O. Box 15 Sumterville, FL 33585

Ten - Ten Net QSO Party

Starts: 0000 GMT Saturday, July 15
Ends: 2400 GMT Sunday, July 16

This is the summer edition of the Ten - Ten International Net QSO Party. Activity is on 10 meters only, any mode. It is open to all amateurs, but non-members are not eligible for awards.
They are however, encouraged to submit a log.

Exchange: Name, QTH and 10-10 membership number for Net members. (Date and time to be noted on log.)

Scoring: One point per contact, add an additional point if QSO is with a 10-10 member. Total QSO points is your score, there is no multiplier. The same station is counted once only. (Include name of your Chapter for credit)

Awards: First and 2nd place certificates in each U.S. and Canadian call area, and to 11 continental and subcontinental areas, including KH6 and KL7.

Mailing deadline for logs is August 30th to: Grace Dunlap, K5MRU/Ø, P.O. Box 13, Rand, Colorado 80473

Rhode Island QSO Party

Two Periods (GMT)
1700 Sat. to 0500 Sun. July 22/23
1300 Sun. to 0100 Mon. July 23/24

This is sponsored by the East Bay Amateur Wireless Association. The same station may be worked once on each band and mode, and R. I. stations may work other in-state stations.

Exchange: RS(T) and QTH. County for R. I., state, province or country for others.

Scoring: *For R. I.* - Two points per QSO, 5 points for R. I. Novice and Techs. *All Others* - Two points for each R.I. QSO, 5 points if it's with a Novice or Tech. (Novice and Techs must sign /N or /T to identify license class) Contacts with Club station N1RI are worth 10 points.

Final Score: *For R.I.*- Total QSO points × R.I. counties + states + provinces + DX countries worked. *All Others* - QSO points × R.I. counties worked. (Max. of 5: Bristol, Kent, Newport, Providence and Washington.)

Frequencies: C.W. - 1810, 3550, 3710, 7050, 7110, 14050, 21050, 21110, 28050, 28110. Phone - 3920, 7260, 14300, 21360, 28600, 50.3, 145.1 (No Repeaters)

Awards: Certificates to top scoring stations in each R.I. county, state, province and DX country, and to Novice and Tech. winners in R.I. There is also a Club award in each state, province and DX country. (Minimum of 3 logs per club.)

Include a summary sheet with your entry, showing the scoring, club affilation and other information.

Mailing deadline is August 31st to: East Bay AWA, P.O. Box 392, Warren, R. I. 02885. Include a s.a.s.e. for copy of results.

County Hunters C.W. Contest

Starts: 0000 GMT Saturday, July 29
Ends: 0200 GMT Monday, July 31

The County Hunters invite and encourage mobile and portable operation, from the less active counties, during this contest.

The same station may be worked on each band for QSO points. Portable and mobiles changing counties may also have repeat contacts. Stations on county lines exchange only one number but each county is counted as a multiplier.

Exchange: QSO no., category (P - portable or M - mobile) RST, state, province or country, and county for U.S. stations.

Scoring: QSO's with a fixed station-1 point, 3 points if it's a portable or mobile. Multiply total QSO points by number of U.S. counties worked. Mobile and portables calculate their score for contacts made within a state.

Frequencies: 3575, 7055, 14070, 21070, 28070. It is requested that P or M stations use frequencies below 7055 and below 14070, others spread out above.

Awards: Certificates in three categories:

F - Top fixed or fixed portable in each state, province or county, with 1000 or more points.

P - Top score in each state, by a portable operating from a county other than its normal location, with 1000 or more points.

M - Top scoring mobile in each state, operating from 3 or more counties, with a minimum of 10 QSOs from each county.

There are also Trophies for the single operator Portable and Mobile in the United States. Additional awards where deemed appropriate.

Stations with 100 or more contacts *must* include a check sheet of counties worked. Enclose a large s.a.s.e. if results are desired.

Mailing deadline is Sept. 1st to: C.W. County Hunters Net, c/o Jeffrey P. Bechner, W9MSE, 673 Bruce Street, Fond du Lac, Wisc. 54935

New Jersey QSO Party

Two Periods GMT
2000 Sat. to 0700 Sun. July 29/30
1300 Sun. to 0200 Mon. July 30/31

This is the 19th annual party sponsored by the Englewood A.R.A. The same station may be worked on each band and mode, and N.J. may work in-state stations for QSO and multiplier credit.

Exchange: QSO no., RS(T) and QTH. County for N.J., ARRL section or country for others.

Socring: N.J. stations score 1 point for W/K and VE/VO contacts, 3 points for DX. Multiply total by ARRL sections worked. (max. of 75). KP4, KH6, KL7, KZ5 etc., are 3 point contacts and are also section multipliers.

Out-of-state stations multiply total N.J. QSOs by N.J. counties worked. (max. of 21)

Frequencies: 1810, 3535, 3905, 7035, 7135, 7235, 14035, 14280, 21100, 21335, 28100, 28600, 50-50.5, 144-146. Phone on even hours, 15 on odd hours and 160 at 0500 GMT.

Awards: Certificates to the top scorers in each N.J. county, ARRL section and DX country. Second place awards if 4 or more logs are received from that section. Also Novice and Technician awards.

Use GMT, indicate the multiplier only the first time it is worked, and include a summary and QSO check sheet. A large s.a.s.e. if you wish a copy of the results.

Statons planning activity in N.J. are requested to advise E.A.R.A. by July 8th so that coverage of all counties may be planned.

Logs must be received no later than Aug. 26th and go to: Englewood ARA, P.O. Box 528, Englewood, N.J. 07631

Awards *(from page 80)*

amateur radio (or lack of it) in the near east Arabic countries "Win", WA2QNW has been visiting. Win, a County Hunter, needing about 11 to make them all. Win was host to many of us a few years ago at his QTH in Bogota, and then later at his new/present QTH in Old Bridge, N.J.

