amateur 73 radio

#122
One Dollar
November
1970

Amateur Radio News Page

November MCMLXX | Monthly Ham News of the World | 73 Magazine

ELEVENTH ANNUAL NOVEMBER ISSUE

Through thick and thicker 73 has, to the disappointment of its detractors, somehow managed to survive. This survival has frequently been quite marginal, as the gaunt but dedicated little group which publishes the magazine will testify.

One of the things that has kept morale high at 73 is the ability to publish humorous little items which are obvious only to the more intelligent readers, items such as the announcements of new certificates for amateurs contacting the editors of the other ham magazines, knowing full well that these chaps are inactive and have been either for years or life, and have their call letters as a subterfuge because they are editors.

It is an interesting statistic that 73 has, in its ten years of life, published almost as many technical and construction articles as QST has in fifty years! In its short lifetime 73 pioneered first the Nuvistor, then the transistor, and now the IC. The large number of articles published has allowed 73 to cover all aspects of the amateur radio hobby while still pushing the new developments such as ATV, RTTY, and FM.

The editorials in 73, though often accused of being anti-ARRL by League stalwarts who either have not read them or else have read them carelessly, are proamateur radio and anti any person or group who is doing badly by our Nell. Where the ARRL has done particularly despicable things such as at the New York World's Fair, in the Don Miller affair, and things like that, 73 is critical. Would you have it any other way?

No 73 Display At Hudson Convention

Despite assurances from several ARRL officials that a 73 display and booth at the New York Hudson Division ARRL Convention was out of the question, both the publisher and editor tried valiantly to convince ARRL Director Daniels to let the magazine in. He flatly and steadfastly refused to permit 73 to exhibit either in its own booth or in conjunction with any other exhibit.

Hudson Division ARRL members should be proud of Director Daniels' strength of conviction, no matter what fairness and decency would seem to demand of him.

ZA2RPS COMES THROUGH

The OH2BH expedition to Albania in August was over almost before it started, with under 800 contacts made before being shut down by authorities. Thus not too many amateurs were convinced that Frank Turek DL7FT would be able to pull off his promised try at getting on from ZA.

As reported in the West Coast DX Bulletin, Frank was supposed to start operation about September 14, but was only heard for a short time. The rumor mills started grinding at full tilt. 1. He would be on CW only. 2. He would favor California stations. 3. He was back in Germany and being worked from home. 4. His papers were not in order and he was not allowed into Albania. 5. He was on the air but from outside Albania. 6. The transmitter was giving trouble. It was a tense time for the DX'ers indeed.

On September 15th Frank and DJØUJ opened up full bore and spent full time working everyone available until 0800 Friday (18th). Few serious DX'ers missed working Albania this time.

EYEBANK DEFIES FCC

In spite of the notice of illegal operation issued to operators of the renowned eyebank net by the Federal Communications Commission, the net is continuing to function routinely. The FCC says the eyebank net is illegal because it was formed originally by the Lions Club, a nonamateur organization. But hams don't agree with the ruling. "Public opinion," says one amateur, "is on our side. . . When the FCC gets enough power to jeopardize the lives of American citizenry, things are bad, but when the Commission actually uses that power, things are intolerable." The only way to bring the matter to a head, he indicated, was to ignore the FCC ruling and wait for the fireworks.

In Washington, FCC staff members are themselves more than a bit embarrassed by the situation. James Barr, chief of the FCC's Safety and Special Services, blames the hams for the predicament. It was a ham who brought the whole thing about, he said, because he wanted a literal interpretation of a somewhat ambiguous ruling. "Somebody asked a question and we had to give a straightforward answer. . . It would be better if they didn't ask the question."

Some hams, though, throw the blame back on Barr. His interpretation of the ruling, they say, borders on the sublime. As one noted amateur spokesman puts it: "The Fed has got to reach way, way out for an interpretation that prohibits nets used in the public service, particularly in view of the fact that ham radio exists for the sole threefold purpose of 'public service, convenience, and necessity'."

"Which of the ham magazines would be interested in a news item about me flunking the General 73 times?"

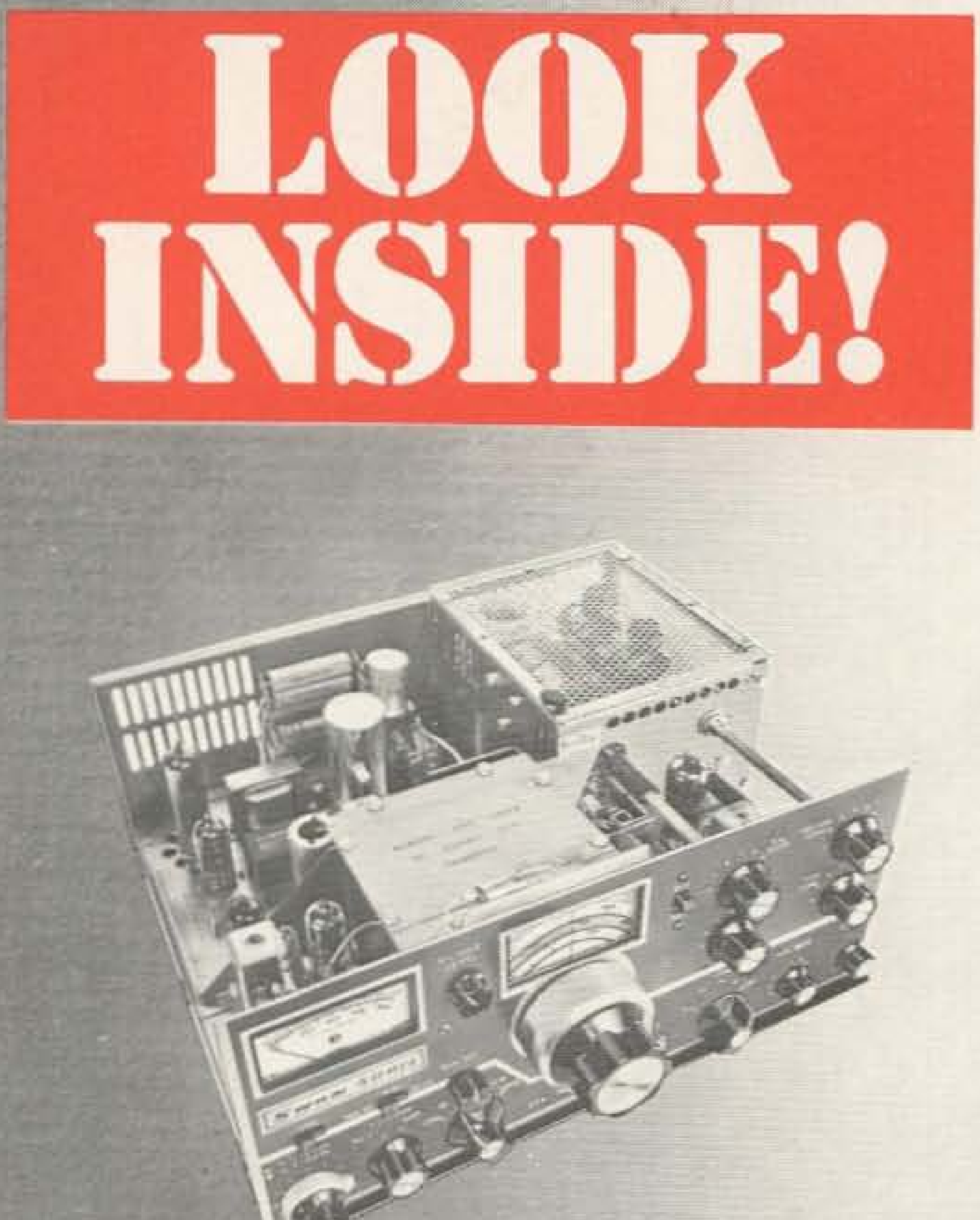
Y I MAY BE ACTIVATED

Iraq is now the most unworked country in the world and, considering the Mideast situation, activity there at this time seems unlikely. Martin OH2BH promises to make a major try ... on from the Finnish embassy ... ber 17. This boast might be dismissed if it were not for his history of coming through on these promises. Martin was the first one to make it from Albania in many years and his operation there, followed by DL7FT, took ZA off the most wanted list for just about all of the top DX hunters. The October 17th pileups are frightening to contemplate.

Martin expects to be accompanied by OH5SE and they will stop off in Lebanon for a week before going to Y1. One more document is being awaited before everything will be complete. The DX fraternity is getting edgy, beam headings for Iraq are being posted on operating desks, and airmail envelopes for the QSLs are already being addressed in expectation.

IN THIS ISSUE:

- NOVICE XCVR PROJECT
- LOW-COST KEYER
- BUILD A WATTMETER
- GENERAL STUDY GUIDE



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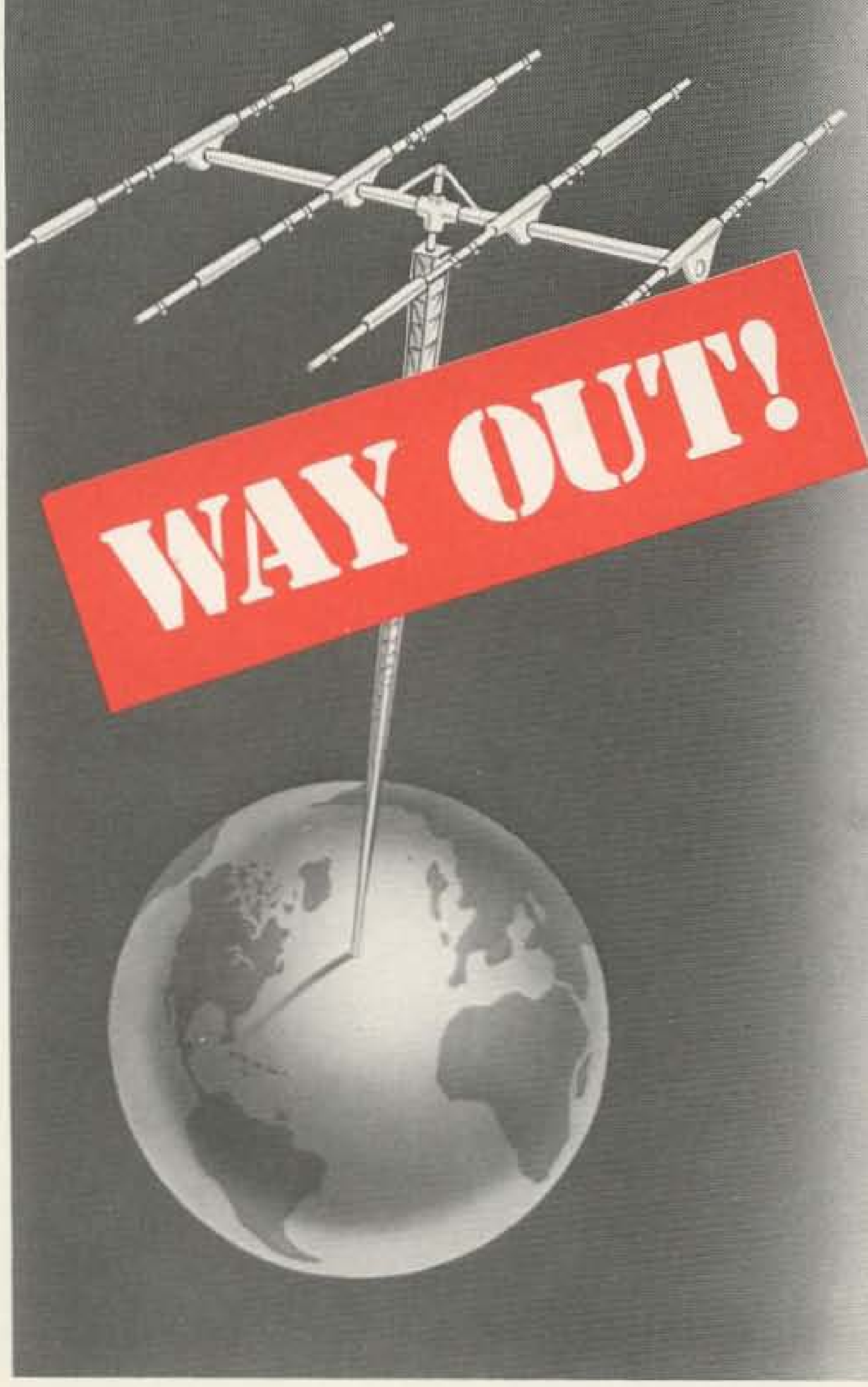

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4 element Model TB-4H $169
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3 element Model TB-3 .... $119
2 element Model TB-2 .... $ 99
Vertical Trap Antenna, Model 1040.... $59.50

SWAN
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305 Airport Road Oceanside, California 92054
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#122 November, 1970

73 amateur radio

Features

Contents

73 Magazine is published monthly by 73, Inc,. Peterbcrough, New Hampshire 03458. Subscription rates are $6 for one year in North America and U.S. Zip Code areas overseas, $7 per one year elsewhere. Two years $10 in U.S. and $12 overseas. Three years $14, and $16 overseas. Second class postage paid at Peterborough, N.H. and at additional mailing offices. Printed at Menasha, Wisconsin 54952 USA. *Phone: 603-924-3873.* *The magazine would be a whole lot thicker if you would let manufacturers know that you appreciate their support of 73. We could print a big lump of pages and go out in a glorious blaze of bankruptcy, but we prefer to be conservative and give you the number of pages the ads will pay for. If you can help convince advertisers to use 73 you will have a bigger and more enjoyable magazine. If you let them advertise in the other magazines instead then you get skinny reading.*

Amateur Radio News Page

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NEW PROPOSALS FOR ITU AIRED BY FCC

The latest Commission proposals for presentation to the 1971 World Administrative Radio Conference (WARC) of the International Telecommunication Union (ITU) to be held in Geneva, Switzerland, in 1971 have been issued by the Commission in Docket 18294.

A proposal by educational grouns to allocate the 108 MHz frequency band for FM direct satellite broadcast was rejected because the Commission said that the signal from the satellite would represent a potential interference source over roughly one-third of the world. The current U.S. proposal covers a multiplicity of channels in the 88–100 MHz band.

A proposal suggested by some educational groups to reserve the 470–890 MHz band for direct satellite-to-home broadcast, the Commission stated, is consistent with the Commission's footnote accommodation of television broadcasting from space in the frequency band 614–890 MHz.

The suggestion by these groups to reserve the 2500–2690 MHz band exclusively for educational TV, public TV services, and other educational and noncommercial communications was not adopted by the Commission. Comments were invited, however, with respect to definite proposals to use this band in a manner compatible with other existing or proposed uses.

designated non-Government communication-satellite service bands for use as up-links.

The Commission retained in its proposals for the broadcasting satellite service a definition of the term "direct reception" as encompassing both individual reception by members of the general public and by those engaged in community reception-group viewing or listening. The Commission explained that its proposal visualized an evolutionary process beginning as a communication-satellite service to conventional earth stations for program distribution, progressing to a process in which service could be rendered to smaller earth stations for local distribution systems, and finally becoming a direct satellite-to-the-home service.

The Commission modified its proposals to include the requests of amateur radio service organizations that power flux density limitations not be imposed against the service, but that the service be governed by the normal constraints inherent to secondary status and regional allocations under which they have conducted terrestrial operations over the years – with the added stipulation that space techniques be permitted in the shared bands only if a reliable means of telecommand is provided to control emissions so as to prevent interference to stations of a primary service in the band. The Commission also suggested that amateur groups be given authority to use exclusive worldwide bands in the high frequency spectrum for space applications.

To minimize the probability of radio interference to space and planetary studies by radio astronomers, the Commission proposed that the WARC adopt a resolution urging the ITU member governments not to transmit from spacecraft in certain frequency bands in the region above the earth's ionosphere or from locations that could cause interference on the far side of the moon. It also suggested that the band 21.850–21.870 MHz be allocated exclusively to the radio astronomy service.

Interested parties were invited to file comments on these proposals by September 23, 1970, and replies by October 5, 1970. The Commission said it anticipated that the formal United States proposals would be transmitted to the Secretary General of the ITU on or about January 1, 1971, and that it would not expect to give favorable consideration to requests for extension of time for filing comments.

FCC Waives Third-Party Rule For Australis-Oscar

The U.S. and Australia have agreed to a temporary exemption to the international limitations on third-party communications, the FCC says. Chief James E. Barr, FCC Safety and Special Services Bureau, confirmed the exemption in a letter to E.J. Wilkinson, the director general of Australia's version of the FCC.

Barr said the waiver would be valid "between certain Australian amateur stations and United States amateur stations to permit the exchange of information on matters relating to the next amateur satellite experiments." The arrangement is effective now and will remain in effect until "four months after the satellite ceases to transmit."

HAM LOSES FIGHT TO KEEP ANTENNAS UP

The current U.S. proposal for the use of the 2550–2690 MHz band contemplates space-to-earth transmissions in the earth sciences satellite service, with one or two sophisticated earth stations, remotely located, using extremely sensitive receiving systems capable of using power flux densities well below the sensitivity of Instructional Television Fixed Service receivers; and, in the 2500–2550 MHz band, communication satellite operations in Alaska, space-to-earth. In each case, the band would be shared with terrestrial services.

Broadcasting network interests, commenting on Commission proposals, expressed general agreement with tentative U.S. proposals, but stated that they are exploring alternative domestic satellite and terrestrial program distribution systems and may comment later on frequency needs.

The Commission had proposed earlier that there be sharing between the broadcasting-satellite and communication-satellite services in the 11.7–12.2 GHz band, with the communication-satellite service limited solely to the distribution of television program material. It decided that limiting the communications-satellite service solely to the distribution of TV program material would waste spectrum space, in view of the uncertain status of the broadcast-satellite service, and removed the limitation from its proposals.

On the question of choosing an up-link to send program material to the satellite for broadcasting in another band allocated to the broadcasting-satellite service, the Commission said that since broadcasting is normally a Commission-licensed function, it had

FCC Denies Proposal To Change EXTRA CLASS Requirement

A petition by Anthony R. Gorgano requesting amendment of Sections 97.21 and 97.23 of the rules to delete the 20 wpm code requirement from the amateur Extra license examination has been denied by the Fed.

In support of his request, Mr. Gorgano argued that only 13 words per minute is required for an amateur Extra license under Article 41 of the Radio Regulations, Geneva, 1959. He contended that improvement in the amateur radio service and advancement in skills in communication are a result of new techniques and experiments such as amateur satellites, slow-scan television, facsimile and repeaters, and single sideband, and that these advancements in voice communications skills owe nothing to the ability to expertly send and receive Morse code.

The Commission said that although it agreed that the 13 wpm code requirement is adequate to comply with international regulations and that code ability is unrelated to voice communications, it would, nevertheless, continue its practice of expecting candidates for the highest class of amateur licenses to possess more than a minimum acceptable level of competency in the communicating and technical phases of the art.

Which leads one to wonder why the FCC does not require today's amateurs to be skilled in such other unrelated communications media as smoke signaling, semaphore, drum-beating, and letter writing.

When Mike Staal (K6MYL), of San Jose, California, was ordered to lower his antennas because of a normally unenforced ordinance, he applied for a variance. At a public hearing, the local planning commission denied his request.

So Mike appealed the decision and attended another hearing. His neighbors stated that his antennas "detracted from the character of the neighborhood." Under closer scrutiny, however, the neighbors were thinking beyond "character." Some complained of his antennas "causing garbled reception on TV, stereo, and radio sets."

A local newspaper reported that Mike had suggested to one woman neighbor that the interference might be attributable to inherent problems within her own electronic equipment. According to the lady, she paid $50 subsequently for "unneeded" repairs The local newspaper quoted the woman as summing up her feelings with, "He's a pest."

Mike Staal isn't standing pat just yet. He has engaged a local attorney–ham and intends to press the issue. He also has notified ARRL headquarters and requested the League's assistance. In a four-page letter to John Huntoon (League's general manager), Mike Staal capped his request for aid:

Nine times out of ten if a ham's neighbors can watch TV, and or listen to their hi-fi stereo systems in peace – what the ham does antenna-wise or otherwise is strictly ignored. I hope the League and headquarters can begin some action to change the events that are bound to occur if the present situation continues.

73 News Society Page

Trillium Weekend

November 20–21, 1970

Trillium Weekend contest will be held by The Ontario Trilliums from 0300 GMT November 21 (7:30 p.m. EST Nov. 20) thru 0300 GMT November 22, 1970.

The Trilliums being the host club will call "CQ TW." All others will call "CQ TOT."

Exchange signal report, name, QTH, and Trilliums will give their club numbers. CW and fone contacts will each count as 5 points. Low-power

1970 ARRL Roanoke Division Convention

The 1970 ARRL Roanoke Division Convention will be held in Raleigh, North Carolina, sponsored by the Raleigh Amateur Radio Society. Activities will begin on Saturday, October 31 and continue through Sunday, November 1. Governor Robert W. Scott will proclaim the following week (November 1 through November 7) as Amateur Radio Week in North Carolina in recognition of the public and community service performed by licensed amateur radio operators.

The convention, almost a year in planning, will include in its program a full variety of features to hold the interests of all devotees of amateur radio as well as their XYLs. Featured speakers will be highlighted throughout the convention, during both the individual programs and at the main banquet.

On Friday, October 30 from 1600–2200 EST, a talk-in to convention headquarters will be conducted on 75 meter SSB, 6 meter SSB, and 2 meter FM. The talk-in will continue from 0800–1200 EST on Saturday, October 31 for those arriving on that day.

Activities, commencing at 1000 EST on Saturday, October 31, will include items of interest such as a DX forum (hosted by the North Carolina DX Association), MARS programs, RACES and CD programs, manufacturers presentations, NET forum, FM and repeater discussions, state-of-the-art and space communications programs, and many more. Of particular interest will be the ARRL forum attended by Vic Clark, W4KFC, our

$2.75 per person with advance banquet tickets $8.00 per person, a total of $10.75. Registration at the time of the convention will be $3.00 per person and banquet tickets will be $8.50 per person, a total of $11.50 at the door. Due to a limited number of persons able to attend the banquet, tickets will be sold on a first come–first served basis so get your requests in early. Hotel reservations will be available for those desiring them and will be made and confirmed by the pre-registration committee on request.

Watch your mailbox for further announcements concerning one of the finest ARRL Roanoke Division conventions ever held. Plan to come to Raleigh, North Carolina's capital city, for the 1970 ARRL Roanoke Division Convention on October 31–November 1.

Annual Indiana QSO Party

This contest, sponsored by IUPUI Amateur Radio Club, will take place from 1900 GMT Saturday December 5 to 0600 GMT December 6, and from 1600 GMT to 2400 GMT on December 6. It is open to all amateurs. Same station may be worked on different mode and different bands. The exchange will be QSO number, report and state, province or country. Indiana may work other Indiana stations. Suggested frequencies: CW, 3535, 7035, 14035, 21035, 28035; PHONE, 3955, 7265, 14295, 21395, 28600, 50400 kHz. Scoring system: Score one point for each

TELEPHONE PIONEER QSO PARTY

by W2SNJ

The Stanley S. Holmes chapter of Ham Pioneers invites all telephone pioneer ham radio operators in the United States and Canada to participate in contacting as many individual members as possible and to reach members in as many different chapters as possible.

The QSO party will start at 1900 hours GMT, Saturday, December 5, 1970, and will end at 0500 hours GMT on Monday, December 7, 1970. All bands may be used and the same station may be worked on more than one band.

Phone User: Call "CQ Telephone Pioneers."

CW User: Call "CQTP"

Score one point for signal report exchange with a Pioneer in any chapter, and one point for exchanging reports with each different chapter.

Send log extract showing date, time, station worked, chapter name and number and contact number, not later than January 5, 1971 to:

Frank J. Wojcik W2SNJ
Stanley S. Holmes Chapter
Telephone Pioneers of America
100 Central Avenue
Keaney, New Jersey 07032

Swap Shop

Monroe County Radio Communications Association announces a Swap & Shop on M-50, 4 miles west of Monroe, Mich. Oct. 11, from 10 a.m. to 4 p.m. Doors open at 8 a.m.

multiplier of 1.25 for all transmitters running 150W CW, 150W AM, 300W PEP, and under.

Each Trillium station may be contacted twice. For example; one fone contact and one CW contact (same band), or two fone contacts (different band), or two CW contacts (different band). No cross band or cross mode operation allowed. CW contacts must be made below 3.725, 7.150, and 14.100.

Logs must show: date, time in GMT, RST, band and mode, TOT number, as well as name and address and claimed score. All logs must be signed by the operator.

Nonmember with the highest score will receive a Trillium Plaque. Each participant who submits a log (one contact will qualify) will be eligible for a lucky draw.

The TOT gals will operate all frequencies and modes on 80, 40, and 20 meters during contest time. If you can't find them, check the following net controlled frequencies. There will also be a mystery station in operation. Working the mystery station will give you 10 bonus points.

Frequency	Date	Time (GMT)
3.855	Nov. 21	0300*
3.685	Nov. 21	0200**
7.240	Nov. 21	1300
7.103	Nov. 21	1430
14.280	Nov. 21	1830
14.140	Nov. 21	2000
14.035	Nov. 21	2130

*7:30 p.m. EST Nov. 20)
**9:00 p.m. EST Nov. 20

Send logs to Betty Peterson VE3ASZ, 19 Innismore Cres., Scarboro, Ontario, Canada. Logs must be postmarked not later than December 31, 1970, and received not later than January 15, 1971.

Roanoke Division Director, and league officials from headquarters.

A flea market will be conducted all day Saturday with a CW contest, a homebrew contest, and a QSL Card contest on Sunday morning.

Highlight of the convention will be the banquet to be held on Saturday night featuring a well known and very entertaining speaker. Climaxing Saturday's activities, cerimonies of the Royal Order of the Wouff Houng, the amateur secret society of the ARRL, will be held at midnight.

Latest radio gear and related equipment from several manufacturers will be on display at convention headquarters during the day Saturday.

Girls, we haven't forgotten you. The XYLs are planning a fantastic luncheon, complete with speaker and mementos of your visit, followed by a shopping spree in Raleigh's modern North Hills Shopping Center, a completely enclosed. all weather center with inside access to all stores. Transportation will be provided to and from the Shopping Center. There will be a ladies hospitality room on Saturday for your entertainment with coffee, snacks, and a presentation by Merle Norman Cosmetics. In addition, a suite of rooms has been reserved just for the girls so you can freshen up, prop up your feet, straighten your seams, etc. Cost of the luncheon and transportation for the shopping spree is $3.50 for pre-registration or $3.75 at the time of the convention.

Convention headquarters is the Statler Hilton Inn, located at 1707 Hillsborough Street in Raleigh, just a short drive from all major highways into Raleigh.

While pre-registration is scheduled to close on October 20, registrations will be available at the time of the convention. Pre-registration will be

contact and multiply by the number of states, provinces, or countries. Out of state stations use the number of different countries worked for the multiplier. Awards: Certificates will go to the first place winner in each state, province, or country and first place in Indiana counties. A special award will be given to the highest scoring station in and out of state. The mailing deadline is December 31, 1970. Send your log to Contest Chairman, Thomas J. Thamann, WA9MXG, 5013 Nowland Ave., Indianapolis, Indiana 46201. For results please include SASE.

Book Review --

The Fifth Edition of SINGLE SIDEBAND FOR THE RADIO AMATEUR has been revised to include some up-to-date theory and practice. With a great deal of new material, a new emphasis has been placed on the application of solid-state devices in sideband radio equipment.

Among the thirty-odd articles (reprinted from QST) are those describing station accessories, receivers, phasing and crystal-filter SSB exciters, sideband transceivers and transverters, plus five linear amplifiers. One new entry is a solid-state transceiver covering the 80–10 meter amateur bands plus a communications receiver using phase-lock techniques.

73's evaluation: A useful book for the sincere SSB enthusiast with a penchant for building. But don't expect transistors and ICs on every page. The book is basically last year's model jazzed up with semiconductor circuits sprinkled sparsely hither and thither.

Donations $1.25 in advance, $1.50 at the door. Prizes, auction, free parking, many contests. Talk in: 146.94, 52.525, 50.4, 3.930.

RSO CONVENTION

The Windsor Amateur Radio Club will be hosting the annual Radio Society of Ontario (RSO) convention 1970 this coming October 23–24th.

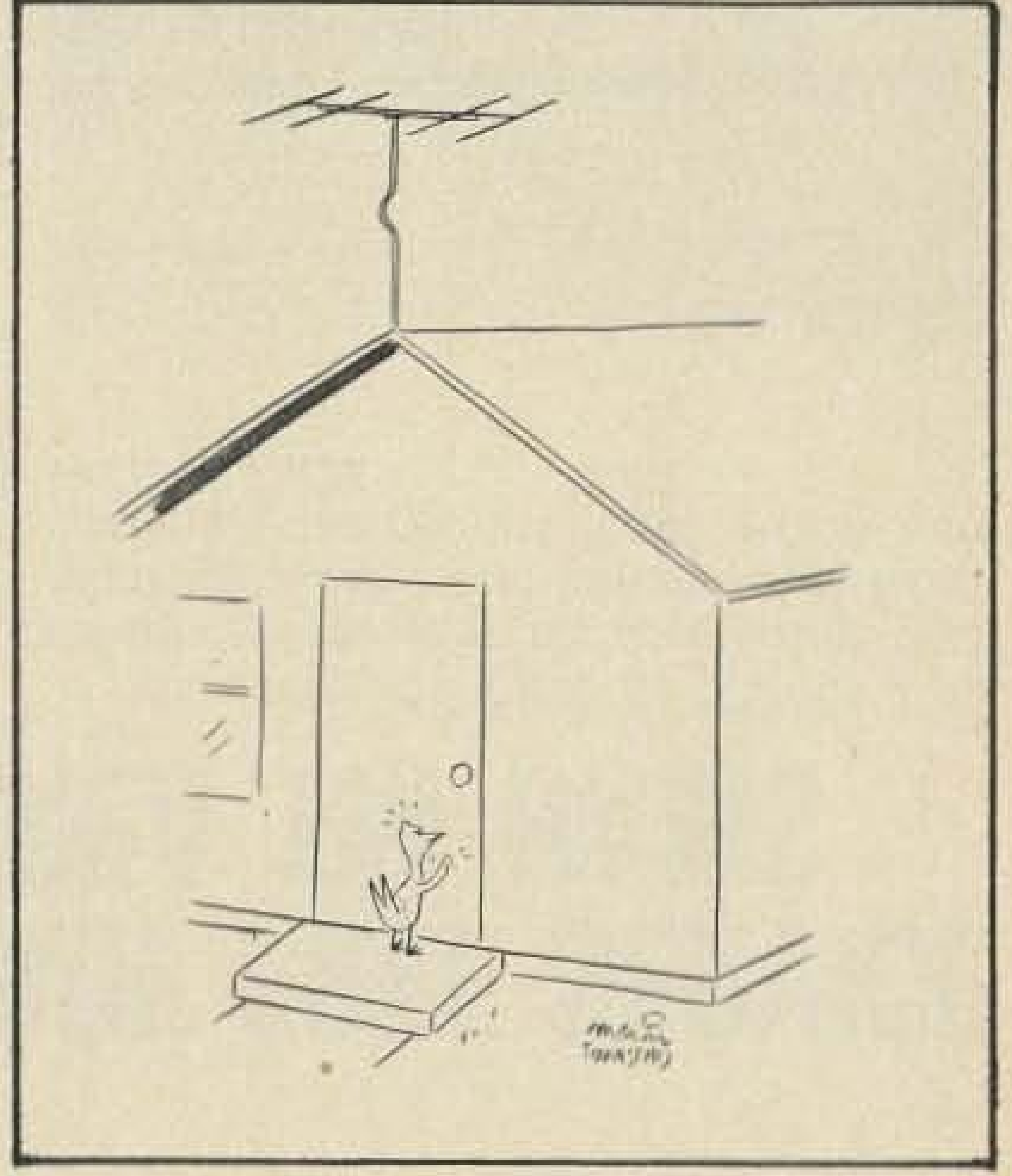
Date: October 23–24, 1970 (Fri. & Sat.)

Place: Holiday Inn, Riverside Drive, Windsor, Ontario, Canada. (Across the river from Detroit, Mich.)

Registration: OM, $4; YL, $3; Students, $2.

Talk-in stations on 75 and 146.94 FM. Programs for the ladies. Door prizes. Manufacturers' displays, etc.

Tentative forums include RSO, antennas, amateur TV, FM, servicing and homebrew, RTTY, solid state, and more.



Inter-Regional Allocations Changed By FCC

Parts 2, Table of Frequency Allocations, and 97, Amateur Radio Service, have been amended to incorporate the provisions of Nos. 117 and 156, and Resolution No. 10 of the 1959 Geneva International Radio Regulations for international contacts by amateurs in the 7000–7300 kHz band. The amendments become effective October 9, 1970.

In No. 156 (Table of Frequency Allocations – 10 kHz to 40 GHz) the 7000–7100 kHz band is allocated exclusively to the amateur service on a worldwide basis. The 7100–7300 kHz band is allocated in Regions 1 and 3 to the broadcasting service and in Region 2 (Western Hemisphere) to the amateur service. No. 117 requires that stations of one service in one region must not cause harmful interference to stations of another service in the other region or regions. Resolution No. 10 provides that inter-regional amateur contacts should be only in the 7000–7100 kHz band and that administrations should make every effort to see that the broadcasting service in the 7100–7300 kHz band in Regions 1 and 3 cause no interference to the amateur service in Region 2.

In its order, the FCC listed a seven-point rule change, as follows:

1. Among the International Radio Regulations adopted as a result of the Ordinary Administrative Radio Conference, Geneva, 1959, are Numbers 117 and 156. In No. 156, which incorporates the Table of Frequency Allocations – 10 kHz to 40 GHz, the band Regions or sub-Regions, a band of frequencies is allocated to different services having equal priority, the basic principle is the equality of right to operate. Therefore, stations of one service in one Region must operate so as not to cause harmful interference to stations of another service in the other Region or Regions.

2. Resolution No. 10 gives additional force and effect to Numbers 117 and 156, as they apply to the Amateur and Broadcasting Services. It resolves that inter-Regional amateur contacts should be only in the band 7000–7100 kHz and that administrations should make every effort to ensure that the Broadcasting Service in the band 7100–7300 kHz, in Regions 1 and 3, does not cause interference to the Amateur Service in Region 2.

3. To reflect these provisions in the Commission's Rules and Regulations, Part 2, Section 2.106, the Table of Frequency Allocations, is amended, and a new NG62 footnote is added following the Table.

4. Likewise, Section 97.61 is amended to delete the current "limitation (3)" as it now reads and to modify "limitation (4)." The new "limitation (3)" and "limitation (4)" incorporate the provisions of Numbers 117, 156, and the new footnote NG62 after the listing of the 3800–4000 kHz frequency band and after all of the listings of the 7000–7300 kHz band in the chart. Appendix 2 to Part 97 is also amended to include the text of Resolution No. 10.

CHANNELIZING MADE FREE SERVICE TO CHICAGO AREA FM HAMS

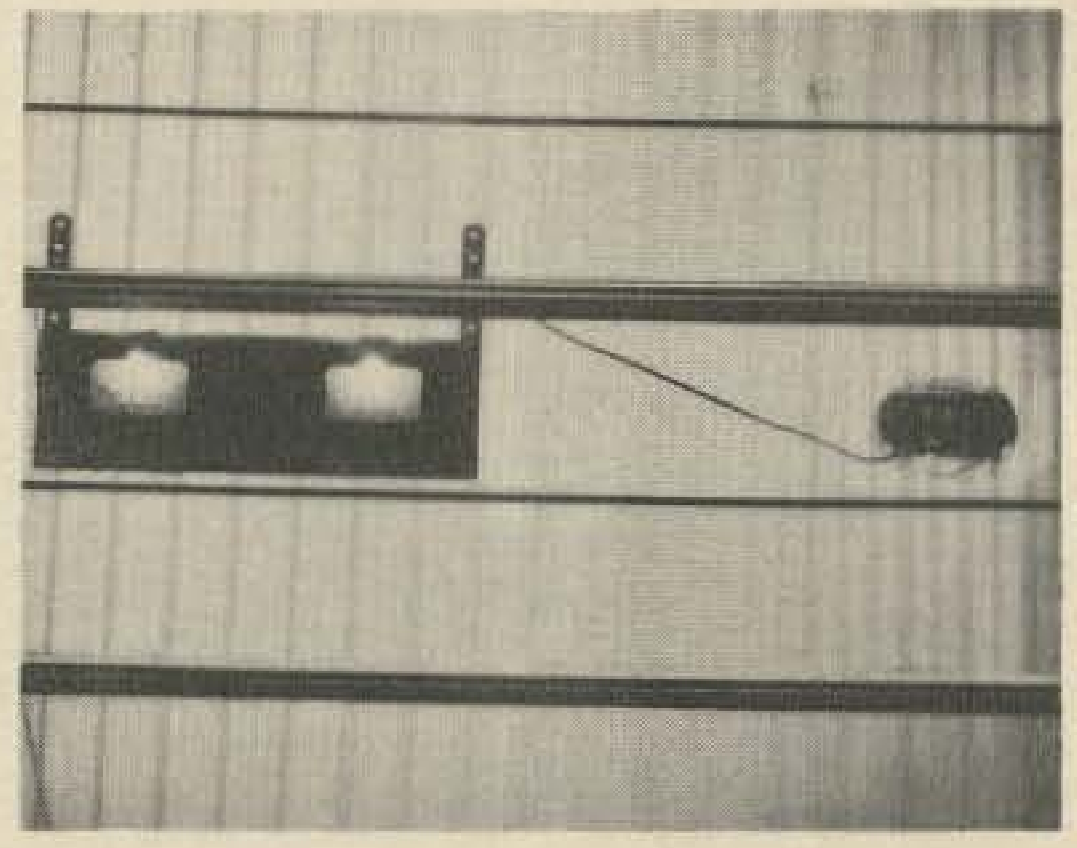
The people at Spectronics Inc., of Oak Park, Illinois, have initiated a unique little service that should prove appealing to the local 2 meter FM crowd. They have installed a well calibrated FM receiver in the store and connected two large easy-to-read meters – one to monitor deviation level and the other to indicate frequency.

They installed the meters near the front window of their store so that FM'ers can pull up in their mobiles and get accurate readouts of the two most critical transmit characteristics.

Art Housholder, manager of the firm, said the receiver in the store was always left on anyway, so why not allow it to be used by Spectronics customers as a standard?

Apparently, Spectronics' 2 meter FM customers approve of the idea, because there always seems to be a lineup of vehicles outside the window. It's kind of a drag, though, some customers complain. Parking is at a premium in the neighborhood, anyway; and local hams kind of feel guilty parking out fron and blocking the view when they're dropping in for no better reason than to buy something.

As one local puts it, "There's so many people coming and going that you really can't feel comfortable overhauling your rig out front unless you do it at 3 a.m.



Customers of Spectronics (near Chicago) can get their mobile FM units shaped up if they do it in front of the store. In the window are large meters to indicate frequency and deviation of strong signals.

7000–7100 kHz is allocated on a worldwide basis exclusively to the Amateur Service and the band 7100–7300 kHz is allocated in Regions 1 and 3 to the Broadcasting Service and that where, in adjacent

FCC Violators Get More Than Warnings

The FCC continues its crackdown on violations, and is toughening its bite, as the following actions will attest.

August 27 – JOHN W. SATTERTHWAITE, III, FAYETTEVILLE, N.C., licensee of amateur radio station WB4FOS. Ordered the license revoked, effective October 6, for repeated violation of Section 1.89 of the Rules by failing to reply to official communications (SS-302-70).

August 28 – MARTIN C. HIGGINS, LA CRESCENTA, CALIF., licensee of amateur radio station WA6AGX. Ordered the license revoked, effective October 7, for repeated violation of Section 308(b) of the Communications Act of 1934, as amended, and Section 1.89 of the Rules by failing to reply to official communications requesting information (SS-290-70).

September 3 – STEVE M. FRIED, BROOKLYN, NEW YORK, licensee of amateur radio station K2PTS. Ordered to show cause why the license should not be revoked for repeated violation of Section 1.89 of the Rules by failing to reply to official communications (SS-054-71).

GETTYSBURG OFFICE EXAMS TERMINATED

Effective September 4, 1970, amateur operator examinations will no longer be given at the FCC's Gettysburg, Pa., office. Alternate locations for examinations will be available at the Commission's offices at Balitmore, Md., Washington, D.C., and Philadelphia, Pa.

DOCTORS HONORED

At the recent annual meeting in Chicago of the Medical Amateur Radio Council, Ltd., six physician hams were awarded certificates of merit for service to the world via amateur radio.

Those honored were all MARCO members.

The Medical net meets every day on 7260 kHz at 0100 GMT, and 14.280 MHz at 0200 GMT for phone traffic, and on CW at 7060 kHz at 0230 and 14.060 MHz at 0230 GMT; the former on Mondays, the latter on Fridays.

The council is a charitable and scientific membership corporation to meet medical–electronic and radio communication needs. Its purpose is to establish personal communication among its members and their ham colleagues for dissemination of factual medical, electronics, and communication information both theoretical and practical. MARCO has members throughout the world who are either doctors of medicine, dentistry, veterinary medicine, or of other allied sciences. It also has other associate and affiliate members who are medical students, pharmacists, registered nurses, or in other allied medical professions.

First Modulated GaAs Injection Laser?

Ralph Campbell (W4KAE), of Lexington, Ky., announces that he has successfully modulated and detected an injection laser made of gallium arsenide. His equipment consists of an RCA TA-7610, whose nominal peak output is 10W operating on a wavelength of 9050 angstroms.

Pulse repetition rate was 8 kHz; transmitting optics an F/1.2 zoom projection lens, frequency modulated by voice and a Sonalert singing signal. The receiver was a United Detector Technology type PIN-6LC with CA-3035 integrated circuit (modified for video bandwidths) and a one-shot multivibrator for FM detection. Although previous range limit was 2.4 miles with a pulsed 7W (peak) unit, expected range of the newly developed equipment is up to 20 miles line-of-sight, with photomultipliers. Schottky-barrier photodiodes and FF600 fotofets are recommended for solid-state detection. Campbell is writing a book on gallium arsenide injection lasers, for publication in 1971.

Ham Auction

The Chicago Amateur Radio Club, W9CAF, will hold a ham auction on Sunday, October 25, 1970. Location is St. Viator Hall, 3608 N. Kedvale (3 p.m.). For info call CO-7-3724 or KI-5-3622.

EXPO 71

According to the latest Amateur Call Book, the number of new licenses has gone down in the past few years. The main theme of the Expo 71 exhibition will be to reawaken the interest in both the amateur in his hobby and also those of the public leaning in that direction.

Expo 71 will be a family affair, with a Kiddy Ride Park and Indian Village for the kids. A trailer camper area, and restaurant on the park site.

AMERICAN RADIO CLUB REGIONS

Charter applications have been received from several groups in response to the article on page one of the August Amateur Radio News Page of 73.

In the works are charter petitions from the following groups:

Lone Star Region (Houston, Texas)

Lincoln Trail Region (Urbana, Illinois)

Swampland Region (Metarie, Louisiana)

Gold Coast Region (Miami, Florida)

The American Radio Club will accept bids from groups of radio amateurs interested in establishing Chartered Regions of the Club. Send a list of the founding members (five or more), the area included in the Chartered Region and the name of the proposed Region to the American Radio Club, % 73 Magazine, Peterborough, N.H. 03458.

Classified

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January 1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

SOLID STATE VOM for sale. Triplett 601. Brand new, never used. Net $150, first $100 takes it. Prepaid. K. Grinde, 536 W. Hillsdale, Inglewood CA.

TOLEDO MOBILE RADIO ASSOCIATION'S 16th annual hamfest and auction will be held February 21, 1971, Lucas County Recreation Center, Maumee, Ohio. $1.00 registration. Open table sales. Map and info write: TMRA W8HHF, Box 273, Toledo OH 43601.

WANTED: Computer core memory. Send description and price wanted to: John Clements, 1125 Pacific St., Apt. 1, Bremerton WA 98310.

DRAGON FLY . . .antenna, for 20-40-75 meters . . .no traps . . .no compromise . . .eight months in development . . .one feed line . . .SWR one to one guaranteed. Construction drawings $5.00. Box 423, Wakefield RI 02880.

RBB-RBC MANUALS, New, $5.00; Used, $4.00. OS-8 oscilloscope manual, $3.00. Some QST 1929, 30, 31, etc. Radio 1939, 40, 41, etc. Write for list. James W. Holloway W6LFL, 2027 Harton Rd., San Diego CA 92123.

SELL: SX-100, speaker $110; Valliant $100; Apache $75; SB-10 $45. WANTED: AR-22 Rotor control. Bob Miller WA6MTY, 1377 Newport, Long Beach CA 90804.

HEATH HW-32-A, almost new; HP-13 supply, mike, and Newtronics mobile antenna — all for $110.00. Will ship: WA4TST, 507 Pinecone, Waycross GA 31501.

CHARTER JET FLIGHT to SAROC. Roundtrip New York City to Las Vegas $229.00, depart JFK 10:00 a.m. January 7th. Roundtrip Chicago to Las Vegas $199.00, depart O'Hare 12:00 noon January 7th. Return January 10th. Includes meals and drinks aloft, Flamingo Hotel Room three nights double occupancy, transportation and baggage in and out of Flamingo Hotel, dinner show, midnight show, Saturday buffet luncheon, Sunday buffet breakfast, SAROC tickets, tax and gratuity. $60.00 will confirm reservation, includes one dollar service fee. Final payment due before November 25th. Flight cancellation or written request for deposit refund will be accepted until December 1st. SAROC, Box 73, Boulder City NV 89005.

INSENSED AT INCENTIVE LICENSING? You and your club can actually do something about it. Send for free petition requesting incentive licensing apply only to ARRL members since ARRL proposed the changes. Send SASE to Committee to Preserve Amateur Radio, Box 99, Annapolis Junction MD 20701.

SALE: Pick up W2BDS "Big Bertha" plus rotator system, stacked 20m 646X, stacked 15m 532X, stacked 10m 523X, complete with phasing lines, remote controlled 8 pos. coax switch plus 40m 329X. Not everyone can afford, but — if you have desire and "mon" — come — take it away. Only $9,495.22 offered by M.D. Ercolino (201) 775-7254 before noon or (201) 531-4990 afternoon.

SB101 and HP23A. Factory aligned 8/69. Package with Turner 454X, bug, Heath swr bridge. Complete station, excellent condition; $275. WA2EWK, Kitchell Road, Convent NJ 07961.

SELL: Gonset G-76 transceiver 80 through 6 with ac/dc supplies, $195.00. WANTED: Collins 312B4. State price and condition. W7TMF, 1254 Heather Lane SE, Salem OR 97302.

FOR SALE CAP transceiver Heath HW-18-1 4602.5 and 4630 kHz. Assembled and tested never used. Insured and shipped for $120.00. J.D. Clowdus, Box 73, Springer OK 73458.

SUCCESSFUL HAMS invest in W6SAI Handbooks for top-man results! Cubical Quad Handbook, $3.95; Beam Antenna Handbook, $4.95; VHF Handbook, $3.95; Better Shortwave Reception, $3.95; Electronic Construction Practices, $3.95. Sold by leading ham dealers. On orders to publisher, please add 20¢ per book for handling/postage. Radio Publications, Inc., Box 149-C, Wilton CT 06897.

COLOR ORGAN KITS $7.50. IC power supplies $2.75 to $8.50. Computer grade electrolytic capacitors $.35. Xmtr transistor TRW PT3690 $2. Used variacs. Nuvistors. Catalog. Murphy, 204 Roslyn Ave., Carle Place NY 11514.

DERRICK ELECTRONICS will not be undersold on new Swan equipment. We'll beat any legitimate deal. Check around, then write. 108 East El Paso, Broken Arrow OK 74012.

WANTED! Numerous back issues of different radio magazines. Huge Free List. Trading old radio shows, airchecks, interested in commercial movie material. Thomas King, Auxier KY.

ROCHESTER, N.Y. will again be headquarters for the huge W.N.Y. Hamfest, VHF Conference and Flea Market, May 15, 1970.

Editorial:
An Old Timer Looks At The League

by George Brook Taylor W4PZS

Many of us feel deluded and disappointed in the way our hobby has been going the past few years. . .the League and its dictatorial policy toward its membership and its incompetent direction. . .the FCC for blindly accepting an injudicious proposal made by the League, that has resulted in the chopping up and cally motivated it cannot without bias represent its membership or the other U.S. amateurs in Washington.

Censorship in QST is enforced as in a military operation. Check it out. Write a clear sensible letter in opposition to one of their proposals, explain in careful detail why it will be detrimental, unworkable, or unfair. It will *never* be published! The membership has to be composed of Yes Men. If you want to get along in the League

REGENCY SCANNERS: Hi-band 8-channel $105, low-band 8-channel $109. With all accessories. Excellent condition. R. Coburn, PO Box 92, Manchester NH 03105.

SALE: Autronic keyer, key. Brand new condx; value $79.50, $19.95. Best offer by 15 November takes both. Rev. Windolph W9NHO, Quincy College, Quincy IL 62301.

RED HOT! 5RK Delta tri-bander — sensational break through in Delta Loop design. Proven outstanding DX ant. Highest quality — also heavy duty high performance quads. Check our low prices. Island Electronics, 4103 Ave. S, Galveston TX 77550.

GET YOUR "FIRST!" Memorize, study—"1970 Tests-Answers" for FCC First Class License, plus "Self-Study Ability Test." Proven. $5.00. Command, Box 26348-S, San Francisco CA 94126.

GONSETT COMMUNICATOR II for 2 meters. Asking $65.00 plus shipping. Sound electrically and physically. Edward Van Hise, 50 Gardenview Terrace, Apt. 9, Hightstown NJ 08520.

TRADE, SELL: SP-600-JX General Coverage Receiver (vfo & crystalled channels) for FM base station usable as repeater. O.C. Powell, 214 Chandler Rd., Goldsboro NC 27530.

ALLIED 5-band SSB transceiver and ac supply, A2517/2518 (reg. $450), new, only $325. R4B, new, $375. Sochor, 419 S. Euclid, Oak Park IL 60302.

BUY, TRADE, SELL: Used amateur receivers. Steven Kullmer, Evergreen Hatchery, Dysart IA 52224.

WANT TO buy or trade for I-177 tube checker. D. Plotter, 2844 San Gabriel, Austin TX 70802.

WANTED: Receivers for 160 and 2m. Examples: Ameco All Wave Rx; Allied A-2515; etc. W2SPB, 1325 Laurel Ave., Ocean NJ 07712.

SELL: Two Synchro tape machines (Remington Typewriter/Friden Tape/Card Punch and Reader) $150. Operation instructions and manuals for Friden units only. Some tape and cards included. Complete description in late 1968 issues of 73. Tektronix 511AD $95. Tektronix 514AD $150. Manuals, probes, and some spare tubes included. Richard E. Lee, 660 Poinsettia Ave., Titusville FL 32780.

TELETYPE PICTURES FOR SALE: Volume 2, 16 pages containing 50 pictures $2.00. Volume 3 coming $1.50. Also audio and perforated tapes. W9DGV-c, 2210-30th St., Rock Island IL 61201.

NOVICE CRYSTALS: 40—15m $1.38; 80m $1.83. Free Flyer. Nat Stinnette Electronics, Umatilla FL 32784.

GREENE . . . center dipole insulator with . . .or . . .without balun . . .see November 73, page 107.

SAROC January 7—10, 1971. Flamingo Hotel Convention Center, Las Vegas, Nevada. Sponsored by Southern Nevada ARC, Inc., Box 73, Boulder City, Nevada. Advance registration $14.50 per person accepted until January 4, regular registration at door, includes Flamingo Hotel Late Show and drinks, Sunday breakfast, cocktail parties, technical seminars and meetings, ARRL, DX, FM, MARS, QCWA, WCARS-7255, WPSS-3952, and WSSBA. Ladies Program. Flamingo Hotel SAROC room rate $12.00 plus room tax, per night, single or double occupancy January 3 thru 12, 1971. Mail accommodations request to Flamingo Hotel. Mail advance registration to SAROC. W7PRM, Club President, SAROC Convention Chairman.

DTL INTEGRATED CIRCUITS: Guaranteed new — gates 70¢, buffers 80¢, F/F 90¢, dual F/F $1.15. Add 20¢ for postage. Also other inexpensive parts. Lists & prices from Mitch-Lan Electronics Co., Dept. 1170, PO Box 4822, Panorama City CA 91412.

butchering of our already overcrowded bands. Yet, even with such catastrophic events we still have a wonderful hobby.

Much is heard today about the lack of growth of amateur radio. Incentive licensing undoubtedly accounts for this condition. After the League started this fiasco and caused widespread dissension in the amateur ranks, the hobby began to lose favor and attractiveness to the newcomer and many an oldtimer quit in disgust.

The FCC has proved by its actions it knows little about the amateur and his problems and cares even less. The amateur is indeed a second-class citizen as far as the FCC is concerned. Several independent polls showed amateurs to be overwhelmingly against incentive licensing. The FCC received thousands of protest letters that did not adhere to their 14 copy rule. The 14 copy rule may be necessary and correct for the application for a formal rule change. It should *not* apply to all correspondence, such as an expression of views by the individual licensee to the FCC. These should be given full consideration. Obviously they were ignored. This 14 copy FCC red tape should be cut.

A quarter of a million licensees should have representation on the FCC board. The FCC should revoke incentive licensing immediately. It is an unnecessary expense to the heavily overburdened taxpayer. It is wasteful use of the time of the FCC examiners when its *only* accomplishment is to inflate the ego of the licensee.

The League has proved its ineffectiveness to the U.S. amateurs in its refusal to open a Washington bureau and register as a lobby. We know the reason – they are afraid they may lose some of their government tax and mailing privileges they now unjustly enjoy. The League is so politi- you do what you are told.

Vote a good regional director into office. He starts making noise, adding up figures, asking embarrassing questions, opening closed doors, and he soon finds himself on the outside. You hear about the secret prior meetings, the demands, the deals, the instructions to the directors.

A few years ago the League made much about what a big annual million-dollar operation their publishing business had become; then a few months later, when they decided to solicit contributions and gifts for their new building, they suddenly became the poor-boy, never again was their big business mentioned or a financial report printed on their pages. You did find many bouquets, sweet bouquets scattered throughout telling how wonderful is the League. They harp endlessly how everyone that is not a member or a contributor to the building fund is a free-loader. The *League* is the *real* free-loader. They have been free-loading their writers and the U.S. taxpayers for years.

The League should *reform*, have its house thoroughly cleaned, and free itself of government subsidies and special benefits. Only then can it properly function and be a democratic organization fit to properly represent the U.S. amateur radio operators.

Until 1964 I wore my ARRL lapel pin with pride; but after that I became so ashamed of the League I removed it. To show the League my disgust for several years when I sent in my annual dues I asked for it to be a subscription to the magazine only as I no longer desired membership. Finally, in October 1967 when the FCC gratified the League by enacting the incentive licensing thing, that was for me the death certificate of the ARRL and QST.

NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

In this day of women's liberation movements perhaps we should examine our attitude toward our wives. Perhaps not. As long as they hold their jobs, bring home enough money to help buy a new rig now and then, bring the meals into the shack between schedules and don't plan nights out during contests, maybe we should agree with them.

A woman is as good at some jobs as a man any day. She is better at many. And if she is as good, why shouldn't she be paid just as much. Particularly if she is your wife.

Of course if you are the employer, then your perspective may be biased and you may have a poor attitude toward the argument. Employers tend to cloud the basic issues with irrelevant factors in order to justify their own greed or even their own subconscious wish to dominate women.

For instance some employers will plead that it takes an employee about six months on the job, man or woman, before they know their work well enough to function efficiently. The six month training period can cost the employer plenty as the result of errors. One wrong ad in a magazine and $400 to $600 goes down the tubes . . . or more if the advertiser cancels $6000 worth of ads as a result. The employee is sorry and promises to do better.

Once trained, what are the differences between a man and a woman on the same job? Very little in many cases. Lots in others. The employer has nothing whatever to worry about as long as the woman has no children who can get sick and need care, has a husband that is not going to get a job elsewhere, and does not get pregnant.

You may find this hard to believe, but I personally know of a publisher in New Hampshire who has a women's lib wife and pays man-type salaries to his women employees. So far this year three of his highest paid employees, girls that he trained for many months, left the state because their husbands moved. This is a poor example of company loyalty, admittedly, for the employer is out who knows how many thousands of dollars. If he'd hired men for the jobs they might still be there. The publisher is left wondering whether the equal pay policy isn't awfully one-sided.

Is the solution unmarried girls? Not on your buttonhook, these gals will get married at the drop of a proposal to the first bum that offers to rescue them from that miserable sweatshop where they while away their coffeebreaks, extended lunches, and rest periods. Seriously, though, many gals do bring the same sense of dedication and enthusiasm to their work as a man, even though they may realize that their true goal is bringing up their family and keeping it happy.

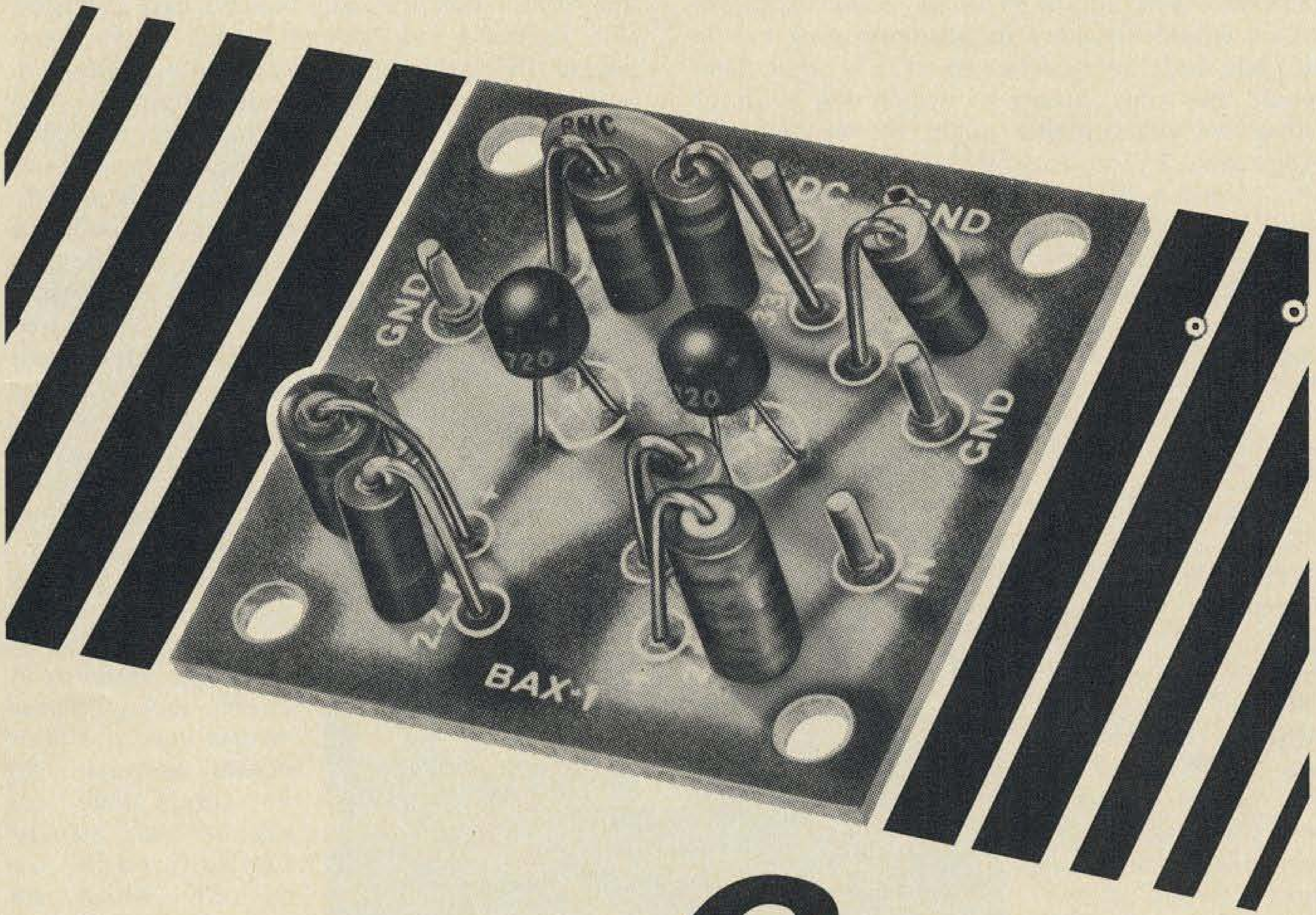
Women's lib will get a big shot in the arm when the girls can come up with reasonable answers for those misguided employers who figure that women should be paid less because they bring in less in the long run. Should men stay home with the sick children half of the time? Should men change their jobs if the wife gets a better job in another city? Should we start working hard on some practical system for the men to have the babies, thus freeing women from morning sickness and the delivery room? Or perhaps we are getting ready to go back to the old system where the woman stops work for a few minutes, has her baby, and goes back to work. Are we mollycoddling our women too much with this free vacation in the hospital arrangement?

Hear! Hear!

One nice thing about driving in Europe is that you don't have to keep one eye always peeled for the fuzz. In the U.S., where speed limit signs are everywhere and the limits proclaimed often impractical and ignored, it behooves the driver to watch for radar, hidden patrol cars, and such.

My mind has been greatly eased by a new book, "Take Your Traffic Ticket To Court – And Win!" This book, written by a retired judge, should enable anyone to win just about any traffic ticket case. Why line up at the cashier's window and pay that fine? Do you take it for granted that the police always correctly interpret the vehicle code? Do you pay the fine to save time and trouble even when you know you're really not guilty? If you're shelling out more and enjoying it less, this book will help you to insure your legal rights.

(cont. on page 98)



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International BAX-1 Broadband Amplifier is a general purpose unit which may be used as a tuned or untuned amplifier in RF and audio application. For example: when used as untuned RF pre-amplifier connect between antenna and receiver antenna posts. Ideal for SWL, Experimenter or Amateur applications. Easy to build. Complete Kit........................**$3.75**

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Gain at 150 MHz	6 db
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5. **Operational Impedance**	50 to 500 ohms
6. **Noise**	less than 10 microvolts rf across 50 ohms; audio less than .0005 volts
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Mounting	4 holes with spacers

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Leaky Lines

AN EDITORIAL by DAVE MANN K2AGZ

1 DANIEL LANE, KINNELON NJ 07405

At first blush the "Hobby Class" license proposed in July's issue of 73 excited resistance on my part. I felt, as do many others, that we ought not to favor any class of license which would not have an accompanying hurdle of code and theory attached to it, so that there would be some means by which the unfit or otherwise unacceptable might be weeded out. And then I got to thinking seriously about it... I mean objectively; weighing the alternatives; trying to envision the results which might come about as a result. Although I would not have liked to admit it at first, I now feel constrained to state that I have changed my mind concerning the subject. And I will tell you why.

Recent actions relating to the amateur service do not indicate any marked inclination on the part of FCC to consider our problems as seriously as it considers its own. Their principal action, which was supposedly implemented for the best interests of amateur radio, that is, incentive licensing, was brought about as a result of ARRL suggestions. The change did not originate with the Commission. Or, if it did, way back in the past, it was kept alive by ARRL, which the FCC regards as the spokesman for all hams. Most of their other actions; creation of Citizens Band, raising fees for licenses and renewals... these and others are indicative of the fact that we are hardly at the top of FCC's list of priorities. We have sometimes noticed an apparent unwillingness to crack down hard on violators of FCC regulations who happen to be nonhams, particularly CB'ers and commercial intruders into our spectrum. Such persistent flouters of the laws have not only gotten away with their illegalities, they continue unabated.

It is clear that the FCC, understaffed and underfunded, is far too busy with commercial radio, television, telephone, communications satellites, radioteletype, wire services, and others, to be able to devote themselves more than casually to the ham bands. That is why we must continue our policy of self-policing. That is why we must devise and suggest the changes that will improve our condition in the scheme of things. If the Commission, sometimes all too prone to reject wise suggestions in favor of unwise ones, is too busy and harassed to find avenues for our growth, then we ourselves must do so.

The effects of the presently constituted Citizen Band allocation are too well known to have to be recapitulated here. Those for whom this service was originally created have not been able to make full use of it, due to excessive misuse by hobby-oriented persons seeking an outlet for their repressed energies, but unwilling to devote any study or thought to obtaining amateur licenses. There have been some efforts among the CB'ers themselves to halt this travesty ... to build a nationwide organization similar to ARRL, so that all quasi-ham activities in CB... civil defense, fire watch, road patrolling, small boat safety, etc., might be coordinated in a constructive fashion. They are aware that this is the only way in which a program of self-policing, such as our own, can minimize the numbers of inveterate violators in their ranks. These efforts have not been notably successful. To be sure, there are clubs and associations, such as REACT, which are currently trying. But the deliberate violators constitute such a staggering percentage, that it is unrealistic to expect REACT and others to be sufficiently broad-based that a significant dent can be made.

In many instances we amateurs are blamed for interference which originates with this illegal CB operation. We have had to face indignant neighbors, demanding a cessation of our legitimate activity, when the true culprits have been local CB hobbyists. Since we are visible in our communities, operating openly, and since TV repairmen are notorious sometimes for attributing reception difficulties to the "ham with the big antenna tower in the next block," the problems continue unabated, and we must constantly deal with repeated efforts to limit amateur radio, while the 27 MHz lunacy goes on and on and on, like a communicable disease, unchecked.

The creation of this hobby license would effectively lessen these irritating conditions. It would open a viable source of income to the manufacturers of radio equipment, and would undoubtedly result in higher pay envelopes for many of the hams who are employed in the electronics industry. It would provide a large source of additional revenue to the FCC. It would assist greatly in the development of new VHF techniques. It would liberate 27 MHz for the legitimate use of those whose livelihood may

(cont. on page 96)

Virgo Himself

Editorial by Ken Sessions

Death of a Rig

We should be ashamed. All of us. The ham fraternity has collectively brought sufficient pressure to bear on one of our most reputable manufacturers that a fresh and necessary unit of exceptional design was dropped. The manufacturer – Swan Electronics – will lose money because of tooling and design expenses that will never be recouped. The amateurs lose because they'll not get the benefit of a truly great transceiver design approach. And all because a few ham do-gooders jumped to some irrational conclusions.

But let me start from the beginning: Engineering thinkers at Swan had noted the lack of activity on 10 meters and put their heads together to see what they could do about it. Here's what they learned: When 10 meters is open for comparatively long periods, the band gets progressively more populated.

It seems obvious that amateurs enjoy working 10 meters, but not many people monitor enough to know when the band is open and when it is not. As a consequence, many openings come and go witnout hams around to take advantage of them. What 10 meters needs, Swan said, is a surefire and quick method of knowing when 10 is usable for DX.

One excellent solution was the one adopted by Swan – simply incorporate an 11-meter receive capability in a 10-meter transceiver. With all the nearly constant signals on the 11-meter CB channels, an opening could be detected there almost instantly. Then the operator need but fire up the 10-meter transmitter (which won't work on 11, by the way) and put out a call.

With enough hams using the system, everyone benefits: 10 gets active, openings no longer go unnoticed, and another dying band gains renewed popularity.

A good idea? At 73, we thought so. But there were a handful of loudmouths who didn't. They wrote to Swan. They wrote to the FCC. They wrote to the ham journals, including 73, where their comments were filed where they belong – in the wastebasket.

Their complaint? Swan's new transceiver (No. 1011) can transmit and receive on 10 meters, but they feel its "receive only" capability for 11 meters would encourage CB'ers to buy and modify for illegal operation on the CB channels.

It apparently didn't occur to the whiners that any linear that will operate on 10 will operate on 11 meters; that many manufacturers – including a few "respectable" ham manufacturers are actually building and selling high-power linears *exclusively for* the CB channels. They didn't take note of the fact that virtually any transceiver that operates on 10 can be made to operate on 11. Such facts eluded them. All they could see was an 11-meter receive capability built into a 10-meter transceiver – and that was enough to get them going.

As editor of 73, I'd like to put in my two cents worth: First, the ham radio field is not a lucrative market. Manufacturers are – as often as not – in this aspect of the business because of personal management ties to amateur radio. Partially for this reason we amateurs should do our best to encourage and support these manufacturers (whose profit margins are far too narrow considering the engineering, development, and marketing efforts that must be expended for every item produced).

Second, I consider it blue-sky speculation for any amateur or group to assume that any manufacturer's products are going to be used for any purpose other than that for which they were designed. Take the case of the Swan 1011, for example. There seems to be three possible misapplications: (1) CB'ers could conceivably buy the transceiver and modify it for 11-meter transmit operation; (2) CB'ers could conceivably buy the unit and use it for illegal operation on 10 meters; (3) hams could buy it and use it for unlicensed operation on 11 meters.

From my experience in the CB field (I am also editor of a national CB magazine), I feel it is safe to say that not one CB'er in two hundred has the technical capability to successfully complete the necessary transmitter modifications – which takes care of item (1).

As far as item (2) is concerned, I believe that there aren't many CB'ers who are interested in joining us hams on 10 meters. I see every action notice that follows up an FCC violation, and do not remember a single case in the past 10 months where a CB'er has been nailed for operating on the ham band. Some CB'ers operate DX illegally; some use "skip" names instead of assigned calls; some run high power; some ragchew illegally; some have unlawful antenna setups. But there is no indication that any of them are infiltrating the ham bands.

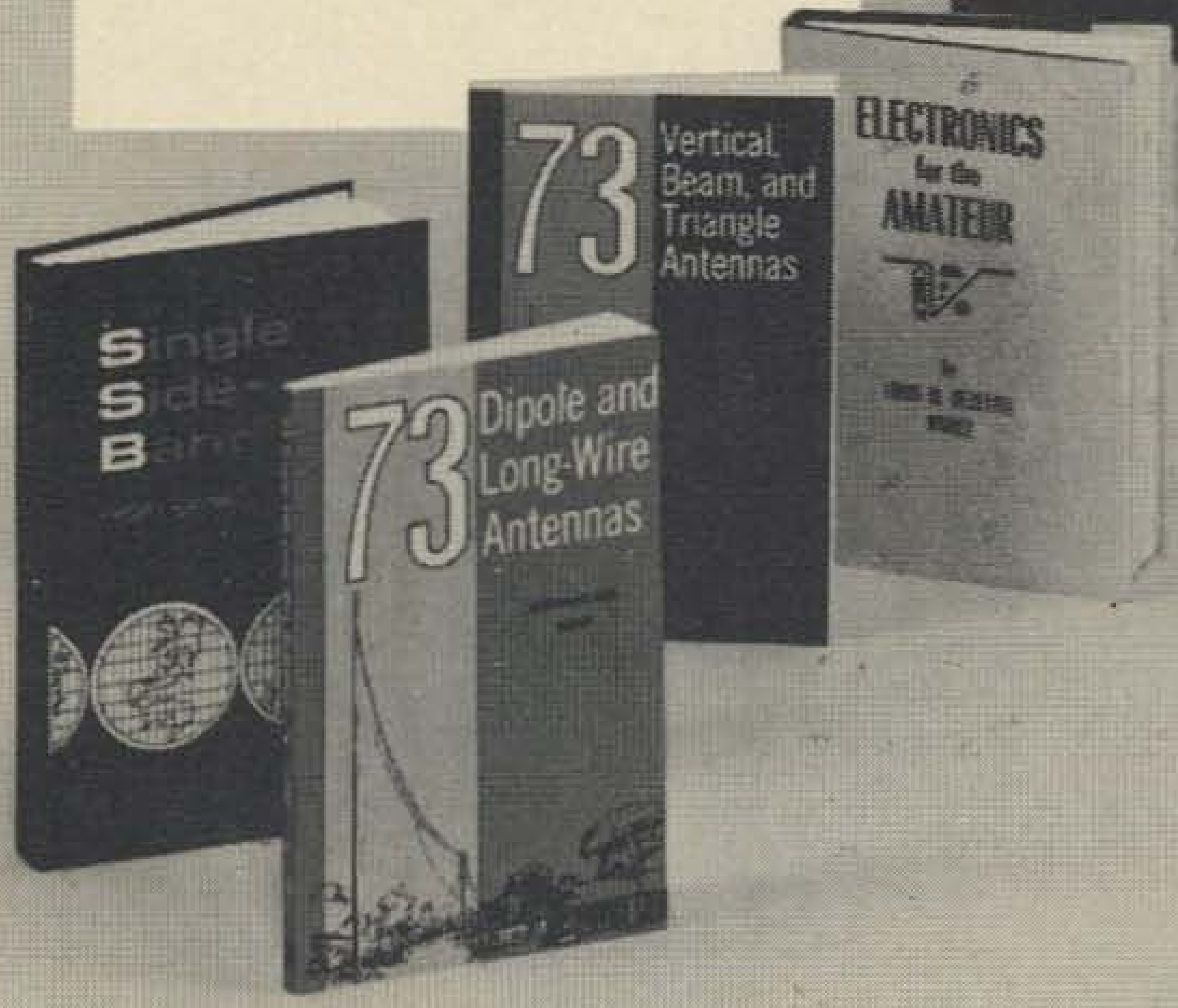
Item (3) should speak for itself; how many amateurs do *you* know who would go out of their way to bootleg on CB? Enough said.

But the damage has been done. Swan only recently announced the 1011 addition to its line. Now, just weeks later, the addition is canceled. Swan's letter to ham dealers reads:

> For the first time in our history we have introduced a new model transceiver that has met with the disapproval of a number of our radio amateur customers. Letters we have received indicate a serious concern that the 1011 will be operated on the 10 meter band by CB'ers or other unlicensed

(cont. on page 97)

Important E&E Books from SAMS



18th Edition of the famous E&E RADIO HANDBOOK

by WILLIAM I. ORR, W6SAI. Completely updated edition of the famous communications book that is the electronics industry standard for engineers, technicians, and advanced amateurs. Explains in authoritative detail how to design and build all types of radiocommunications equipment. Includes ssb design and equipment, RTTY circuits, latest semiconductor circuits, IC's, and special circuitry. Order **24020**, *only* **$13.50**

Single Sideband: Theory and Practice

by HARRY D. HOOTON, W6TYH. This one-source guide emphasizes basic principles and circuitry of ssb. Covers the origin of ssb, the derivation of ssb signals, carrier-suppression techniques, sideband selection, and a complete analysis of all types of ssb equipment. Order **24014**, *only* **$6.95**

73 Dipole and Long-Wire Antennas

by EDWARD M. NOLL, W3FQJ. The first compendium of virtually every type of wire antenna used by amateurs. Includes dimensions, configurations, and detailed construction data for 73 different types. Appendices describe construction of noise bridges, line tuners, and data on measuring resonant frequency, velocity factor, and SWR.
Order **24006**, *only* **$4.50**

73 Vertical, Beam, and Triangle Antennas

by EDWARD M. NOLL, W3FQJ. Describes the design and construction of 73 different antennas used by amateurs. Each has actually been built and air-tested by the author. Appendices cover construction of noise bridges and antenna line tuners, as well as measurement methods. Order **24021**, *only* **$4.95**

Electronics for the Amateur

by LOUIS M. DEZETTEL, W5REZ. This is one of the few books on the theory of electronics and radio that programs the material for the amateur. Discusses radio-wave propagation as it applies to amateur band frequencies, reception and transmission pertaining to ham equipment, and the special field of antennas and how to feed them. Contains all the information required to pass the theory sections of the FCC exams.
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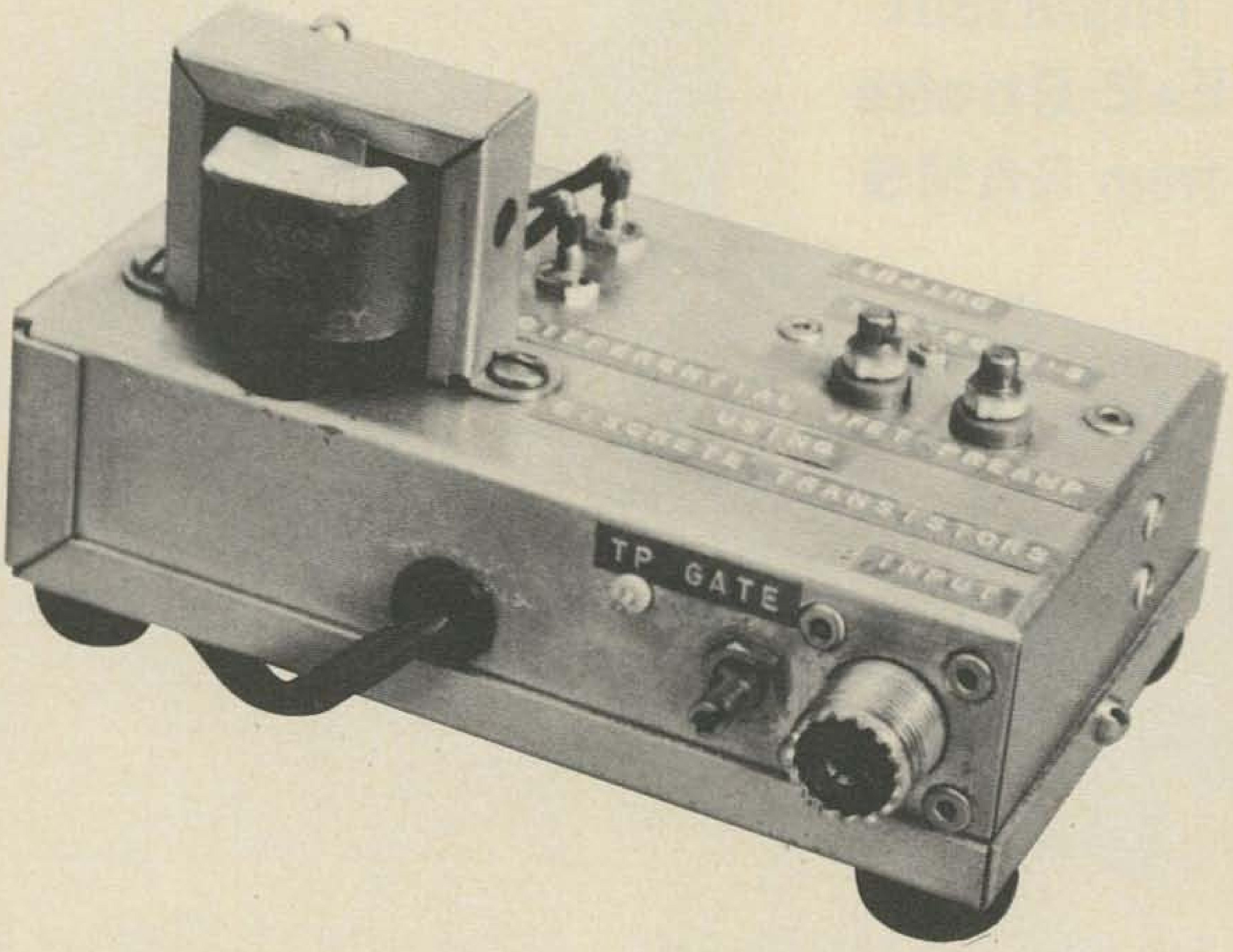


DIFFERENTIAL J-FET PREAMPLIFIER

Ralph W. Campbell W4KAE
316 Mariemont Drive
Lexington KY 40505

How about trying a J-FET (usually pronounced "jay-fet") preamplifier using discrete transistors, in the *differential* configuration? "Differential" is circuitry best known through work with integrated circuits; but there is no reason why we can't use "discretes" to achieve the results we seek. The amplifier presented here is the result of searching through various amateur and professional publications for the lowest-noise solid-state circuit – revealing little "new" – except for this mode of operation.

I turned to RCA's IC-41 linear integrated circuit manual for comparison of various bipolar IC hookups; the RCA CA-3028 looked most interesting, so I then chose Motorola's MFE-2000 as a discrete J-FET replacement. The RCA CA-3028 boasted 0.5 dB better noise figure in the differential mode, as compared with the cascode circuit. Hopefully, a similar "edge" in performance should exist with the J-FETs. The interesting thing about this new circuitry is that one semiconductor is in an "idling" position, while the other device does the amplifying! This results in two advantages: (1) The high-gain transistor (which may oscillate) can be made the idler; or even a lower-gain, cheaper J-FET with the same noise figure can be plugged in; and (2) noise reduction with balanced, push-pull input, is achieved. Junction field-effect transistors (J-FETs) have further advantages, such as superior resistance to overloading, wide dynamic range with the higher drain voltages, and ease of input matching.

With exception of low-noise multiple devices (two J-FETs diffused on a single chip) these discrete transistors solved noise problems readily apparent to the ear. After listening tests, the 2 meter noise reduction seems about 1 dB; however, as to actual noise figure (not with the gain provided), I would assume only 0.5 dB to be the real improvement.

Another advantage with the differential mode is that neutralization requirements are greatly reduced. A tee section decoupler stopped all tendency for oscillation, even when higher-gain MFE-2001s were substituted. With a spot noise figure of 1.6 dB typical, we have a great 2 meter preamplifier! While I don't do more than estimate noise figure and gain, it is true that attempts were made to use University of Kentucky measuring equipment, but it was not operational.

Theory

Design of the preamplifier is straightforward. Dc biasing is just like vacuum tubes, except the supply voltage is much lower. I followed W1DTY's *Field Effect Transistor Primer,* (73 Magazine, Dec. 1965), and I must admit both "experimenter" and "paper" design techniques were applied. To get going on the "paper" design, I used the normalized FET transfer curve presented in that article, and referred to Motorola's *Semiconductor Data Book*, 3rd Edition, to determine pinchoff voltage V_P. Values given are 4.0V for V_P and 10 mA for I_{DSS}. With regard to Fig. 1, 10 mA and 6 mA are marked on the vertical axis for values of I_D; and the 0.6 ratio point is selected as described below. In case you've guessed 6 mA is the operating drain current!

Gate-to-source voltage is normalized or divided as with I_{DDS} and, since we have I_{DDS} set to be 10 mA and V_P at 4.0V, the loadline can be determined by dividing 4V by 10 mA, which works out to be 0.4 in normalized kilohms. The reason for using kilohms is that this saves time; and to check this scale plotting factor, simply extend the R_S=1 kΩ line until it intersects the upper right-hand coordinates.

The unknown ratios are now found. This is so easy that I used the "unknown" I_D/I_{DDS} ratio (above) by accident. Since we know the load line is to be 400Ω, it is drawn between the 300Ω and 500Ω lines already present on Fig. 1. (For clarity, I've

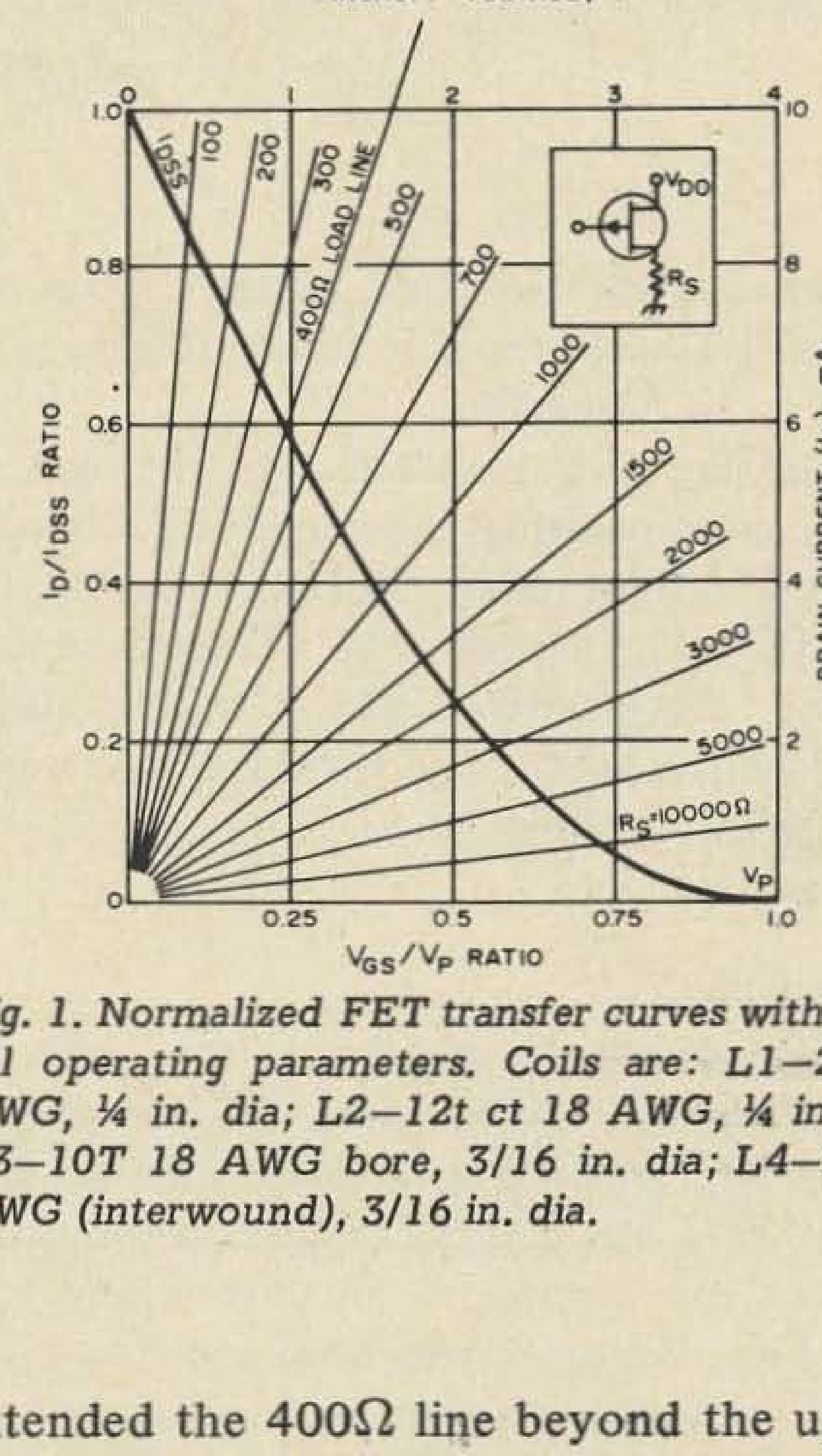


Fig. 1. Normalized FET transfer curves with typical operating parameters. Coils are: L1—2t 18 AWG, ¼ in. dia; L2—12t ct 18 AWG, ¼ in. dia; L3—10T 18 AWG bore, 3/16 in. dia; L4—2t 18 AWG (interwound), 3/16 in. dia.

extended the 400Ω line beyond the upper horizontal axis.) Now, where this line intersects the transfer curve (running parameter) we see a vertical and horizontal intercept at the 0.6 and 0.24 points for our ratios of I_D/I_{DSS} and V_{GS}/V_P, respectively. The use of this information can help the designer choose the operating point for any values up to 30 mA or 25V with the Motorola MFE-2000.

Measurements

The operating point voltage was measured to be −1.2V, and operating

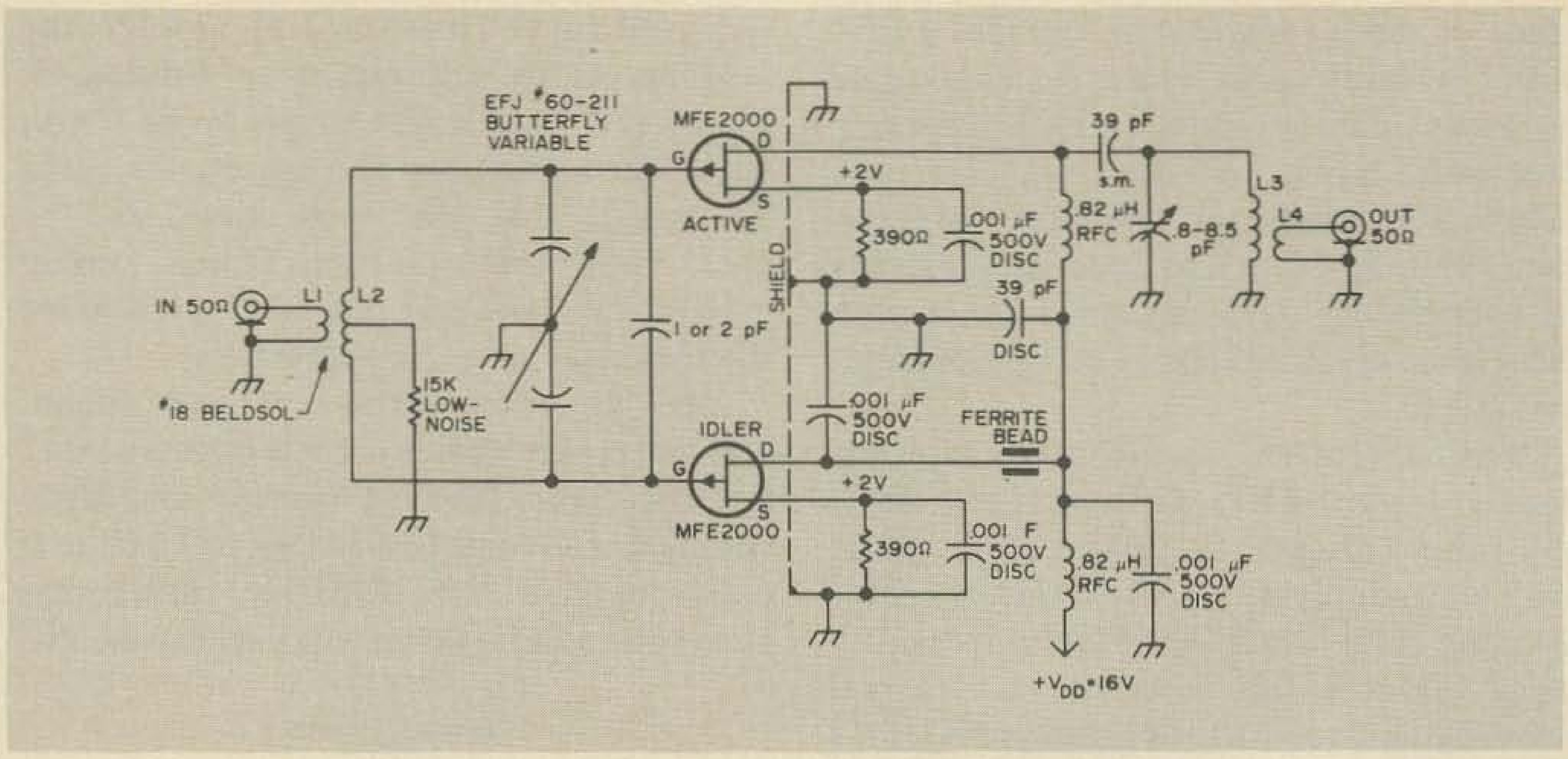


Fig. 2. Low noise J-Fet preamplifier for 2 meters.

current was measured at 5.5 mA. Gain of the J-FET differential preamplifier was found to be 3 S-units.

Choosing the gate-leak resistor was a matter of consulting the literature, where I found a circuit using TIS-88s (similar to 2N4416), which had a 27 kΩ gate return resistor. Having two MFE-2000s, I took about half-value for this resistance for both transistors operating in parallel.

Construction

The lead photo shows the top view of the differential J-FET preamplifier whose circuit appears in Fig. 2. This unit is built within an LMB 531EL endlock aluminum chassis. Note that each capacitor there is a large Ferroxcube ferrite bead (56-590-3B), which prevents man-made noise from entering the enclosure. The standoff on the side of the enclosure is the test point for drain-to-ground voltage checks. "Pop" rivets are seen in their use as interunit shield fasteners for the partition inside.

For the preamp, I used a 0.8–8.5 pF gold-plated piston capacitor. (The piston trimmer is shown in the closeups.) Other types of pistons having the same capacity and capacity range would work as well; however, the gold plating probably improves resettability and lowers rf surface ground losses.

Between the glass tank circuit and shield partition is the tee decoupling network, which is dc fed from the voltage doubler power supply. The common leg of the tee is resting on a 240 pF button bypass (value not critical), while to the right and left are the Miller molded, shielded 9240-707 rf chokes.

A feedthrough fitting is connected through the partition wall of the internal shield to the right-hand (single) drain connection; and the 39 pF silver-mica blocking capacitor rests against the chassis end plate. The shield partition tongue is bent to fit, and soldered onto the body of the partition. This makes a firm contact with the preamp bottom cover, when in place.

To the upper left of the shield is a piece of RG-174/U coaxial cable which connects to the test point.

A tubular ceramic capacitor across the variable capacitor (see closeup photo) provides signal resonance at the unmeshed position. The insures minimum noise characteristics, through the tuning range. The fixed capacitor should be to have a value within the operating range of the variable. This technique, by the way, also prevents false noise dips or peaks.

The power supply (Fig. 3) is a conventional full-wave voltage doubler with a trimming and surge resistor in series with the 6.3V secondary. Drain-to-source volt-

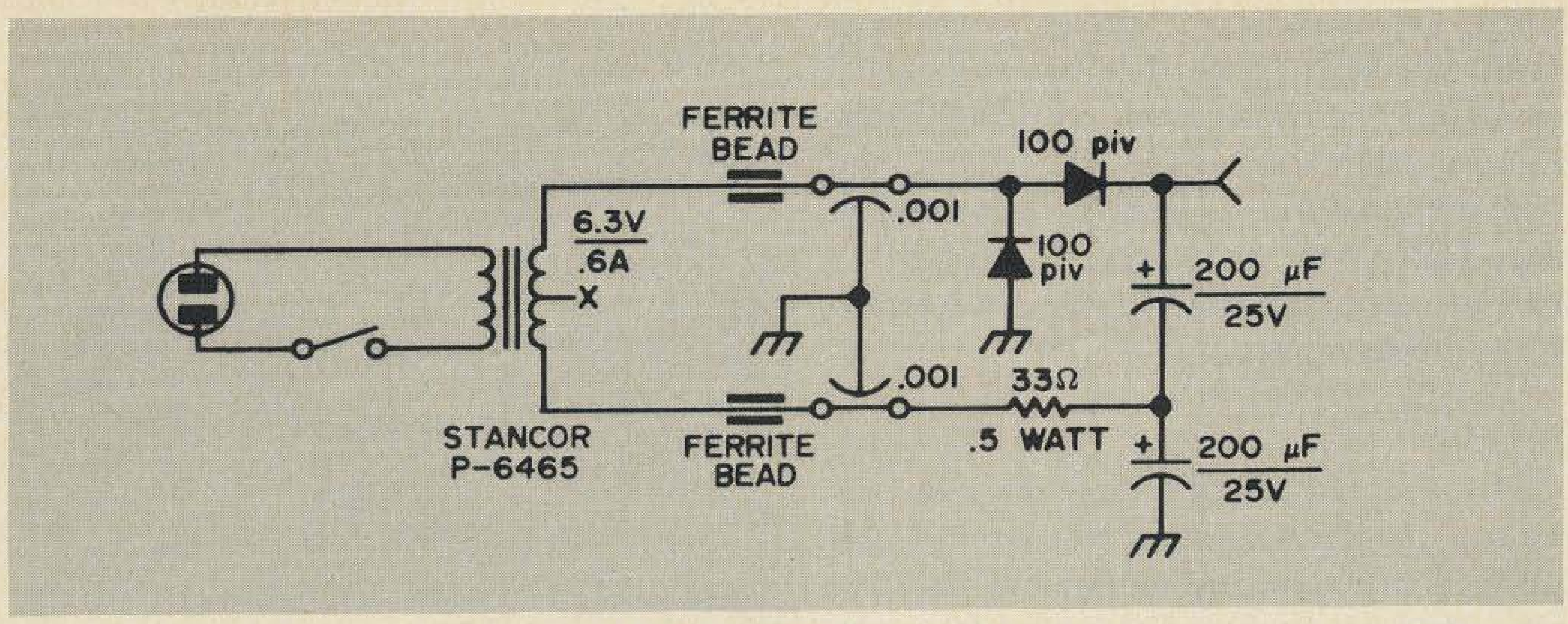


Fig. 3. Power Supply.

age "trimming" of the power supply is done with this surge resistor. Use of the tee should completely eliminate all oscillation.