The 10th annual County Hunter's Convention will be held on July 6-8, at the Holiday Inn, 4545 N. Lindburg Blvd., Bridgeton, Mo. You do *not* have to be a member of any organization, all county hungers ate welcome. If you do not yet have details, get in touch, at once, with Art, WØBK or Jim WØFF.

Keep those cards and letters coming in and tell me, How was your month?

73, Ed., W2GT

DX *(from page 70)*

The intra club competition is one way for the club as a whole to work as a team. The club prizes, regardless of size, provide increased incentive.

If you can churn up the competitive nature of the club, challenge the club that beat you last year. There is nothing like beating another club. But a word of caution, your challenge will probably spur them on too.

Another corollary project is the club DXpedition for the contest. Airfare is getting reasonable and group travel even cheaper. Now is the time for those October/November reservations. Take the gals along and make a DX vacation out of one of the club's activities. If you work it right, you'll get support to do it again.

Many fine articles have been written on DX club contest DXpeditions, but there is nothing like asking those who went last year. So, as part of the early planning, check with past groups. When you decide where and when, announce the trip early to avoid losing that choice spot to another group. Then again, it might be great to have three simultaneous DXpeditions to China. Yet, the St. Peter and St. Paul Rock Hilton can only handle one group at a time.

Thanks!

I wish to thank the following publications for their support and inputs to this column: *The DXer, DXer Magazine* (W4BPD), Geoff Watt's *DX News-Sheet, Long Island DX Bulletin* (W2IYX), *Long Skip* (VE1AL/3), *North Florida DX Assn News* (N4UF), *Totem Tabloid*

(WA7RVA), *VERON DX News* (PAØTO) and the *West Coast DX Bulletin* (WA6AUD).

73, and the best of DX, Rod W70M

QSL Information

A2CBW to DK3KD
A35DG to W7YEM
A4XFV to DJ7OM
A4XGY to K2RU
A6XB to K1DRU
A6XCS to PAØCPS
A7XAH to DJ9ZB
A7YXX to DF4NW
A9XCC to K4CG
C5ABK to G3LQP
C6ABA to G3AME
C35DG to W7VEF
CEIBLL to WB4LFM
CE3XV to WA3NGS
CEØZE to N4WW
CEØZM to K1MM
CN8CC to F6CVE
CN8CW to WA3HUP
CN8CX to WBØMSZ
CR6IK to W8CNL
CT2SH to W3HNK
DA1BD to W8IMZ
DA4CC ('78 WPX) to W8IMZ
DT7DK to DM2DUK
EA6DC to K8QN
EL1F to WB4IUX
EP2DD to K9YPW
EP2DT to OZ6DT
EP2LA to WD4NYY
EP2LI to WA4PYF
FB8WF to F6APG
FB8XS to F5VU
FB8ZM to F6BCN
FG7AN to WA3EDS
FGØDYM/FS to W3HNK
FGØGEX to K7GEX
FHØOM to DJ1TC
FHØYL to I8JN
FK8BB to DJ9ZB
FMØAMF to K2KGB
FMØBZW to W2MIG
FOØXA-XH to HB9MX
FPØDW to VE2UN
FY7AN to WD8CPU
FY7AQ to WD8CPU
FY7AU to WD8CPU
FY7YE to W5JLU
GD5BLG to DJØUP
GD5BLH to DJØUP
GU5CIA to N6MA
H5FXT to VE3FXT
HC8GI to W3HNK
HH2DW to W3FM
HK9QA to K4TXJ
HPØPOL to SP2BBD
HZ1TA to W4UL
J3AJ to W7LLC
J28AA to I8JN
J28AY to F6ETO
JD1YAA to JARL
JT1AN to W7PHO
JX9WT to LA5NM
JY5US to DJ3HJ
K9AX/DU2 to W4FLA
KC6DA to WA6EKM
KG4KP to WA4IVG
KG6RE to K7ZA
KG6RI to K7NF
KH6JFI/Kure to WA6PYN
KM6FC to W5RU
KM6FD to W5RU
LA7JO to WB5HGS (post April '78)
N4VV/CE3 to WA3NGS
N4ZC/KH6 to K4MQG
QE5CA/YK to K4BKL
OX3AX to OZ5DX
P29AC to F6CYL
PJ2CC to WB8EYL
PJ8MIG to W2MIG
PY7BXC/Ø to PY7AZQ
PZØDX to W2VP
S79D to N4NW (post 1 Jan '78)
S79DF to ON6FN
ST2HF to G4GFI
STØRK to DL7FT
SV1IV to DJ9ZB
SVØWTT to W6GBG
TJ1AD to WB4WHE
TJ2P to WB4ZNH
TR8FB to WB4IWW
TU4AM to I8JN
VKØAC to VK3AOK*
VE1AJC/SU to VE1AIZ
VO3CC to VO1AA
VP2KT to WB2TSL
VP2LEU to K6SVL
VP2LL to W2MIG
VP2MT to WB8LDH
VP2SAB to W2MIG
VP2SAH to WB2AMO
VP2SQ to W2MIG
VP2SZ to WB8OBA
VP5BJN to WB4LFM
VP5MA to WB4LFM
VP8NP to G3ZKH
VP8OX to LU2AFH
VP8PL to G3LIK
VR4DT to WØVU (U.S.)
VS6FX to DL7HM
VU2LQA to DL6TU
VU2UH to SP9AJT
WA8VDJ/KH6 to WA6PYN
WB8VLG/DU2 to W7IZH
WP4BDL to KP4AM
XT2AE to DJ9KR
YBØADD to W5EZ
YBØADF to WB6DXL
YS1RVE to WAØJYJ
ZB2G to K2FJ
ZD8HR to N6HR
ZD8KG to K4KBL
ZD8RG to K8VIO
ZD9GG to ZS1Z
ZE8JJ to K9UIY
ZL4LR/A to N4NX
ZS2MI (opr Gordon) to W4SSU
3AØGY to MB2EZG
3AØJF to F6DYK
3CIX to SM6CSB
3D2CC to VE6AKV
3V8BZ to DL1HH
4S7EA to WB9OQA
4S7JD to K4MQG
4S7TE to SM7TE
4Z4LF to WB2WOU
5U7AG to K1VSK
5V7AS to IT9AZS
5Z4RT to I8JN
6ØZ1 to W6SN
7P8BG to VE3EUP
7X4AH to F300
7X5AB to W2KF
7X5AS to F6CBS
8P6FA to VE2QO
8P6HB to WB4HOI
8R1CB to W2MIG
8R1IW to W2MIG
9A1A to IT9TAI
9G1MA to VE4OE
9H1FF to K9DID
9J2DX to I8JN
9J2ES to W7VRO
9K2EX to SMØBYD
9L1CA to WB4HWE
9L1KB to WB4HWE
9L1MF to G4BHJ
9L1SA/A to WA3NCP
9L1SA/B to WB4HWE
9L1SA/E to WA4UDG
9N1NFO to WB4NFO
9M2DW to DJ3HJ
9Y4VU to W3EVW
9Y4VV to K9KXA