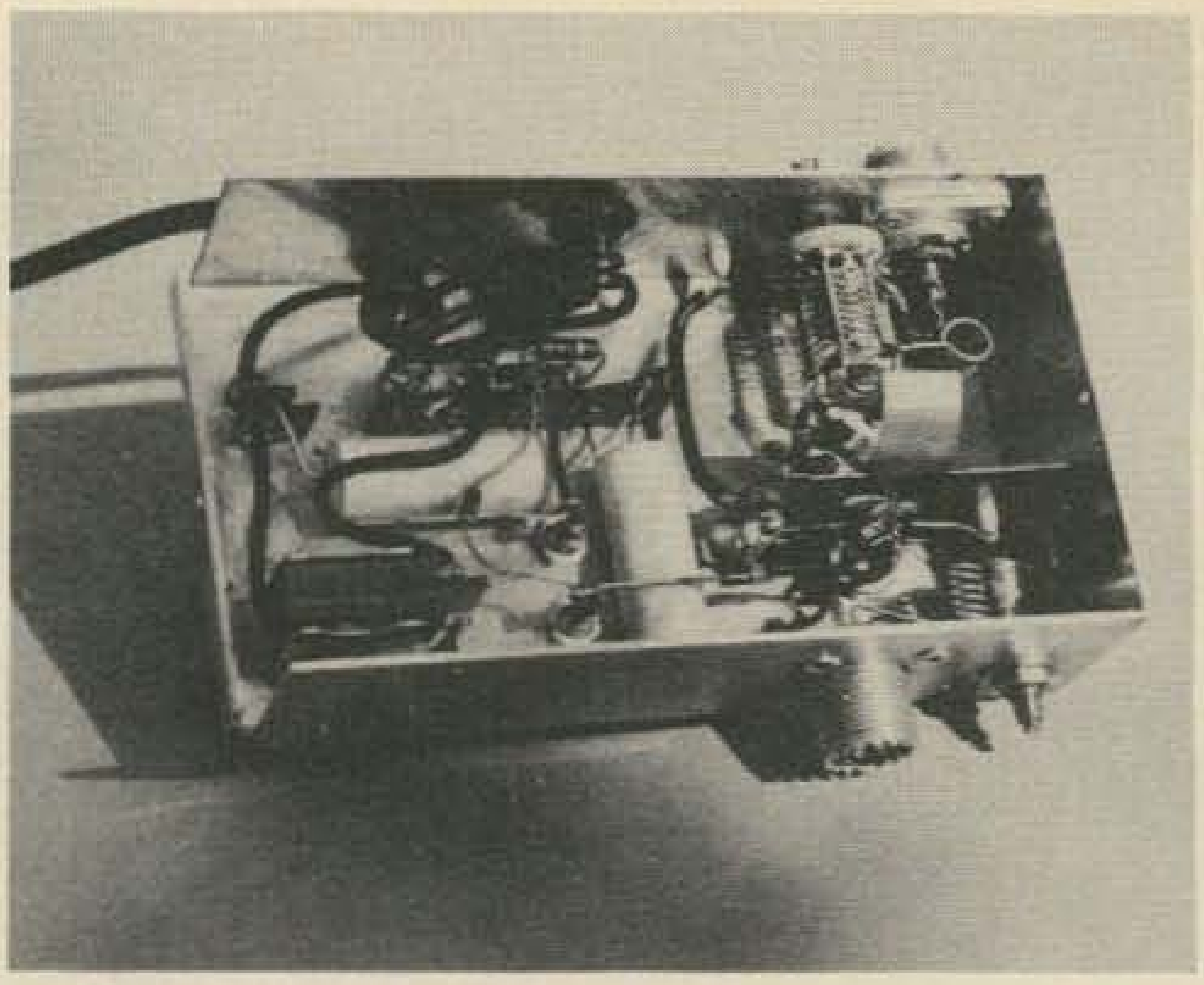
Alignment & Adjustment

Noise figure estimating is always a curious business, since the variables involved depend upon usually inaccurate assumptions about generator impedance, signal level, and transmission line matching. One big problem was how to find a signal or noise dip. With a balanced differential input I found either a pair of dips at either end of the butterfly tuning range or a pair of peaks at these range ends. Between, I observed either a small peak or small dip, depending upon signal levels being fed to the preamp.

Before dipping and peaking adjustments were made, I used a Heathkit tunnel-dipper to place resonance at 144 MHz. This was with the input variable at the minimum capacity setting, the J-FETs in their sockets, drain and gate bias voltages present, and with the output piston capacitor adjusted for maximum capacity. Under these conditions, I realized the next thing to do was to load the balanced input tank circuit with 1–2 pF to keep the actual tuning range *below* resonance at signal frequencies, since lowest noise figure is always obtained this way. Strong signals (milliwatts) from my International Crystal 2 meter frequency standard resulted in two peaks at either end of the butterfly range, with a small dip in between. What this meant was that the J-FETs were absorbing several milliwatts of power at the crystal standard frequency, behaving like a generator and a load with the coaxial line voltage dropping between range-end peaks as conditions of maximum-power-transfer were approached. This doesn't mean the front-end input terminal was purely a resistance: The front end is probably matched to the resistance and reactance present; but the resistive condition, alone, is the load seen by the balanced tank circuit looking into the gate terminals. This procedure is the "strong-signal" method of obtaining lowest noise figure in the differential mode. Now here's another:

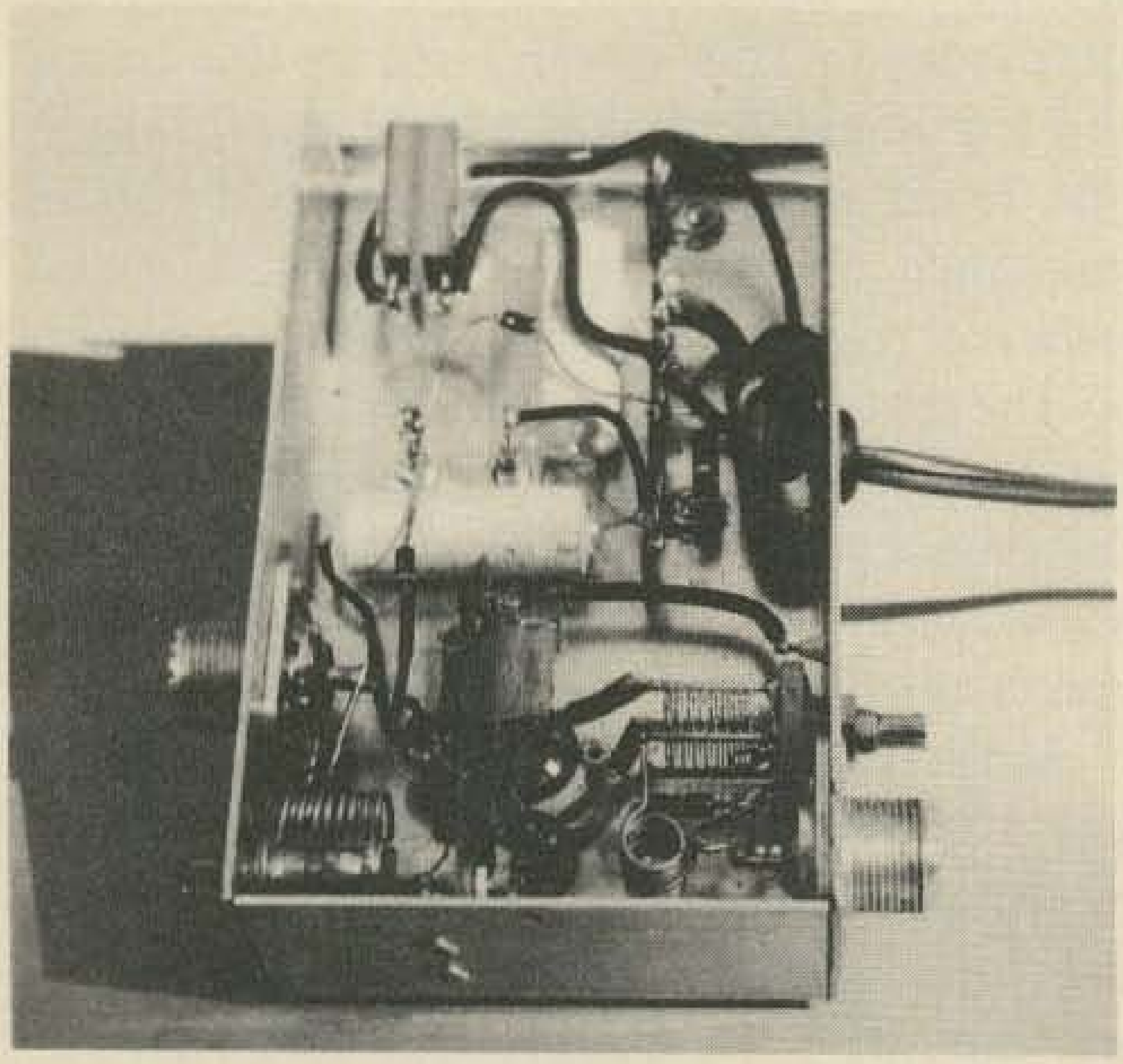
Most amateurs probably don't have a safe strong-signal source; so the weak-signal method is offered as an alternative. Using the Ameco TX-62 exciter, I found I could set the drive to minimum and, with the spotting switch, found it to be possible to send a weak signal (microwatts) into the differential J-FET preamplifier for noise adjustments. Of course, it is desirable to have the input fed from a terminated coaxial connector capacitively coupled through the open contacts of a Dow-Key SPDT relay. The termination used was a shielded CesCo PL-52 CB radio 5W dummy load. With the termination switched in and the desired weak signal from the Ameco exciter, I adjusted the capacitor for a peak between the two range-end dips. Confirming this as the low-noise point is easily checked by switching back and forth from dummy load to antenna (during a period of minimum band activity).

An explanation of circuit conditions would probably show that peaking occurred at the microwatt level, with the highly reactive generator coupling making the weak-signal source impedance appear very high. This would make any response other than resistive (matched at the gate terminals) immeasurable.



Operation

The differential J-FET preamplifier has been a pleasure to use. Not even locals overload my receiving equipment and the noise figure is so low I can hear transmission line noise (observed on incoming signals with separate antennas of about the same gain) when comparing RG-9 or RG-8 with a similar length of Aluminum Foamflex cable. I might add that without the



low-noise line, little can be achieved in "system" noise reduction, when dealing with the ever-present thermal agitation noise prevalent in most VHF gear.

The MFE-2000 J-FETs by Motorola showed very little tendency to oscillate using the differential amplifier configuration. I tried MFE-2001s, a higher-gain version, which did oscillate with one transistor of the pair chosen; however, the noise figure appeared to be the same.

Only one transistor is fully operative in the differential mode: but if you think the noise doesn't go up upon removal of the idling J-FET, just try removing it on a weak signal! Even a quick retune with a single active FET will show more noise than with two.

Use of the transfer curve brought out so clearly in W1DTY's primer should find extensive application in "power" FET work: For one thing, the normalized character of the curve can be altered to fit any device (including FETs like the CP-650 and CP-651, by Crystalonics) for operation in the power-gate region. For another, the curve can be force-fitted to suit both depletion and enhancement modes.

Conclusion

Regardless of how accurate a "paper" design is, always test the unit thoroughly in the laboratory before reconciling results with it. The "experimenter" method is always a valid check. Before building the unit described in this article, make sure you're using low-noise coax such as Amphenol 21-539 or Communications Products Aluminum Foamflex, or a very short length of the regular kind. The reason is that without the feedline having this characteristic, chances are you will not be able to notice "less noise" on incoming DX signals.

I would encourage others to try their hands at FET designs similar to this. And don't forget: If your receiving equipment doesn't use at least one three-lead semiconductor device in the first stages – it may be obsolete!

. . . W4KAE ■

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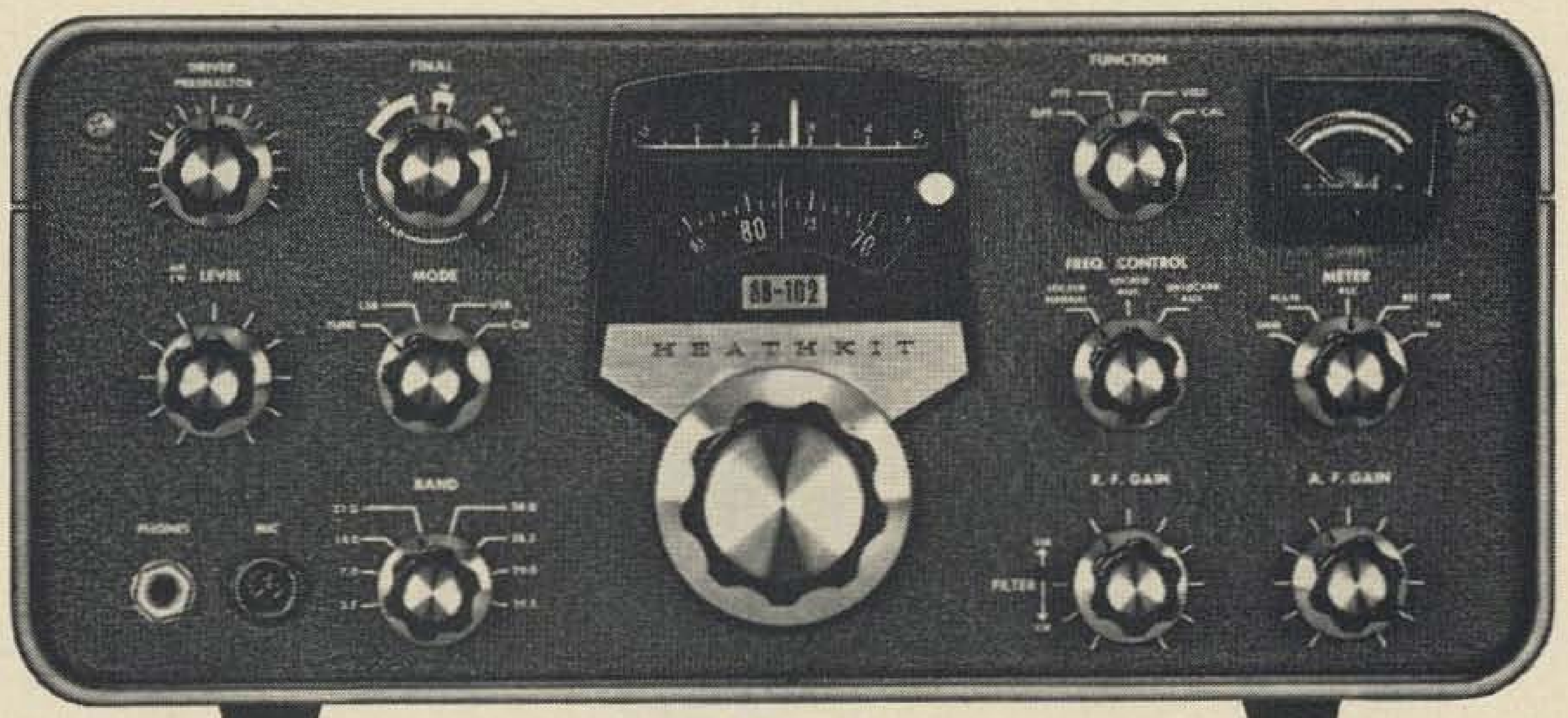

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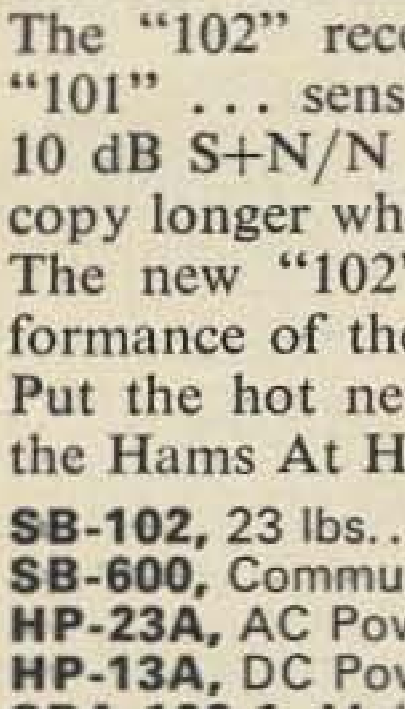

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RF APPLICATIONS OF THE DUAL-GATE MOSFET

Suleyman Sir, Fairchild Semiconductor
313 Fairchild Drive
Mountain View CA

Metal-oxide-semiconductor field-effect transistors (MOSFETs) that feature two independent insulated gates represent a new class of semiconductor device, extending the analogy between transistors and vacuum tubes beyond the triode. In effect, these devices, called dual-gate MOSFETs, are the solid-state analog of the dual-grid vacuum tube (tetrode).

Dual-gate MOSFETs have all the characteristic features of single-gate MOSFETs (high input impedance, low noise, and wide dynamic range) but, in addition, provide better agc and cross-modulation characteristics and significantly lower feedback capacitance. While addition of a second gate increases manufacturing costs slightly, the small price increase is more than offset

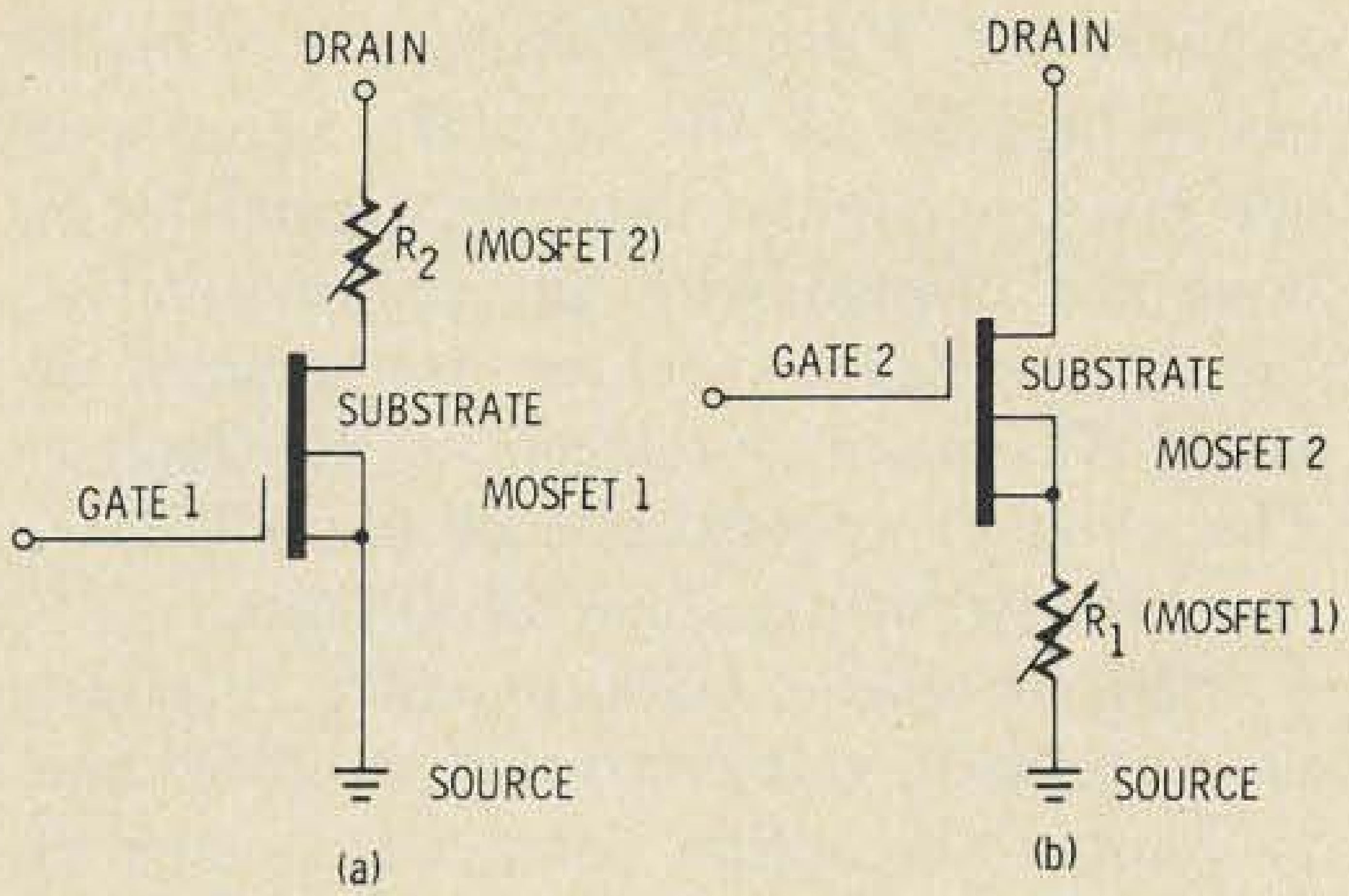


Fig. 1. Two equivalent MOSFET circuits to show signal injection at (a) gate 1 and (b) gate 2.

by eliminating the need for some components normally required in conventional MOSFET circuits.

The special characteristics of dual-gate MOSFETs make these devices ideal as UHF, VHF, and FM amplifiers, VHF and FM mixers, and i-f amplifiers.

Circuit Performance

Dual-gate MOSFETs, like other FETs and bipolar transistors, are used for signal amplification. The signal can be injected at either of the two gates, but normally gate 1 is used for signal injection and gate 2 for gain control. This preference can be explained by analyzing the two alternative equivalent MOSFET circuits shown in Fig. 1. Figure 1a shows the equivalent circuit with signal applied to gate 1, and gate 2 ac-grounded. In this mode, when the dc bias of gate 2 is changed, MOSFET 2 acts as a variable-load resistor on MOSFET 1, representing a gain change.

By contrast, Fig. 1b shows the equivalent circuit with signal applied to gate 2, and gate 1 ac-grounded. In this mode, gate 1 is used for gain control and MOSFET 1 acts as a series source resistor. As the dc bias voltage on gate 1 is changed, the value of the source resistor will increase or decrease, and gain control is accomplished. However, this mode of operation results in lower gain because of the degenerative series resistor, and since gate 2 is closer to the drain, the feedback capacitance is higher compared with the other mode of operation.

When the device is operated as shown in Fig. 1a, the MOSFET is analogous to the common-cathode, common-grid cascode tube amplifier used for high degree of isolation between input and output stages.

Dual-gate MOSFETs have the following advantages over the triode MOSFETs.

- Low feedback (reverse-transfer) capacitance, which allows the device to operate as a very stable amplifier.
- Excellent agc performance with an agc range of approximately 50 dB. This characteristic makes the device ideal for use in front-end applications. The agc range of Fairchild's FT0601 is shown in Fig. 2.

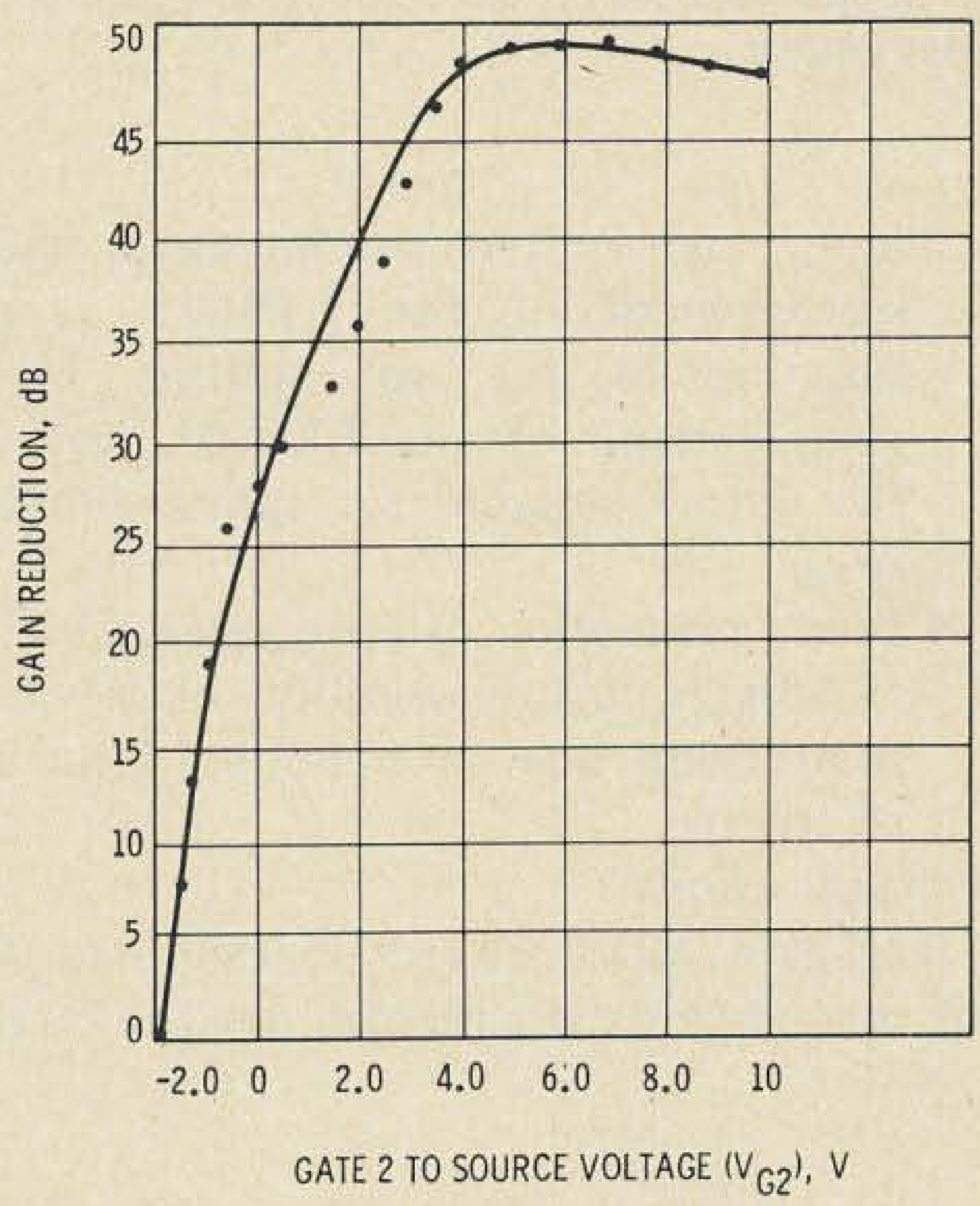


Fig. 2. Agc performance of the FT0601 (V_D = 15V, F = 200 MHz).

- Good cross-modulation performance. Dual-gate MOSFETs have square-law transfer characteristics; therefore, they are suitable for amplifiers that require minimum cross-modulation distortion.
- Uniform and fixed input and output conductances, which do not change greatly with the agc voltage. This can be seen in Fig. 3, which shows the

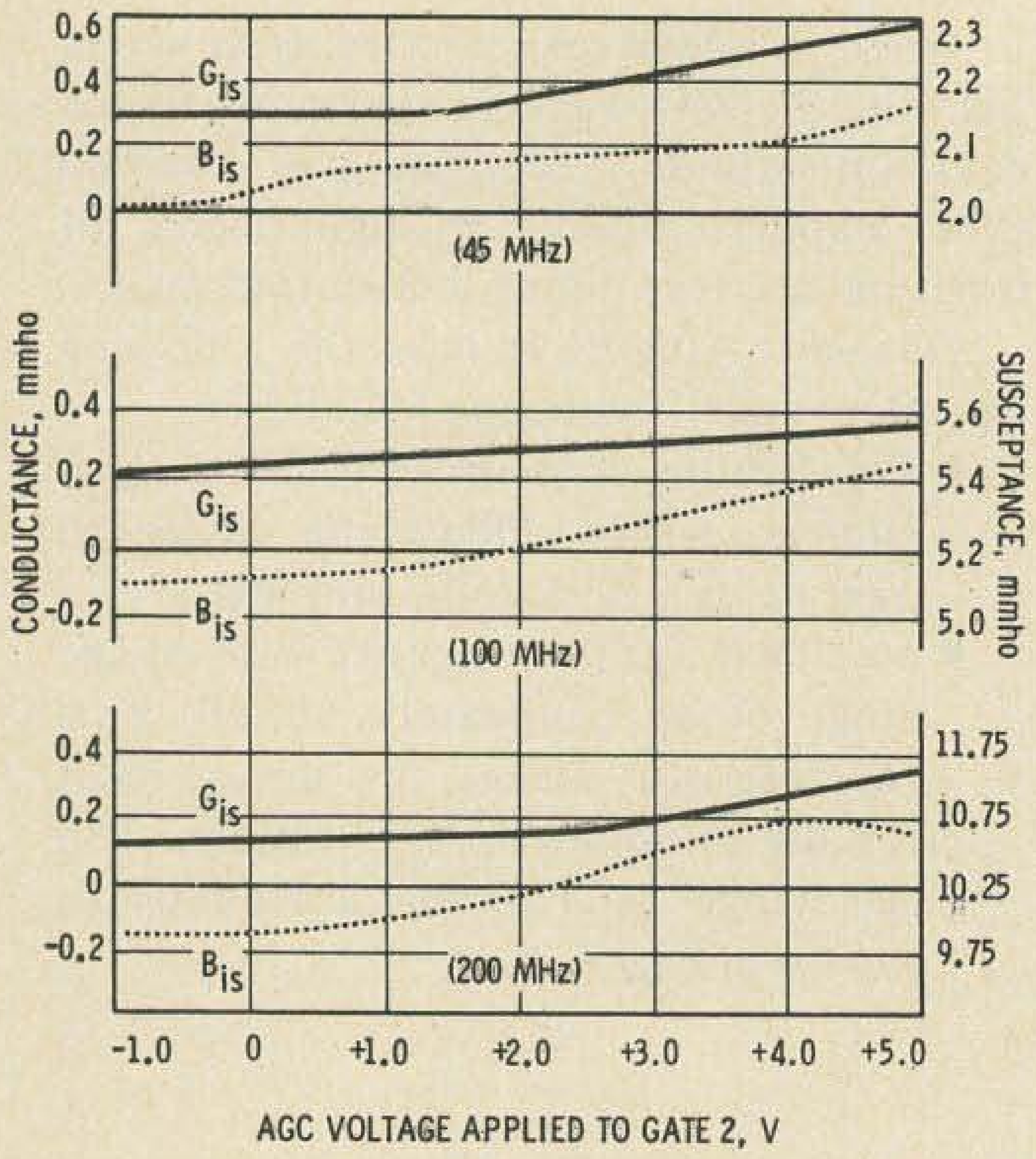


Fig. 3. Admittances of the FT0601 as a function of agc voltage.

input and output conductances and susceptances of the FT0601 as a function of the agc voltage. This characteristic of the FT0601 makes the device suitable for tuned amplifiers.

- Diode protection of both gates, which eliminates the possibility of device destruction due to buildup of static electricity.

RF Applications

Dual-gate MOSFETs offer two important advantages over bipolar devices in rf applications. First, agc operation is made easier because of the separate signal and agc gates. Secondly, their input admittance does not change with agc; consequently, the performance (center frequency) of MOSFET tuned amplifiers is unaffected. The chief rf applications of the FT0601, listed below, utilize these advantages.

VHF Amplifier. Good-quality receivers use automatic gain control at the front end to improve reception for a wide range of input signal levels. For agc operation, dual-gate MOSFETs have a built-in advantage owing to their separate gates, especially in the VHF region. VHF amplifiers built with the FT0601 eliminate cross-modulation distortion, decrease receiver noise, and avoid shifting of the receiver's center frequency. Figure 4 is a circuit schematic of a VHF amplifier using the FT0601.

VHF Mixer. The FT0601 has good gain throughout the VHF band and can be used as a front-end amplifier. However, the device has a nonlinear transfer function region and, therefore, it can also be used as a VHF mixer to provide conversion gain. The mixing action takes place in the least linear section of the VHF band, and the gain is obtained where the device is completely linear. Therefore, when a VHF mixer is designed, a compromise is needed between gain and mixing action, and, as a rule, gain is sacrificed. The conversion gain is defined as the ratio of i-f power output to rf power input.

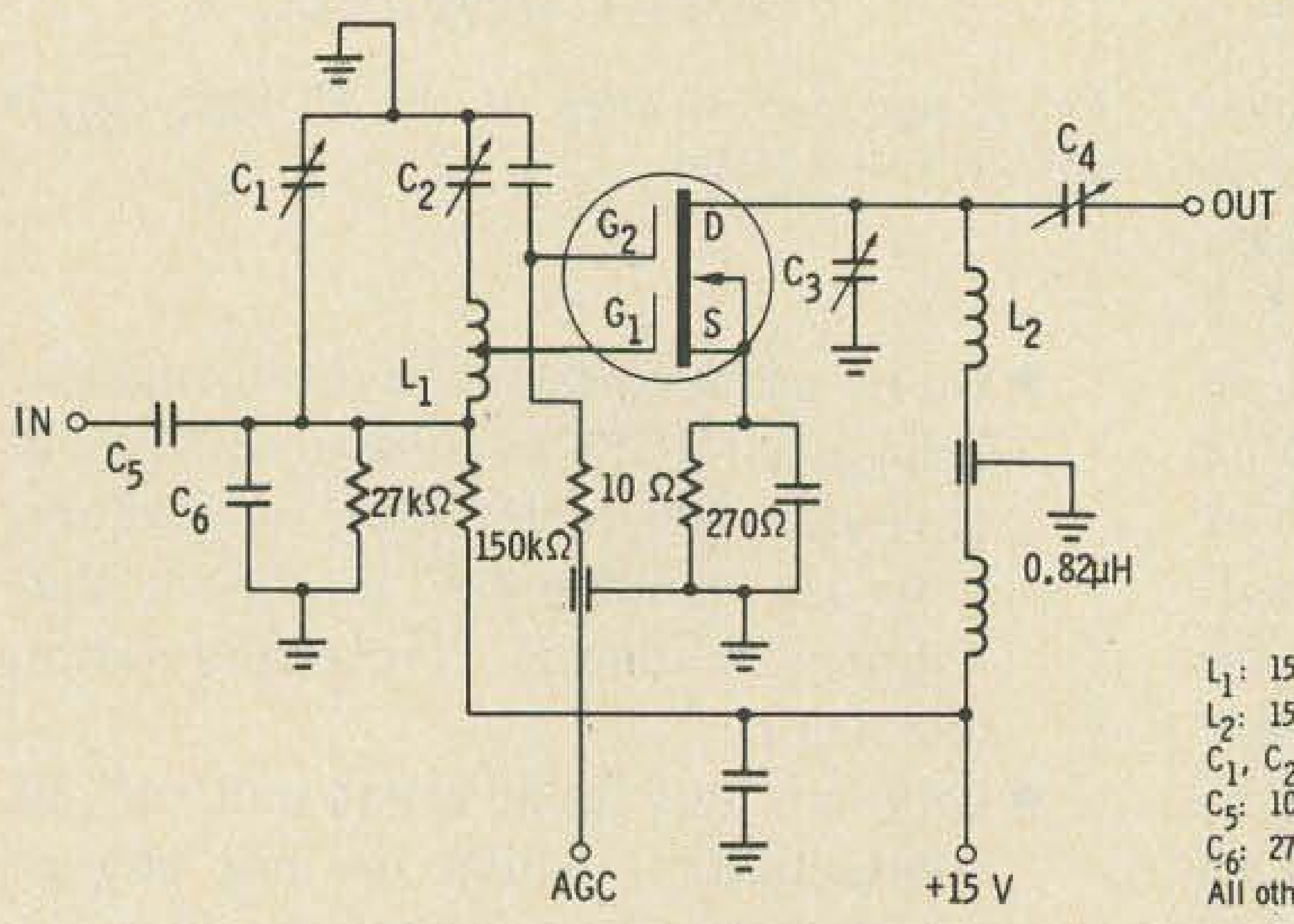


Fig. 4. VHF amplifier.

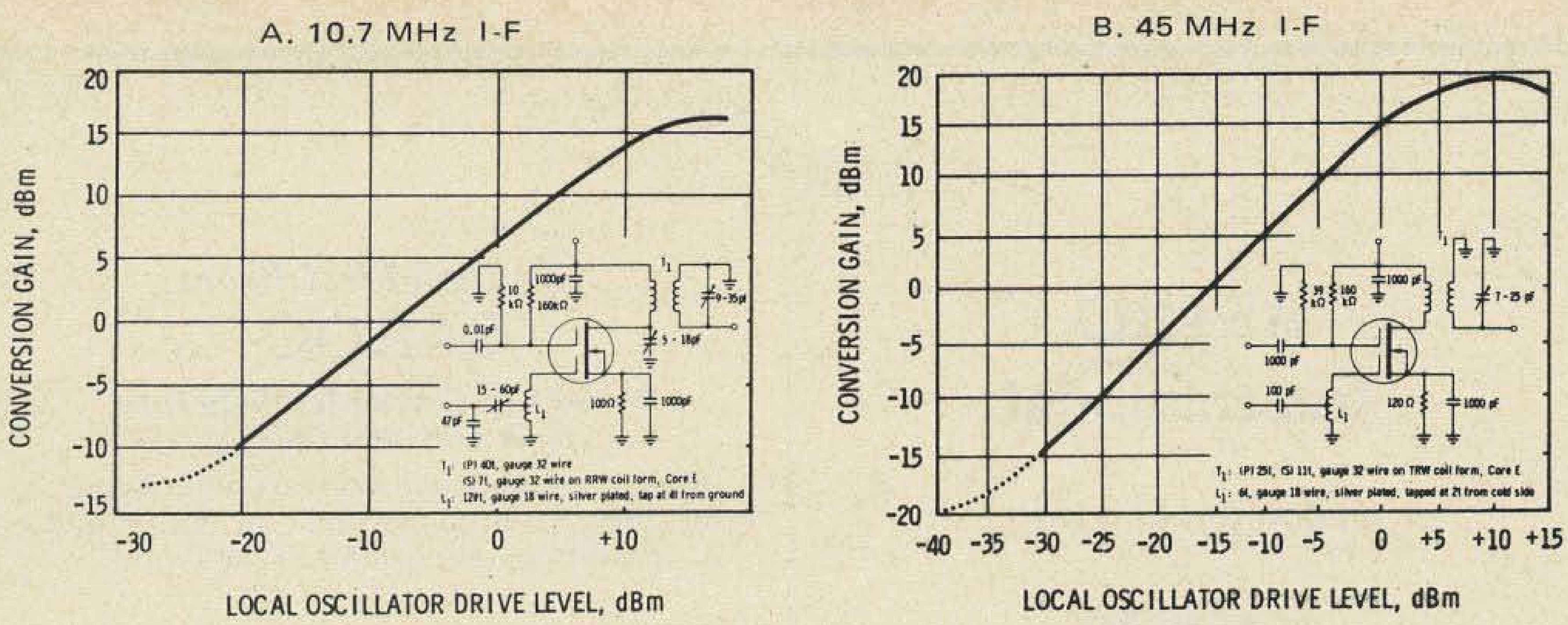
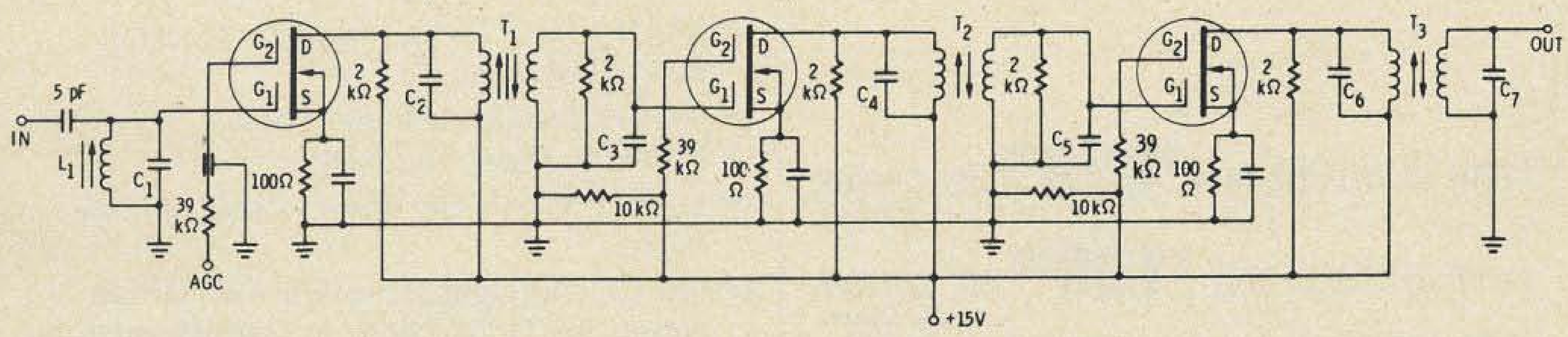


Fig. 5. Conversion gain vs local oscillator drive level for the FT0601.

The amplifier provides optimum rf power gain with the FT0601 when the drain current varies between 8 and 10 mA, while the mixing action takes place at drain currents of 3 to 4 mA. Our experiments indicated that best conversion gain is obtained when the device is biased at 5 to 6 mA of drain current.

When a dual-gate MOSFET is used as a VHF mixer, the local oscillator and rf signals can be applied to separate gates. We obtained the best conversion gain with the rf signal applied to gate 1 and the local oscillator signal to gate 2. We biased gate 1 to dc ground and applied the rf signal to this gate through a conjugately matched network; but did not conjugately match the network to the i-f impedance of the device to avoid the possibility of oscillation. The conversion gain as a function of local oscillator drive level, and the circuits used to measure the conversion gain are shown in Fig. 5 for 10.7 MHz and 45 MHz. We designed these circuits with emphasis on stability and high gain, thus the chosen bandwidths are not optimum: 1 MHz for the 10.7 MHz signal and about 2 MHz for the 45 MHz signal.



C_1, C_3, C_5, C_6, C_7: 10 pF, dip mica
C_2, C_4: 15 pF, mica
All other capacitors: 1000 pF
L_1: 6-1/2t, gauge 24 wire on 5/16" form, J-slug
T_1, T_2, T_3: 6-1/2t, gauge 24 wire, J-slug, 5/16" form, adjustable

Gain: 62 dB
BW: 4.5 MHz @ -3 db
AGC Range: -9 V max, +4V min AGC, 3 db tilt
I_t: 27 mA

Fig. 6. 45 MHz i-f strip using the FT0601.

IF Strip

Dual-gate MOSFETs are suitable for i-f strips where the Q of the tuning circuit is critical. We built a 45 MHz strip using a FT0601s in all stages. However, to avoid instability, a large amount of mismatch was needed in all stages; therefore, we loaded the stages with 2 kΩ input and output admittances. The circuit schematic of the strip and the performance data are shown in Fig. 6.

. . . Sir ■

Peter A. Lovelock W6AJZ
235 Montana Avenue
Santa Monica CA 90403

Remote Quad Tuning

The cubical quad has become one of the most popular beam antennas for the DX'er. But something less than popular is the problem of tuning the parasitic wire reflector for optimum performance. Many weary miles of tower climbing, seasoned with ripe expletives, have been expended on this labor of love. Field strength meters, arm-waving assistants, neighboring hams, and even CB handsets have been pressed into service. . .after all of which there is lasting doubt that the beast is really adjusted right on the nose. How much happier if this onerous task could be accomplished in the relative comfort of the shack!

Well, pilgrim, your search is over. For tuning a quad can be relegated to the mere twist of a knob as you relax at the operating position.

Whether homebrew or commercial, the length of the quad reflector is commonly cut for one wavelength, identical to the driven element. Tuning is provided by inserting the appropriate amount of inductive reactance – dependent upon spacing from the driven element – to produce the necessary phase shift in the reflector for maximum forward gain or front-to-back ratio.

Figure 1 illustrates three popular methods for adjusting inductive reactance at the reflector. Figure 1A uses an adjustable shorted stub which exhibits an inductive reactance at its open end, the value of which depends upon the position of the shorting bar; 1B incorporates an open stub, the length of which is made greater than ¼ wavelength, so that it similarly exhibits an inductive reactance which can be varied by the capacitor. Figure 1C uses a suitable coil with an adjustable tap, and is the method included with a number of commercially manufactured quads.

As old hands will know, the actual adjustment is quite critical for maximum performance. For example, I have found that with the method of Fig. 1A, plus or minus ¼ in. in positioning the shorting bar

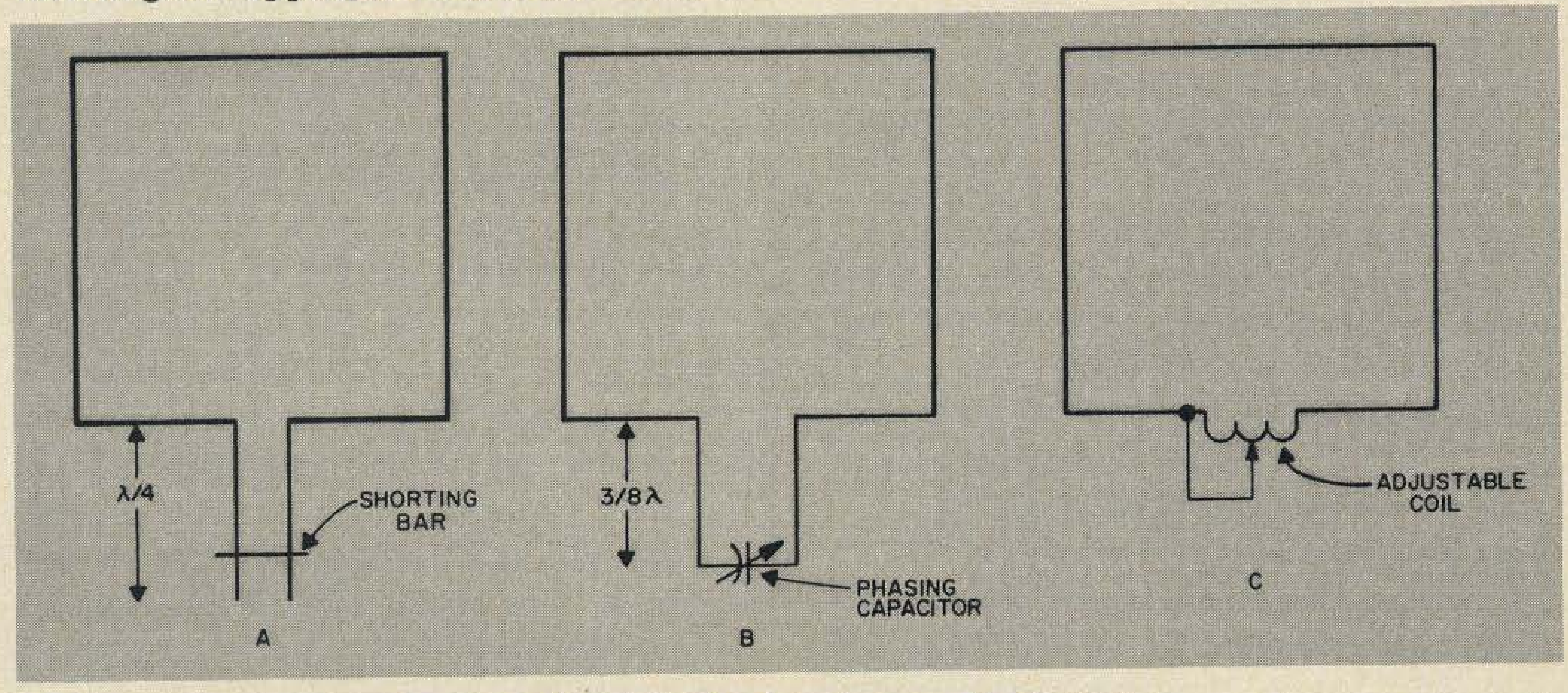


Fig. 1. Basic methods of tuning quad reflectors.

makes the difference between a directional quad and bidirectional stacked dipoles.

The remote method of tuning my quad reflector is an adaptation of Fig. 1B. Since an open-ended stub greater than ¼ wavelength is inductive at its terminals, it follows that extending the length of the stub by any multiple of half wavelengths will produce the same inductive value at the terminals. Connecting a variable capacitor across one end of this extended stub will enable the value of inductive reactance at the other end to be varied.

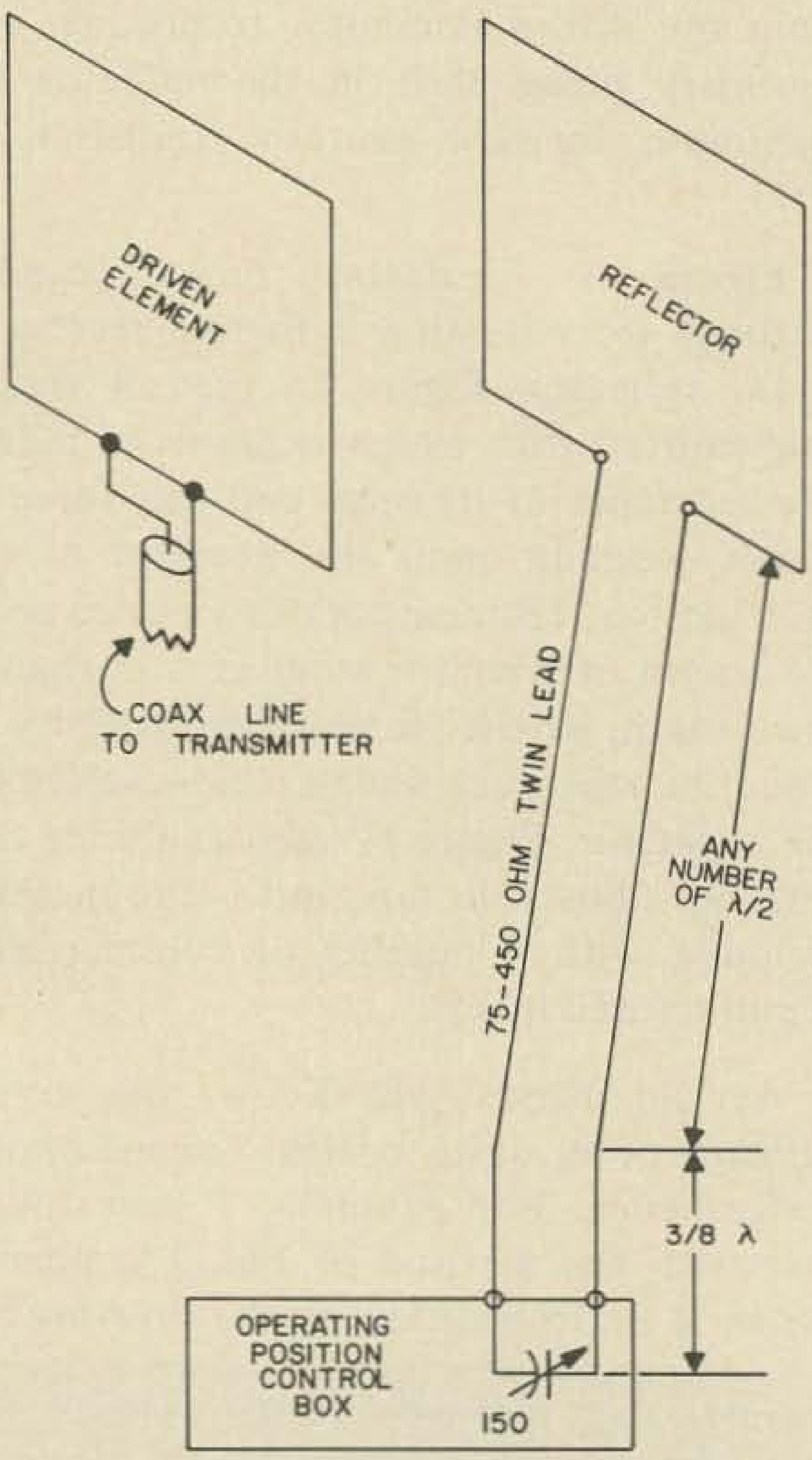


Fig. 2. Arrangement for remote tuned stub.