SVØWZ—12104 Blaketon, Upper Marlboro, MA 20870

*VK3AOK—Box 110, Blackburn 3130, Australia

QSL HELP WANTED

VP2AAP—1972 XW8FA—1974

QSL Managers Available

W4DZZ W7VRO WA2JOC WB4NQG

QRP *(from page 62)*

Those of you who are interested can show up for the net. We had some very good sessions back during the years when the 80 and 40 meter nets were active. I will be quite interested in hearing from those of you who are definitely committed, (within reason), to a real effort at a revitalization of the 80, 40, and 20 meter QRPp Net schedules. Drop me a card letting me know your ideas.

News And Views

de . . . WB8OWM, Skip Westrich, 1309 24th St., NW, Canton, OH 44709: "Just worked KH6JHS QRPp to QRPp for 49th State. Now need only KL7."

Info and QTH's

As the two last letters indicate, it is periodically necessary to print some basic information, addresses of interest to QRPp newcomers.

QRP ARC I: *The QRP Amateur Radio Club International* is a 100 watt-and-under organization, but has encouraged QRPp activity by offering two awards for QRPp operators. (1) The *WAS-QRPp* certificate is offered to QRPp stations providing a log-list of qualifying contacts along with the usual statement attesting to the use of 5 watts and under, in making the contacts. I am not certain as to whether the certificate is awarded for the first 20 states, with sticker endorsements at 30, 40 and 50 levels, or not. The club has undergone some reorganizations and I'll be receiving further details in the future. (2) The *KM/W* certificate is awarded for working 1000 miles per watt of power. Application should indicate power level used in the qualifying QSO and distance covered. The distance (in miles) should be greater than 1000 times the power (in watts). The *QRP ACRI Newsletter* is finally being published again. Editor is WA2JOC, William W. Dickerson, 85 John St., Red Bank, NJ 07701. The club member is given a "QRP" number to be used in club sponsored QRP activities.

QRP activities

G-QRP-Club: The G-QRP-Club is an English organization dedicated to under -5 watts activities. At present, membership is at about the 300 level, mostly from the

U.K. The club publishes a newsletter *SPART*, which includes operating news, short technical articles, notes on operating activities, etc. G-QRP-C offers several awards. The *QRP Countries Award* basic certificate is awarded for 25 countries, with sticker endorsements at each additional level. The *Two Way QRP Award:* is for G-QRP-C members only, (anyone can join), and is for two-way QSO's when both stations use under five watts input. The basic award is for 10 countries, with endorsements for each 10 additional countries. (Ed Note: The G-QRP-Club unfortunately choose *input* rather than *output* power as the standard for QRPp work.) In addition, the club sponsors "Club Activity Weekends" periodically on 3540 and 7040 kHz. The G-QRP-C wins our full support and praise for the excellent work it is doing in Europe. There are a number of us U.S. amateurs who are members of the club and I'd encourage others to join. Write, (including SASE and IRC coupons 30 cents) to Rev. G.C. Dobbs, G3RJV, 8 Redgates Court, Calverton, Nottinham, GC14 6LR, England. *Milliwatt Awards:* Two awards initiated when *The Milliwatt* was in operation are still offered, and have been detailed in earlier issues of *CQ* and in stories about winners. *DXCC-QRPp* is offered to any station providing bonafide QSL proof of two-way contact with stations in 100 ARRL countries while not exceeding 5 watts output. *DXCC Milliwatt* is for working the same, while not exceeding 1 watt output. Applications should include 100 QSL's, log listing of contacts in alphabetical order (call signs), voucher attesting to compliance with power level, and a $15.00 fee. A large trophy (30 inches or so) is awarded to successful applicants. See earlier issues of *CQ* for stories on the winners of both awards. If possible, photos and a story can be included if the applicant is dead-certain that the QSL's comply with the ARRL list. Clearly show origin either from the DX station or his QSL manager.

QRPp Calling Frequencies

QRPp stations are encouraged to call "CQ QRP" and monitor the following frequencies: 3040, 7040, 14065, 21040, and 28040 kHz. These are the international calling frequencies. I've been pleased to hear European QRPp stations using them here. So, give them a try. And *call* CQ—if everyone listens, no one hears anything! Well gang, that wraps it up for this month. I'll be back in the U.S. in August, which is either now or next month, and you will be able to send in letters with a reasonable chance of me receiving them. Meanwhile, good luck QRPping and hope to hear some of you across the pond.