In plain words, you cut a length of transmission line to the number of half-waves needed to reach from the quad reflector to your operating position, plus an additional 3/8 wavelength. The adjusting capacitor at the operating end may be about 150 pF (variable receiving type). Figure 2 illustrates the setup.

Transmission line used for the elongated stub would ideally be on the open wire, 300–450Ω type. However, if this is physically impractical, 300Ω TV line will work almost as well, though moisture on the line may result in reactance variations out of the adjusting capacitor's range. The best solution was found to be the tubular, foam-filled, low-loss 300Ω TV line, which exhibited minimum variations when exposed to rain or snow.

In calculating overall stub length, the velocity factor of the actual line used must be applied. Taking the basic stub length to the 3/8 wavelength, the formula will be

$$\frac{351}{f(MHz)} \times V \times M$$

where f = resonant frequency of the driven element and V = velocity factor of the type of line used for the stub. Added to the basic stub length must be a length of line suitable to run from antenna to operating position, for which the formula is

$$\frac{468}{f(MHz)} \times V$$

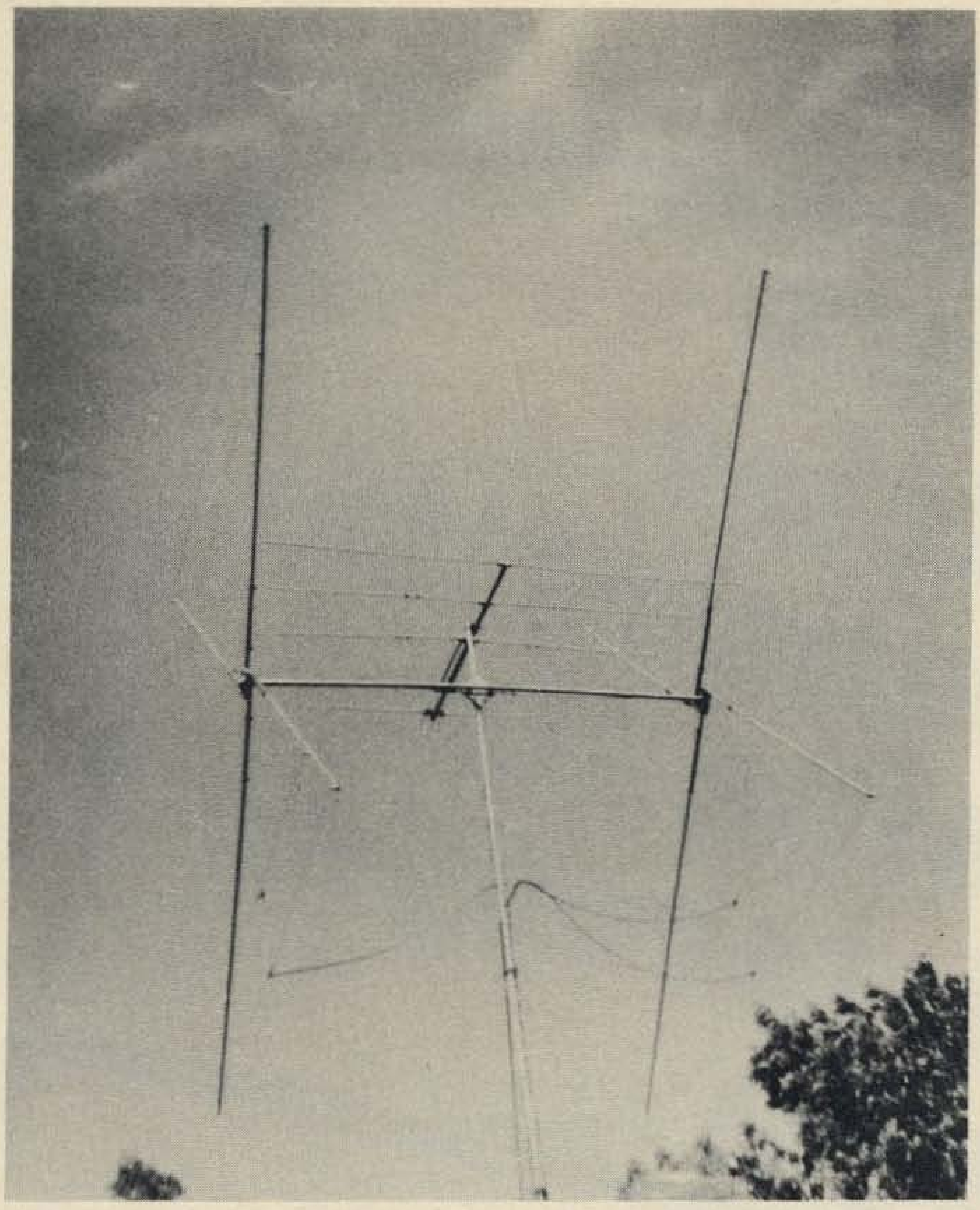
where m = the multiplier to achieve the length required.

For example, using 300Ω TV line with a velocity factor of 0.82 for a resonant frequency of 28.5 MHz, the basic stub length would be 351/28.5 x 0.82 = 10.0 ft. Supposing antenna-to-shack distance is a 50 ft run – an additional length calculated as 468/28.5 x 0.82 x 3 = 40.2 ft. The length of the basic stub, plus the half-wave multiple extension will then total 50.2 ft.

Velocity factors for readily available balanced lines suitable for constructing the elongated stub are as follows:

a) Open wire (any impedance) V = 0.975
b) Flat TV line (300Ω) V = 0.82
c) Tubular TV line (300Ω) V = 0.82
d) Flat TV "twin lead" (75Ω) V = 0.68

Once you have the elongated stub cut to the required length, and connected to the open terminals of the reflector, connect the variable capacitor to the operating end and turn the quad back on to a groundwave signal; another local ham or a signal generator with short antenna positioned a few wavelengths away. Vary the capacitor and watch the receiver S-meter for a null



10 and 15 meter quad with remote tuning stubs.

on the signal. If none is noted it will be necessary to carefully prune the stub to bring the inductive value into the range of the capacitor. Cut off no more than 2 in. at a time, reconnect the capacitor and try again. Repeat this process until varying the capacitor produces the desired null. Finally prune the stub just enough to bring the null to the mid-value of the capacitor.

It is assumed that the driven element has been resonated and matched to the transmission line before adjusting the reflector stub. Once the stub has been pruned, and power is applied to the antenna through an swr bridge, a distinct variation in swr will be noted as the stub capacitor passes through the null position, and if the driven element is properly matched minimum swr will occur at reflector-optimum setting of the capacitor.

When the quad is facing a ground-wave station it is possible to adjust the stub capacitor for maximum signal, and the setting will be slightly different from that for front-to-back ratio. The capacitor will also compensate for wet weather conditions and permit optimum tuning of the reflector when moving around the band.

For a multiband quad, a separate elongated stub will be required for each reflector. The photo shows my 10 and 15 meter quad (don't be confused by the TV antenna mounted between the elements), with the common transmission line at the left and the two stub lines to the right. While this method has been described for a two element quad, there is no reason why it can't be applied to 3 and 4 element quads, if you care to run the extra lines, or to any parasitic type array for that matter.

With the tuning capacitors mounted in a small box at the operating position, assurance that your quad is giving maximum performance is as simple as just tweaking a knob.

. . . W6AJZ ■

2 Watt 6 Meter Transmitter using the Heterodyne VFO

Bill Hoisington K1CLL
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Peterborough NH 03458

This article describes the breadboard design, tuneup, and results of an rf power stage on 6 meters using the $2.95 Motorola 3-watt HEP-75 transistor (similar to the famous 2N3866). This rf stage is designed to work from an input power of 120 mW such as furnished by the 6 meter crystal-heterodyne-vfo circuit described in a previous issue of 73 Magazine. Two types of inputs are detailed, one using a single capacitor, and the other a matching network for use with any length of cable. At a dc input power of 2W using a 12V battery, a good clean watt of rf output power is obtained.

Circuit and Design Theory

Figure 1 shows the schematic, using the input matching network. The design of a VHF input circuit can take various forms, depending on whom you read, what you read, and the proposed use of the rig. In

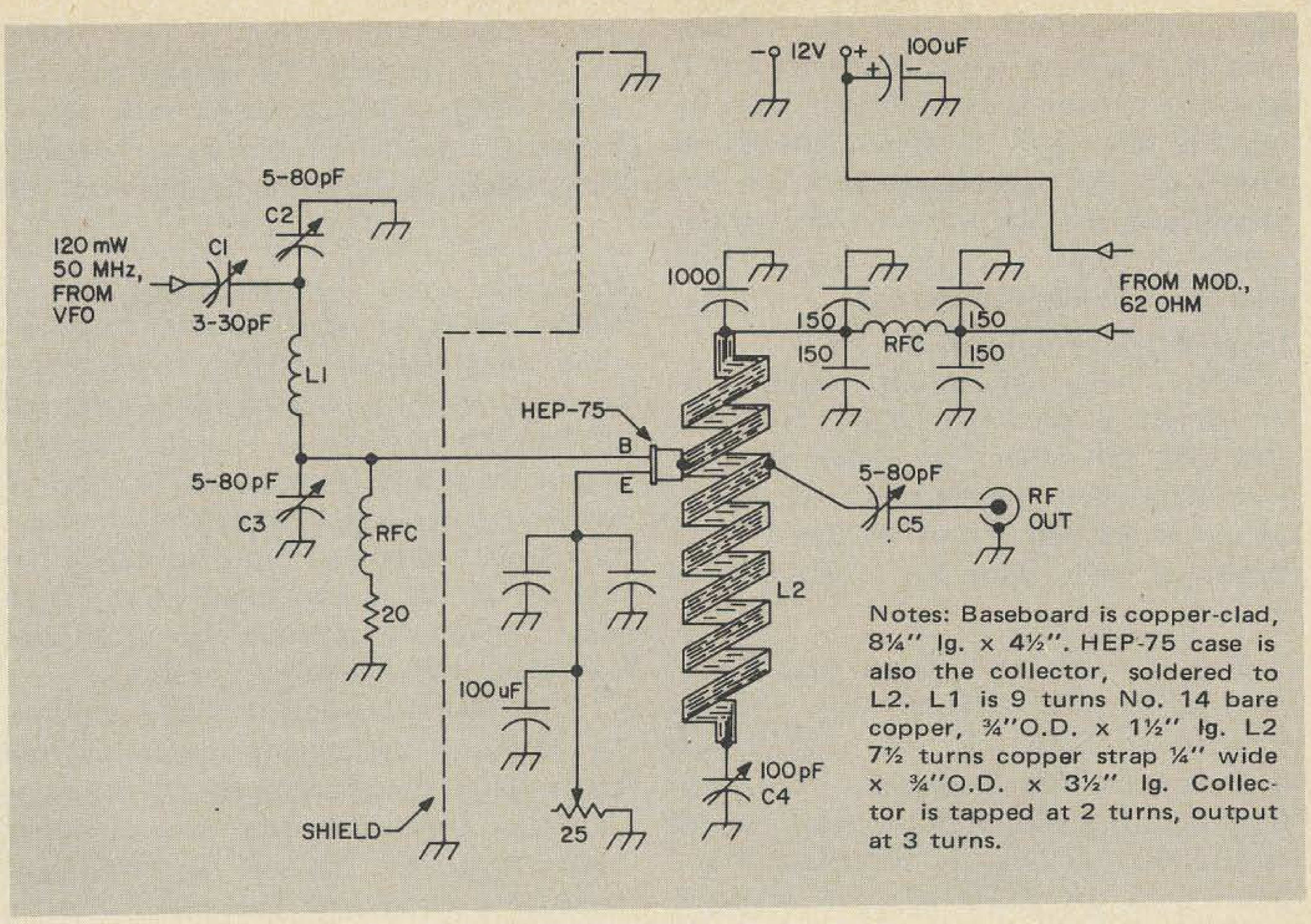


Fig. 1. 2 watt, crystal-heterodyne-VFO 6 meter rig.

this case, we want sure-fire operation, an easy-to-build circuit, freedom from self-oscillation, smooth tuning, 12V operation, and "carrying" type portability for hill-topping emergency use, and mobile work, as well for use at home.

The circuit in Fig. 2 uses a capacitor from J1 to the base. It works, and should be sufficient in the case of an excess of input power (not too likely), and where you don't mind adjusting cable length. However, if you're building up from only 120 mW of vfo output, you may want maximum power transfer along with the ability to match various cable lengths, and direct inputs (as in the case of packaging the entire rig in a box).

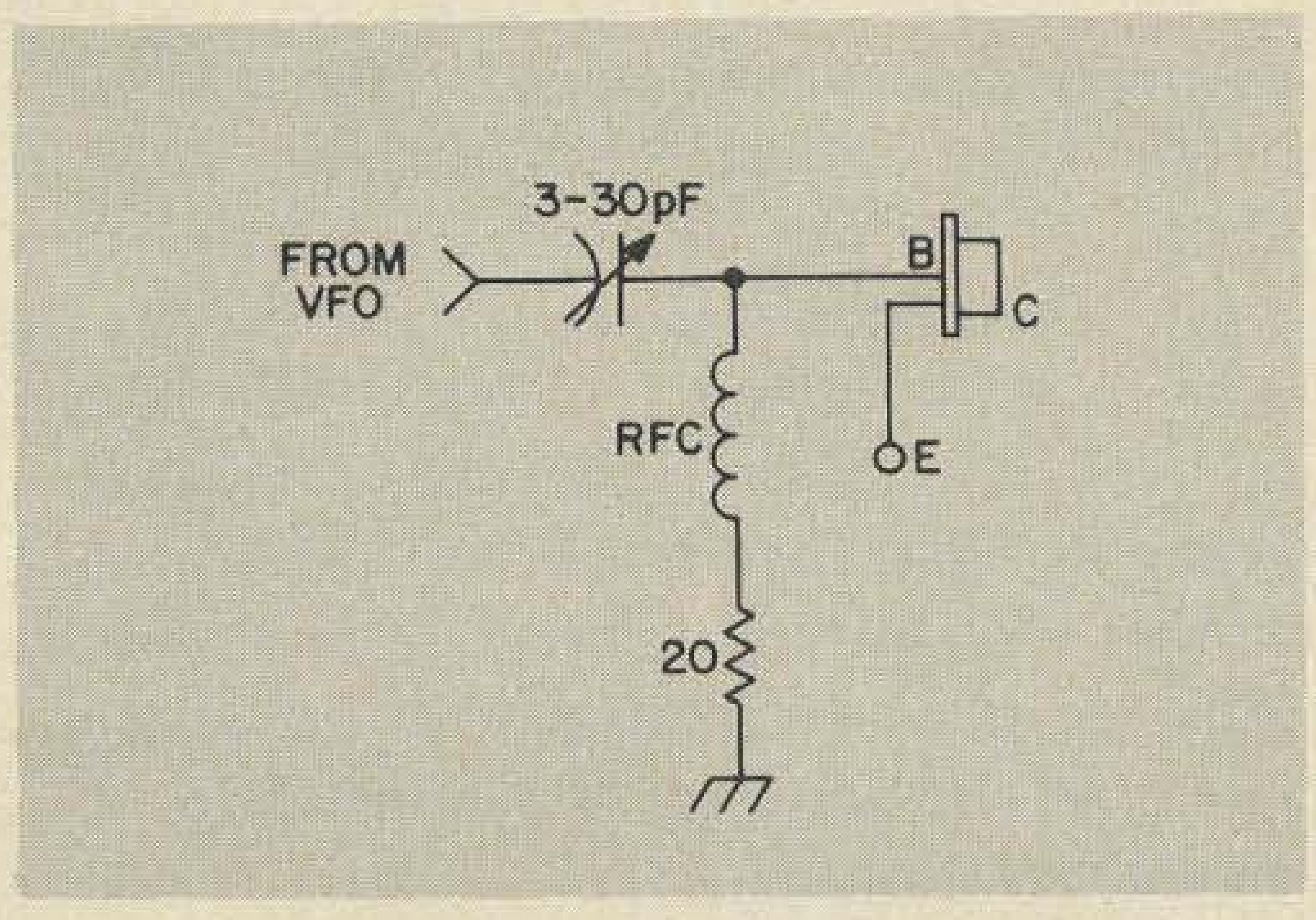


Fig. 2. Simplified input circuit, 2 watt, 6 meters. (Temporary)

The circuit of Fig. 2 is reliable and good for a "quickie" any time. But it does not always furnish maximum drive or best input match unless the cable length and output tap on the vfo output inductor are adjusted. These latter are of course indications of mismatch, but for short lengths of cable there is little loss, so you can operate that way if needed.

DC Base Lockup

This nasty little trouble has not been mentioned in the rather large amount of literature persued here through recent years. I can just hear some know-it-all lads saying, "Ho, Ho, he's just discovered the Poniatowsky effect." Well, maybe so, but whatever its name is, it arrived here and I don't like it! Here's what happens: With an rf choke from the base to ground and *no* resistor, and an rf input driving the collector to about 200 mA, cutting off the rf excitation does not cut off the collector current. There is no rf involved and it seems to be a dc type of hangup. Just for fun I'll wait until someone tells me its name. In the meantime, back on the breadboard, the cure was easy. Just include a little resistance in the base circuit. That's why the 20Ω job is there.

Input Matching and Base Circuit

After trying out various combinations of circuits as shown by RCA, Motorola, Fairchild, and others, the circuit of Fig. 1 was judged best. Inductor L1 can also be an air-wound coil 5/8 of an inch O.D., 8 turns per inch, with 5½ turns (not too critical).

Just a word of caution here about overloading receiver inputs while testing transmitters. While checking with the lab receiver, with its antenna only 10 in. away from the 1W rf output of the amplifier, the receiver was completely blocked out and detuned by the rf. The addition of only 1 in. of wire as a test antenna brought things back to normal. A very peculiar effect; expect almost anything when you start to run power. In solid-state VHF, "power" refers to anything over 1W.

Emitter Circuit

No trouble here. Two capacitors were used for bypassing, which are not really 100% in parallel. That is, with the ground leads of the capacitors going to slightly different ground points and the two leads cutting down the lead inductance by a large factor, the emitter is pretty well tied down to the ground plane rf-wise. A 25Ω pot controls power output from about 0.25 to 1.0W with 120 mW of rf input power and 2W of dc power.

Due to the base resistor requirements, no limiting resistor was needed in series with the 25Ω emitter pot which operates nicely as an rf power control (although 2W dc input does not particularly strain the HEP-75). A 100 μF capacitor was later shunted from the emitter to ground for better modulation properties.

Collector Circuit

Several requirements must be met here, some of them not usually compatible, but things worked out quite well as you will see in the results section. A good high-Q inductor is desirable for maximum selectivity when loaded by the antenna, and at the same time good heatsinking is needed. Fortunately, there is a design that will accomplish both of these requirements at the same time. The secret; Plenty of copper. Thus the edgewise-wound copper-strap inductor shown in Fig. 1. The collector is internally connected to the case, and to keep the inductance low and the heat conductance high, the case can be soldered directly to the copper strap. Do not use a large iron, and be sure to tin both the strap and the transistor case first. Use the minimum amount of time and heat to do this, consistent with a good solder joint.

Note that the collector is tapped pretty far down on the inductor (near the cold end); this is done for impedance matching purposes. With direct currents of nearly 200 mA at 12V, you can see that the rf impedance will be low. This gets to be a big problem when you get up into the hundreds of watts, but at 2W matching can be done by tapping the collector on the second turn of a 7½-turn coil as shown.

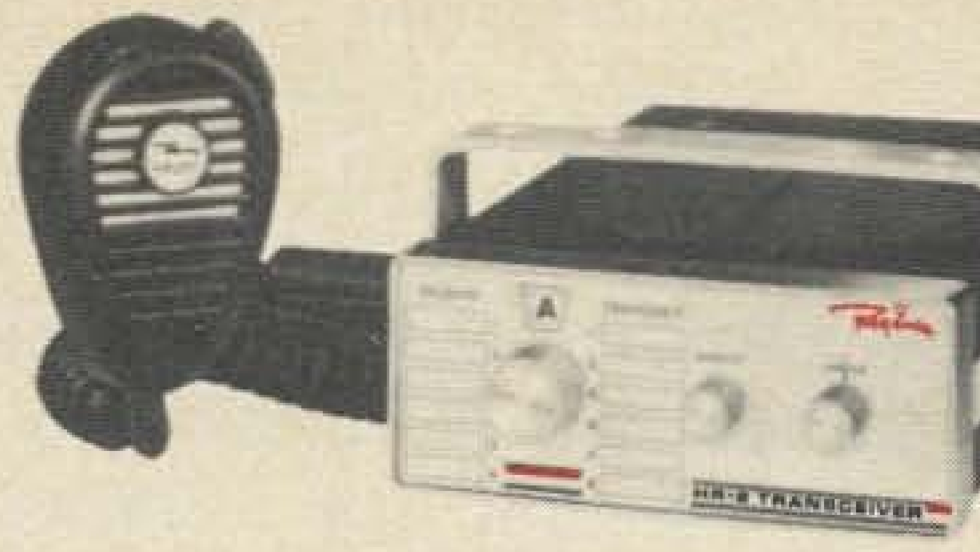
The copper strap also takes care of the heatsink problem by conducting the heat away from the collector in both directions along the strap. With more powerful transistors, use is made of a beryllium oxide or aluminum oxide insulating stud, which conducts heat quite well but *not* electricity. So far they cost a lot more, but we can always hope they will come down in price.

Collector Dip Notes

With the HEP-75 collector circuit detuned, the current is near 200 mA; with it tuned and unloaded, the current drops to about 50 mA just like in the good old days with tubes. Believe it or not, a spark can be seen when applying the pencil test to the high rf end in the unloaded condition. I generally load the circuit with the antenna so that a slight dip of, say, 10% is obtained. With an rf power indicator in the antenna line a precise adjustment can be made.

The RF Output Match

While not critical, the output connection does require care and testing to obtain



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Tapped onto L2 and 2½ turns (Fig. 3) is a 5–80 pF Arco compression trimmer (Model 462), which does a good job of matching a 0.9 or 3W bulb to the collector.

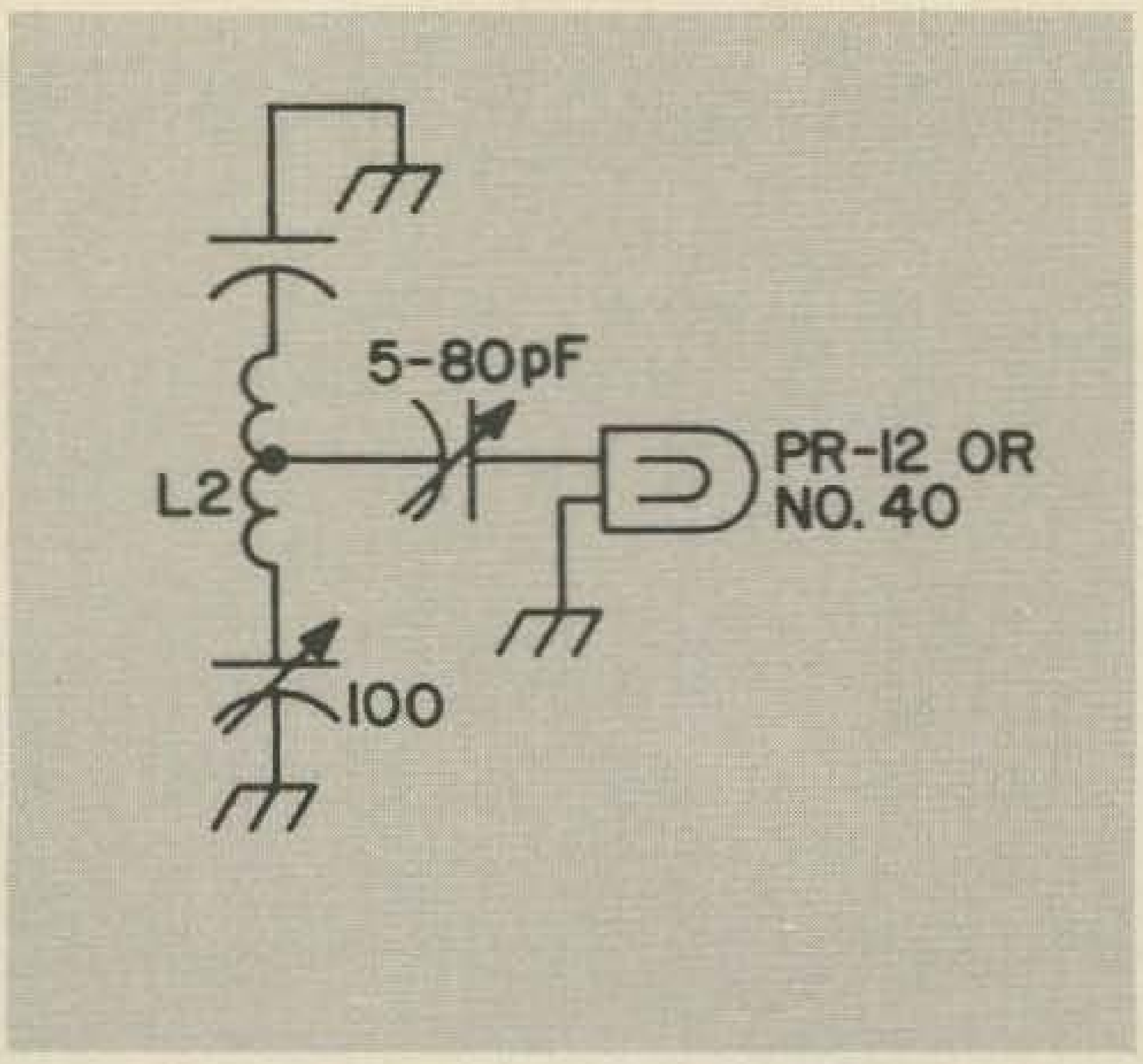

Fig. 3. Output test circuit.

With the input circuit of L1 tuned correctly and 180 mA showing in the collector circuit while detuned, and rocking C4 slowly through the dip at resonance, the proper adjustment of output coupling capacitor C5 can be obtained.

The adjustment for a pilot light match is not necessarily the same as for a 50Ω cable. Leading to coax requires readjustment of output capacitor C5 and possibly the tap on L2.

I found 160 mA to be about the maximum output. If you load L2 down to where there is less dip, your power and selectivity against harmonics will suffer. It is best to use a shade less coupling, sacrifice a small percentage of your power, and obtain good discrimination against harmonics. (Don't forget that second harmonic of 50 MHz right in the middle of the FM band!)

Homebrew Wattmeter

This is something I'll really have to look deeper into, because there are rf wattmeters on the market, but they start at $49.50 for 2–30 MHz and go up in price along with the frequency. With all the material that the young builder has to purchase, perhaps on an "allowance" budget, he just has to pass up such luxuries.

In the meantime, back at the old bench, turn to page 259 of Lafayette's 1970 catalog and you will find a list of pilot lights with a wide variety of wattage. You can push these along at a lively dc clip to perhaps twice the rated voltage. After all, most of them sell for only 15¢ to 90¢. The only thing is that after you get up to a watt and over it begins to be a little tough on the eyes! So use a higher rated lamp than actual rf power. In the Lafayette list you will see the number 48 and 49 for 120 mA (good for oscillators), the 40 and 47 at 1W, the PR13 for 2.34W along with the PR12 for 3W, and the 432 and 433 for 4.5W, etc. A lot depends on what you can find in your local hardware store if you're in a hurry right now to know how many watts output you have. There comes to mind the question of whether or not the pilot lamps light to the same brilliancy on rf wattage as they do on dc. All I can say is that when a lamp is lit by rf to the same brilliance, there must be *at least* that much wattage. If the final is tuning nicely at the proper loading point, as mentioned above for maximum power out, it is reasonable to suppose that most of that rf is going into the filament of that pilot lamp, and will show up as heat.

To make a real handy wattmeter for pennies, set up a little panel or minibox with lamp, battery, pot, and dial knob calibrated in watts. To calibrate, simply read the amps times volts for different positions, using the method of successive approximations to get round numbers for easy reading on the dial.

To solder a connection onto the aluminum base of a bulb, use a good clean tinned iron, scrape the aluminum clear of any oxide, and use a rubbing motion of the iron to tin the aluminum for about 3 or 4 seconds. Friction, plus heat and solder flux, helps solder to adhere adequately to aluminum.

For use with the transmitter, just position the wattmeter bulb alongside the one lit by the rf and adjust for the same

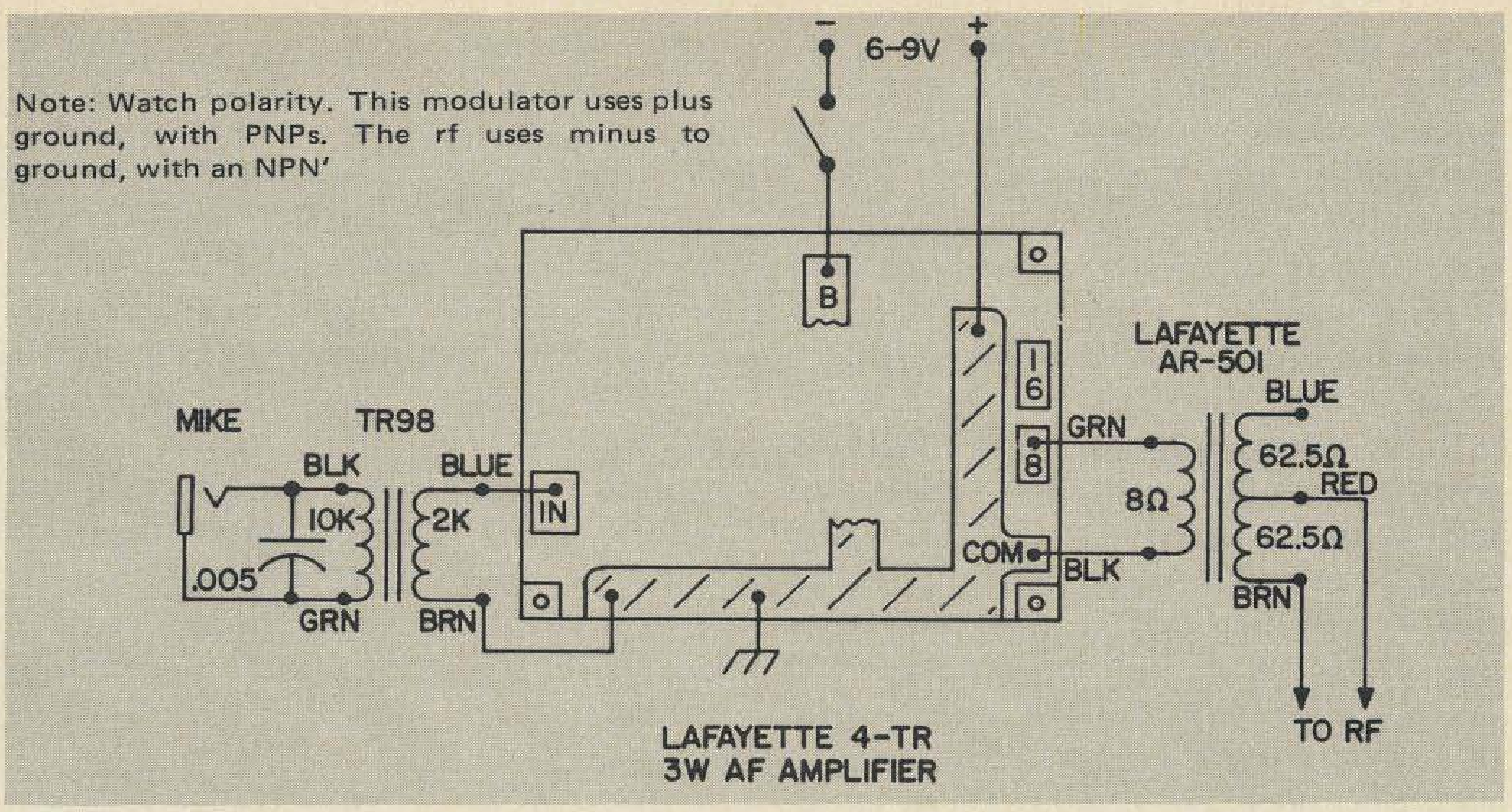

Fig. 4. Modulator circuit, 2 watt, 6 meter rig.

brilliance. The human eye is supposed to be quite good at this type of comparison. It works.

The Modulator

There is a ready-made unit for the modulator, which only costs $7.95 and has 3W of audio output. This is the Lafayette "4-TR," 99E91432. It is a chunky little package, uses an RC-coupled input stage, a transformer coupled driver, and two power transistors in push-pull, with an output transformer having 8 and 16Ω outputs.

The unit fully modulates the 2W rig. At this particular time I have yet to decide between the transformerless output circuits and those using a transformer. It may well be that certain systems need transformers, and others, such as hi-fi sets, are better without them. As some engineers have pointed out (mainly those engineers from telephone companies!), the best of FM broadcasts reach you through a minimum of ten or a dozen transformers, so why worry about one more?

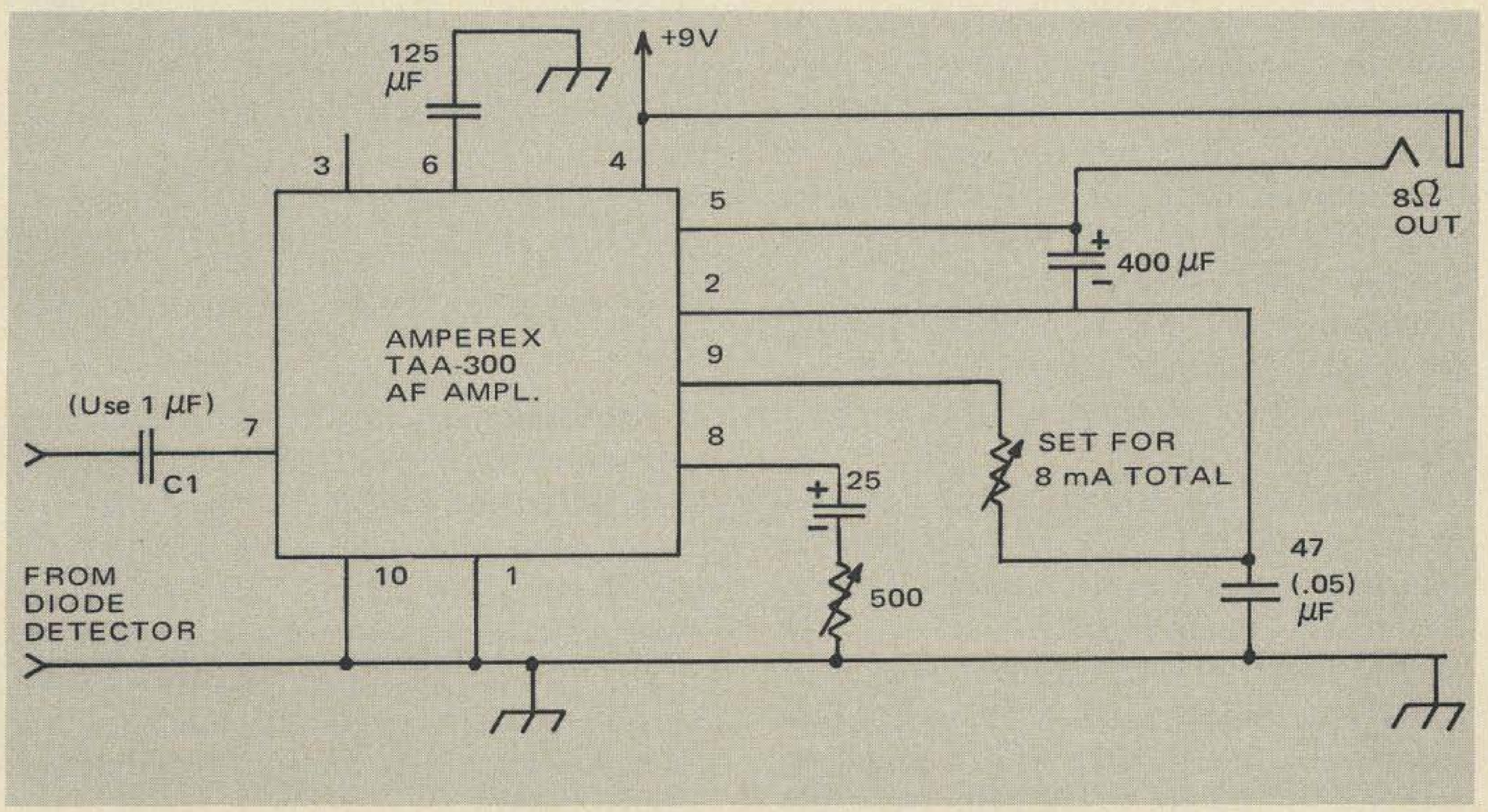

Fig. 5. Modulation monitor, 2 watt, 6 meter transmitter.

So, for a modulation transformer, not having found the ideal as yet, we use another, back to back with the 4-TR winding of 8Ω, The nearest to 75Ω I could find was the Lafayette AR-501, which has an 8Ω winding on one side and a 125Ω winding on the other (centertapped). It worked out fine on the air, in the circuit shown in Fig. 4. As the power goes up on this type of rig, with one or more HEP-75s, possibly to 10W or so, the modulation impedance will drop below the 48Ω region. In this area there is the 10W "universal" transformer with taps at 4, 8, and 16 on one side and 8, 12, 16, 24, and 48 on the other side, at only $3.95. A major benefit of low-impedance solid-state devices now becomes evident, as you don't have to pay for much copper.

In my transmitter, only the final is being modulated. Tests were carried out using only a 6V battery on the modulator because the only 9V batteries I had on hand were those little jobs for Jap radios – and they will *not* furnish 500 mA!

Excellent modulation reports were obtained on the air, however.

A good idea for checking your own modulation on a dummy load before you put it on the air is to use an Amperex TAA-300 integrated circuit, as shown in Fig. 5. This little gem is actually a miniature hi-fi set all by itself, and it really tells you what your own rig – with *your own voice* modulating it – sounds like to others on the band. To do this you need also a set of earphones, with good padding to keep your voice from reaching your ears through the air. The Lafayette Model 8X stereo headphones ($7.95) are excellent for this, with 8Ω impedance per phone. Just connect the two phones in parallel in a three-circuit jack.

Connect a tuned diode receiver in front of the TAA-300 to pick up the rf from the transmitter, and use the Amperex external circuit as shown in Fig. 5.

The TAA-300 is an excellent example of a modern audio-type IC using eleven transistors and five diodes, with a frequency response of 20 Hz to 25 kHz. Naturally, you don't need all that range for voice communications work so the following modifications were used to cut down the highs and reduce the lows. Replace C1, 0.6 μF, with a 0.01, and install a 0.005 across the input jack. Regular treble and bass tone controls can be made up but they should be put in a minibox to minimize hum because there is a lot of gain at 60 Hz in the little tin can. I also put a pot in place of the 48Ω feedback shunt resistor, because making the negative feedback control variable has very interesting possibilities, as you will see when you operate it. The TAA-300 also makes an ideal amplifier for any amateur receiver using transistors.

On The Air

Not waiting to hook up an rf power monitor, I connected the 50Ω cable from my 4-element beam through a ceramic rotary switch for use as in Fig. 6, to change

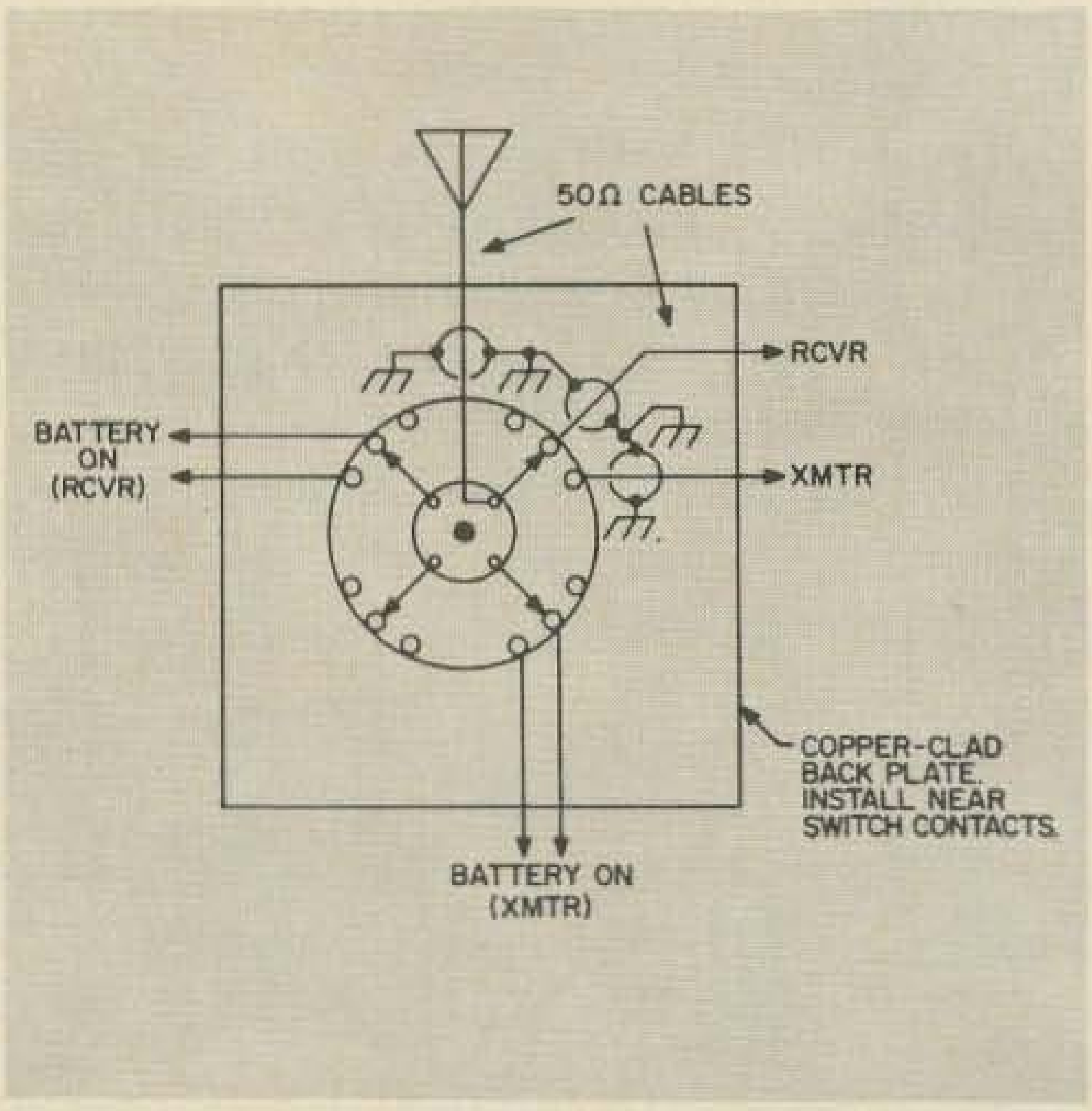

Fig. 6. Send-receive switch, 6 meter, 2 watt transmitter.

over the antenna and turn the receiver and transmitter on and off, and tuned for the same dip in the collector current that had shown maximum power into a PR-12 3W pilot lamp. This did the job. In October 1969, I tuned the vfo to a good loud signal on the band and he came right back to me. This was W1ZLG, a Massachusetts station 55 miles away. His report: "Modulation very very good."

. . . K1CLL ■

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Larry Waggoner WAØQPM
7611 Cottontail Lane
Wichita KS 67212

SEMIAUTOMATIC FM CHANNEL SCANNING

The completion of the second 2 meter FM repeater in Wichita left me with the problem of trying to monitor both repeater frequencies simultaneously, on a one-receiver budget. Manually flipping the channel selector was a tiring method which set me to work on a way to electrically perform this same function with the least expense and design effort. The solution was a circuit made up of a "flasher" module, two transistors, and five resistors.

I call this a "semiautomatic" scanner because the unit will not "lock on" when a signal appears on a vacant channel. It

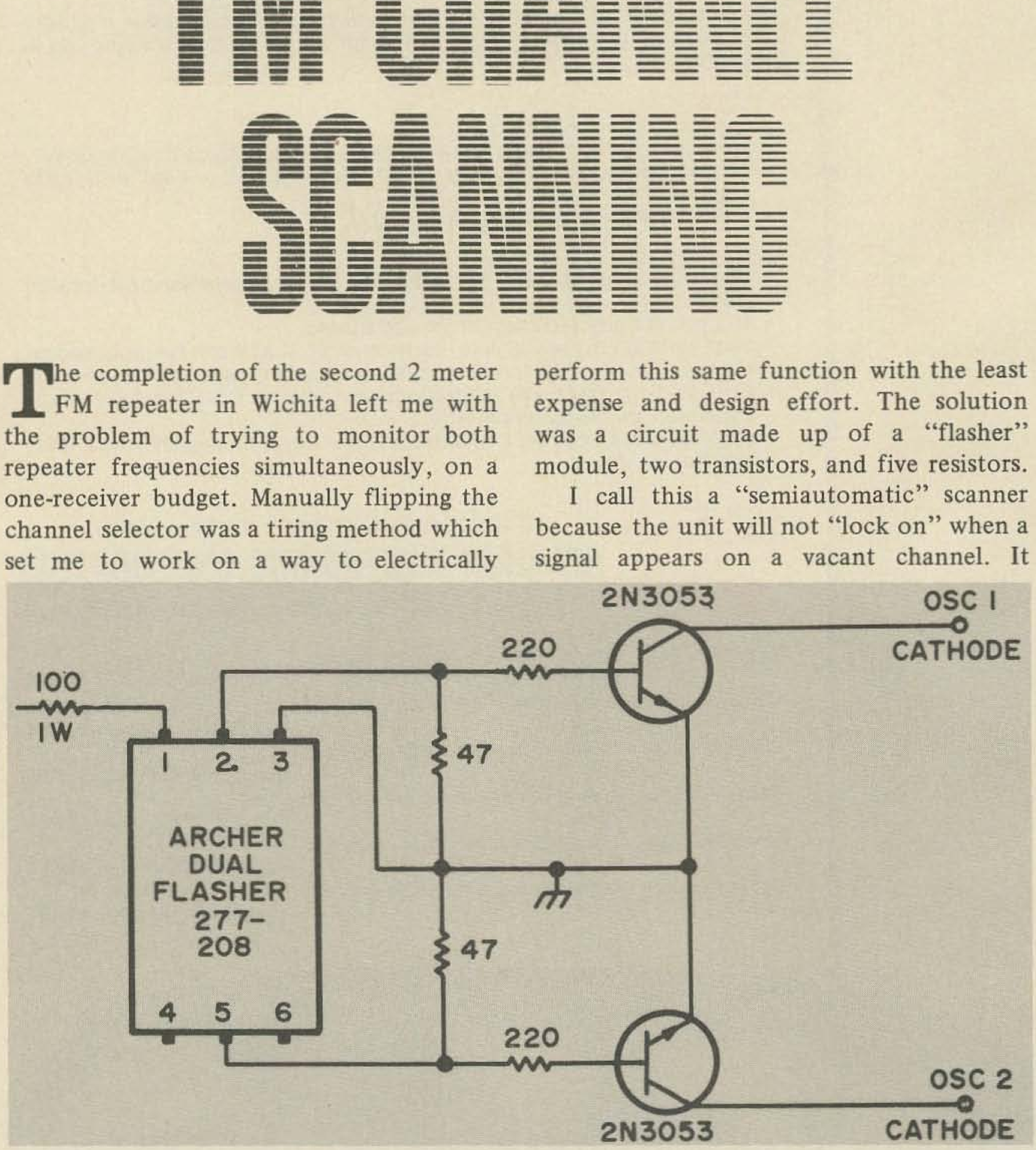


Fig. 1. A nonlocking scanner can be made easily by using an Archer dual flasher in conjunction with an external switching circuit.