73, Ade, K8EEG/W0RSP

Personal Computing *(from page 57)*

system of storage, rather than a cassette, can store up to 90k bytes per disk. With 10 or 12 disks you can store everything you ever read, or with a full disk at a storage rate of 250k bytes per disk, you can store enough data to last for several years. All of these have higher costs, of course, and an improved system should be thought of some where along the way, but for now either the CHALLANGER IIP PET 2001, or TRS-80 will get you started in a more modest way.

Personal computing is a terrific hobby that will enhance your knowledge whether you want it to or not. It just seems to sink in fast. And if you have been thinking about buying an expensive video game, why not add a bit more money and buy something that will act as a video game *plus* all of the other features I have described? I think you will find the investment will be repaid in many ways over the years. I had no knowledge of the computer field when I backed into it, and am still in the novice stage, but with lots of reading, and asking questions of those amateurs that I find on the air are also into enjoying computers, I have reached the advanced amateur stage. My initial investment of $600 has been more than repaid in hours of enjoyment.

A final word on togetherness. Computer clubs are springing up like spring grass in many areas of the country. If you have some or lots of questions, why not try to find some club activity in your area? It usually can be found in the local computer store, or ask some of the people that you run across on the ham bands. These clubs are a great place to expand your knowledge with demonstrations put on by members, and manufacturer's representatives who want the community to know what is going on in their area. But what ever you decide to do remember that there is no substitute for hands on experience. Dive in and enjoy it. The folks here don't byte.

Troubleshooting *(from page 44)*

nections, tag each of the leads in order to make the proper connections when replacing the part. Be careful not to damage other leads by pulling or pushing them away.

Never remove or replace a solid-state device with the battery or power source connected to the set. Failure to observe this precautionary measure may result in damage to the device from surge currents, etc.

Although generally more rugged than the electron tube, solid-state devices are affected by electric shock, heat and humidity. In transistorized or etched wire circuits, use a narrow point or wedge soldering iron with a 25 to 40 watt maximum capacity. If the soldering iron must be operated from the a.c. line, an isolating transformer between the soldering iron and the line is recommended. Do not use a soldering gun; damaging voltages can be induced in circuit component parts.

Preshape and cut the leads of the new solid-state device to the proper length, using a sharp cutter to prevent undue stress on the leads entering the device. Pigtail leads should have a minimum clearance of 1/16 inch between bend and body of the device. Shape and bend required in a gradual curve. Sharp (90°) bends are not acceptable.

With the new part properly positioned, quickly solder the leads to the connections; whenever the wiring allows, use a heat sink (such as long-nosed pliers) between the soldered joint and the transistor. Make well-soldered joints. A carelessly soldered joint may create a new trouble and is one of the most difficult troubles to locate. Be careful not to allow drops of solder to fall into the equipment; they may cause short circuits.

When replacing power transistors, make sure that the heat sink has been replaced before applying power to the set. Failure to do so will cause the transistor to overheat and burn out. A typical power transistor mounting is shown in fig. 3.

After a part has been replaced, make any necessary adjustments and check the performance of the equipment to be sure that the original trouble has been remedied and that no new trouble has developed in the equipment as a result of the repair.

RTTY *(from page 42)*

You will quickly pick up the procedures used in a RTTY QSO.

As a sub-population of the amateur community RTTY-ers are, without a doubt, the most considerate, helpful and friendly. Don't be afraid to make mistakes, don't be concerned about typing too slowly and don't be worried about inexperience. We were all that way at one time. The big difference is that RTTY-ers don't seem to lose their sensitivity to new-comers after having become old-timers.

Most RTTY activity is found on 40, 20 and 15 meters, although there is activity on other bands, a large portion of which appears on two meters. However, the bulk of the activity is on twenty meters and that band is a good starting place. The usual hang-out is between 14.075 MHz and 14.1 MHz.

On weekends you can copy all the big guns of RTTY, including those very talented artists who send their *oeuvres* over the air.

The next, and final, installment of this series will discuss video RTTY.

QSK *(from page 54)*

pad to the junction of R116 and its .001 uF by-pass capacitor. Route the wire from the "S" pad along the cable harness entering the final amplifier compartment. Run it parallel to the red screen supply wire and close to the chassis. Solder it to the junction of R17, a 680 ohm, 1/2 watt resistor, and terminal strip P, lug 3.

Unsolder the black wire on the function switch F1R, pin 7. Bend this wire out of the way, as it will be used later. Solder the cathode, banded end, of a 1N914 diode or equivalent, diode D, in fig. 3, to F1R, pin 7. Keep the diode body as close as possible to the switch solder tab. Cut the free, anode, lead of the diode to 1/4" in length. Slip a piece of insulating tubing or spaghetti insulation over the free end of the black wire that was originally connected to F1R, pin 7. Solder the free end of this black wire to the anode or free end of the diode, D1, now connected to F1R, pin 7. Slip the insulation tubing over the diode lead and neatly position it so as to avoid shorts or stress on the diode body. Connect the remaining free wire on the cathode keying board coming from pad "SP," to the function switch F1R, pin 7. Route this wire as neatly as possible.

This completes modification of the transmitter for QSK.

Operation With The Modifications

To restore the transmitter to its original state, simply connect a jumper between the "+300 Volt" and "screen" jacks. The transmitter should then operate according to the Heath instruction manual. The "PTT" jack can be used with any external switch for manual operation of the VOX circuits, both in s.s.b. and c.w. Interconnection with the QSK is identical to that described for the Collins 32S-3[2], specifically fig. 11 of that reference. Follow the test and tune up procedures outline in references 1 and 2.