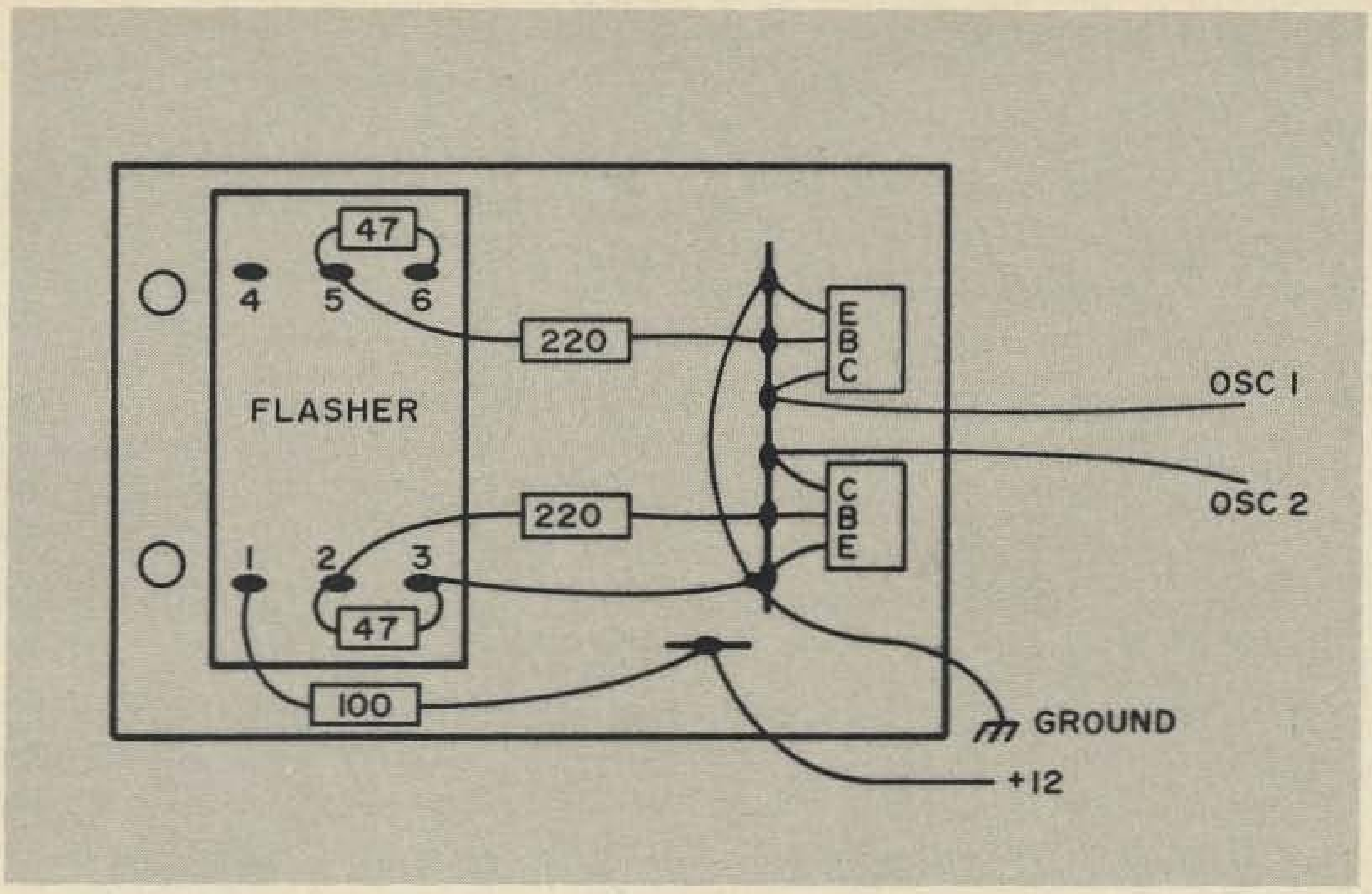


Fig. 2. Parts arrangement for mounting in GE Progress Line unit. When the scanner is in operation, all other cathode grounding circuits must be out of the circuit.

simply scans by monitoring first the F1 channel, then F2. When the operator wants to halt the scanning action, he merely turns off the unit by placing the frequency selector switch on the rig to the appropriate channel.

My mobile rig is a GE Progress Line, which switches receive frequencies by dc grounding the cathode of the desired oscillator. The idea was to use transistors to switch the oscillators, then make one of the low-priced experimenter flasher modules turn the two transistors alternately on and off. The module selected was the Radio Shack *Archer* dual flasher (277-208). The *Archer* unit is a 6V transistor multivibrator which cost $2.50. It can be easily duplicated, but the low-priced

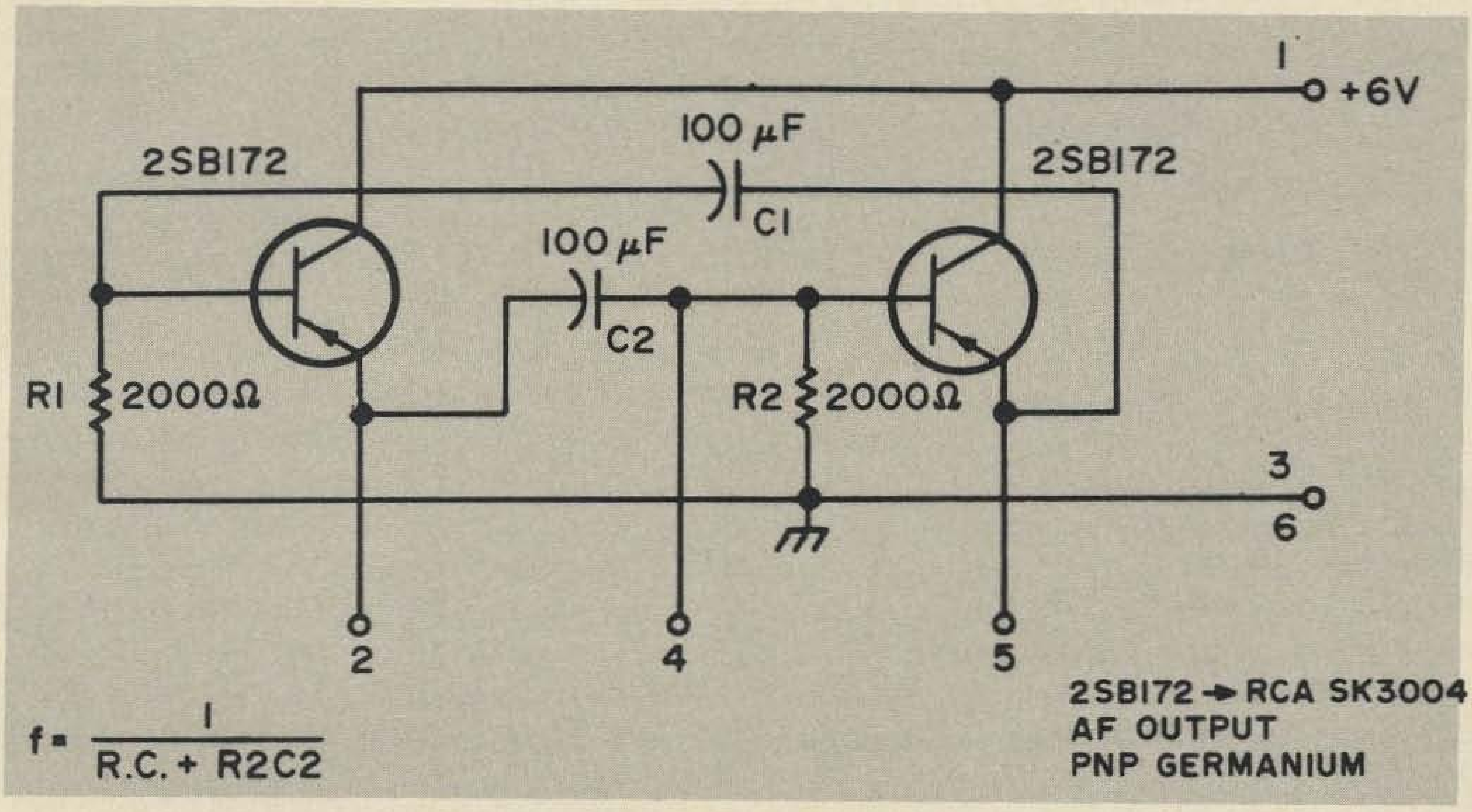


Fig. 3. Circuit diagram of the flasher module. Changing the RC values here (text) will permit variation of the switching frequency.

module is in an attractive case and includes a mounting socket.

For cathode switching, I used 2N3053 transistors because they were on hand; they are also very inexpensive if purchased new. If you make any substitution, choose a transistor that has a high collector–emitter voltage rating to withstand the potential difference between the floating cathode and ground.

In the circuit (Fig. 1) the 100Ω resistor is used to drop the 12V battery voltage to the level required by the module. The 47Ω half-watts are the load resistors, and the 220Ω resistors are used to supply a proper keying voltage to the transistor.

The "channel scanner" can be mounted up front with the control head or in the trunk with the receiver, as mine is (Fig. 2). When the unit is in operation, all other channel grounding must be lifted. On my rig I have a three-position switch which selects .94, .82, or, in the third position, leaves the cathodes floating and applies voltage to the scanner. The scanner can be permanently wired into the receiver. The switching transistors, with no voltage applied, offer a very high resistance which does not affect normal operation. If you have to rewire your receiver for remote switching, be sure to provide an rf ground at the tube cathode. GE uses a .02 μF capacitor.

The *Archer* flasher module is designed to operate at a frequency of 2.5 Hz. In this way, each channel is sampled about twice a second. The frequency can be changed by prying open the flasher module and changing the RC values. The circuit works according to this formula: I found that a frequency of 0.25 Hz was best for me (R1 and R2 20K, C1 and C2 unchanged). At this rate each channel is sampled for two seconds. You can also "lopside" the rate. I sample 146.94 for two seconds and 146.82 for 0.2 second (R1 = 2K, R2 = 20K, C1 and C2 unchanged).

I have been using the scanner for three months with no problems. The unit may not be as convenient as two receivers, but for the price, the "channel scanner" is a good way to always know what is going on, and where.

... WAØQPM ■

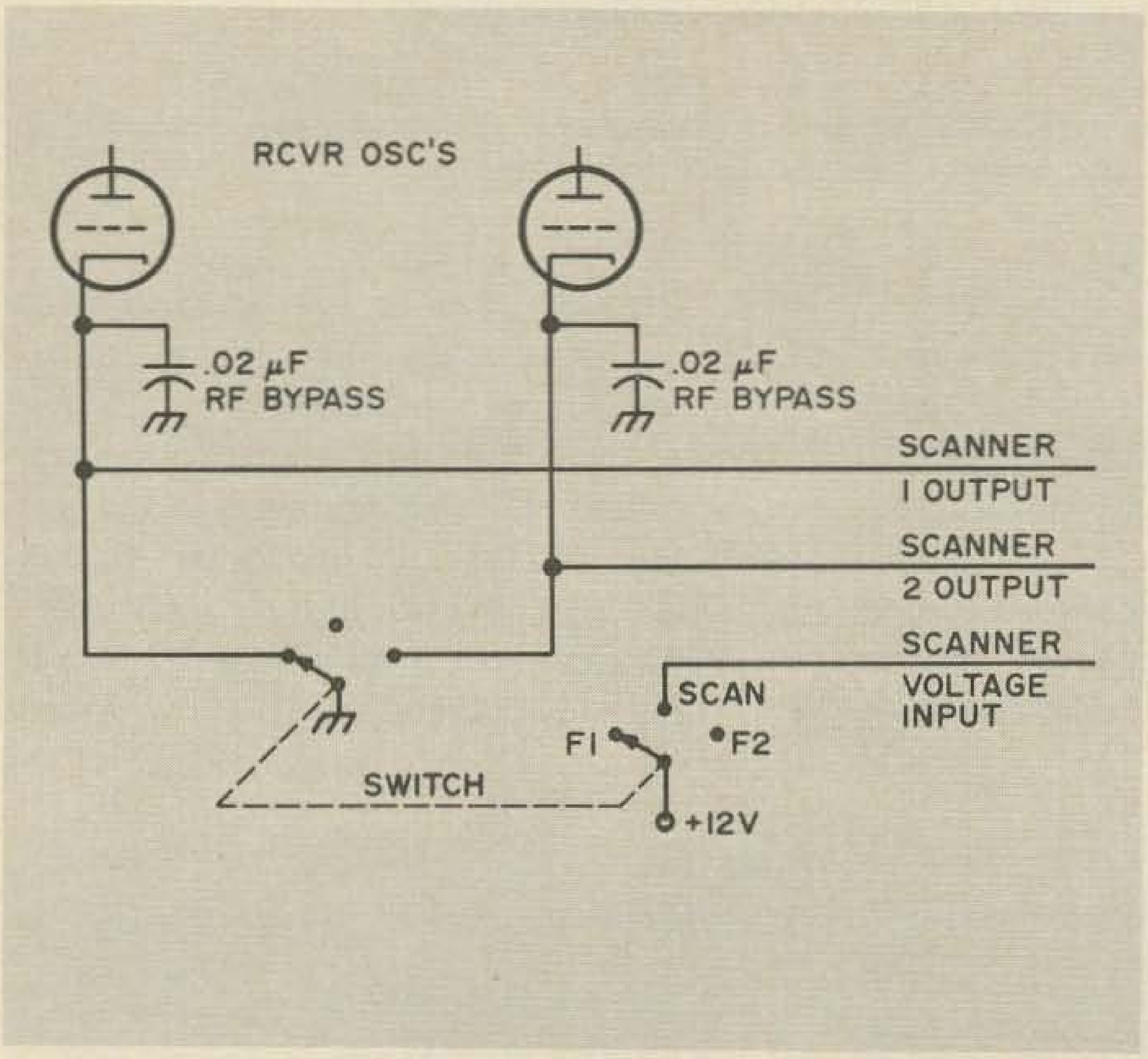


Fig. 4. This wiring diagram shows how the frequency selection is controlled. In the F1 and F2 positions, the appropriate cathode is grounded directly. In the scan position, the cathode ground is lifted and +12V is applied to the scanner.

Walt Pinner WB4MYL
7304 Lorenzo Lane
Louisville KY 40228

LOW COST AUTOMATIC KEYER: A "FIRST PROJECT"

If you don't build, START . . . if you do, try this one tonight

Here are details for constructing a 3 x 5 in. solid-state automatic keyer containing as few as two dozen components and five transistors. The speed range is from 10 wpm to far too fast for me. Over the past two years several versions of this keyer have been built and I have found the circuit to be very tolerant of transistor substitution (get 'em out of the junkbox, computer boards, or old transistor radios). The current drain is low (8–15 mA) and the unit performs well for a minimum-cost project.

Application

If you already own a transceiver with a built-in sidetone oscillator and have 12V ac available, you need only build the basic circuit Fig. 1, omitting the area in dotted lines. The circuit may be tucked inside your transceiver or mounted in a standard 3 x 5 in. minibox. If installed internally any convenient front panel control may be changed to one having the additional 100 kΩ speed control section needed without the necessity of hole drilling. A clear plastic disk may be installed behind the existing knob for speed adjustment, thereby maintaining the original appearance of the rig. On units with the earphone jack on the front panel, you may consider moving this jack to the rear apron and installing the speed control in this location.

Construction

Virtually all the components are point-to-point wired; therefore, if you enjoy making circuit board projects, a full-size layout is included in Fig.2. Figure 3 is a large component placement diagram. Several manufacturers produce copper foil tape, and a board may be made without etching by merely attaching pieces of this foil tape to heavy acetate or other base material. When using this method, it is imperative that a low-wattage soldering

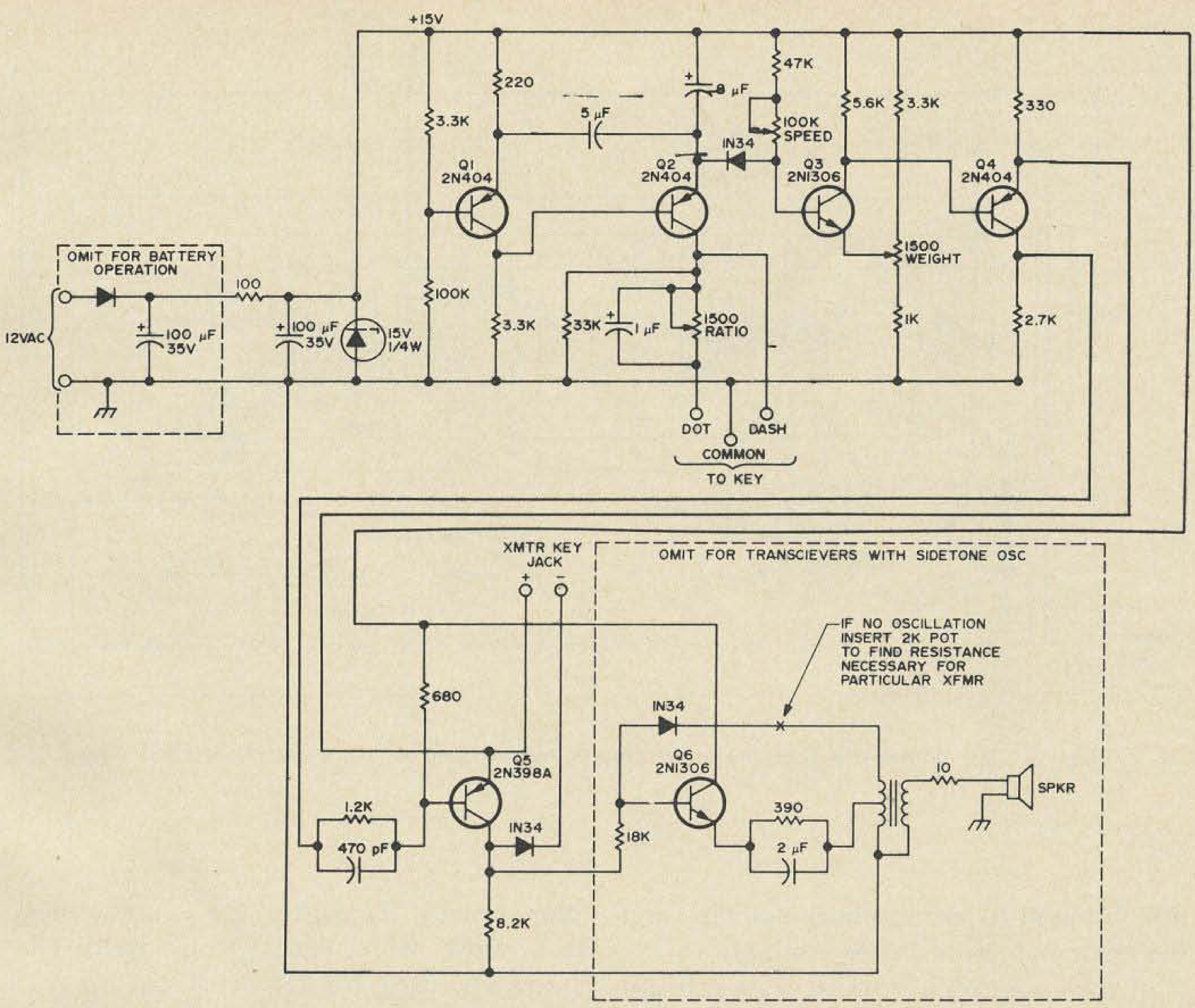


Fig. 1. Schematic diagram for the keyer. Note the marked-off areas at the left and right of the basic circuit. The enclosed area at the left is a rectifier so the power can be drawn from an existing 12V source. The sidetone oscillator is shown at right.

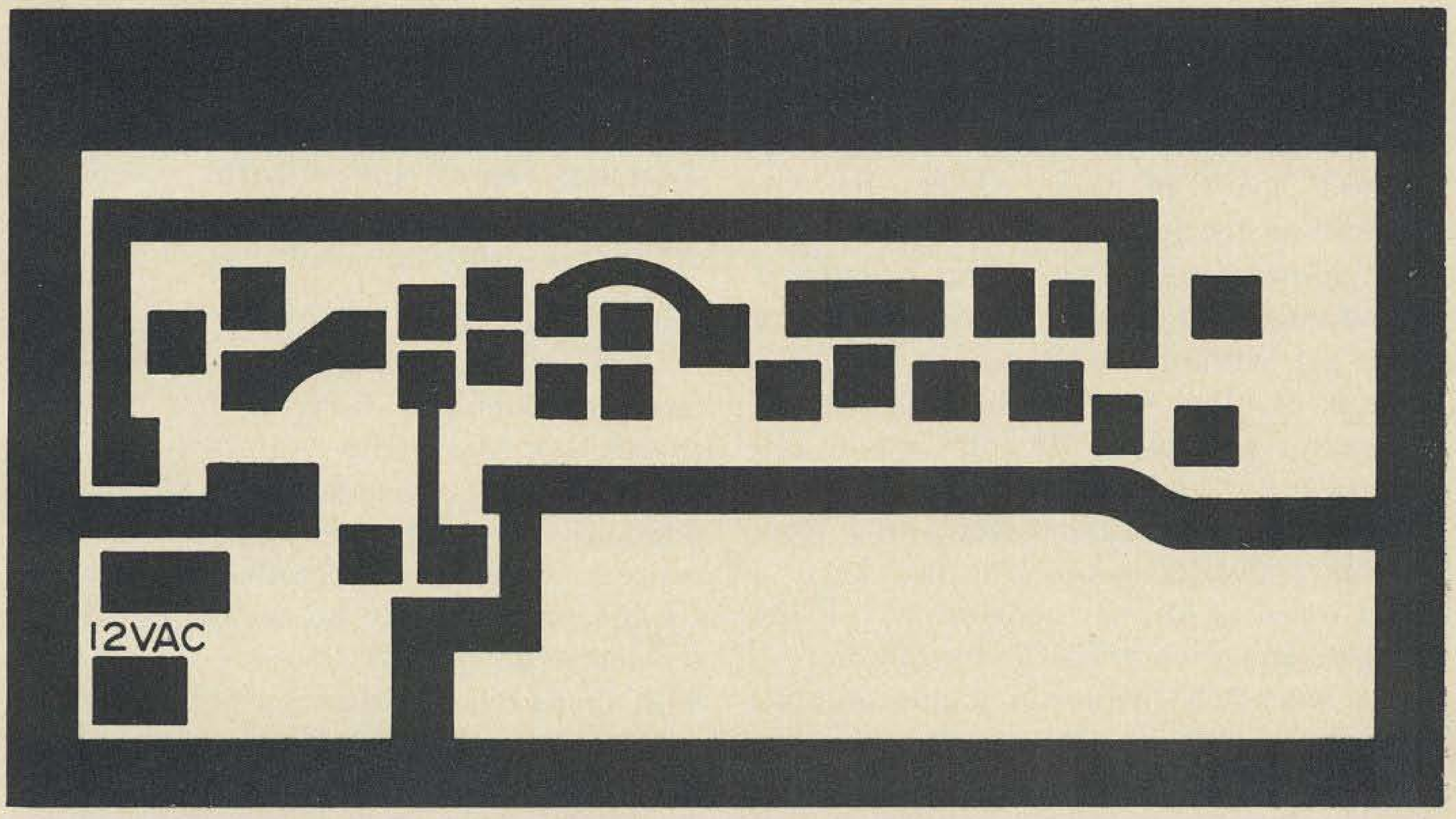


Fig. 2. This drawing may be used as-is to photographically produce an etched circuit board for the keyer assembly.

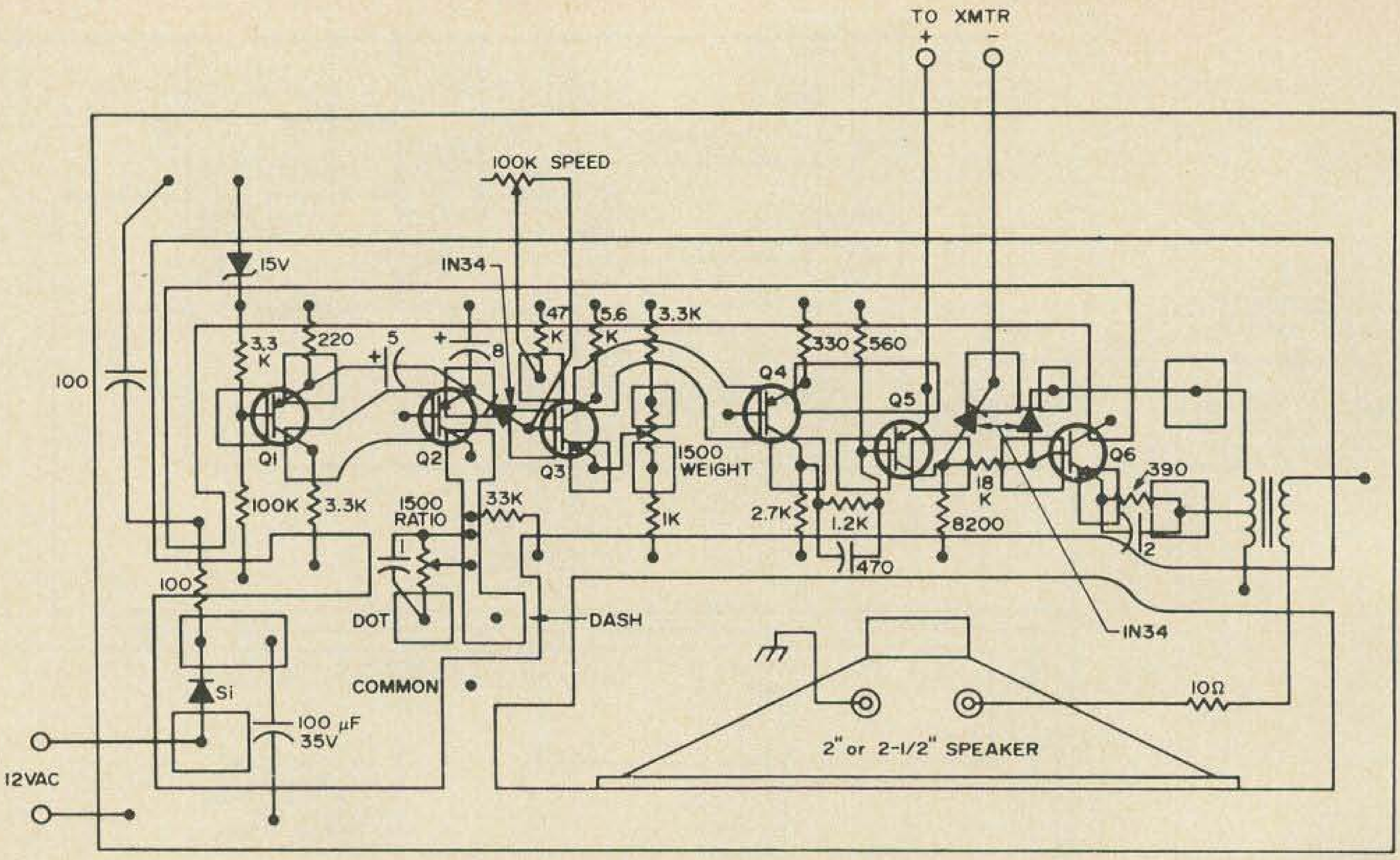


Fig. 3. This composite sketch should help in positioning of parts on the etched board.

iron be used to protect both the tape and the semiconductors during assembly.

A third approach is to use Vector board or Plexiglas and drill holes using the layout in Fig. 1, which will accept the Teflon base pin standoffs which are so common in many types of surplus gear and computer boards. Using this method, only three or four jumpers are required for the entire project. Should you elect to use the printed board or tape, solder all components to the foil side of the board. This will allow you to drop the completed board inside the minibox or secure it inside your rig without the need for electrical spacers or other insulation. This approach also saves you about 50 holes which you may need for a later project.

The speaker and transformer came from an old transistor radio. The last keyer I built used a driver transformer in the output, and even with the terrible impedance mismatch there was ample volume. Transistor Q6 can be almost any NPN audio transistor. Transistors Q1, Q2, and Q4 are very common on surplus boards or are available from Poly-Paks for about a dime apiece. Transistor Q3 is not critical and most NPN types work well. The transistor used for Q5 must have a V_{ce} rating in excess of the voltage at the transmitter during key-up periods. A 2N398A has a V_{ce} and V_{bc} rating of 105V, which is adequate for most transmitters. I found this transistor in a surplus pilot lamp assembly (24¢). The 1N34, zeners, and power supply diodes are all off computer boards, and with the exception of the zener, which should be 14–18V, other diodes may be substituted.

Circuit Description

This circuit, though relatively simple, produces dots and dashes which are self-completing. An audio oscillator provides ample volume for group work (if incorporated). This unit was designed for transmitters which are grid-block keyed. Cathode keying may be accomplished by replacing the 8.2 kΩ Q5 collector resistor with a reed relay or other sensitive relay.

Transistors Q1 and Q2 produce a sawtooth pulse for timing. The particular transistors used as well as the applied voltage will affect the speed range. If you desire to alter this range, increase the value of the 5 and 8 μF capacitors for slower speeds and decrease these values for faster speeds. Transistor Q3 acts as an amplifier, while Q4 and Q5 form a trigger circuit to key both the transmitter and the audio oscillator.

Power Source

A simple but effective power supply can be obtained by connecting a few components across the 6V filament line, as shown in Fig. 4. Since the current drain is

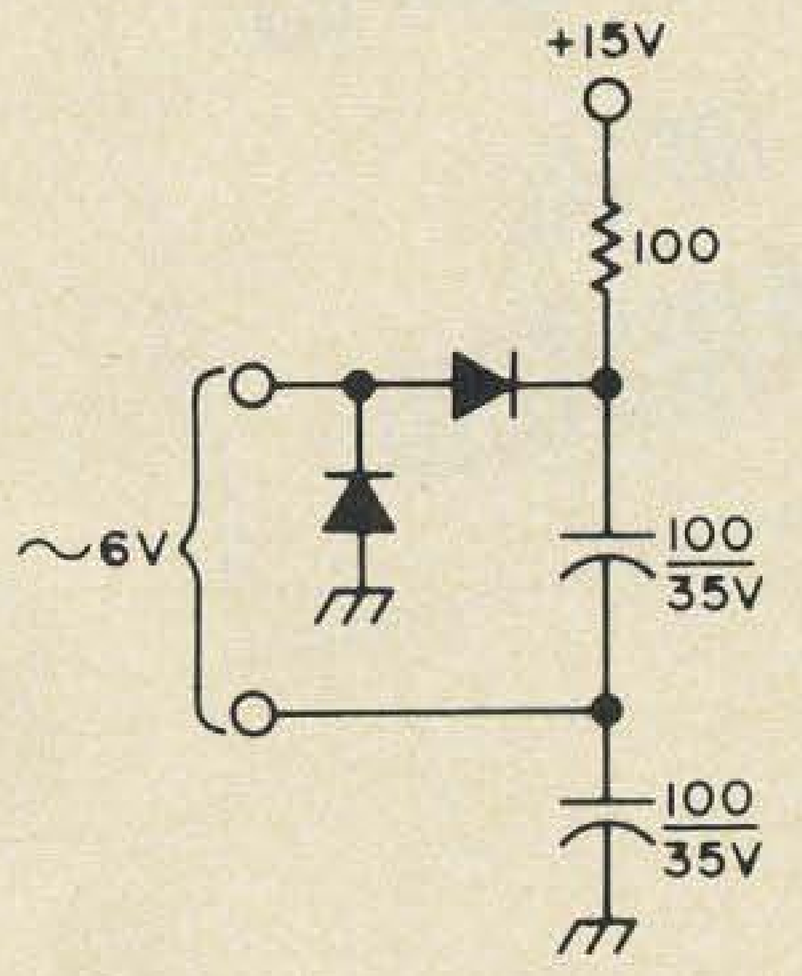
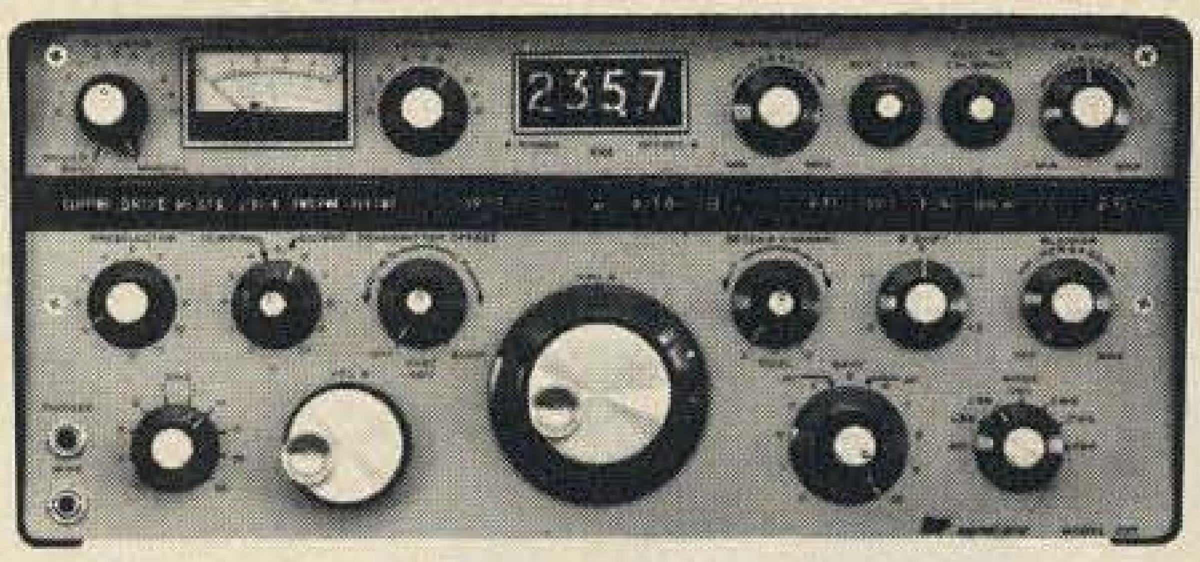


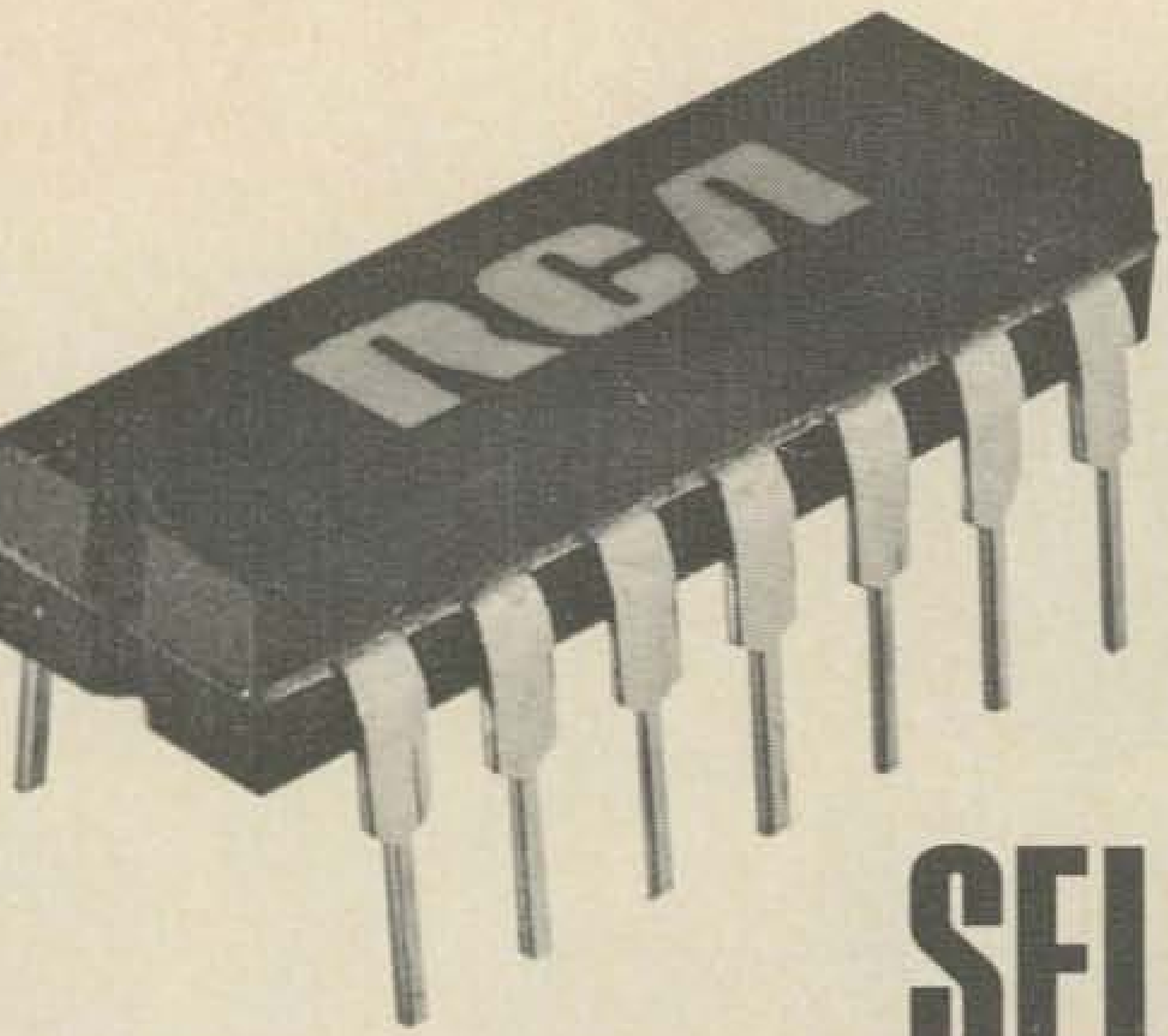
Fig. 4. A simple filtered voltage doubler circuit will convert the 6V ac filament line to 15V dc.

so small, though, a simple battery – connected between the 100Ω resistor and ground – will last a long time. You might even hunt around inside your rig for a 16V cathode resistor point and tap the necessary power there.

. . . WB4MYL ■



Eugene L. Klein, Sr. W2FBW
137 Ashford Road
Cherry Hill NJ



AC SWITCHING WITH SELF-POWERED ICs

A new approach to power switching of ac circuits: RFI is eliminated, power supply diodes are protected, switch contact wear is reduced, and tube heater life is extended!

A cure-all to ac switching problems? Not so! But RCA's little CA3059 integrated circuit device goes a long way in eliminating many of the bugs we inherited with Tesla's genius. Formerly known as a monolithic silicon zero-voltage switch, it is now more handily identified by RCA's "CA" number. It is no bigger than a 2W resistor, yet it contains its own power supply and all the other functions shown in Fig. 1. When used with a half-dozen or so other common components, it does many wondrous things. Several are described in this article.

Basically, we would like to accomplish switching when there is no incoming voltage; that is, when the power line voltage crosses zero. This happens twice each cycle, or 120 times per second at 60 Hz. If we switch at this precise moment, no current is flowing through the switch; thus, radio-frequency interference is eliminated, as is contact wear. Incandescent devices, such as tube heaters and pilot lights, which have very low cold-resistance, are heated up "gradually" during a half-cycle if voltage is applied at one of the "zero" crossing times. They are, therefore, not subjected to a destructive high-current surge as before. In the same manner, we reduce the high surge current and minimize the peak inverse voltage imposed on our rectifiers when initially turning on a power supply. The zero-crossing detector in the CA3059 synchronizes the output pulses of its circuit with the time of zero-voltage in the ac cycle. Figure 2 shows this relationship.

But to be useful in switching normal loads, an external power device is needed. Thyristors such as SCRs (half-wave) or triacs (full-wave) are ideal for this purpose. Either one is readily triggered by the 100 μs pulses from the CA3059. The zero-voltage switch is designed primarily to trigger a thyristor that switches a resistive load.

Because the output pulse supplied by the CA3059 is of short duration, the latching current of the thyristor becomes a significant factor in determining whether other types of loads can be switched. (The latching-current value determines whether the thyristor will remain in conduction after the trigger pulse is removed.) Provisions are included in the CA3059 to also accommodate inductive loads.

For example, for load currents that are less than approximately 4A rms (or that are slightly inductive), it is possible to retard the output pulse with respect to the zero-voltage crossing by insertion of capacitor C_x from terminal 5 to terminal 7 as shown in Fig. 1. The insertion of capacitor C_x permits switching of loads that have a slight inductive component and

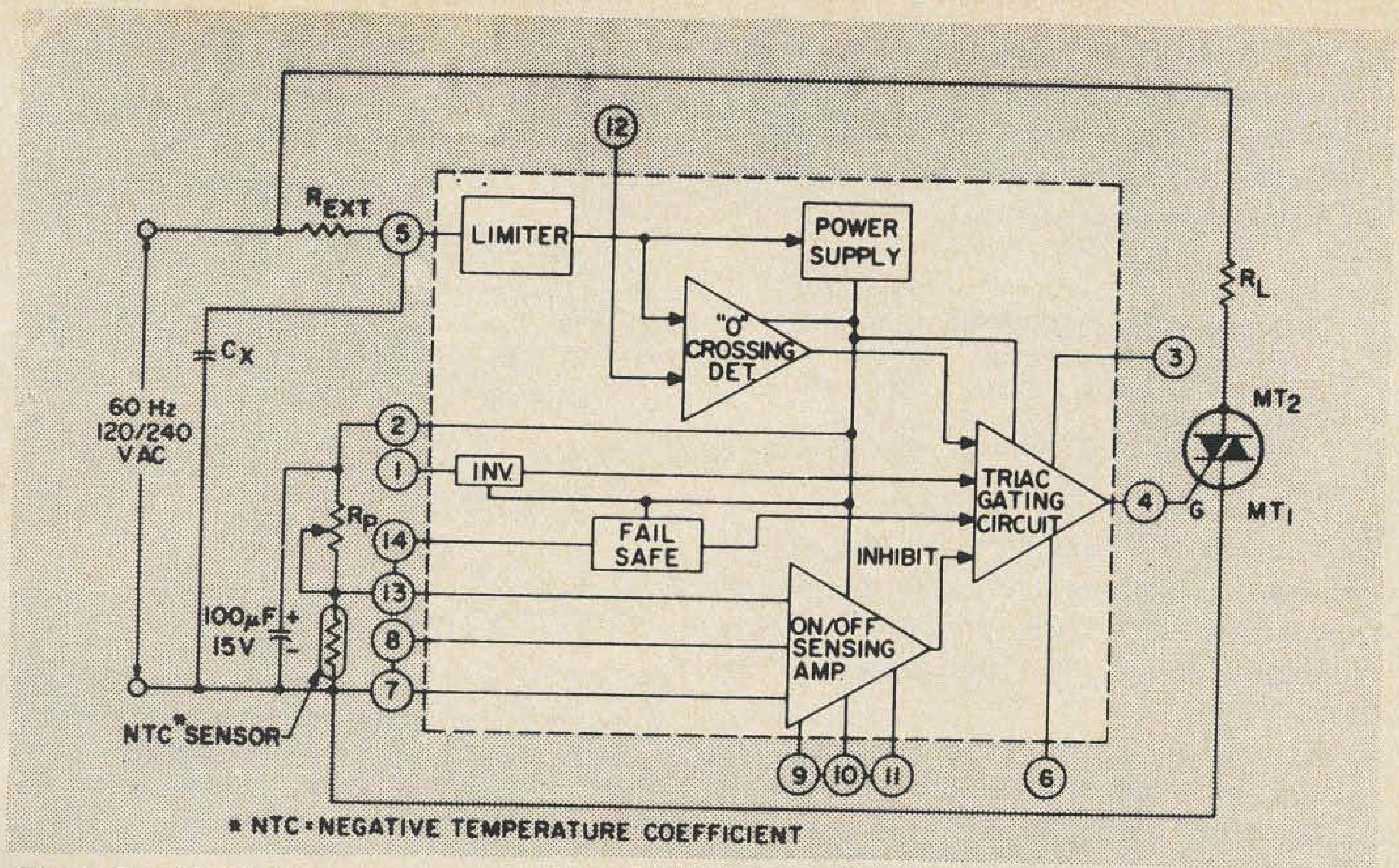


Fig. 1. Functional block diagram of CA3059. Few external components are required in this basic circuit when used to trigger the gate of a triac. The sensor may be a temperature-sensitive thermistor, a photoelectric cell, or a simple off-on switch.

that are greater power than approximately 200W. For loads less than 200W, it is recommended that the user employ the RCA-40526 sensitive-gate triac with the CA3059 because of the low latching-current requirement of this triac.

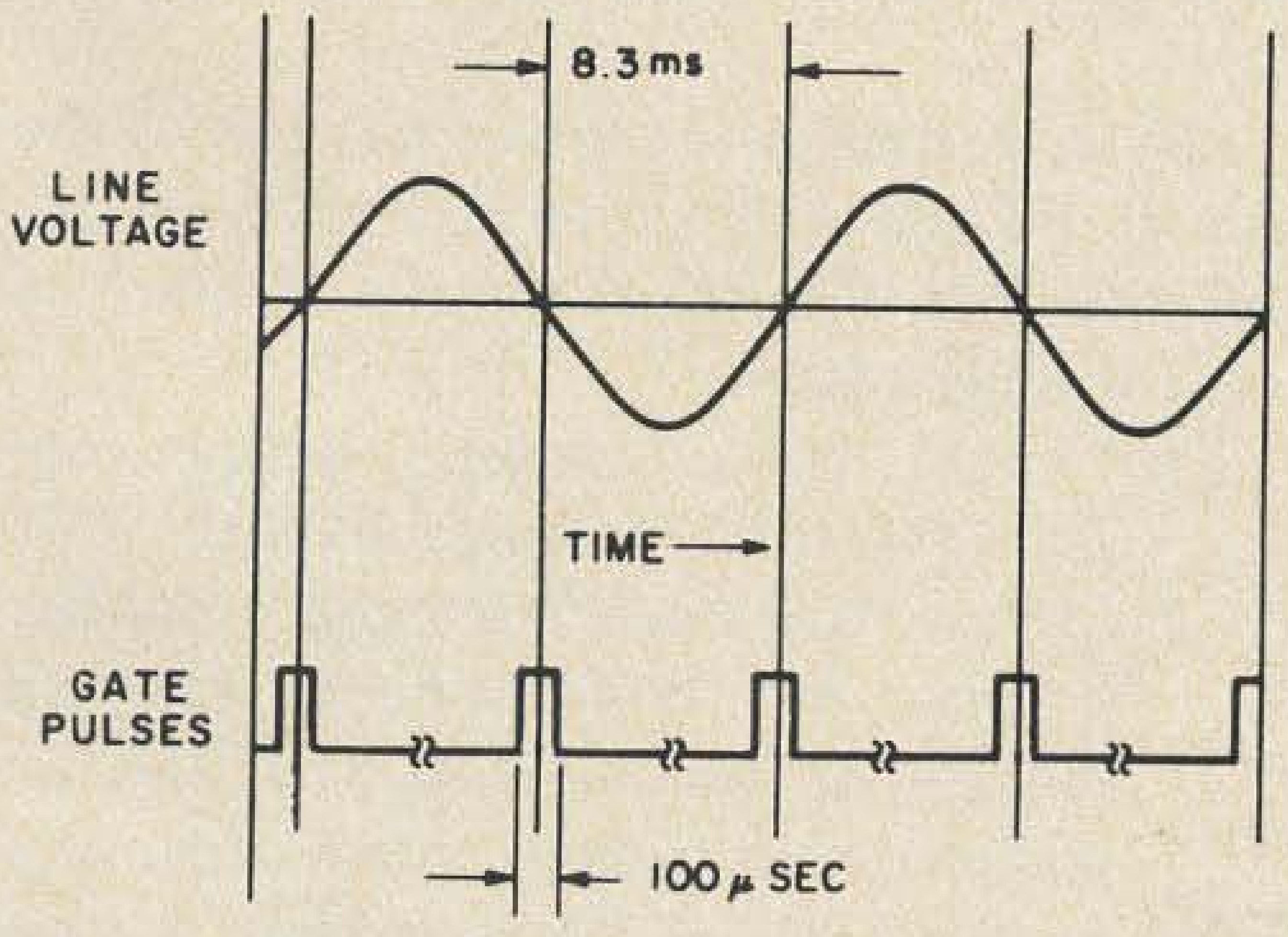


Fig. 2. Timing relationship between output pulses and the ac line voltage. Notice that the gate pulses are present to trigger the triac at zero line voltage.

Figure 3 shows an application which is useful in switching noninductive loads. Lamps and electric heaters can be controlled in this circuit by a simple switch, photoelectric cell, or temperature-sensing thermistor.

Inductive loads up to 200W can be controlled by the configuration shown in Fig. 4. In this case, terminal 12 is connected to terminal 7, and the zero-crossing detector is inhibited. Whether a "high" or "low" voltage is produced at terminal 4 is then dependent only upon the state of the differential comparator within the CA3059 integrated circuit, and not upon the zero crossing of the incoming line voltage. Of course, in this mode of operation, the CA3059 no longer operates as a zero-voltage switch. However, for many applications that involve the switching of low-current inductive loads, the amount of RFI generated can frequently be tolerated. This curcuitry is particularly useful as a differential comparator. Such comparators have found widespread use as limit detectors which compare two analog input signals and provide a go/no-go output, depending upon the relative magnitudes of these signals. In many industrial control applications, a high-resolution, fast switching unit is not essential. The CA3059 is ideally suited for use in such applications.

The chart below compares some of the operating characteristics of the CA3059, when used as a comparator, with a typical high-performance commercially available IC differential comparator.

PARAMETERS	CA3059	Typical IC Comparator
1. Sensitivity	50 mV	2 mV
2. Switching speed	>20 μs	90 ns
3. Output drive capability	4.5V at ≤4 mA	3.2V at ≤5 mA

The CA3059 can be used as a simple solid-state switching device that permits ac currents to be turned on or off with a minimum of electrical transients and circuit noise.

The circuit shown in Fig. 5 is connected so that after switch S1 is closed, electronic logic waits until the power-line voltage reaches zero before power is applied to the load. Conversely, when the switch is opened, the load current continues until it reaches zero.

This circuit can thus switch a load at zero current regardless of whether it is resistive or inductive. The maximum load current that can be switched depends on the rating of the second triac. If it is an RCA-2N5444, an rms current of 40A can be switched.

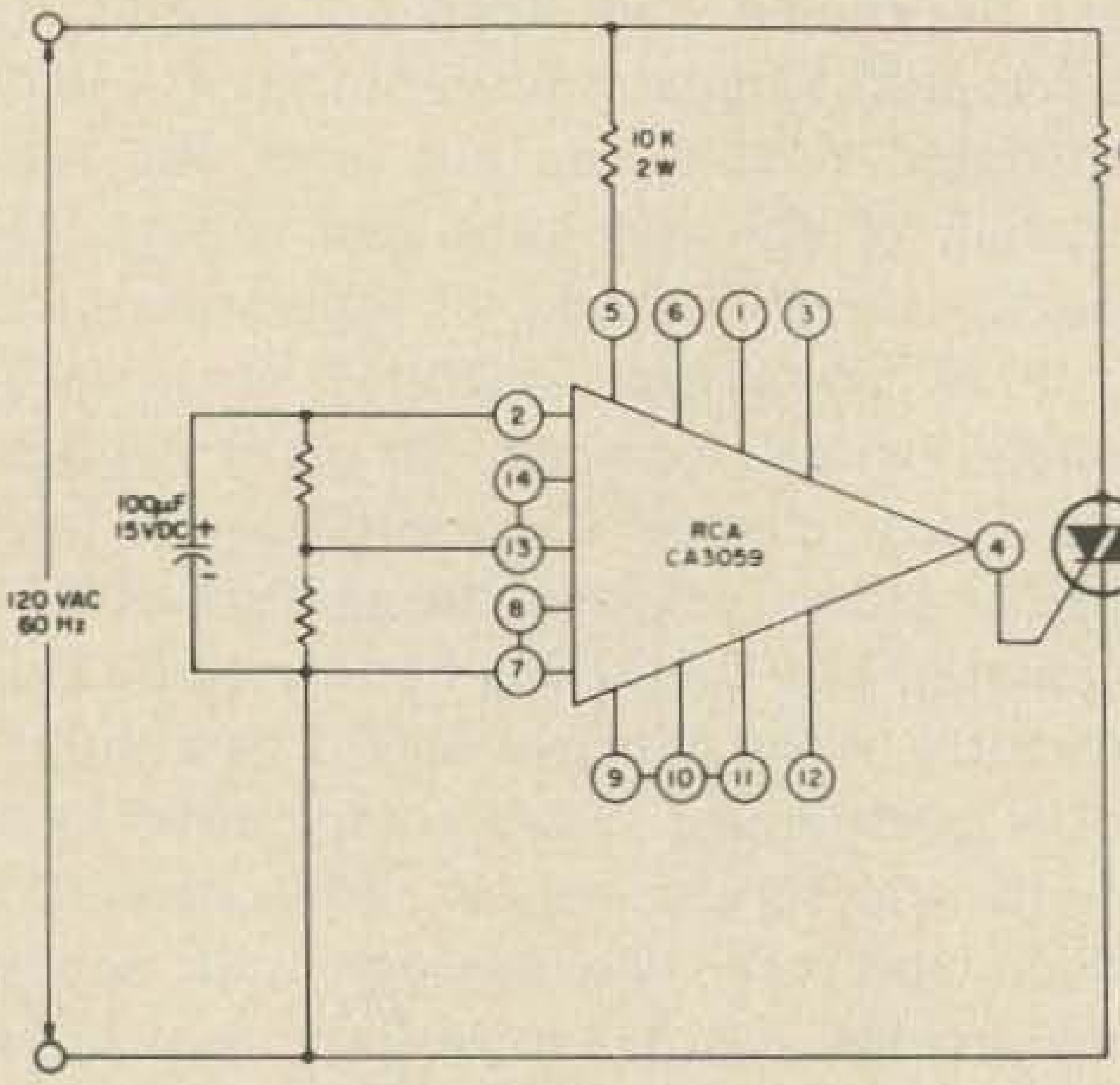


Fig. 3. Controller for resistive loads. The RCA 2N5444 triac can be used for load currents up to 40A. The RCA 40668 triac will switch intermediate loads and the 40526 will handle lighter loads and those which are somewhat inductive.

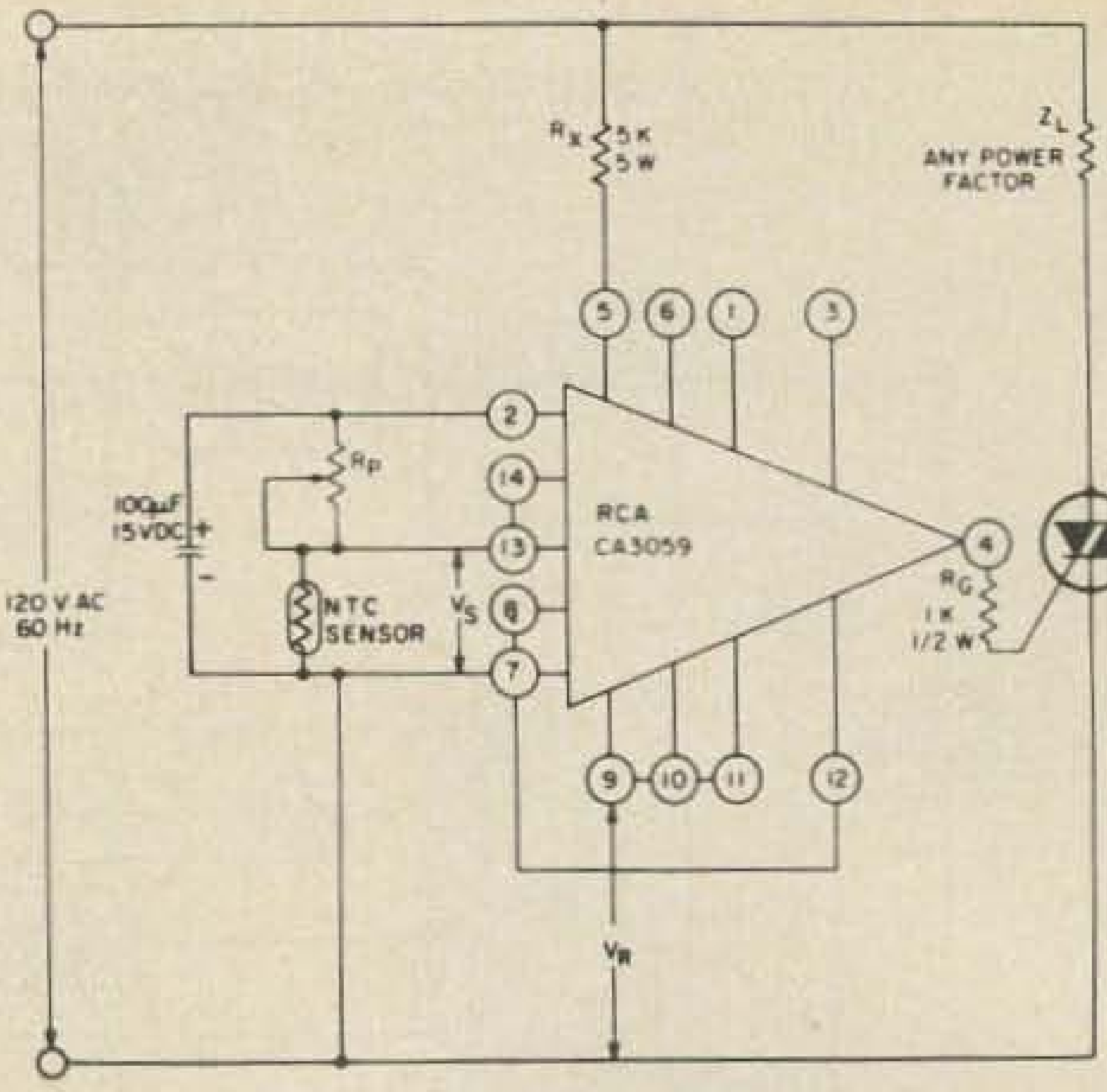


Fig. 4. Differential comparator circuit. The load is switched on when the voltage difference between V_S and V_R becomes less than 50 μV. Note the jumper between terminals 7 and 12, which deactivates the anti-RFI feature.

Figure 6 is a schematic diagram of the CA3059 zero-voltage switch. This should prove helpful to the more advanced experimenter who wishes to design his own circuits for specific applications. Some of these may include:

- Relay control
- Heater control
- Valve control
- Lamp control
- Photosensitive control
- Synchronous switching of flashing lights
- Power one-shot control
- On-off motor switching
- Differential comparator

By referring to the schematic and to the functional block diagram of Fig. 1, we can identify the following circuits within the zero-voltage switch:

1. Limiter, power supply – permits operation directly from an ac line.
2. Differential on/off sensing amplifier – tests the condition of external sensors or command signals. Hysteresis or proportional-control capability may easily be implemented in this section.
3. Zero-crossing detector – synchronizes the output pulses of the circuit with the time of zero-voltage in the ac cycle to eliminate RFI when used with resistive loads.
4. Triac gating circuit – provides high-current pulses to the gate of the power controlling thyristor.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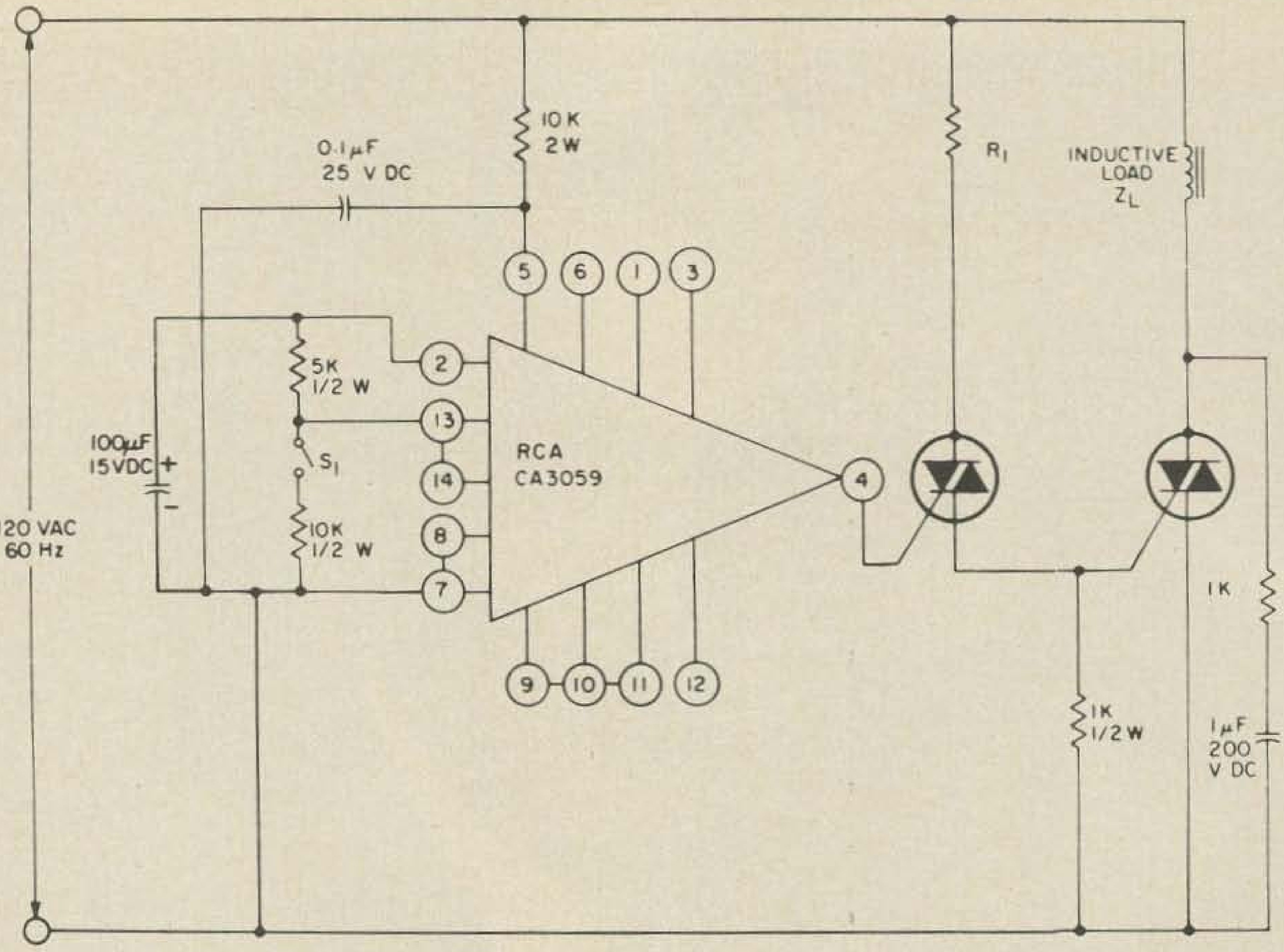

Fig. 5. Practical power switch. Heavy inductive loads can be handled by adding the 0.1 μF capacitor and by cascading the two triacs (RCA 40526 and2N5444). With the latter heavy-duty triac, R1 should be the highest suitable value less than 10 kΩ.

In addition, the CA3059 also provides a built-in protection circuit which may be connected to remove drive from the triac if the sensor opens or shorts. And thyristor firing may be inhibited through the action of an internal diode gate connected to terminal 1. In addition, high-power dc comparator operation is provided by overriding the action of the zero-crossing detector.

Additional information is available in RCA specification sheet File 397 and companion application note ICAN-4158. . . .W2FBW ■

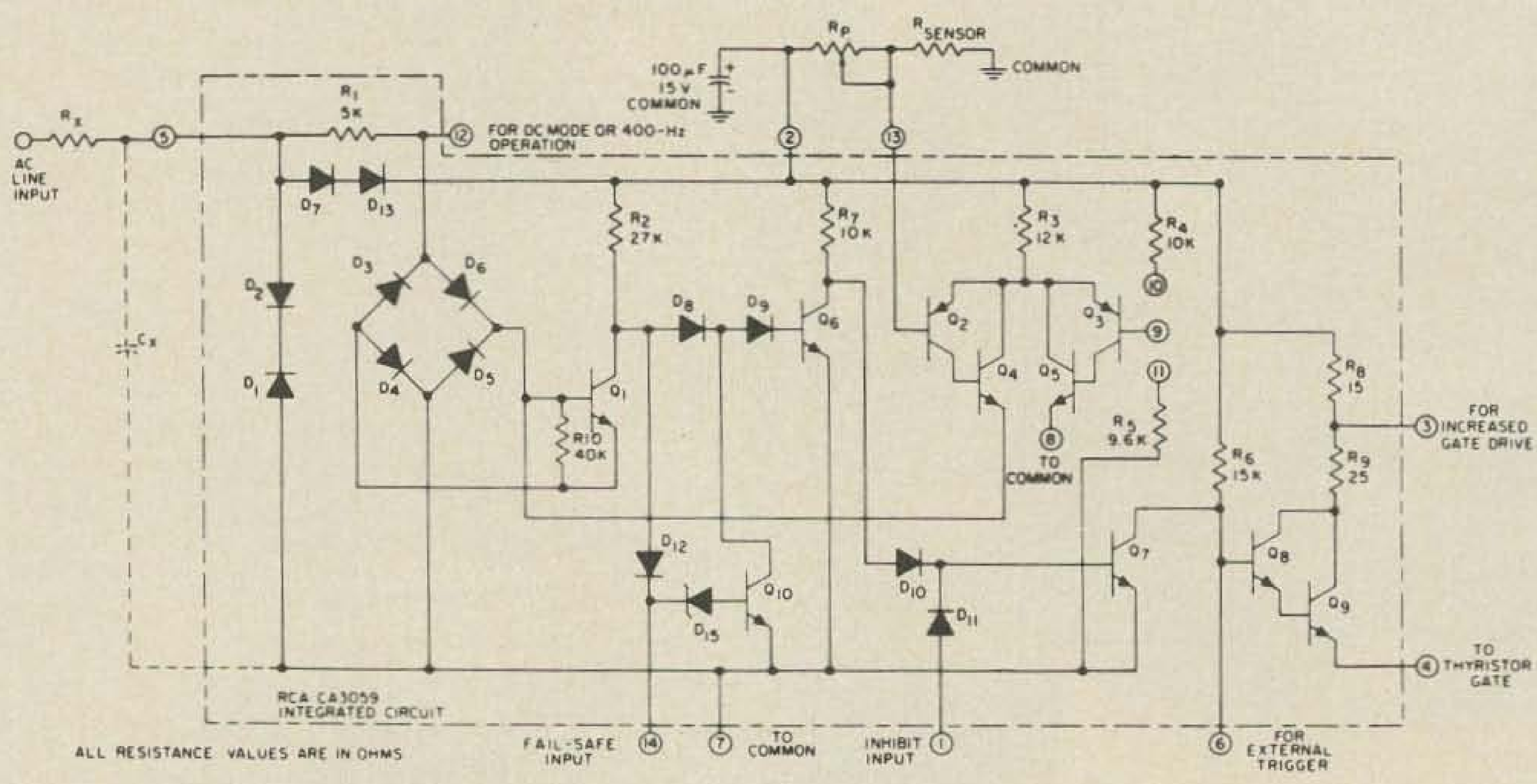

Fig. 6. Schematic diagram of CA3059 zero-voltage switch. This miniature device contains the equivalent of 10 transistors, 14 diodes, and 10 resistors.

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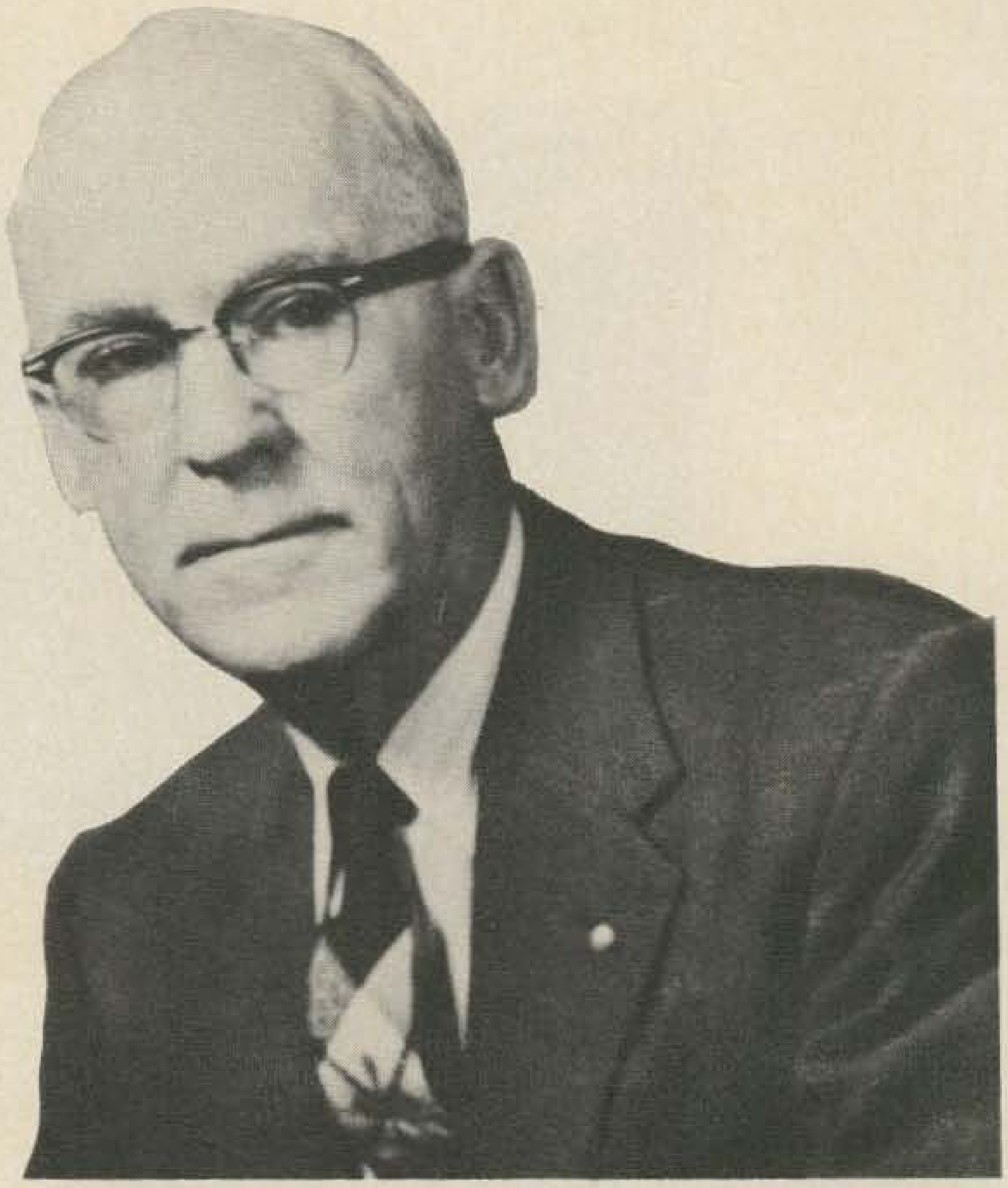

E. E. Krebsbach pictured in recent years at the KGCX mike

The scene is eastern Montana, circa 1926. Seated before a roll top desk on which is stacked a small but complete broadcasting station and engaged in winding a hand-cranked phonograph is E.E. Krebsbach, entrepreneur of Radio Station KGCX, then located in Vida, Montana. The phonograph was vital to the operation of the station, its broadcast music being produced by the simple expedient of placing its microphone (which formerly saw service as a desk-stand telephone) in front of the Victrola.

Vida, a hamlet with a population then and now of only about fifty people was, in 1926, not blessed with electric power lines so the seven and one-half watt signal of KGCX was generated with the aid of a thirty-two volt farm light plant.

Farmers of the area, their day's work done, would fire up their crystal sets or perhaps a squawky Grebe regenerative receiver to listen to the evening's program on "that banker feller's station over in Vida." Reception was mostly via headphones except for those rare occasions when (wonder of wonders) relatively distant CKCK located in Regina, Saskatchewan, achieved loudspeaker levels with their signals. Such an event caused businessmen in the towns of the area to hurry home to bring their wives and children "down town" to hear this marvel of the Twentieth Century. The trip to Main Street was made at breakneck speeds in Model T Fords with much dust generated from the unpaved streets, lest the signal fade out before the entire family heard it (invariably their comment was "It was coming in RIGHT ON THE LOUD SPEAKER") and because in those days, there usually was only one receiver in each village, more often than not being owned by the town physician or druggist, as befitting persons representing Science in the community.

The operator of the radio receiver sat amidst a farrago of wires, dry batteries, wet batteries, gooseneck speaker, huge loop antenna, etc., and was regarded with considerable respect in the community for his ability to snatch music and voices out of the air. The reader should understand that just anyone could not, of course, and would not be permitted to operate the radio receiver. One had to be qualified as a RADIO EXPERT. Many dials and knobs had to be manipulated precisely to bring something intelligible out of the squawks, squeals, and static crashes produced by the receiver, and if the expert was out of town, the radio was mute until he returned. The townspeople stood around it when it was operating, listening on multiple pairs of headphones all plugged into the same jack.

Telephones of the hand-cranked variety were commonplace in the villages of the area by the mid-Twenties, and the Montana mind could comprehend how talking across miles of wire was accomplished. The process of radio broadcasting, however, was not so easily understood. It was something tinged with wonder, with sheer magic, with unbelievability that a man could speak into a microphone and *be heard miles away without benefit of any connecting wires between the two points.* A radio tuned to Krebsbach's station was set up on a kitchen table (the humble origin of the table was disguised by a generous use of bunting draped around it) at a school carnival in the area. One Scandinavian farmer, upon being informed that the music emanating from the radio was coming through the air from Vida, declared emphatically that "SUCH A TING YUST CAN'T BE DONE" and explained the whole phenomenon away as being accomplished with the use of a phonograph concealed under the table's bunting.

Early operation of the station was extremely informal, and the financial rewards small. Krebsbach once accepted a rooster as fee for advertising a sale of roosters. In the absence of telephones, farmers often used it to communicate with their homes.

Picture in your mind's eye, if you will, a distinguished silver-haired United States Senator with a white-vested expanse of abdomen of senatorial proportions, clutching the telephone mike in a well-manicured paw, and in all seriousness, campaigning for re-election over KGCX. Some weeks later, his challenger also spoke over the station, but the strength of the signal on that occasion was weak, due to a loose screw in the station's antenna system (which was all of forty feet high) and unjustified complaints of bias on the part of station management were heard.

Vida was by far, the smallest town in the U.S. that had a standard broadcast station. Radio maps of the United States issued by RCA about 1927 show a vast expanse of Western territory devoid of dots representing broadcast stations except for the one designating KGCX.

In addition to lacking electric power lines, indoor plumbing (to this day, it is still equipped with what the flowery French call *"chalets de necessite"*), and a number of other metropolitan conveniences, Vida also suffered from a lack of public transportation, inasmuch as it wasn't served by any railroad or bus line.

In other words, you just couldn't get there.

Unless perhaps you could hire someone in Wolf Point, Montana, the nearest railhead, to make the trip to Vida in an open touring car, but in the spring, summer and fall seasons the road was often a sea of mud, and in the winter it was apt to be "drifted in" (a local colloquialism meaning the road is blocked with snow drifts) with the temperature standing at thirty below zero.

Here E.E. Krebsbach is pictured operating KGCX's first tramsmitter in 1926 at Vida, Montana.

Vida's inaccessibility caused visits of the District Radio Inspector (whose home base was Seattle) to be rare, although he was supposed to make an inspection of the station every six months. About 1928, however, Krebsbach received a telegram requesting that he meet the Inspector's train at Wolf Point the following morning at 9 A.M. Hurried long-distance telephone negotiations by Krebsbach arranged for a First Class operator to arrive at Wolf Point on an 8 A.M. train and the trio (Owner, Engineer, and Government Inspector) drove out together to the First State Bank of Vida, where the Inspector retired to another room with his equipment to make certain tests after leaving instructions to turn on the transmitter and to transmit a musical selection. He heard plenty of carrier wave, but no modulation whatsoever. Understandably flustered by the presence of the Inspector, Krebsbach had forgotten to remove the receiver hanging from the converted telephone-microphone, which short-circuited the mike and prevented any music from being broadcast. This difficulty was corrected, only to have the RI discover that KGCX was regrettably occupying a position on the radio dial twenty-two kilocycles away from the spot assigned to it by the Department of Commerce in far-off Washington, D.C. Since contemporary broadcasting stations are now required to maintain their frequency within twenty *cycles*, this was an error roughly equivalent to a London-bound jet landing in Capetown through an error in navigation. The Inspector's last words before boarding his return train to Seattle were, "I set your frequency–now don't fiddle with it."

In 1929, the station received permission to move to Wolf Point (population 2,500) contingent upon increasing its power to 250 watts. Mr. Krebsbach mail-ordered the required parts for the new transmitter and as a promotion stunt, displayed the various components of the new transmitter-to-be in the show windows of Wolf Point's stores. Even the local Chinese restaurant got into the act; the big plate transformer made a fine prop against which to lean the fly-specked menu.

Bert Hooper, Chief Engineer of CKCK in Regina, Canada was summoned to Wolf Point to assemble the new transmitter which he did in three days and three sleepless nights.

It looked it.

Hooper traveled to Wolf Point by means of an open cockpit Tiger Moth airplane, leaving Regina on a Sunday, which was a windy, gusty day so typical of the upper Midwest. It was necessary to have a man hanging on each lower wing of the aircraft to steady it until it gained speed for take-off. Navigation on the flight consisted of flying low enough to read the station names on the prairie railroad depots. Upon reaching the International Border a stop was, of course, mandatory to comply with the requirements of Customs and Immigration laws. However, the actual Boundary itself does not, in the subject area, consist of an impenetrable fence and a gate with barber-pole stripes as depicted in the movies. Rather, it consists of nothing but open and endless prairie land, marked every half mile with a concrete post and with Russian thistle "tumbling weeds" blowing back and forth from one country to the other in utter disregard of protocol. In those days, the Border officials were not stationed at the Boundary itself but rather at the nearest town to the border, which in this case was Scobey, Montana, some sixteen miles south of the International Line. Since Scobey, or for that matter, no other town in the area had an airport, a handy cow pasture was used as a landing field. In landing, the plane narrowly missed several holes excavated by gophers and arrangements were made to avoid such a stop on the return flight by an agreement with the border officials that flying twice around the Scobey water tower would constitute sufficient identification.

ONCE around would have been more than enough, since unidentified airplanes were sighted in that area and era only slightly oftener than Halley's Comet.

While Scobey had no airport, it did have two airplanes, owned by nearby farmers who agreed to escort the Canadian plane to a safe (?) landing field in Wolf Point. Now let Mr. Hooper continue the story as related in a recent letter to the author: "There were two Jennys (American and Canadian World War I training planes which two farmers had bought in Minneapolis for $50 each) that took off with us from Scobey to guide us to Wolf Point. One pilot wore a brilliant red silk shirt and the other pilot a brilliant yellow one. They flew alongside us on the left side. With the up and down air currents, one minute we were looking down at them in their cockpits and the next moment they would be above us. Those Jennys were equipped with OX 5 water cooled engines and were a bit slower than us so we had to throttle back. It was a wonderful sight. . .We collected the various components which Ed (Krebsbach) had placed in the various store windows for advertising and I went to work. The pilot, Ted Holmes, was anxious to get back to Regina, so I worked around the clock until nearly daylight, around 3:15 A.M. Wednesday morning. Just missed a herd of cows in taking off, and to avoid them (we didn't see them until it was almost too late), Ted pulled the stick back into his stomach and we missed the power lines by an inch. We got back to Regina about 6 A.M. The Moth was equipped with an inverted six cylinder air-cooled engine of the latest English type and we could do all of 90 mph. I still think of those farmers and admire them for their nerve in buying two surplus training planes for $50 and flying them to their farms in Montana from Minneapolis. No licenses were required in those days. Must admit I did a lousy job in building the transmitter, but if I could have had a night's sleep and more time, I could have done a much better job. The plane was needed back in Canada to fly somewhere to pick up a sick person and fly him to a Regina hospital.'" (Author's note: Mr. Hooper did an *excellent* job, considering the very short time he had available to build a complete broadcasting station. The wonder is that he could do it at all in three days. The transmitters he built for CKCK were absolutely beautiful in appearance and performance. The $50 purchase price of the war-surplus airplanes referred to included three flying lessons. "Graduation ceremonies" from the miniscule flying course consisted of a handshake from the instructor who then pointed in a generally west by northwest direction and said "Montana is thataway.")

It will be related later in this story what excitement was caused in the towns of the area by an airplane circling overhead. It is easy, therefore, to imagine the carnival atmosphere instantly created in Wolf Point that hot and dusty Sunday afternoon when not only a single airplane, but *three* of them started circling the town with obvious intent to land.

Incidentally, Hooper had passed his First Class radiotelegraph operator's examination at age 15 while he was living in Vancouver, B.C. and employed there as a telegraph messenger boy. Shortly afterward, he arrived home for supper one evening to find instructions awaiting him to report as Radio Officer aboard a vessel due to sail at 8 o'clock that evening. An obliging tailor worked overtime to cut a foot or so off the trousers and sleeves of a Radio Officer's uniform to make it fit young Hooper, who was slight of build, and gold thunderbolts affixed to the telegraph company's cap completed his uniform. He rode his bicycle to the dock, arriving at 7:45 P.M., carried the bicycle aboard and in his haste, reported to the Captain with his right trouser leg still furled around his ankle and held in place with a bicycle clip, and became perhaps the youngest "Sparks" ever to sail the seas.

The new transmitter tried hard to look like the latest product of RCA, but (reflecting its hasty construction) the whole effect was touchingly like that of a small boy's drawing of his conception of what a transmitter looks like.

It worked fine.

A tragic note in the history of the station occurred when an operator was electrocuted when he tried to replace a filter condenser in the high voltage supply without interrupting the program.

One of KGCX's more dramatic services to its listeners was to warn ranchers of the area when the nearby and treacherous Missouri River was on one of its rampages. Ol' Big Muddy has a nasty habit of changing its channel without warning, and in the spring, it often piles up chunks of ice, some as large as an automobile, with resultant flooding behind the ice jam.

Basketball was, and still is, a leading divertisement in the small towns of the upper Midwest during the long bleak winters, which hardly ever last more than seven or eight months. (An old cliche in the region has it that the climate of the area can be described as being eleven months of winter, one month of poor sledding, and thirteen months of wind.) Once, when Wolf Point High School was playing Poplar, Montana, the gymnasium was filled to absolute capacity by an enthusiastic crowd. KGCX's announcer, unable to gain entrance, had to borrow a step-ladder and peer through a transom to watch the game and broadcast the play-by-play account. When Wolf Point reached the finals in the state basketball tournament, local pride was outrageous and coverage of the final game was demanded of and provided by KGCX. A telephone was set up on the playing court at Great Falls, and a reporter relayed an account of the game to an announcer in Wolf Point who broadcast the game. One ardent Wolf Point fan, unwilling to wait for the broadcast version of the game, slipped unnoticed into the KGCX studio and was monitoring the reporter's account of the game on one of the station's extension telephones. When he heard the final score he shouted "WE WON" so loudly it blasted the transmitter right off the air. It was an hour before repairs could be made and the station could give its listeners the final story of the game.

One Saturday evening when the Krebsbach's were out of town (when the cat is away, etc.), an out-of-state dance orchestra (Duke Snyder and His Happiness Boys) which was barn-storming the area, dropped in at KGCX to provide some live entertainment. With the aid of a large supply of Montana moonshine, the Boys lived up to their name, and along with the technician operating the station, became progressively Happier as the evening wore on, and stayed on the air all night, a distinct departure from normal station policy. The hilarity knew no bounds and as the percentage of alcohol in the blood of the musicians increased, so did the tempo of the music. The human nose can detect and classify over 16,000 odors. Whether alcoholics can smell the fusel oil in liquor from afar or whether they are unerringly guided to a source of free liquor as surely as the honey bee is directed toward the nectar of the flowers by some not-yet-understood sixth sense, is as yet unknown, but in any event, several of the town lushes soon increased the size of the party. Large platters of fried oysters, fetched from the nearby Hotel Sherman, supplied the calorie energy to keep the festivities going at full blast until they were reluctantly stopped on Sunday morning with fond farewells (performed as only a drunk can) on the part of all concerned, *only* because of the necessity for the station's engineer to run in a broken-field stagger that would have delighted the late Knute Rockne with the station's only microphone to one of the town's churches to cover a regularly scheduled Sunday morning church services broadcast. Some of the local merrymakers, stoned beyond ambulation, remained draped over the studio chairs and leered glassily at all comerss, while the orchestra retired to its sway-backed bus, which had a particularly apt-to-break-down-any-moment look about it, to sleep it off in time for their evening performance.

In Wolf Point, the station was associated with an oil company and located in that firm's service station. The clatter of a tire iron, unfortunately dropped on the concrete floor when the mike was open, would occasionally assail the ears of KGCX's listeners. Nevertheless, the station continued to fill a need in the area and in 1936 was granted a power increase to 1,000 watts.

KGCX dominated the air in its domain in more than one way during the late Twenties, since the oil company maintained (as a public relations device) an airplane which roamed over an area a couple of hundred miles in all directions from Wolf Point and which had the box-car size letters "KGCX" painted on the underside of the lower wing. As previously intimated in this story, the appearance of ANY aircraft in the area's sky was cause for great excitement and if it landed, the pilot NEVER had to walk into town, since shortly after landing he and the airplane would be surrounded by a crowd of the townspeople, who had driven out for a closer look at the flying machine and the Superman who could actually make it fly. The pilot, a somewhat taciturn individual who was reported to have laughed aloud once in 1919 or thereabouts and who was cross-eyed beyond any hope of surgical correction, occasionally cracked up the plane upon taking-off or landing and such an occurrence was, of course, THE thrill of the summer for the village, surpassing in excitement and over-the-backyard fence conversations even such great events as the visit of the Yankee-Robinson Railroad Circus With 500 People And 200 Animals, or the erection of the tent for the annual Chautauqua. The writer remembers attending something called a "rally" with his father at the site of an oil (?) well near Mohall, North Dakota, at which A.C. Townley, a Huey P. Long in microcosm, was the attraction and who arrived via airplane, which "buzzed" the crowd for dramatic effect before landing. To be able to shake hands with Townley was, for many a farmer in attendance, worth a trip ten times the distance. Upon being queried as to whether he was successful in shaking hands with the Great Person, one farmer was heard to reply, "No, but I TOUCHED his sleeve." Doughnuts and coffee, the latter conveniently heated with the bona-fide natural gas genuinely issuing from the well, were served following which samples of oil were extracted from the well (in tomato cans lowered on a string) to further on-the-spot sales of oil stock by the promoters. The great advantage of the well in question was that it produced oil already refined. A digression to include the Townley story was made only to assure the reader that had it been advertised merely that an airplane would be on hand, with rides going for a dollar a throw (without any celebrity being present), a large crowd, albeit not as huge, would still have attended. Thus the choice of an airplane as an advertising gimmick for both the oil company and KGCX was a brilliant one.

KGCX's antenna actually spanned the main street of Wolf Point, with the transmitter- studio- service station building and one antenna tower on the north side of the street and the other windmill type tower situated in a park-like setting on the south side of the street. This arrangement caused the maximum signal to be radiated in an easterly and westerly direction, directly at the most populated areas of the world. Too, the "flat-top" antenna (a type no longer used these days) was very conducive to the production of sky-wave signals which might be reflected back to earth from the Kennelly-Heaviside layer of the ionosphere thousands and thousands of miles from the little Montana town in which they were generated. In those embryonic days of radio, there were few stations on the air and consequently little or no interference between stations. Therefore, once the signal was started on its way from Wolf Point, there was nothing to stop it and it might fall back to earth in Tokyo or Tangiers or Tampa, depending on "skip" conditions and Mrs. Krebsbach mailed out many a printed Official Confirmation postcard from KGCX upon frantic requests from DX listener hobbyists living thousands of miles distant from Montana. It takes but little projection to place oneself in their shoes and imagine their fascination with such an exotic-sounding name as *Wolf Point, Montana*, bringing visions of timber wolves, Indians astride Pinto ponies attacking the military outpost, etc., to the mind of a listener, for example, in New York City who had never been west of Philadelphia. Remember, this was back in the Twenties and it wasn't a great span of years since such events had actually occurred in the area in question.

The unusual placement of the antenna towers caused hardship for a KGCX relief operator who arrived in Wolf Point via evening train at the height of a Montana blizzard. (It is useless to try to describe to those readers who have spent their lives in Southern climes what carnival Mother Nature engages in during these prairie storms, which usually claim the lives of several persons each winter. Suffice it to say that visibility is often cut to five feet or perhaps less.) This engineer, now an official of the Federal Communications Commission, located the "wrong" tower (the one in the park) and spent a freezing and fruitless half hour in the storm searching for the nerve center of the station. The possibility that KGCX was literally "working both sides of the street" never occurred to him. With all stores closed (what manner of customer would venture out in such weather?) no one was around to help the lost engineer and it was only by sheer accident that he stumbled into the other tower across the street and into the safety of the transmitter room.

Sparse population in the Wolf Point area, coupled with adverse business there, precipitated a financial crisis for the station in the early Forties. With total station income for the year 1941 down to only five hundred dollars, it was obvious that *something* had to be done, and quickly. Eyeing a map of the area, Mr. Krebsbach wisely decided that a move to Sidney, Montana (population 5,000) with establishment of auxiliary studios in Williston, North Dakota (population 10,000) was the solution, and the Federal Communications Commission agreed. The move was accomplished in 1942. A complication arose when a major piece of the equipment which had always performed beautifully in Wolf Point, stubbornly and positively refused to work at all in Sidney.

In 1948 KGCX secured another power increase which required the erection of a second tower to protect another station hundreds of miles away from interference by KGCX. A consulting engineer was imported to Sidney to properly locate the new auxiliary tower. After much computation with his slide-rule, he selected the exact spot and the big job of erecting the two-hundred feet high structure was completed. When the last turnbuckle was tightened on the last guying cable, he dusted off his hands and stepped back with a smile of satisfaction to admire his work. As a final-final check, he again consulted his slip-stick. Gradually his eyes opened wider and wider until they approached the size of Satsuma plums, realizing that he had made a monumental error with the result that the whole tower had to be taken down piecemeal and re-erected at a spot some twelve feet away.

Some years later, the tower came down again (although considerably faster) with the suspected help of saboteurs.

During the Fifties, KGCX employed an announcer who, like the late Jack London's character in *Burning Daylight*, attempted to burn the candle at both ends by adopting a daily schedule of announcing all day and doing all night what comes naturally to young men. While the spirit was willing indeed, the flesh sometimes revolted from lack of rest, and the strains of Debussy's *Clair de Lune* or other soothing music from the studio speaker occasionally dropped the fledgling announcer off into the kind of sleep bordering on that from which there is no awakening, with the result that KGCX's slot on the radio dial became deathly and apparently permanently silent. On an automobile trip a hundred miles or so distant from Sidney, with his car radio tuned to his favorite station, Mr. Krebsbach noticed this state of affairs and (apparently considering it to be somehwat less than ideal) made haste to the nearest town and the nearest telephone to correct the situation. The thoughts of Mr. Krebsbach during the comatose announcer incident are not known to this writer, but I am sure his fine Christian faith remained unshaken, in contrast perhaps with that of The Poor Sisters of Perpetual Adoration, who were recently bilked of nearly two million dollars in a Texas oil scheme and who may now be possibly at least a nickle's worth less perpetually adoring.

The original KGCX transmitter has been lost in the shuffle from town to town. Still preserved, however, is the 32 v to 1,000 v motor-generator (which provided the high voltage for the type 210 final tube) its armature frozen fast, never again to help waft the music of the A & P Gypsies into the blue Montana skies.

The $125 investment in the original transmitter has paid off handsomely; this writer estimates that KGCX is currently worth at least a third of a million dollars and perhaps more.

With comic incidents long past, modern equipment operating dependably, and with financial problems solved, the seven and one-half watt baby has grown into a powerful five thousand watt giant which blankets a large area with its Mutual network and local programs.

Fortune has smiled twice upon Wolf Point since, for the second time, it had a radio station thrust upon it when, in 1957, after business conditions had improved there, Mr. Krebsbach returned to his old stamping grounds after an absence of fifteen years and built KVCK there, a one-thousand watt sister of KGCX.

Mr. Krebsbach, although in declining health, continues as this is being written as owner and General Manager of KGCX and deserves the heartiest of congratulations for building his station from a back-room hobby into the respected and important entity it is today . . . W6CXC

THE SST-I

solid state transceiver for 40 meters

Calvin Sondgeroth W9ZTK
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Sandwich IL 60548

This is the age of the transceiver in ham band operation. Although there are many medium- to high-power commercial SSB packages available with self-contained transmitter and receiver, there is not much to choose from for low-power CW work. This article describes a small unit which is solid-state and provides about 2W input with a self-contained battery power supply. The receiver is simple but quite effective for CW work, and its performance matches that of the cheaper superhets. All the components are readily available and no special parts were used in the design. Since the transmitter is crystal-controlled, this little rig would make an ideal beginning station for the Novice.

Receiver

A QST article by D. DeMaw (May 1969) described a solid-state direct conversion receiver using an RCA linear integrated circuit. This design requires a minimum of parts for CW (and sideband) reception since the incoming signal is mixed with a local oscillator at the signal frequency for audio output directly from the product detector. Although the selectivity is not as good as a superhet with i-f conversion, the results are entirely adequate for general operation. The receiver far outperforms any superregenerative set I have built, and I've tried many circuits.

The front end is double-tuned to prevent responses on strong signals outside the 40 meter band; two toroids tuned with a 140 pF double-section variable capacitor accomplish this, as shown in the transceiver schematic, Fig. 1. The incoming signal is lightly coupled to the IC product detector to prevent loading the input circuits, and the local oscillator uses an identical toroid in its tuned circuit. The oscillator circuit is tuned by a 50 pF variable with a small trimmer in series to adjust the bandspread to cover the full 180 degrees on the dial.

Audio from the detector is coupled out through a small transistor interstage transformer with a 10 kΩ potentiometer across the secondary as a gain control. A single stage of audio amplification precedes the audio amplifier, which is the push-pull audio section salvaged from an old transistor broadcast radio. This generates plenty of audio to drive a small loudspeaker (also from the BC set); and if just headphone operation is desired, the 2N3391A will provide enough output by itself.

The original article on this receiver used an audio bandpass filter between the detector and the audio amplifier. This had two large toroids and, in the interest of size reduction, a low-pass filter consisting of a single LC section provides adequate cutoff of high-frequency hiss and noise which is present without any filtering at all.

The inductance in the filter is the secondary of an interstage audio transformer shunted with a 0.1 μF capacitor to ground; this arrangement cuts off around 2000 Hz. The capacitance value can be adjusted to provide proper cutoff with the particular audio transformer used. The receiver is usable without the filter, but the high-frequency components in the detector output become annoying after an extended period of operation.

It will be noted that two 9V batteries are shown on the schematic to power the receiver section. This was done because the *rf–first audio* portion used a negative ground system while the push-pull output of most of the small imported radios uses a positive ground system, and the output transformer secondary has one side tied directly to ground. Various ground arrangements were tried to eliminate one of the batteries, but the two-battery setup was finally decided upon. This does split up the load on the batteries somewhat and increases their life. The rf portion draws about 15 mA and the audio section anywhere from 10 to 50 mA on strong audio peaks.

CW Monitor

A unijunction audio oscillator is included on the audio output module for monitoring while transmitting. The monitor output is fed into the audio output amplifier after the gain control, and the monitor level is set for suitable volume which is independent of the receiver volume control setting. Voltage for the monitor is obtained from the transmitter supply and it is keyed along with the transmitter.

The 100 kΩ resistor and the 0.01 μF capacitor in the emitter lead of the unijunction provide an audio tone of about 600 Hz; this can be raised by lowering the value of the emitter resistor if you prefer a monitor pitch of higher frequency.

Transmitter

The transmitter, crystal-controlled for simplicity, used three 2N697 transistors – two in the rf section and the third as a switch for keying. The keying switch was added to reduce the current through the key contacts, although it could easily be eliminated and the final connected to the negative supply continuously, since it does not draw any current without drive from the oscillator. The keying arrangement shown was a result of using the transmitter which had already been built when the transceiver idea came up.

The oscillator is connected in a Pierce circuit with the crystal between collector and base. The 1 kΩ potentiometer in the emitter controls the drive to the final. The oscillator collector uses a slug-tuned coil with a small link wound over the cold end to the couple into the final amplifier.

The final, operated without any bias, runs class C. It uses a *pi* network in the output circuit,

SWR Bridge and Meter Circuit

For tuneup while operating portable it was considered desirable to include some means of monitoring final collector current as well as some way of indicating when a match to the antenna was obtained, since random-length antennas are convenient. A small pilot light could be used to indicate relative current in the final, but the addition of the 0–1 mA meter and the swr bridge has proved its worth in the field.

The meter is set by a three-position switch to read either final-stage emitter current or forward or reflected power. For emitter-current readings, the voltage across a 10Ω resistor in the emitter lead gives a full-scale reading of approximately 100 mA with the meter specified. A 20 kΩ potentiometer is connected in series with the meter for swr measurements and must be set to zero resistance for final current indications.

The swr bridge is standard in design except for the two transistors added as dc amplifiers. They were found necessary to get indications with the low power output of the transmitter. The gain mismatch between transistors does not really allow the swr to be measured accurately, but a good indication of a proper match to a 50 or 72Ω coax line can be obtained by adjusting for minimum reflected power and maximum forward power. A two-section switching arrangement could be used to eliminate one of the transistors, thus providing more accurate readings. The bridge conductor is a piece of ¼ in. copper tubing; the pickup wires are of 14 AWG solid wire. The assembly is built in a small channel bent up out of aluminum sheet metal as shown in Fig. 2. In order to get readings with the bridge it must be mounted off the main chassis with an insulating spacer and the channel connected to ground via the coax shield on the input and output only.

Construction

The main housing for the transceiver is a Bud SC-3030, which is 6 x 10 x 7 in. This volume allows construction without crowding yet keeps the unit small enough to be easily portable. The transmitter is built on a separate minibox 2¼ x 2¼ x 5 in. and can be put together as a separate unit with a couple of leads provided for a crystal socket on the front panel of the main enclosure. The transmitter is mounted to the front panel by the key jack which has one side tied directly to ground. In addition, a barrier terminal strip was provided on the rear panel for connection of an ac power supply for fixed station work. The drive control potentiometer was mounted inside the transmitter since it is not adjusted in normal operation. The final amplifier transistor was mounted on a piece of .040 aluminum about 2 in. square which serves as a heatsink. Since the collector is connected to the transistor case, the heatsink must be insulated from ground.