Crystal Filters *(from page 35)*

frequency by placing a small 10 pF trimmer across each higher frequency crystal (one for each crystal pair in both circuits). These trimmers are adjusted so that as a test signal is moved across the i.f. passband, a symmetrical bandpass, or as close to it as possible, is obtained. This can be done using a calibrator signal and slowly tuning a receiver about it while the S-meter readings are observed. The procedure is a matter of cut-and-try, especially in the case of the four-crystal filter. But, do not adjust the tuned circuit also while doing this. Especially in the case of the four-crystal filter, this can lead to confusion as the center frequency of the filter may be shifted. If the filter works satisfactorily without the symmetry adjustment, it is probably best to leave it alone and just enjoy the filter's performance.

A final note concerns the relationship of the filters bandpass to the b.f.o. frequency. If a sharp c.w. filter is used, the beat frequency at which a signal is heard while centered in the filters bandpass will depend on the frequency separation between the b.f.o. frequency and the center frequency of the filter. If a particularly sharp filter is used, one may want to change the b.f.o. frequency to obtain the beat frequency one considers most pleasant. To obtain increasingly sharp selectivity, one can in most cases switch in only one additional crystal (fig. 1) or two additional crystals (fig. 4) to bring the crystal frequencies closer together rather than complete sets of crystals, so long as the resultant beat frequency is acceptable. The same is true of SSB reception as long as the speech quality is acceptable except when b.f.o. crystals are switched for l.s.b. and u.s.b.. In this case when a narrow bandpass is utilized it generally will be found necessary to switch crystals by pairs to preserve good speech quality.

The crystal filters described can go a long way to improve the performance of many pieces of equipment while doing it in an economic manner. They can be fairly easily implemented if one first carefully studies the i.f. chain characteristics in a piece of equipment and then decides on the desired crystal frequencies. CQ

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CERTIFICATE FOR PROVEN Two-Way Radio Contacts with Amateurs in all ten (10) call areas. Award suitable to frame and proven achievements added on request. SASE brings TAD data sheet from W6LS, 2814 Empire Ave., Burbank, CA 91504.

MEDICAL: Any licensed amateur radio operator in the medical or paramedical field should join MARCO (Medical Radio Council). Contact: Stan Carp, M.D., K1EEG, 44 Main St., Saugus, MA 01906. (617) 233-1234.

LOOKING FOR old Lionel trains. Interested only in "O" gauge, excellent to like-new condition. Primary interest is locomotives prior to 1952 but will consider conplete sets or more recent models. Am willing to buy outright for cash or swap radio gear to meet your needs. Write: Dick Cowan, WA2LRO, c/o CQ Magazine, or call (516) 883-6200.

FOR SALE: Spectra Physics 137P 2mw laser tube, brand new, never used, $80. G.R. 572B 1 kHz Hummer $15. Irwin Math, 320 Northern Blvd., Great Neck, NY 10021.

FOR SALE: Old issues of Ham Radio, CQ, 73, QST. Some complete runs. Send s.a.s.e. for lists and prices. A. Dorhoffer, K2EEK, CQ Magazine, 14 Vanderventer Ave., Port Washington, NY 11050.

HW-202 w/built-in Sandlin scanner, crystals; ITC Multi-2000; Bearcat 101 scanner. All good condition. Karl Thurber, W8FX/4, 233 Newcastle Lane, Montgomery, AL 36117.

WANTED: Extra coils for SW-3 receiver. I have odd-ball coils and need your single extras to make up complete set. Buy or trade. Bill Orr, W6SAI, c/o Eiamc, 301 Industrial Way, San Carlos, CA 94070.

SELL: 2 meter FM Sonar transceiver, AC P/S, mobile bracket $175. Heath HW-32A with sapre tubes $65. George Pataki, WB2AQC, 34-24 76th St., Jackson Hgts., NY 11372.

WANTED: Commercial type 50 ohm dummy load, 2 kw or greater. Rod, W7OM, 5632 47th Ave., SW, Seattle, WA 98136.

SALE: Sony ICF-5900W multi-band receiver designed for SWL's. Like new condition w/manuals. $100. Schultz, W4FA, Box "L", FPO New York 09544.

SSTV AND PHOTOGRAPHERS—Make offer; 1 each, like new, Fujitar lenses-135 mm, f 4.5, Telephoto 35 mm, f. 3.5, wide angle. Cary Cowan, c/o CQ Magazine, or call (516) 883-6200.

SELL: CQ Magazines complete. Reasonable offers, cash or trade. Nagle, 12330 Lawyers Rd., Herndon, VA 22070.

WANTED: Pre-war issues of Short Wave Craft Magazine. Bill Orr, W6SAI, c/o Eimac, 301 Industrial Way, San Carlos, CA 94070.

WANTED: Collins 51-R receiver (VHF). Bill Orr, W6SAI, c/o Eimac, 301 Industrial Way, San Carlos, CA 94070.

WANTED: Antique Glass-Looking for old milkglass-purple, slag, carmel, and greentown. Tell me what you have. I pay the highest prices. Write: Jack Schneider, c/o Cowan Publishing Corp., 14 Vanderventer Ave., Port Washington, NY 11050.

COLLINS KWM-2 and 516-F2, Wing Emblem. Waters, $800. CX7 CW (400Hz) filter, $100. 5-inch TV Monitors. Bob Sullivan, N$RS, P.O. Box 6216, Arlington, VA 22206. (703) 430-3155.

SALE: Heath IM-28 VTVM kit. New, perfect. Ordered by mistake. $40. Schultz, Box "L", FPO New York 09544.

The book "CQ YL" has been updated again with a new supplement bringing the YLRL Officers section up to date through 1977, plus a report on the 7th International YLRL Convention held in Houston in June 1976. If you have a copy of "CQ YL" and would like to add the new supplement (the pages are "slotted" so they can be inserted directly into the book's spiral backbone), drop a note with your request to author/publisher Louisa Sando, 9412 Rio Grande Blvd., NW, Albuquerque, NM 87114. Please enclose $1.00 to cover the cost of printing and mailing. The one and only book about YLs in ham radio, "CQ YL" contains 23 chapters, over 600 photographs. Order your autographed copy, or a gift copy, from W5RZJ, $3.50, postpaid.