A twice-size PC board layout for the receiver *rf–first audio* section is shown in Fig. 3. The integrated circuit is soldered directly into the circuit board, although a socket can be used. Don't be too concerned about damaging the integrated circuit. The one here had to be removed from the board once by cutting the leads above the board and remounted by soldering extension leads to it indicating that these little devices are really quite rugged. Without a proper unsoldering tool, it is difficult to remove the IC once it has been soldered in so a socket might be a good idea even though the board is not laid out for one.

To facilitate parts placement and circuit identification, the composite layout/schematic of Fig. 4 is included. This should help to speed your final assembly process.

The audio output amplifier from the discarded broadcast set was mounted on a small piece of Vector board along with the components for the CW monitor. Fortunately, the radio I dismantled had been built in two sections, with the audio stages on a separate small circuit board. Other radios might have to be operated on to get just the audio section to use in the transceiver. The input to the amplifier can be located by tracing down the leads going to the volume control in the original radio. The wiper arm on the control is connected to the input.

The receiver modules are mounted to a small subchassis which was extensively worked on with tin shears. It is made from a standard open-end 5 x 7 x 1½ in. aluminum chassis. The front is cut off to clear the controls on the front panel and the rest notched and cut where necessary to clear the main enclosure. A vertical shield was positioned across the transceiver between the receiver and transmitter, although this is probably not absolutely essential.

The subchassis provides adequate mounting space at the center (between receiver and transmitter) for the transmit-

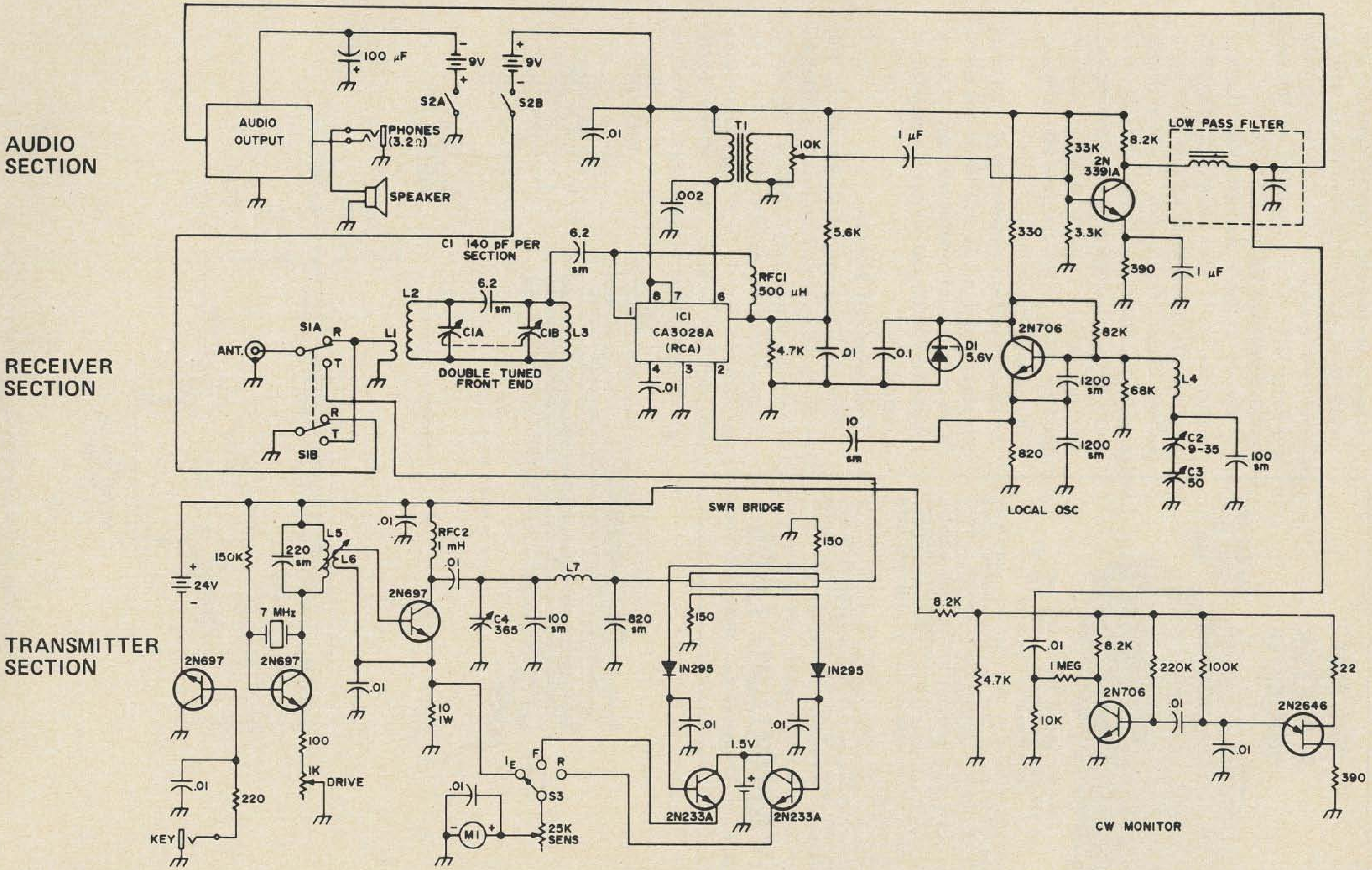

Fig. 1. Schematic diagram of solid-state 7 MHz transceiver.

ter batteries and the two 9V batteries are mounted to the rear enclosure wall with a homemade bracket of sheet aluminum. The 1.5V penlight cell is mounted on the swr bridge channel as shown in Fig. 2.

The swr bridge is mounted near the rear of the transmitter and the bridge channel is insulated from the main enclosure as mentioned above. Connection to the bridge should be made with small coaxial cable going to the transmitter *pi* network and the transmit–receive switch. Similar coax is used to connect the receiver and antenna connector to the switch.

The photographs show the general construction and panel layout used, but other builders may find other arrangements more desirable. The general layout is suggested as a logical one.

Adjustment and Tuneup

When the receiver is operating, the oscillator frequency is adjusted to cover 40 meters by alternately padding the tuned circuit with fixed capacitance and varying the trimmer in series with the main tuning capacitor to achieve the desired band-spread. By setting the trimmer, the entire

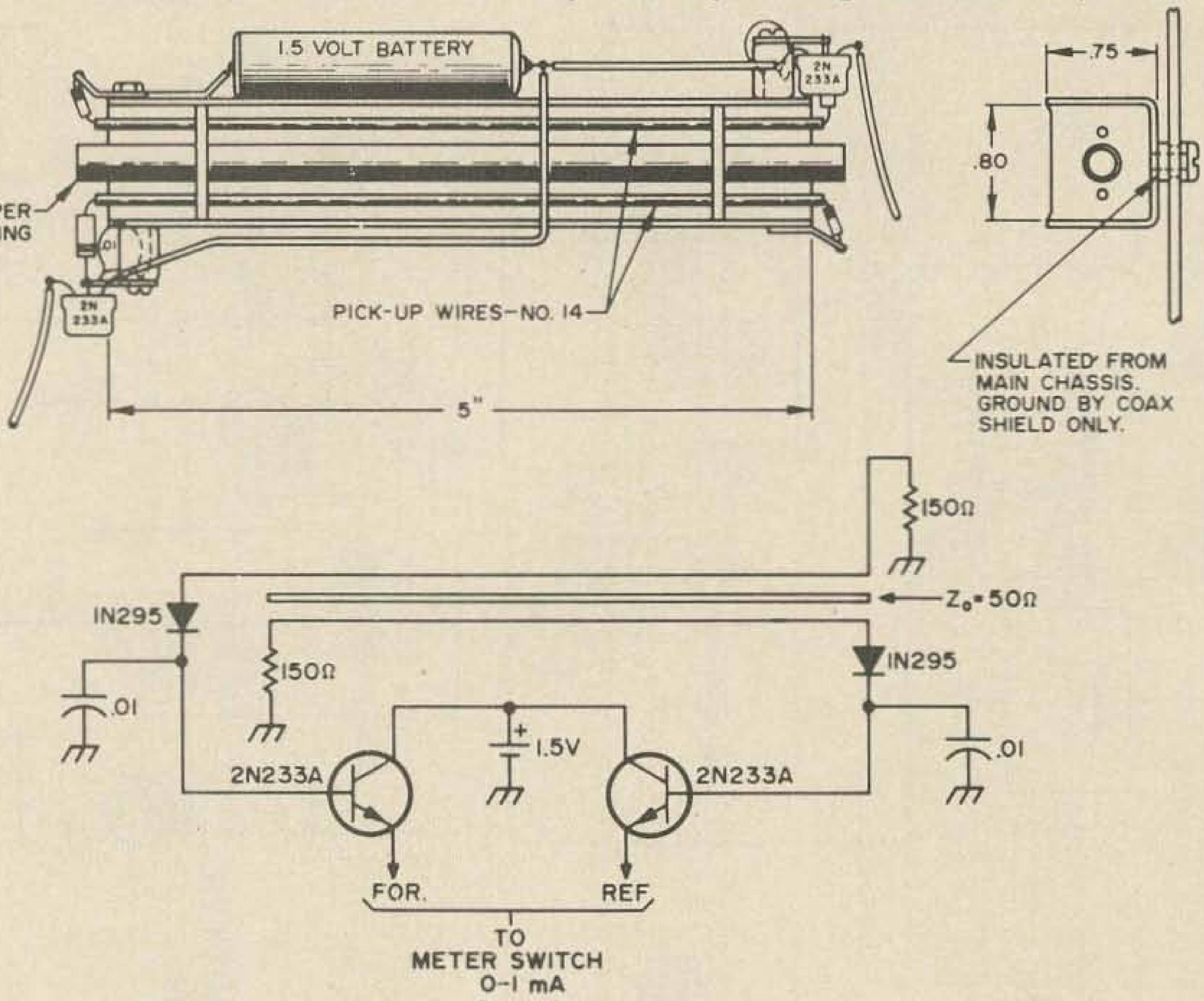

Fig. 2. Swr bridge assembly and placement data.

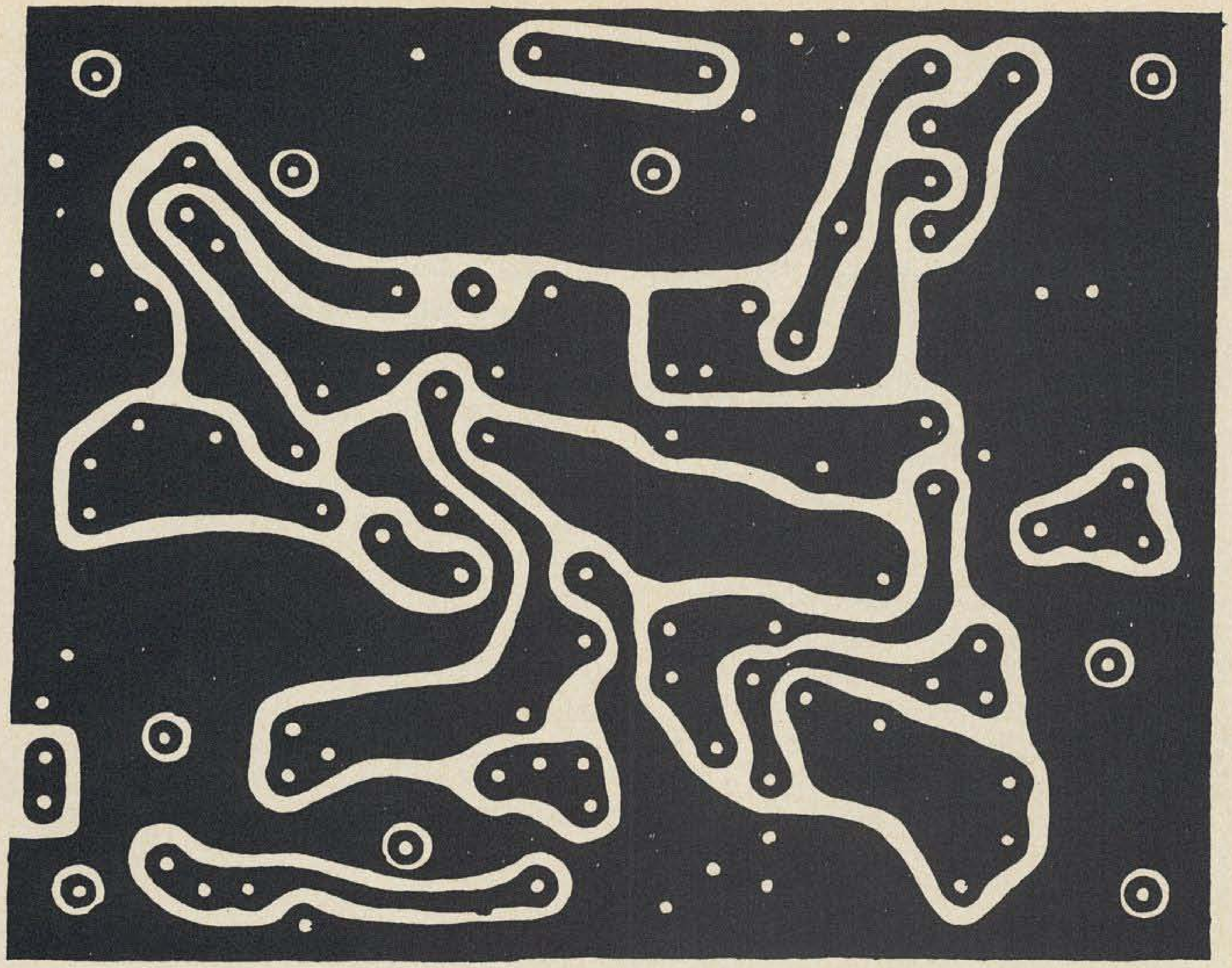

Fig. 3. Double-size PC board layout for the rf/af section of the receiver.

band can be tuned or the bandspread limited to just the CW portion. Other arrangements might give different bandspread, but the transceiver described covered the first 100 kHz of 40m over about half the dial and the other 200 kHz over the second half, which was felt to be about right and allowed for monitoring sideband as well as CHU just above the top band edge for time checks as an added bonus.

Some trouble with the local oscillator was experienced at first: Spurious responses were obtained, with 7 MHz appearing at several places on the dial. This indicated that the oscillator was operating at too high a level, which generated unwanted outputs. The two capacitors in series from base to ground on the oscillator determine the amount of feedback and the values were set as shown so that the oscillator provides just enough signal to beat against the incoming signal.

The audio output section and the CW monitor can be checked by connecting the monitor to the transmitter supply and making sure that the audio tone is of the desired level and pitch.

When first tuning up the transmitter, it is a good idea to disconnect the final amplifier until the crystal oscillator is operating properly. The oscillator collector coil slug should be tuned up for proper oscillation and keying. With the final connected turn the drive control pot for minimum drive (maximum resistance) and switch the meter to read final emitter current. (The transmitter should have a dummy load connected during all tests!)

With the oscillator working, increase the drive to the final and adjust the oscillator coil slug and the drive control for around 100 mA of emitter current with 24V collector supply. This gives a little over 2W input to the final and is the normal level for CW operation. A 51Ω (1W) resistor makes an ideal dummy load and it should get warm to the touch after several minutes dissipating the output from the transmitter. A No. 47 pilot light can also be used as a load for indications of maximum output and should light to about full brilliance when the rig is properly loaded up and tuned.

When proper operation into a dummy load is verified, the transmitter can be connected to an antenna and the matching network adjusted in the usual way for proper loading. It is possible to QSY over 100 kHz of the CW portion of 40m without retuning either the crystal oscillator or final amplifier, with only a slight readjustment of the antenna coupler.

Results and Afterthoughts

Results with this little transceiver have

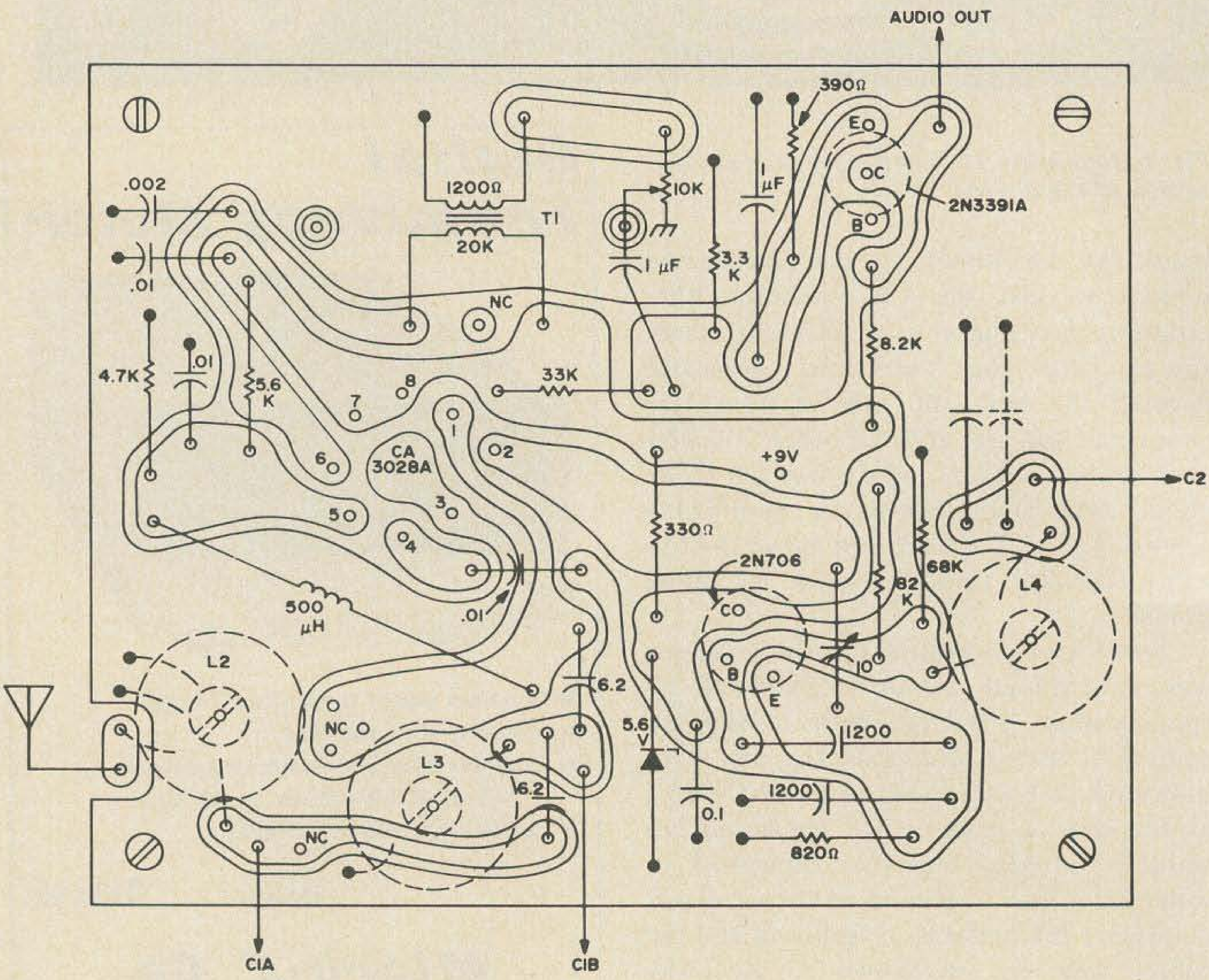

Fig. 4. This composite sketch shows positioning of components on the etched board.

been very good. A watt of power into the antenna may not seem like a lot to the kilowatt operator, but don't underestimate the punch of the signal. I have had stations at 400 miles during daylight operation insist on giving me a 599 report. In general, stations come back to the first call (unless you're covered up by a higher power station calling) and your contact probably won't know you are QRP until you tell him. Crystal control does limit the operating convenience somewhat with low power.

Since the receiver has an oscillator right on the operating frequency some will probably wonder why it is not used as a transmitting vfo also. The answer is that it can and if I were building this unit again I would probably include vfo operation. In fact, some checks were made using the receiver oscillator as a rfo with moderate success. However, the output of the local oscillator is quite low and it was necessary to provide a comple of stages of rather high gain to properly drive the transmitter. These tended to be somewhat unstable in operation and the vfo idea was abandoned, without too much work done in that direction. A conversion-type receiver would probably be better in this respect with the vfo operating at a frequency different than that of the transmitter.

With a suitable antenna coupler or matching network the rig will load into just about any piece of wire for portable work. Operation from the home station has been with a Windom antenna cut for 40m and fed with single wire. This still requires an L-network between the transmitter and antenna for proper matching. A coax fed dipole should work connected directly to the transceiver antenna connector.

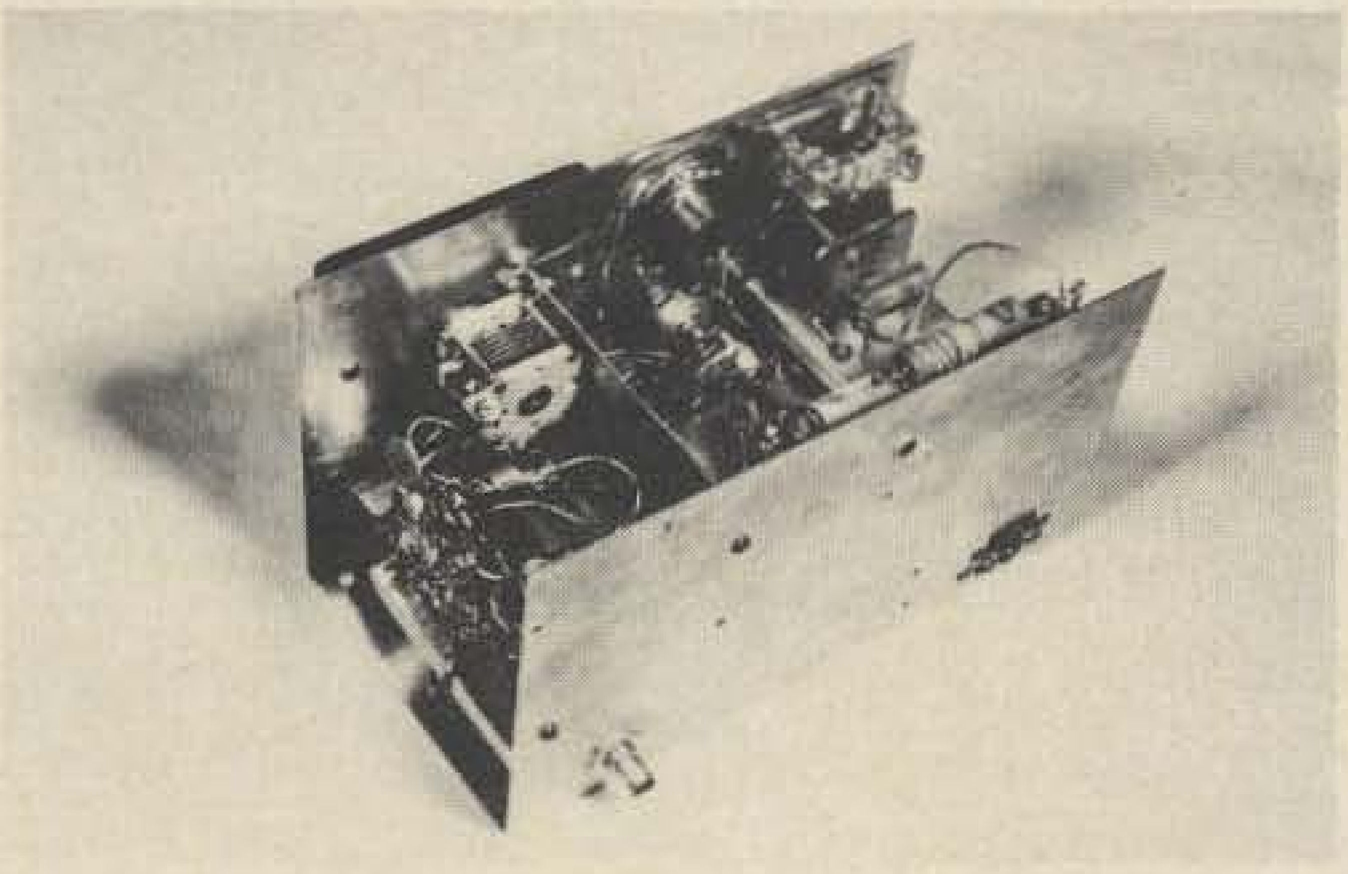

Photo showing shielding and construction of 40m transmitter and receiver in main chassis housing.

Receiver performance has been exceptional and sure beats using a regenerative set with its limited audio output and instability. Drift from a cold start with this receiver is practically nil and it can be used to copy sideband signals with no trouble at all. For CW work, a more selective audio bandpass filter can be used either in place of the low-pass filter inside the transceiver or in the headphone line. A couple of 88 mH toroids and some 0.5 μF capacitors will increase the selectivity markedly when connected as an audio filter. For general operation the filter is not necessary and it does prevent good copy on sideband signals.

With the addition of a balanced modulator, this setup could provide the basis for a simple little sideband rig using the audio section for the speech amplifier, generating a double sideband signal at 7 MHz.

Using currently available transistors, this little transceiver can be used to drive a class C stage to 15 or 20W for a little more signal, but at these power levels a battery of rather monstrous proportions is required; the 2W power level is just about right for the mercury batteries used. And 20W isn't really QRP anyway.

Table of Parts

C1 – 140 pF peri section, dual variable capacitor
C2 – 9–35 pF ceramic trimmer
C3 – Main tuning 50 pF variable capacitor
C4 – 365 pF broadcast variable
CR1 – 5.6V zener, 1N708 or equivalent
T1 – Interstage audio transformer 1.2–20 kΩ 6-T-12 PC (Allied Radio)
BA1, BA2 – 9V batteries
BA3 – 5V cell
BA4 – Two 12V batteries in series, Mallory TR289 or equivalent
IC1 – RCA CA3028A
L1 – 5 turns 28 AWG spaced over L2
L2, L3, L4 – 36 turns 32 AWG wound on .380 diameter toroid core (Arnold A4-380-125-SF)
L5 – 12 turns 28 AWG close-wound on 3/8 in. diameter slug-tuned form
L6 – 3 turns 22 AWG over B+ end of L5
L7 – B&W Miniductor ½ in. 16 TPI, 1 in. long
M1 – 0-1 mA meter (Emico Model 13)
Main tuning dial – Millen Type 10039 midget panel dial

. . .W9ZTK■

A LOW-COST RF WATTMETER

Marc Leavey WA3AJR
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Adelphi MD 20783

You say you just finished building that 2 meter rig and want to find out how much power you're running but can't afford to buy a wattmeter? You've been calling "CQ 80 QRP" all day with your quarter-watt wonder and nobody is answering? Then get yourself up, go down into the workshop, and build yourself a neato-keeno handy-dandy wattmeter.

If we are going to build a wattmeter, let's consider what we want. Accuracy and ease of calibration, as well as simplicity in construction are prime requisites. The meter described here is as accurate as components allow, and it's easy to build. The calibration is logarithmic, which means that a simple graph is possible, and easier than changing the meter scale.

For the mathematicians, I will present the formulas upon which this device is based, and ways of modifying it; for those of you who avoid math whenever you can, look at the graphs and skip these few paragraphs.

To spare undue complexity, assume 51Ω line – other values can be dealt with later. Perhaps the easiest parameter to measure, and one that is proportional to power, is rf voltage. A voltmeter can be made most easily with a series resistor and a 0–1 mA meter. Now let's plunge into the actual calculations.

Assume W is the full-scale meter reading in watts, Z is the line impedance, E is the voltage measured, I is the full-scale meter reading in amps of the basic meter, and R is the value of the series resistor in ohms. We know that the voltage (IR) is equal to the square root of "impedance times power," or 14.270V. Now, since the voltage and the current (.001A because the full-scale movement is 1 mA) are known, simple division yields 14,270. The resistor value, then, is 14.270 kΩ. The upper portion of Fig. 1 is a graph that will enable the nonmathematician to choose the value of the resistor for full-scale readings up to 4 kW, with 51Ω line and a 0–1 mA meter.

Why 4 kW with an amateur power limit of 1 kW? A look at the bottom half of Fig. 1 will explain. Although this is the calibration of the prototype, for 4W full scale, it will double for 40, 400, or 4000W. A half-scale reading, 0.5 mA, corresponds to 1W (1 kW, etc.). This spreads out the range below 1 kW for ease of reading and measuring.

Now get out that soldering copper and gas pliers, and build it. As the schematic (Fig. 2) shows, the circuit is a basic rectifying type rf voltmeter. The prototype was built in a small can of the plug-in-module variety that was scrounged from the junkbox. About the only critical part is the series resistor. The capacitors in the prototype were mica, but ceramic disks

PAGE SEVENTY-THREE
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3. The increased license fee ($9) is unfair and harmful to our hobby. It should be reduced or abolished. Hams perform public service all out of proportion to the other radio services and are a valuable national asset. They should not be taxed. Would you work toward eliminating this tax?
4. We need to restore the growth of amateur radio to the pre-incentive licensing rate. One way is to promote it in magazines, on radio and television. Writers, photographers, and hams in radio and television can certainly band together to achieve this. Any volunteers?
5. Amateurs could take some responsibility for the running of other services such as marine and citizens band. Would you be interested in helping to track down unlicensed stations in other services?
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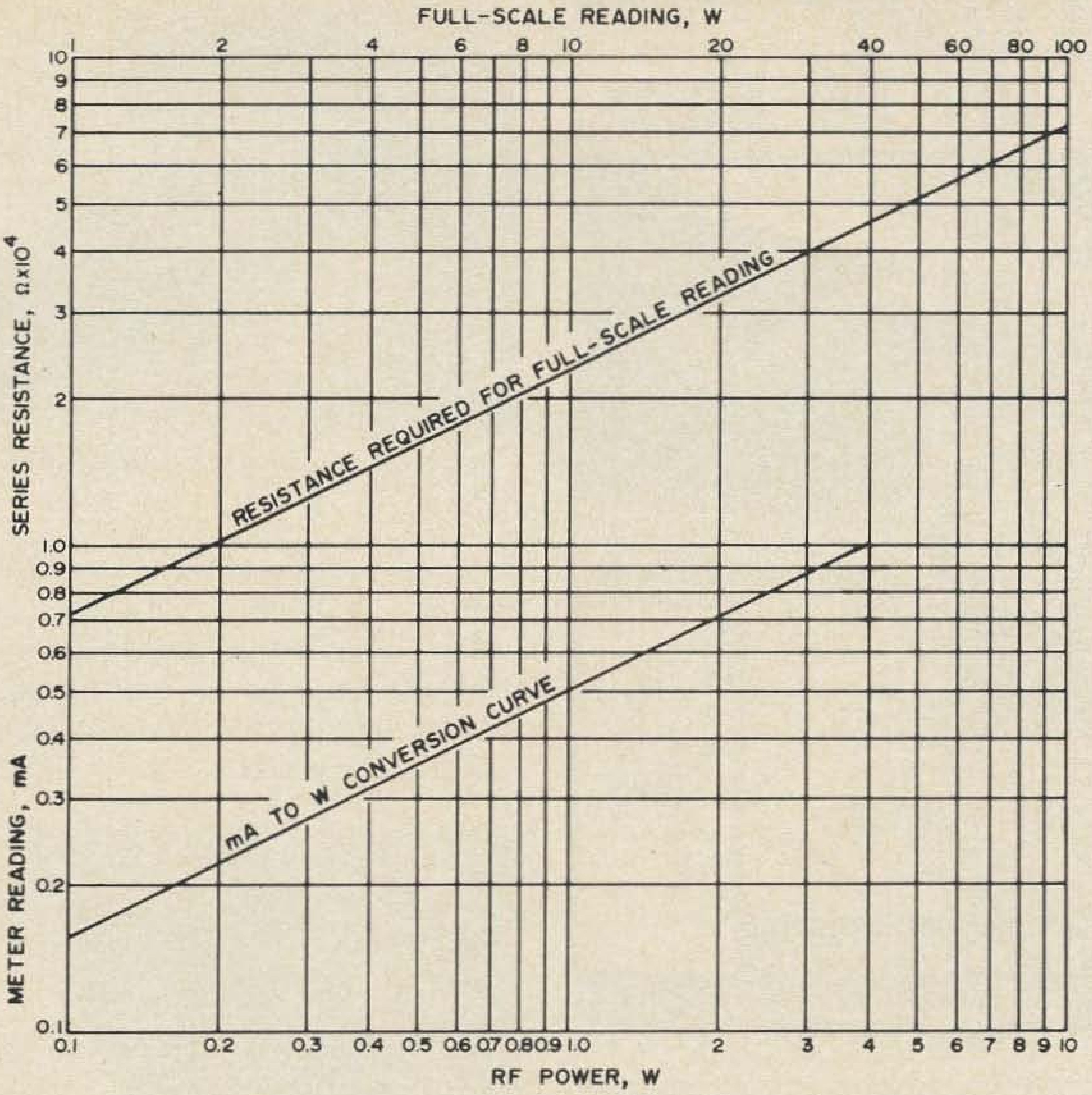
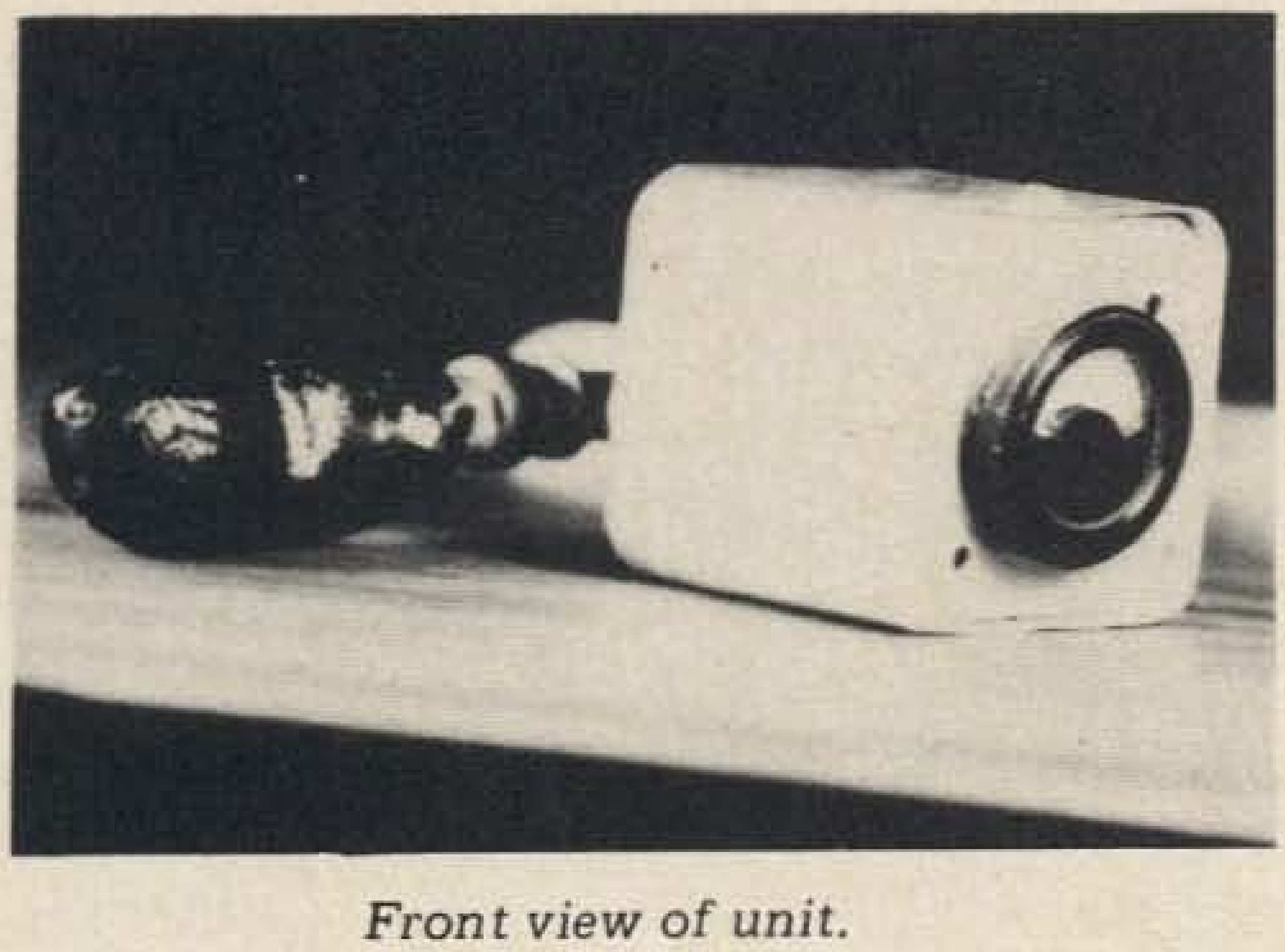


Fig. 1. Logarithmic plots for determining power. The upper curve gives resistance values for determining what the full-scale meter deflection will be (remember to multiply the series resistance value shown on the chart by 12 kΩ). The lower curve will allow you to determine your precise power out if you use a 0–1 mA meter.



Front view of unit.

as shown. Conventional minibox construction or building into a new or existing rig will be more than adequate. Point-to-point wiring is used to permit compactness and reduce lead length.

"Fine," you say, "but I don't have a huge mound of test equipment. How do I calibrate it?" That is the beauty of it – you don't! If the series resistor is accurate, the meter will be self-calibrating to a log scale. Remember, you know R and Z, and the full-scale W. Now assume a half-scale

would work as well. The diode can be a 1N34A, 1N270, 1N52, 1N38A, or just about anything else. Use the old ham's rule of thumb: "When in doubt, try it out!"

Two sockets might prove more convenient rather than one with a coaxial tee

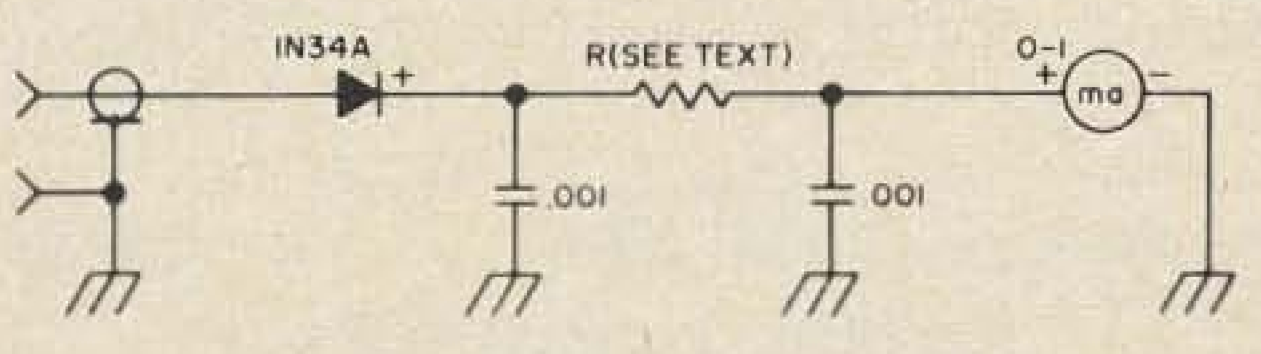
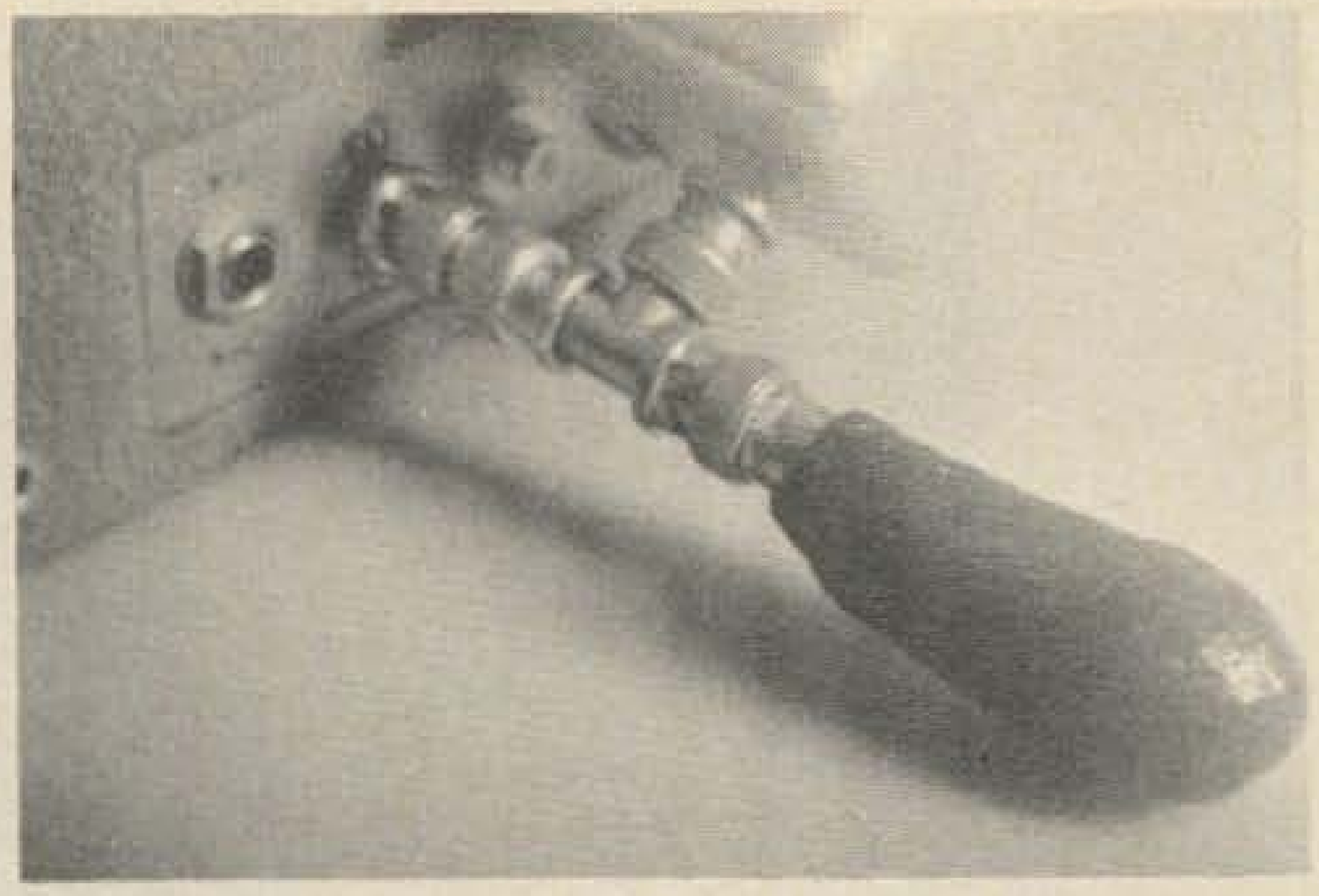
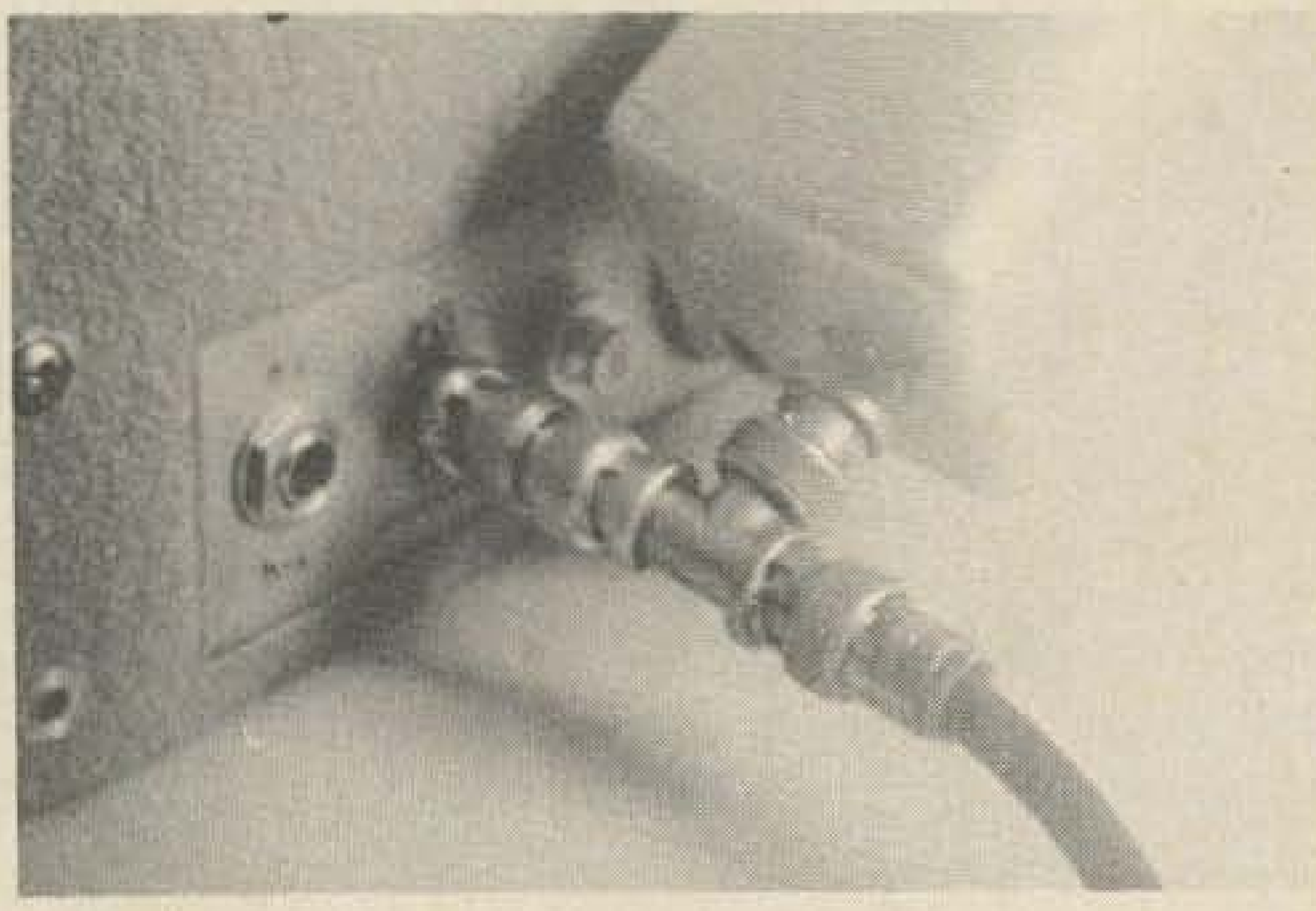


Fig. 2. Schematic diagram of the simple, accurate, and easy-to-build rf wattmeter.



Connection to transmitter with dummy load (see text).

reading, I = 0.0005, and calculate W for half-scale. Plot these two points at 1.0 and 0.5 mA on Fig. 1, and connect by a straight line, which you may extend the length of the graph.



Connection to transmitter with antenna connected.

Install the meter through a coaxial tee at your antenna connector, or through some other predetermined means, and terminate with a dummy load. The one seen in the picture is three 150Ω resistors in parallel, dipped in epoxy, shielded with a copper braid, and installed on a BNC plug. Apply power and read the meter. That's it! The meter can be used with an antenna if your swr is below about 1.2:1.

So what did I promise? A low-cost, rf wattmeter that is inexpensive enough for the Novice, practical and useful enough for the General, and "Extra" accurate. Go raid the junkbox, and add a worthwhile piece of gear to your shack.

. . . WA3AJR ■

Mitchel Katz W2KPE
147-11 76th Avenue
Flushing NY 11367

Calibrate that Calibrator

Most modern receivers and transceivers in use today rely upon a 100 kHz crystal oscillator to calibrate the tuning dial. While some of the calibrators are built in, others come as outboard accessories. In any event the operation of each is the same.

By this time we all probably know what "zero beating" is. The 100 kHz oscillator in order to serve as a calibrator must be "zeroed" to some standard frequency such as the WWV carrier frequency on 5, 10, 15, 20, etc. MHz. With a CW or AM receiver, we can very easily tune through the zero beat point. On SSB receivers because one of the sidebands is missing we can only hear the one side as we approach zero. The other side of zero is greatly attenuated and may possibly not be heard at all. To further complicate matters for us in trying to calibrate the 100 kHz oscillator, as we can only hear down to about 20 Hz, we can't zero in any closer than this. Leaving the receiver at this point, we next turn on the 100 kHz calibrate oscillator. After a suitable warm up period, we turn the tune control of the oscillator and again adjust for a zero beat condition against the WWV frequency. With this method of calibration we have several possible sources of error. First in zeroing WWV with the receiver beat frequency oscillator and then zero beating the 100 kHz calibrator against the bfo. Each of these adjustments is limited to the lower limit of our hearing range, as well as the fact that we are obtaining the zero beat at a relatively low i-f frequency.