HRO 50 OR HRO 60 WANTED, state condx. and cost. JA8LXQ, Tsuyoshi Yamada, 3-Kotobuki, Kitami City, Hokkaido, Japan 090.

CQ BUMPER STICKER reads, "dahdidahditdahdahdidah". Send $1.00 to: D. Mollan, WB7FDE, 780S N.E. 147th Ave., Vancouver, Wa. 98662.

LINEAR AMP 80-15 meters, 1600 watt p.e.p. G.G. on ARC 5 chassis, fan, ant. relay, roller inductor, four 6KD6 tubes with lifetime warranty. Separate 1000 volt power supply, current and voltage metering works great! $125- or trade? Prefer pickup, but will ship at your expense. WA2HFN, D. Krakowsky, 150 Kearsing Pkwy., Monsey N.Y. 10952. 914-425-0360.

MUSEUM PIECE. KAAR conelrad. Every radio Museum should have one. Like new $150.00. W0CVU, C.W. Boegel, 1500 Center Point Rd., N.E., Cedar Rapids, IA 52402.

WANTED: Junk HW-101 mainly VFO and Dial mech. Sterling antique tube tester, make offer. Tim Cook, WA2LZZ, Maple Grove Trl. Pk., Marcy, N.Y. 13403.

SELL: Drake TR-3 DC, AC Power Supplies, microphone, just factory serviced. $425.00. Paul Walhus, 12385 Mays Canyon, Guerneville, CA 95446.

BACK ISSUES: CQ, 73, QST. Free for 39c postage. SASE for list. G. Gargiulo, 17 Whitney, East Hartford, Ct., 06118.

RCA MODEL TK-60A studio broadcast television cameras like-new physically and electrically. Make offer for 2-packed. G. Alfred Dodds, P.O. Box 25, Brunswick, OH 44212.

COLLINS 75A1- Beautiful cond. w/spk. and orig. manual $110.00. Halicrafters SR 46 6 mtr. AM transceiver, w/remote 6 & 2 VFO and crystal $45.00. Andrew Minutello, WA2-RSU, 114-58 118 St., South Ozone Park, N.Y. 11420.

CALLBOOKS MAGS . . . Will pay $5.00 for 1977 issue. H. Anderson, 816 N. Cedar, Colorado Springs, CO 80903.

HAM GEAR WANTED: Complete station also linear and home brew linear parts reasonable for cash. F.E. Coble, 251 Collier Ave., Nashville, TN 37211.

HAMMARLUND HQ-170A nice $160, Heath DX-60, HG-10, $90, HR-10B $50. W0XD, 314/686-1353 after 5:00 C.T.

GONSET G50 6m $75 and sip. Want HA2 or other 2m xvrtr and 8/13 ft. spreaders. Scanlon, Big Lagoon, Trinidad, CA 95570.

NEED: Someone to build a 2 kw Heathkit. Inquire to: Tim Kaulfuss, 14011 Arara Ct., Glenwood, MD 21738.

WANTED: Hallicrafters HT-44, HA-10 any National receiver, working or not. T.N. Colbert, 1800 Rhodes Rd., No. G12, Kent, OH 44240.

WANTED: One Yaesu FRG-7 reciever. New or used will make offer. Adding it to my CB base station. I already have a Realistic DX-160 receiver. Art Williams, Jr., 576 Springtown Rd., New Paltz, NY 12561, (914) 658-9467.

FOR SALE OR TRADE: Simpon 270 VOM $25. Trade for Swan VX-2 VOX. WD4NZL, 938 Grove Park Dr N., Orange Park, FL 32073.

WANTED: National NCX-5 MKII. State condition and price. George Moynahan, W6AXT, 133 Piazza Way, San Jose, CA 95127.

FEW NEW COAX Relays only $5 each. 12v DC, use up to 550 MHz. W4API, Box 4095, Arlington, VA 22204.

ICOM 21A with digital VFO for 2 meters FM excellent condx, $500. Firm. J.P. Johnson, WB4BYO, P.O. Box 26037, Jacksonville, FL 32218.

WILL Give $100 for factory wired Atwater Kent "Breadboxed" in restorable condition. WB1BVO, 22 Forest St., Branford, CT 06405.

SELL: New Ten-Tec KR5-A Electronic Keyer $30. WB2MJQ, Box 490, Chester, NY 10918.

FOR SALE: SB614 Monitor $140, MFJ CW filter, $20; Sencore FC45 lab counter, $350. Tempo One w/AC and w/DC mobile $450. All equipment new. WD0APV, 7429 Frederick, Omaha, NE 68124, (402) 397-2461.

HAVE TWO 4800 volt plate transformers for sale, too heavy to ship. Need a 200 watt all band c.w. transceiver. Guz, WB2EZU, S-5084 Chapman Parkway, Hamburg, NY 14075.

WANTED: Kenwood 700-S. Sell 4-1000, Alu socket and chimney $100, Sola 7.5 v 45 amp fil. Xfmr $25, 4 Hy 2 A choke $30. Paul Bittner, W0AIH, 1616 South St., Eau Claire, WI 54701.

GALAXY V $180, AC400 power supply in speaker case matches Galaxy $85. Galaxy V VFO (RVI) $50. Heath Fone patch, HD15 $31 (brand new) DX-40 $35. VFI $15. $385 takes all, you pay shipping. K1HXA, F.A. Todd, 11 Valleyview Dr., Merrimack, NH 03054.

QSL CARDS: Your custom design using samples for ideas. White, coated card stock. Send s.a.s.e. (business envelope with 24 cent stamp) for free samples. Marv Mahre, W0MGI, 2095 Prosperity Ave., St. Paul, MN 55109.

FOR SALE: Multi-2000 two-meter transceiver; Johnson 275W matchbox w/SWR; other goodies. SASE for list. Karl Thurber, W8FX/4, 233 Newcastle Lane, Montgomery, AL 36117.

FOR SALE: Eico 753-7520751-CAL $200, Com IV 6m $50, SR34AC $150, Globe Hi-Bander $40, JRC425 $30, Bendix PAR-80 $30. All with manual, all in excellent condition. J. Bedlovies, 30 Ridge Street, Milford, CT 06460.

FOR SALE: Surplus RT-68/GRC receiver - transmitters. 38 to 54.9 MHz. 16 watt FM, with tech. manual $45. Fred Vanpala, 7064 45 Ave., Woodside, N.Y. 11377.

ROTARY SWITCH 4P11P 5/$5; 6P11P 5/$7.25, Dip Switch 10-SPST 10/$15., Transf. 12.2VCT 6A plus 8.5V-5A $6.95, 24V-5A $5.95, 10' RG58C/U 12/$10. Fertik's, 5249 "D" St., Phila. Pa. 19120. 215-455-2121.

10 MTRS: Johnson 352 AM/SSB converted 28.510-28. 800 MHz. $130. Clem Duval, 33727 Brownlea, Sterling Hts., MI 48077. (313) 268-2467.

WANTED - SK 800B Socket and SK 806 Chimner for use with 4CX-1000A tube, Hugh Allen, W2BZ, 401 3rd Ave., Hoddon Heights, N.J. 08035.

DRAKE SSR-1 - Mint one year old. $220. David Mitchell, 1620 Young Rd., Lithonia, Ga., 30058.

SSTV Keyboard - W0LMD version $230.0C, W2WHK, 210 Utica St., Tonawanda, N.Y. 14150. 716-692-5451.

FOR SALE: Heathkit SB-200 Linear. Mint condition, spare finals. $310. Will ship. WB2-BNH (914) 963-0689.

SELL: ICOM IC-211. Less than one year old. Perfect condition. $625.00 postpaid., N5UX, 1432 Pamels, Hurst, TX 76053. (817) 282-0894.

NOVICE ALL-AMERICAN certificate: Work a novice in all 10 call areas. Send list and $1. WB6QBJ, 25 Rudnick Ave., Novato, CA 94947.

TRADE: 3 V02 car license plates for 24 hr. digital clock or kit. VE1RY, 144 Sussex Ave., Riverview, N.B. Canada, E1B 3A7.

MILLEN GRIDDIP Meter 90651 $75.00. Millen Ant. Bridge 90672, $55.00. Both in beautiful condition w/manuals. W1HDB/4, 307 Sunset Blvd., Helbourne Beach, FL 32951.

SRR 11A 14KC to 600KC $250. URR 27 110mc to 190mc $65 cont. tuning. GM550 WWV rec. $60. T282C 100w Xmtr. 200 to 400 mc $75. John Murray, W4DNN, 265 N.E. 173 St., N.M.B. FL. 33162.

NOVICE ALL-AMERICAN certificate: Work a novice in all 10 call areas. Send list and $1. WB6QBJ, 25 Rudnick Ave., Novato, CA 94947.

WANTED: Swinging Choke 4 to 16 Henry 350 Ma., K1DFC, Phil Carpenter, 4 Westwood Drive, Belchertown, Mass. 01007.

NOVICE NEEDS manual and schematic for Globe Scout 680A, Reply WD0FPL, 26 Westmark, Colorado Springs, CO 80906.

NEED A QSL MANAGER? Offering my services to any station or stations needing QSL manager. WB7SVN, Judy Worley, P.O. Box 14, Westport, Wa., USA 98595.

SELL: New tx tubes half price. List 25c Offers, BC348Q, BC375E, ART13, SX28, HT9, Collins 51R more. M. Lynn 10644-146 St., Edmonton, Alberta. Canada T5N 3A7.

FOR SALE: Collins 32S-1, 75S-1, 62S-1 and 30S-1; Lysco transmitter; teletype converter; and teletype 19. K2DDU days (914) 668-3534; nights (914) 337-8773.

WILL SELL OR TRADE- Mint U.S. Stamps, Plate Blocks, and Singles. Want Mexican Gold Coins, or 1 and 5 Peso Bills. Also have choice Philatelic autograph lifetime collection. L.B. Fuqua, W4WBD, Box 6 Maple, Eddyville, Ky. 42038.

JOHNSON 275 watt Matchbox w/s.w.r. ITC Multi-2000 2-meter transceiver. Other goodies list for SASE. Karl Thurber, W8FX/4, 233 Newcastle Lane, Montgomery, AL 36117.

FEW NEW COAXIAL RELAYS, only $5 each SPDT, 12v DC, go to 500 MHz. Use own terminals or solder in set. W4API, Box 4095, Arlington, VA 22204.

WANTED: Air system spclets for a pair of 4X150 tubes. W2KZ 103 Lou Dr., Depew, N.Y. 14043.

FOR SALE: Earphones: Trimm Dependable, Western Electric 500W, Pico, Calrad 85, Cannon Chief $5 each plus postage. Trimm Acme, Scientific, Army AMB HI Short cord. $2.50 each plus PP. Douglas, 2254 Pepper Dr., Concord, CA 94520.

BEARCAT 101 Programable Scanner Ex. cond. $150 (includes delivery) S. Romain, WA2NNQ 750 Donlon Pl., W. Hempstead, N.Y. 11552.

WANTED: Hallicrafters PS-150-120 AC power supply. Hugh McKnight, BOQ 6-337, U.S. Naval Station, Charleston, SC 29408.

WANTED: Heathkit model IB-2A impedance bridge, or similar. Heath SB600 state condition and price. WB8TYI, RR no. 3, Box 139, Big Rapids, MI 47307.

WANTED: Flexowriter 2201 Shop manual, numerical control manual, service notes, CW and RTTY uses. Len Guttersen Box 670, Beverly Hills, CA 90213. Ex-W9OYR.

QSLs Top Quality: Samples 25 cents each, includes rubber stamp info. Ebbert Graphics, Dept. 4, Box 70, Westerville, OH 43081.

OLD CQ's/QST from 1950's for sale. 25 cents each or best offer. SASE for list. N5UX, 1432 Pamela, Hurst, TX 76053.

SELL: Parts for xmtrs, linears. Capacitors, (vacuum, filter, air), meters, equip., all Prepaid. Large SASE for list. W7RGL, 8730 Ferncliff Ave., NE, Bainbridge Island, WA 98110.

SELL: Plug-in SSB-CW product detector for installation in HRO-60, HRO-50, NC 183D. $89.50 p.p. Maximilian Fuchs, 11 Plymouth Lane, Swampscott, MA 01907.

I am looking for the tuning drawers and schematic for the TMC communications receiver model FFR-3. Tell me the frequency, condition and price. L. Thomas, Box 201, Airdrie, Alberta, Canada.

WANTED: Bird wattmeter, HP VTVM, HP Audio osc., Collins s Line, 60-75-100 w.p.m. Gear shift for Model 28 tty. Richard Dawson, 1308 F Street, The Dalles, OR 97058.

DXers! Ham sentences in 54 languages on your QSL card get results. K3CHP's DX QSL Guide, $3.95. Joe Mikuckis, K3CHP, 6913 Furman Pkwy., Riverdale, MD 20840.

SELL: Heathkit IN-47 capacitor box and IN-37 resistor box. Both $18.00, Heathkit laboratory 5-inch oscilloscope 10-18, $70. All exc condition. FOB. K7BD, 103 E. Bartlett, Selah, WA 98942.

ROBOT Mon. 70D and 80A camera, A5, cables, books. W6WDL, 402 E. Plymouth, Glendora, CA 91740.

SALE: Kenwood R-300 SWL receiver, brand new in box. $250. G.W. Adams, P.O. Box 157, Stacyville, Iowa 50476, (515) 737-2120.

MINT TEK 35 MHz solid-state dual trace scope $975 cash or trade for FT301D/AC, TS820S or Drake line. OX5AP, Box 1179, APO New York 09023.

WIND POWER ENTHUSIASTS. "Windheads Net" meets Mon. and Wed. at 2130 MST on 3898 kHz. Check in with Net Control WD5 GQN.

WANTED: Wavemagnet antenna for Zenith models 7S529 to 7S559. Spevock, W8IEG, Route 2, Rivesville, W. Va. 26588.

WANTED: 4th edition ARRL Radio Amateur's Handbook published Dec. 1928. W9DDL/W9SS, 5006 N. Second St., Loves Park, IL 61111.

WANTED: Model 15 or similar printer, also want T.U. must be in good condition. Contact Mike, WA2ONF, (212) 261-6177.

ADVERTISER'S INDEX

NEW READER SERVICE SYSTEM

To speed information to you on products shown in CQ advertising, a new computerized Reader Service System has been designed. For additional information on a particular ad in this issue, tear out the Reader Service postcard bound between pages 84 and 85, and circle the numbers on the card which correspond with the Reader Service numbers listed on the INDIVIDUAL ADS. DON'T CIRCLE THE PAGE NUMBERS! Fill in your name and address, and mail. We'll have your information on the way in short order.

YAESU'S NEWEST RECEIVER
THE FRG-7000

The FRG-7000—Yaesu's newest receiver features improved selectivity, wider frequency coverage, digital readout, with Yaesu's superb quality of construction.

— SPECIFICATIONS —

Frequency Range: 0.25-29.9 MHz
Modes of Operation: AM, SSB, CW
Stability: Less than ±500 Hz drift for any 30 minute period after warmup.
Sensitivity: SSB/CW-Better than 0.7uV for S/N 10dB AM-better than 2 uV for S/N 10dB (400 Hz 30% modulation)

Selectivity: SSB/CW ±1.5 KHz (−6dB), ±4 KHz (−50dB)
AM ±3 KHz (−6dB), ±7 KHz (−50dB)
Power Requirements: 100/110/117/200/220/234 VAC, 50/60 Hz
Power Consumption: 25 VA
Size: 360 mm (W) × 125 mm (H) × 295 mm (D)
Weight: approximately 7 kg.

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CIRCLE 52 ON READER SERVICE CARD

EIMAC tubes win a place in Rockwell-Collins' HF-80 systems.

Rockwell-Collins chooses EIMAC tubes again.

To power their new HF-80 family of 1 to 10 kW hf single sideband radio equipment, Rockwell-Collins needed tubes as well-constructed and reliable as the HF-80 system itself. That's why they went with EIMAC, the way they have for every hf system they've built since 1958.

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The new HF-80 equipment ranges from operator-attended receivers and transmitters to fully automated, remotely located communications stations. The HF-80 is used worldwide in business, military and general government communications. So Rockwell-Collins needed tubes with worldwide availability and technical back-up. EIMAC's proven customer acceptance and well-established reliability were more pluses.

The HF-80 uses EIMAC's 4CX1500B at 1 kW, 4CX5000A at 3 kW, and 4CX15000A at 10 kW with EIMAC's 4CX350A as drivers.

CIRCLE 16 ON READER SERVICE CARD

For more information on what makes these and other EIMAC tubes so special, contact Varian, EIMAC Division, 301 Industrial Way, San Carlos, California 94070. Telephone (415) 592-1221.Or contact any of the more than 30 Varian Electron Device Group Sales Offices throughout the world.

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