A more accurate method of calibrating the 100 kHz oscillator will now be discussed. After the receiver and calibrator oscillator have been warmed up for about 30 minutes, tune in WWV on a frequency that produces a fairly good, steady signal. Adjust the tuning for maximum reading on the S-meter. Having tuned in WWV, turn *off* the beat frequency oscillator. Now turn on the 100 kHz oscillator that is to be calibrated. If a harmonic of this oscillator is fairly close to the WWV frequency, a beat note will be heard. At this time adjust the calibrator "crystal tune" control and the S-meter will start pulsing from a maximum to a minimum value. The closer you get to dead center the slower the pulsing action will become. It is fairly easy to come down to 1 pulse per second with this method. If your receiver doesn't have a meter, you can also hear this pulsation very clearly. In any event you would always tune for the slowest pulse rate.

Note that with this method we have adjusted the calibrator frequency harmonic directly to the WWV carrier rather than to a low i-f. We have eliminated one zero beating step, and this, together with the fact that we are obtaining the zero beat at a much higher frequency, will provide greater accuracy.

Having described the method, here are a few points of general interest:

1. Before attempting any calibration let the equipment heat up for at least a half hour to stabilize.

2. After tuning in WWV, wait until the 400 Hz modulating tone goes off before adjusting the calibrator. If not, you may find later that you zero beat the 400 Hz instead of the carrier frequency!

3. The levels produced in the receiver by WWV and the calibrator oscillator should be about equal to produce a good beat between the two frequencies.

4. Use the highest WWV frequency that will produce a good, stable signal in the receiver. Certainly a 1 pulse per second beat at 20 MHz will provide greater calibration accuracy than 1 pps beat at 5 MHz or better yet than 455 kHz! The accuracy will be considerably greater and it is no more difficult to come by.

Mitchel Katz W2KPE ■

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STUDY GUIDE GENERAL CLASS LICENSE

Part IV: Got a Match?

Nope, we're not discussing the relative health hazards involved in tobacco, gasoline, and kitchen matches – even if we will be using many of the same words. In this chapter, we're concentrating on three major subjects: impedance matching, how filters operate, and transistors.

Up to now, we have established the basics of ac and dc circuit theory to sufficient depth to permit us to cover this broad range of subjects this time. While the subject range is broad, it accounts for only three questions on the FCC's official study list. They are (numbers, as always, are those appearing in the list):

7. What is impedance matching and why is it important?

23. How can transistors be used in electronic equipment? What is the beta of a transistor? Compare the elements of a transistor to a vacuum tube's.

42. What do high- and low-pass constant-k filter circuits using balanced and unbalanced pi- and T-sections look like?

For starters, we'll attempt to discover why and how impedances are matched. This exploration may shock a few old-timers as much as it shocked us during the research stages – because the "why" is, it turns out, rather different from the reasons most popularly believed.

Then we'll turn our attention to filters, with two question: *What is a filter?* – which should bring some order into the names applied to filters as well as uncovering their various uses (and many disguises), followed by *How do filters operate?* This second query which will examine the means by which the more common circuits accomplish their purposes.

With matching and filters accounted for, we can take up transistors – but to provide some groundwork in this area, we'll first explore amplification and bring all kinds of amplifiers into our picture of circuit theory. With that established, we will be in much better position to examine the question *How do transistors amplify?*. This will take care of the other transistor details involved in the FCC question as well.

It's a big bite of information this time, so let's get right into it. Take a deep breath, and we'll be on our way. . .

Why and How Are Impedances Matched?

In previous chapters, we have put together a number of different types of electrical circuits, building each circuit up from different kinds of components. In every circuit, we have had a "generator" or power source of some sort, together with the passive components which make up the rest of the circuit.

In examining these circuits, we have seen that the action of the entire circuit depends upon the relations between the various components which make up the circuit. If any single component is changed, the circuit's action changes. In other words, for any circuit to act as its designer expects it to, every part of the circuit must be what it was intended to be.

Now we can take any single component, or a group of several components which go together to make up a subcircuit, and draw an imaginary line separating that part of the complete circuit from the rest. Having done this, we can name the part of the complete circuit which contains the power source as the *source* and the other part of the circuit as the *load*. Doing this does not change the fact that it is one complete circuit, so that every part must still be what it was intended to be for the expected circuit actions to occur.

In particular, any variation of component values or types in the *load* will affect operation of the *source* just as it would when we looked at the whole thing as being a single circuit.

In practice, almost every electrical or electronic device is an *incomplete* circuit. Only the simple circuits which we study to learn how things work are complete and self-contained in themselves. A factory-built transmitter, for instance, does not come from the store complete with its own 117V ac generator, nor is the antenna a part of the rig as you purchase it. For the transmitter to operate, you must connect it to a power source, and you must provide an antenna as the rig's load.

The importance of impedance matching stems directly from the fact that all practical circuits are incomplete, and must be completed by the user in order to operate. To complete the circuit, the items connected by the user must "match" the equipment – and yet the equipment designer cannot possibly predict exactly how every possible user may connect his product.

The situation is saved by the fact that impedance can be considered to be a constant factor. That is, any circuit which exhibits a specific impedance characteristic can be substituted for any other circuit which has the same impedance characteristics. This is sometimes called the *black box* theory; the name comes from the fact that if you conceal a circuit inside a black box which cannot be opened, the only method anyone has of determining what is inside the box is to measure its performance at the terminals which connect it to the outside world – and all circuits which show the same characteristics in such measurements can be considered to be identical to each other no matter what is actually inside the box.

By specifying the required impedance levels for the power source and the load, then, the equipment designer can assure the user of his product that it will perform as intended.

In its most-used sense, the phrase "impedance matching" means simply providing the required impedance level, and says nothing about what this impedance level may be. In some cases this may mean providing a high impedance compared to the source, and in some cases it may mean a low impedance. The important thing is that the *required* impedance is provided, and it's up to the equipment designer to say what this required impedance may be.

However, impedance matching may also mean other things, and that is where the confusion comes in. One of the most respected ham radio reference books puts it – incorrectly – this way: "It is possible to show that any source of power will deliver its maximum possible output when the impedance of the load is equal to the internal impedance of the source. The impedance of the source is said to be *matched* under this condition."

The error is easy to see if we take the circuit of Fig. 1, in which the impedance of

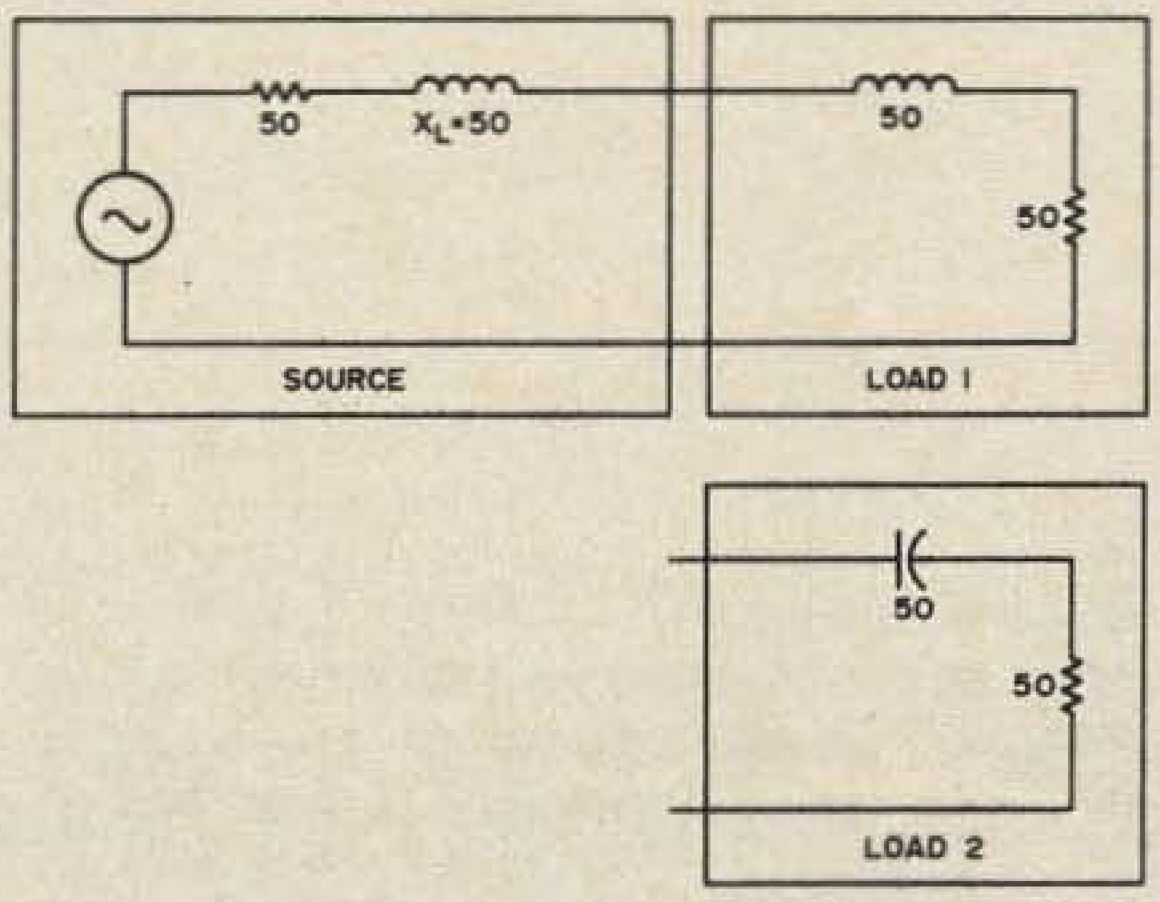


Fig. 1. Differences between "image impedance" matching and "maximum power transfer" matching are shown here and discussed in text. Using "load 1" follows the image-impedance rule, in which load's impedance is exact duplicate of source impedance. You can see that reactance is present, reducing power from the maximum possible. Use of "load 2" follows "maximum power transfer matching" rule in which resistances match but reactances are of opposite polarity. Reactance then cancels, and power is at maximum.

the source is 50+j50 ohms (inductive reactance as well as resistance). If we match this with a 50+j50 ohm load, the total impedance applied to the generator will be 100+j100 ohms. The 100Ω resistance is accompanied by another 100Ω of inductive reactance, and if the generator supplies

100V rms we will get a current through the resistance of only about 700 mA. This 700 mA through the 50Ω resistance of the load will develop a potential of 35V and the power dissipated in the load resistance is 700 mA (0.7A) times 35V, or 24.5W.

If we change the load impedance to 50-j50 ohms, though, to make the reactance of the load equal in amount but opposite in sign to that of the load, the reactances will cancel each other. The circuit is now series resonant. Net impedance seen by the generator is 100±j0 ohms, and 1.0A flows. This 1A develops 50V across the resistance in the load, or a 50W dissipation.

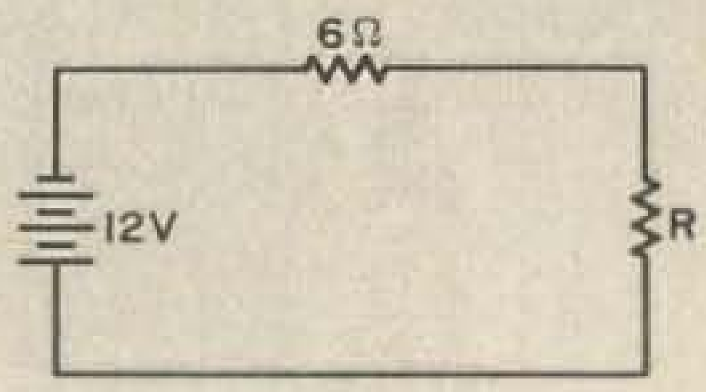
The handbook's statement is incorrect, but several generations of amateurs take it for truth. The *correct* statement is that maximum power is delivered when the resistance components are equal in amount but opposite in sign. This form of impedance matching is known as "maximum-power-transfer" matching. Of course, if neither source nor load involves any reactance, this boils down to equal impedance.

The equal-impedance type of matching defined in the quotation from the handbook is known to engineers as "image impedance" matching, because each of the impedances involved is the exact image of the other. While it does not guarantee maximum power transfer if any reactance is present, it is often employed because of its simplicity.

And as we have already noted, if pains are taken to eliminate all reactance from both the source and the load impedance, the image-impedance match and the maximum-power-transfer match are identical.

An important point to keep in mind during this discussion of matching is that we are limiting ourselves to making changes in the value of the load impedance only, and are leaving source impedance strictly alone. Only with this restriction do our rules and definitions apply.

For instance, let's take the circuit of Fig. 2, which consists of a battery, its internal resistance (drawn separately), and a load resistor. If we could vary *both* resistances at will, we would find that the maximum power in the load resistor would be achieved not when both were of equal value, but when the internal resistance was much smaller than the load resistor. With the internal resistance fixed, however, (say at 6Ω) we find that the maximum power is developed with the same value in the load. With a 12V source and a 6Ω load, we get 6W dissipated in the load. Reducing the load resistor to 5Ω makes our current 12/11A and our dissipated power 720/121W (I^2R), or 5.95W. Increasing load resistance to 7Ω makes the current 12/13A, and the power becomes 1008/169 or about 5.98W.



R	I	POWER
5	12/11	$\frac{5 \cdot 12^2}{11^2} = 5.95$
6	12/12	$\frac{6 \cdot 12^2}{12^2} = 6.00$
7	12/13	$\frac{7 \cdot 12^2}{13^2} = 5.98$

Fig. 2. When impedances are purely resistive, maximum power is always taken by load which is neither higher nor lower in resistance than power supply's own internal impedance. If internal impedance is fixed at 6Ω as shown here, then load resistance of 5Ω draws more current, but smaller resistance results in less power being taken. Load resistance of 7Ω draws less current, and again power goes down. Only when source and load impedance are equal does power taken by load reach maximum 6W level.

Before confusion becomes complete, let's review the key points we've encountered. Impedance matching has at least three meanings. The most common is *providing some specified, required value of impedance as a device's load*. The second is identified as maximum-power-transfer matching, and means to make the load impedance equal in resistance to the source impedance, and equal-magnitude-but-opposite-sign in reactance. The third, called image-impedance matching, means making the load impedance the exact duplicate of the source impedance. Finally, in case both source and load impedance are free of reactance and involve only resistance, the maximum-power-transfer and the image-impedance matches turn out to be identical to each other.

Before we move on to see how such matching is performed, let's look at some examples to illustrate the various meanings.

One ready example not directly connected with ham radio is the matching between amplifier and loudspeaker in a top-quality hi-fi or stereo system. Most of the tube-type amplifiers are rated to operate into a 16Ω load impedance, although they likely have output connectors marked as 8Ω and 4Ω. The speakers, similarly, are rated at either 4, 8, or 16 ohms. The speaker to the amplifier, we simply connect the speaker to the amplifier terminals which are marked with the same impedance value.

In actual fact, the "impedance" rating is somewhat inaccurate since it includes neither reactance nor phase angle, which we saw a while back is required for accurate specification of impedance. In addition, the true impedance of any speaker varies widely over its operating frequency range, and few if any come anywhere within 20% of their rated impedance at more than three or four spot frequencies.

These points make very little difference, because the actual source impedance presented by the amplifier is almost always far smaller than the rated impedance.

What does make all the difference is that the 4, 8, and 16Ω ratings provide a means for specifying the "black-box" characteristics of both amplifier and speaker. Any amplifier with a 16Ω output terminal can be expected to operate with any speaker rated at 16 ohms impedance, regardless of actual impedance characteristics of either amplifier or speaker.

This, then, is an example of the first meaning of impedance matching; we provide a specified, required load impedance value.

Another example is offered by the 117V power outlets in almost every home. While we usually talk about our electric power in terms of voltage or sometimes wattage (a 100W bulb, for example) this still is a close relative of the first kind of impedance matching. We know that any device rated to operate on 117V, 60Hz power will operate when plugged into a normal outlet; we don't have to specify all the electrical charateristics of the power company's generators and transformers on each electric appliance.

Maximum-power-transfer matching is the usual rule for connecting transmission lines and antennas to radio transmitters. The objective is to radiate as much of the transmitter's output as possible, which is just another way of saying "maximum" power. Antenna and feedline matching is often thought of as though it were done on an image-impedance basis – but when the normal practice of tuning the feedline to eliminate reactance is looked at in a slightly unusual light, it can be seen as a way to provide reactance of equal value but opposite sign and so to achieve max-power matching.

In fact, the whole art of matching transmission lines to antennas and transmitters *is* the art of maximum-power-transfer matching, and we will get into this type of impedance matching much more deeply when we get around to looking at antenna theory.

Despite the misconceptions held by most of us as to what an impedance match consists of –,which would indicate that the only true match was an image-impedance match – examples of true image-impedance matching are difficult to find.

Possibly the closest to this situation is the audio practice of matching all long lines to an arbitrary 600Ω impedance, initiated originally by telephone companies in order to provide a "standard" matching condition and adopted by all others who had to deal with telephone lines. Since most audio equipment rated at 600Ω actually has a slight bit of inductive reactance as well (associated with the matching transformers almost universally used to reach the 600Ω level), this type of matching meets the image-impedance definition.

Now that we've defined impedance matching in its three variants, let's see how it is accomplished:

The most common method of matching impedances is by the use of a transformer. A transformer consists essentially of two inductors coupled to each other so closely that the magnetic with the magnetic field

ARRL DIRECTORSHIPS

The ARRL elections for directors are about ready to close. Don't let the do-nothings get into office again. Make sure the fellow you vote for is devoted more to amateur radio than he is to the League.

FM'ers in the Southwest Division should be advised that John Griggs has done more to boost FM than any other director anywhere. His performance record in office has been satisfactory, the Southern California boys say, and he is responsive to the needs of amateur radio. Most important, he does not appear to be glory-hungry and he listens to the advice offered by his informed associates.

Since time is so short, there has been no opportunity to evaluate all nominees, but poor "performance in office" is cause enough to reject some of the directors who are seeking reelection. Here are a few of the directors who, in the opinion of some of our readers, are hurting amateur radio by their past performance (or lack of it):

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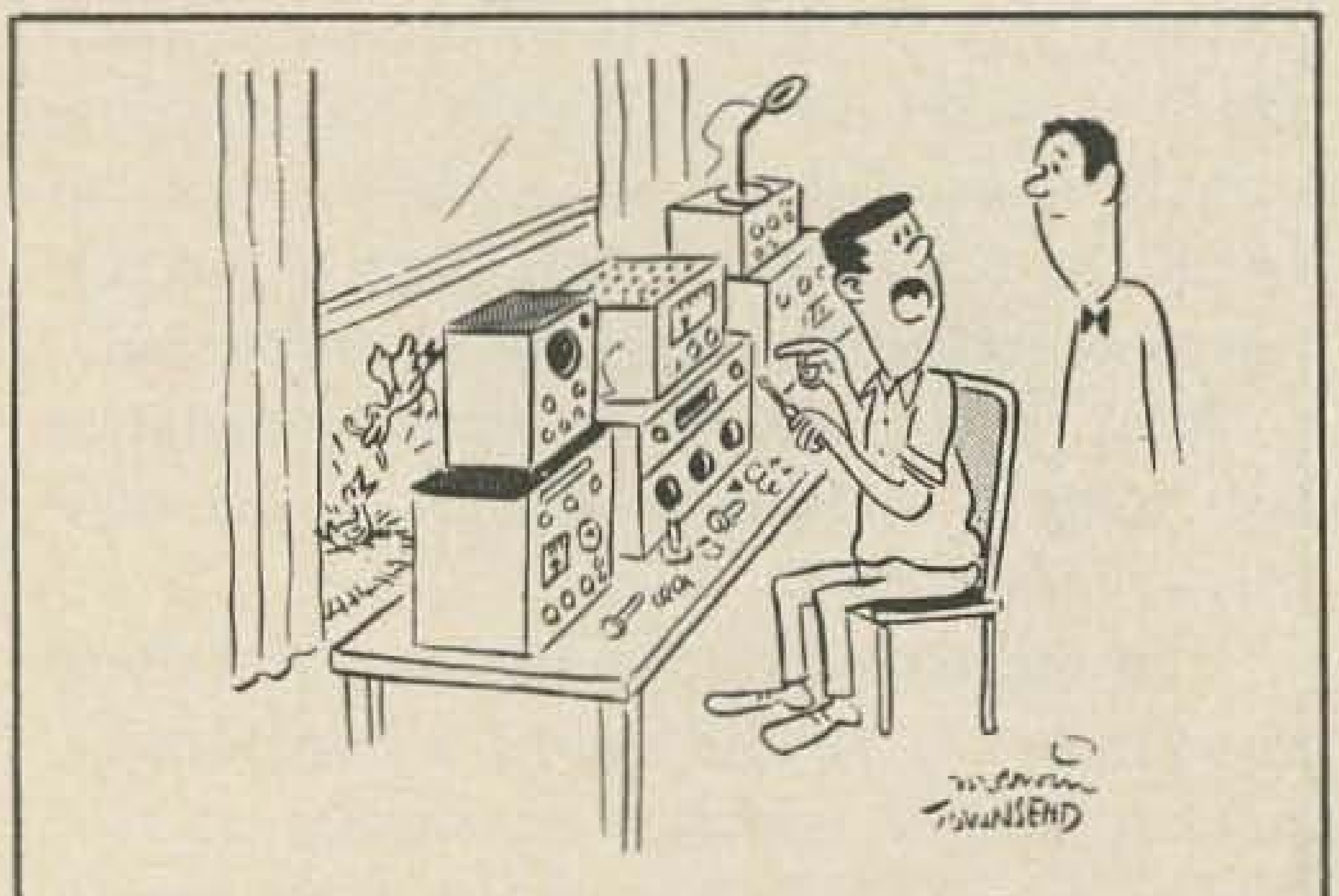
Rocky Mountain
Carl Smith WØBWJ



"I can't seem to locate that peeping sound."

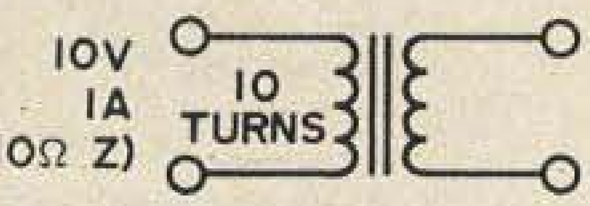
associated with one of them coincides with the magnetic field of the other. When this is the case, a change in current flow through the first inductor causes variations in the common magnetic field, and these variations in the magnetic field induce current flow in the second inductor. Energy is thus transferred or coupled from one circuit to another with no conductive connections; the common magnetic field does the "connecting," replacing the usual wires. Because a change in the magnetic field is necessary for a transformer to operate, the device is effective only with ac. In a dc circuit, a transformer produces one spike of energy in the output when power is applied and the initial current flow begins, and another spike of opposite polarity when power is removed and current flow begins, and another spike of opposite polarity when power is removed and current flow ceases. In between, nothing happens.

Because the transformer does its job by means of the magnetic coupling between two inductors, it introduces a 90-degree phase shift just as would any other inductor. This is usually ignored.

The transformer's ability to serve as an impedance-matching device depends upon the relationships that exist between current intensity, magnetic field strength, and inductance. We've gone through most of the necessary background when we met inductance to begin with. All we need to point out now is that the strength of the magentic field depends upon the number of turns in the inductor, and similarly the intensity of the induced current also depends upon the number of turns, but in opposite ways.

This means that if one of our inductors contained 10 turns it might develop a magnetic field strength of 10 units with one ampere of current. If the other inductor also contained 10 turns, the resulting magnetic field would induce an identical current intensity (assuming that the coupling is perfect and none of the magnetic energy goes to waste). However, if the second inductor contained 20 turns, the current intensity would be only half an ampere because each unit of magnetic field strength would have to release its energy to twice as much wire and could only give each turn half as much. And if the second inductor were only five turns, then each unit of magnetic field would affect half as many turns, and so would produce twice the current intensity.

Keeping in mind that we're talking about a "perfect" transformer which loses no energy, all of the energy put into the circuit must appear in the output. If the input energy comes out to be a 10W rate, with 1A flowing, it must be at 10V. We get that same 10W out; if current intensity is only 0.5A, the voltage must have been increased to 20V, and if the current intensity is raised to 2A the voltage must have been reduced to only 5V. Figure 3 summarizes these points.



TURNS	I	E	Z
5	2	5	2.5
10	1	10	10
20	1/2	20	40

Fig. 3. Transformer operates by converting current changes in primary winding into changing magnetic field, and reconverting magnetic field changes which result into new current changes in secondary. Voltage, current, and impedance levels are all transformed from original values to new values which depend on the ratio of the numbers of turns in each winding. Chart shows results for three sizes of secondary winding, if primary is fixed at 10 turns, and takes 10W (1A) from 10V source for impedance level of 10Ω.

That's where the name "transformer" originally came from, because this device transforms voltage or current levels either up or down. It does so, however, without adding any energy. Any real transformer, naturally, must be less than perfect, so it will really lose a little of the input energy.

The real functions of a transformer are easier to see, though, if we think of the same thing. In an ac circuit, we use impedance rather than resistance in the Ohm's Law equation. Our sample transformer which accepted 1A of current from a 10V source represented a 10Ω resistive impedance (10V/1A). When it stepped voltage up to 20V and current down to 0.5A, it transformed the impedance level from 10Ω to 20/0.5 or 40Ω. When it stepped voltage down to 5V and current up to 2A, the impedance went from 10Ω to 5/2 or 2.5Ω.

By adjusting the ratio of the number of turns on the input inductor (usually called the primary winding) to those on the output inductor (secondary winding), any desired ratio of impedance transformation can be obtained. The rule is simple; the ratio of impedances is equal to the *square* of the number of turns in a transformer with tight coupling between winding. The square gets into the act because the ratio of voltages is the same as that of the number of turns, while the ratio of currents is the inverse of the number of turns (because current goes up as turns ratio goes down). Impedance ratio equals the voltage ratio divided by the current ratio, and dividing any number by its inverse is the same thing as squaring the number.

Normally, this arithmetic isn't necessary; the transformer manufacturers have already done it for you and any transformer you buy which is intended for impedance matching is rated by its intended impedances. You will find, though, that most are rated for specific input and output impedance values rather than by ratio. They will provide the ratio, however, in every case.

That is, if you need a transformer to match 6 kΩ to 8Ω, and have one which is rated at 3 kΩ primary, 4Ω secondary, you have the one you need. 6000:8 is the same ratio as 3000:4 or 1500:2, or 750:1.

You can also use power transformers, in a pinch, to match impedances if the ratios are close enough. To do this, convert the input and output voltage ratings into a voltage ratio by dividing the larger voltage by the smaller. For instance, a 120V to 6.3V filament transformer has a voltage ratio of 120/6.3 or almost 20:1. Convert this to an impedance ratio by squaring it; we get approximately 400:1, which is close enough. This would match an 8Ω loudspeaker to a 3 kΩ power amplifier output, or 16Ω to 6 kΩ.

Most transformers you can buy are for use at audio or i-f frequencies, but the transformer principle is also used in rf circuits. Almost all transmitters use transformer coupling between stages, although not by that name.

The transformer is not the only method of matching impedances, but it's probably the most efficient.

Special amplifier circuits, known as "cathode followers" and "anode followers" when vacuum tubes are used and as "emitter followers" or "common-collector circuits" when transistors are employed, also have an ability to transform impedances, but they do so in a much different fashion. In general, transformer matching cannot always be replaced by special amplifiers, although in special cases they can.

One method of impedance matching sometimes used in audio and communications work is by means of matching "pads," which are circuits of series and parallel resistors so arranged that from one side of the circuit it presents one impedance level, and from the other side, another. The simplest matching pad is the resistive voltage divider, which is merely two resistors in series.

The advantage offered by the matching pad as compared to the transformer is that it is much less expensive – but this is offset in most cases by the fact that a matching pad must waste more than half the energy present in the circuit, and the greater the ratio of impedances to be matched the greater the loss in a matching pad. For an 8:1 impedance ratio, the loss is 35 dB – more than 99.9% of the energy lost! The transformer, while it costs more, rarely has more than 1 dB loss.

What is a Filter?

In any electrical circuit, it's sometimes necessary to select specific kinds of signals and separate them from other kinds also present in the circuit. In general, the devices or circuits used to do this job are known as filters. The name comes from the similarity to a physical filter such as the oil filter in an automobile, which separates grit from the oil.

Any device or circuit which separates signals into two or more groups can be rightfully called a filter. Since a filter is anything which does this job, we must have various categories into which to classify filters.

One major classification method is to divide filters into *active* and *passive* filters. Active filters are circuits which make use of amplifiers as a part of the filter itself. They are relatively recent developments and are seldom encountered in ham radio; about the only devices used by amateurs which may be termed active filters are the Q-multiplier and the select-o-ject circuit. For now, we won't pursue active filters further.

Passive filters are circuits which do not contain amplifiers within the filter circuit. Most filters are of the passive sort, and throughout this installment when we use the term filter we will be speaking of the passive type.

Another way to classify filters is by the type of action they perform (Fig. 4). All

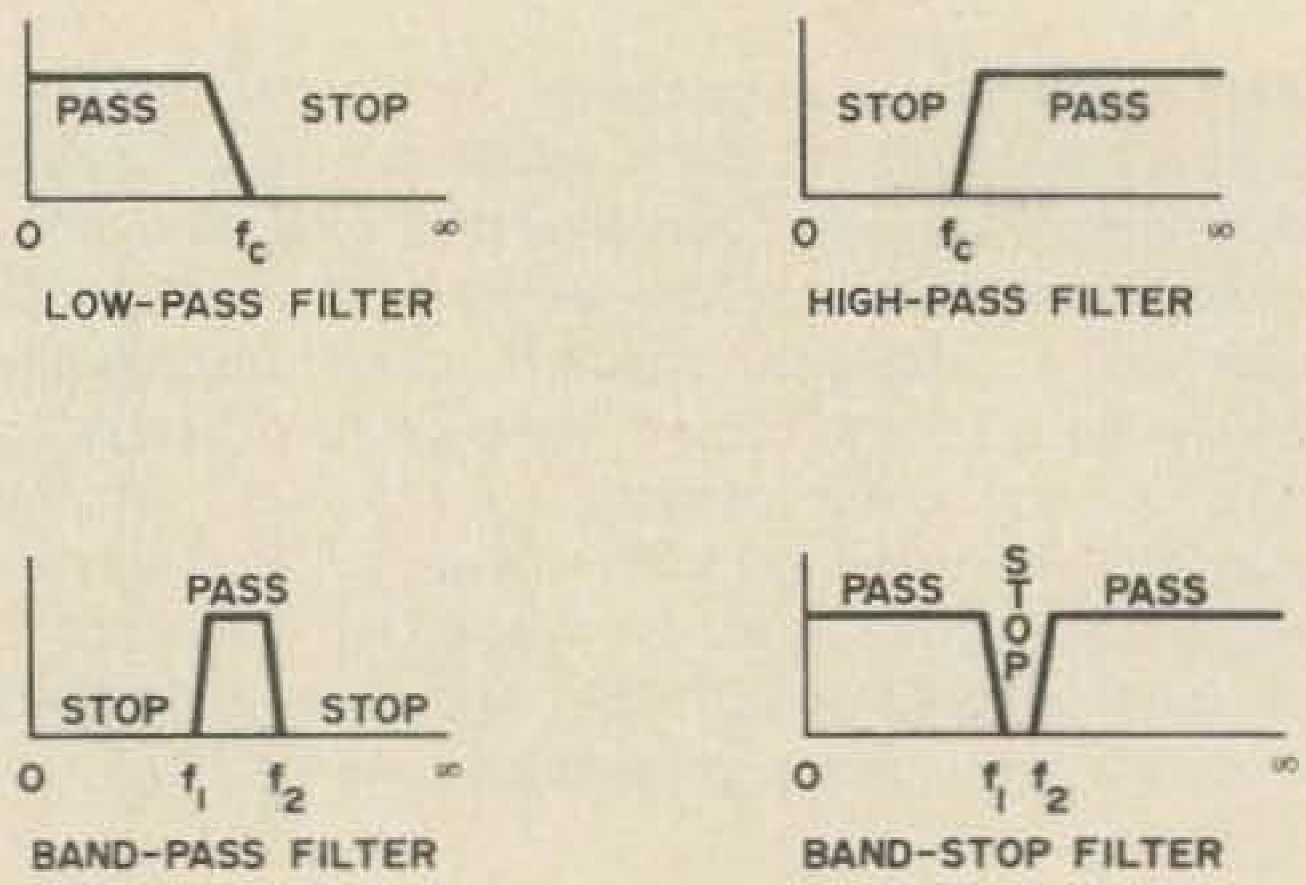


Fig. 4. Idealized frequency-response charts illustrate principal characteristics of low-pass, high-pass, band-pass, and band-stop filters. Each separates applied input signals into groups which are either passed or stopped. Frequencies which mark boundaries between these bands are known as cutoff frequencies.

filters separate signals into two or more groups, but they do so in different manners. This classification scheme puts any filter into one of four groups – low-pass, high-pass, band-pass, and band-stop.

The separation action of a filter can be described as letting one group of signals (passband) go through, and blocking all other signals (rejection band or stop band). The frequencies at which the passband and the rejection band meet are known as cutoff frequencies.

A low-pass filter passes all signals below its cutoff frequency and rejects those above; that is, its passband goes from 0 Hz up to cutoff, and its stop band goes from cutoff on to infinitely high frequency.

A high-pass filter rejects all signals below cutoff, and passes all those above. Its stop band corresponds to the low-pass unit's passband, and vice versa.

A band-pass filter has one passband and two stop bands. The first stop band runs from zero frequency up to the lower cutoff frequency, and the second stop band runs from the upper cutoff frequency to infinity. The passband is the region between lower and upper cutoff frequencies. A resonant circuit, by virtue of its selectivity, is a band-pass filter.

A band-stop filter is the opposite of a band-pass filter; it has two passbands and one stop band, and passes all signals except those between its lower and upper cutoff frequency.

In practice, the band-stop filter is rarely encountered. Power supply filters are excellent examples of low-pass filters with cutoff frequency lower than the ac power line frequency, so as to leave only dc in the output. Tuned circuits are examples of band-pass filters. The kind of TVI filter which is connected to the TV receiver (rather than to the transmitter) is a high-pass filter.

Performance is not the only classification criterion, however. Filters may also be grouped according to the techniques used in their design. This involves two major techniques, each of which has a number of subcategories.

The major design techniques are known as "image impedance design" and "modern network theory" methods. Most filters in the past 50 years have been designed using image impedance methods, although this technique requires the use of physically impossible components and so cannot produce accurate results. Within the last decade or so, the modern network theory method has been brought to prominence to provide more accurate filter action.

Filters designed by image impedance techniques fall into two subcategories, known as *constant-k* and *m-derived*. Both these labels are just names, and bear no relation to the performance characteristics of the filter. The *k* and *m* refer to mathematical variables used in the design equations.

Filters designed by modern network theory methods bear names associated with the mathematicians who studied the various types of equations involved in the theory. The most widely known of these filter types is the *Tchebychev*. Less well known is the *Butterworth* design.

Classification by design method is not rigid, because many of the design techniques overlap. It's quite possible to encounter an m-derived Tchebychev filter, and the entire image-impedance technique is actually a special case of the Butterworth design area, although it's not usually so labeled.

To complicate the question a little more, filters always include both series and parallel components, at least one of which (and often both) is reactive. This means that the most primitive building block possible in a filter is the combination of one series element and one parallel element. Such a circuit (Fig. 5) is known as a half-section.

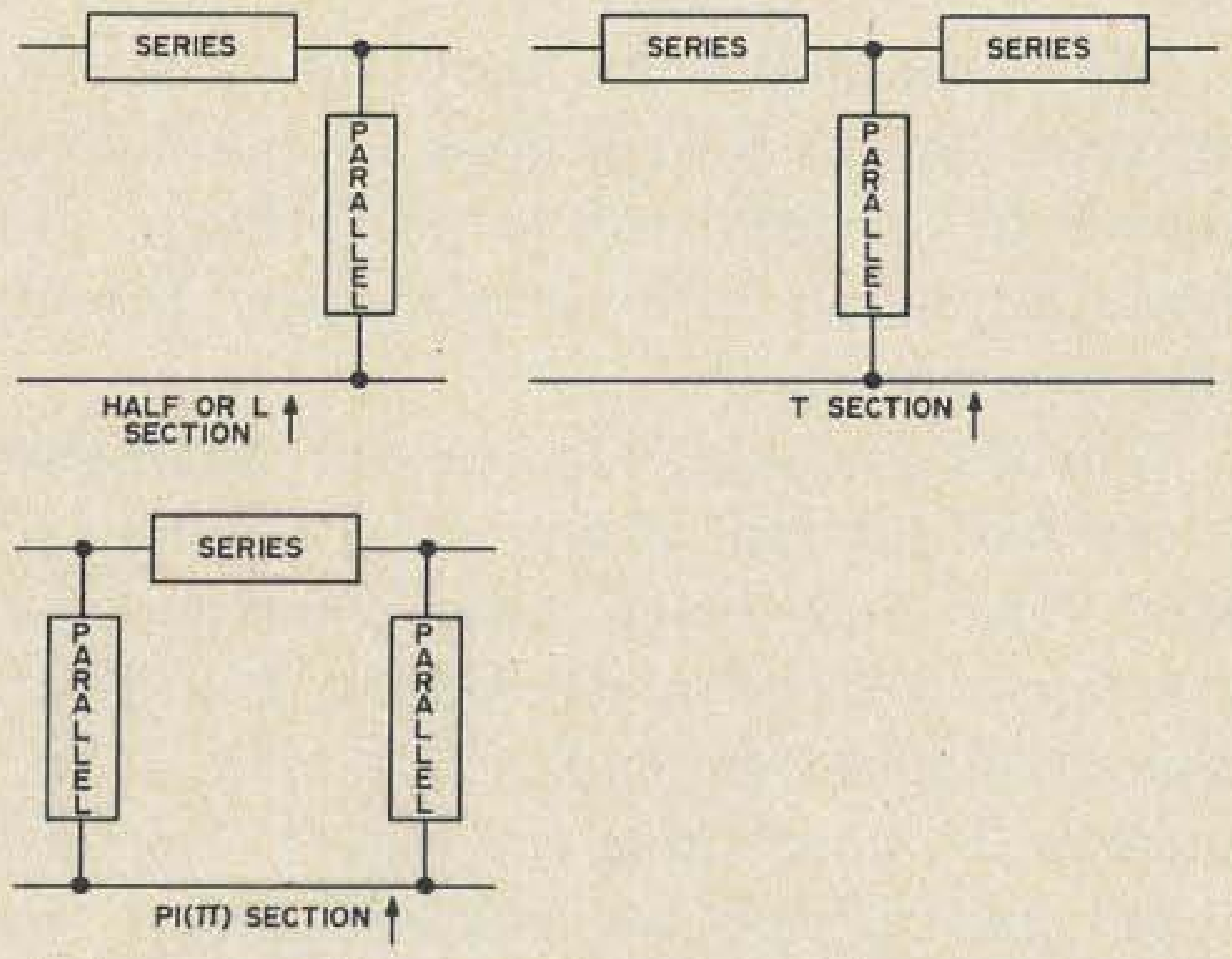


Fig. 5. Different arrangements of components in filter circuits bear names suggested by resemblances to various letters of alphabet. Pi-section resembles no letter in our own alphabet, but is dead ringer for π of Greek alphabet. Elements represented by boxes here may be resistors, capacitors, inductors, or combinations of any or all of these.

Half-sections can be connected together so that the two series elements meet, or so that the parallel elements meet. In either case, the two elements which meet can be combined into a single element; the resulting three-element circuit is known as a section. If it has two series elements but only one in parallel, it's called a T-section (from its resemblance to the letter). If there's only one series element and two in parallel, it's a pi section, from the resemblance to the Greek letter π. And if we don't combine at all but use only a half-section, it's sometimes called an L-section.

That's not all the possibilities, but we have enough on hand for the moment.

The functional description – high-pass, low-pass, band-pass – is most generally used, unless it's necessary to be more explicit about the particular filter circuit involved. Even then, the functional description is usually retained, and the added classification simply tacked onto it, to give us a "low-pass constant-k filter using π-sections" or a "high-pass m-derived filter using T-sections."

A final classification – "balanced" and "unbalanced" – must wait until we examine the details of filter operation for its discussion. Let's move right on.

How Do Filters Operate?

We have just seen that filters act to separate signals into groups by permitting signals in the passband to go through, and rejecting signals in the stop band(s). How is this accomplished?

The clue is hidden in our statement that every half-section of any filter contains at least one and often two reactances. A reactance is frequency-sensitive. That is, its characteristics depend upon signal frequency. By combining reactances of proper types and values, we can get almost any kind of filtering action we may desire.

To show how this works, let's begin with the simplest possible filter arrangement (Fig. 6) containing only a single half-section and a single reactance. We already looked at this circuit, but not in this context. It contains a resistor and a capacitor, with input applied across both and output taken across only one.

This circuit can act as either a low-pass filter or as a high-pass unit, depending upon which element the output signal is taken across. To see how this works, let's assume that the resistor's value is 1 kΩ, and that the capacitor's reactance is 1 kΩ at a frequency of 1 kHz.

For an input signal of 10V at 1 kHz, then, since resistance and reactance are

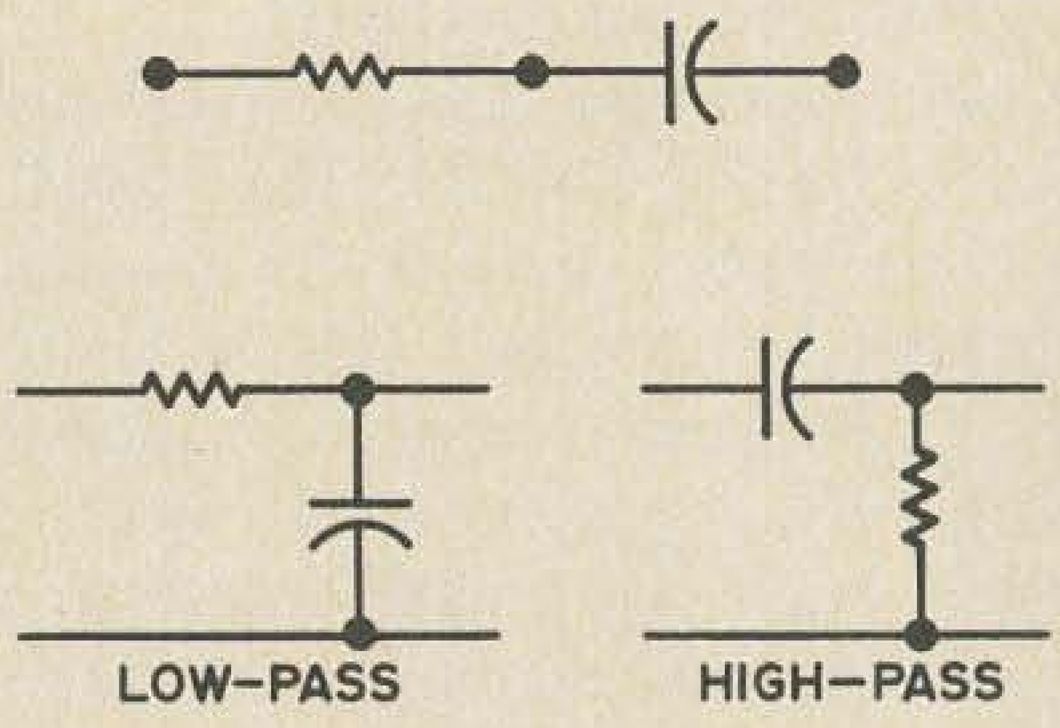


Fig. 6. Simplest filter circuit consists of one resistor and one capacitor in series, as shown at top. This forms an RC L-section, which may be used for either low-pass or high-pass purposes as shown in the two lower schematics. Method by which filter operates is explained in text; all filters work on this basic principle, but more complicated circuits modify it in various ways because they contain not just one but several reactances, each of which behaves differently.

equal at this frequency, we will get the same voltage across either the resistance or the reactance. Because of phase shifting, we will actually find 7V across either; we went into the reasons for this before. With 10V input and 7V output, we have 3 dB loss.

If signal frequency goes up to 2 kHz, the resistance will not change but the reactance will decrease to 500Ω. We now have less voltage developed across the capacitor than across the resistor. As signal frequency is increased still more, the reactance keeps going down; when we reach a signal frequency of 10 kHz, the reactance is only 100Ω, and at 100 kHz the reactance is down to 100Ω. Resistance remains unchanged, so that the voltage division between resistor and capacitor reduces capacitor voltage and leaves most of the voltage across the resistor.

If our output voltage is taken across the capacitor, we have a low-pass filter. As signal frequency goes up, output voltage goes down. If, on the other hand, we take the output from the resistor, our filter is a high-pass unit, as output voltage increases with frequency.

At dc or "zero frequency," all the input voltage appears across the capacitor. At the frequency at which resistance and reactance are equal, 70% of the voltage (half the power) appears across the capacitor. At infinite frequency (a purely theoretical idea, granted) no voltage at all appears across the capacitor. In between, whenever signal frequency is doubled, the output voltage drops to half what it was before, because the reactance drops to half its previous value.

This somewhat idealized description leads to the idea of a "6 dB per octave" cutoff rate. Cutting voltage in half is introducing a 6 dB loss, and doubling the frequency is equal to going up an octave in the musical scale. The theoretical limit of the effect of a single reactance is 6 dB per octave.

An actual RC filter like the one we've been examining does not reach this rate in practice. Its cutoff frequency is defined as being the frequency at which X and R are equal (1000 Hz in our example) and in that region the slope is only 3 dB per octave.

We can improve its performance in several ways. One is to cascade additional half-sections. This modifies its action in many ways, since the first reactance now has another half-section in parallel with it and no longer behaves as a pure reactance. Another (Fig. 7) is to replace the resistor

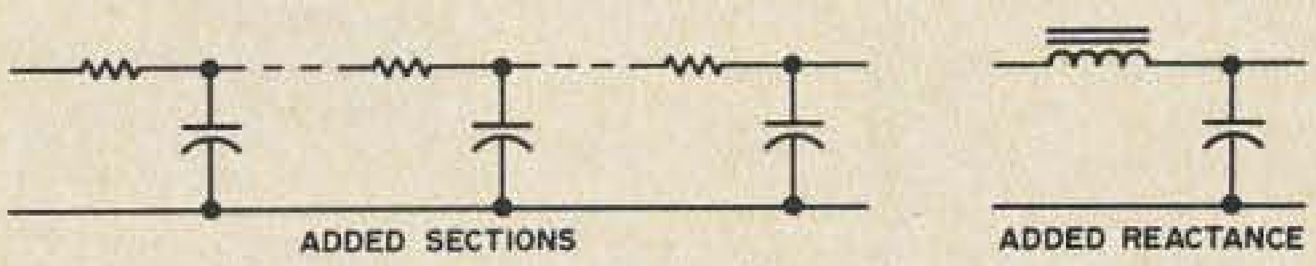


Fig. 7. When performance of simple filter of Fig. 6 is not adequate, either or both of two routes may be taken to improve it. Sections may be added (left) or additional reactances may be included (right). Usual filters encountered in practice do both; design technique is rather complicated but results justify it.

with an inductor, thus putting two reactances in rather than one.

When we do either of these things, we immediately find ourselves involved in the intricacies of filter design. With both inductive and capacitive reactance in the circuit, we have the certainty of resonance at *some* frequency, and this may or may not be good for our purposes. This is not the place to delve deeply into filter design theory; all we can do is skim the surface enough so that we are able to identify the various parts of any kind of filter.

The constant-k filter design procedure amounts to a method for replacing the resistor with an inductor, together with adding additional half-sections, to produce a filter with the desired cutoff frequency and cutoff rate. The resulting filter's input and output impedances will vary in a definite manner which the designer cannot control, so that this type of filter can be used only when its impedance characteristics are satisfactory for the purpose. A typical power-supply filter amounts to a constant-k low-pass filter; the "choke-input" filter uses a T-section followed by an L-section (with two of the three inductors combined into one so that it appears to be two L-sections), and the "capacitor-input" filter is a π-section standing alone.

The m-derived filter design procedure offers the designer another level of control. He can achieve the cutoff frequency and rate desired, just as in the constant-k procedure, and in addition he has the option of controlling either the impedances or the attenuation characteristics (but not both). To do this, a part of the circuit resulting from the constant-k design is converted into a resonant circuit. The ratio between cutoff frequency and the resonant frequency of this converted portion yields the variable named *m*, which gives the procedure its label.

The distinction between a constant-k filter and an m-derived filter (Fig. 8) is simply the presence of a resonant circuit where one would expect to find only a single reactance. If such a circuit is present, the filter is m-derived.

Filters designed according to modern network theory techniques may look the same as either type of image-impedance circuit. In these designs, the engineer trades off the ability to control certain characteristics in order to gain control over others. The most popular Tchebychev designs, for example, permit some degree of ripple (uneven response) in the passband to achieve a cutoff rate greater than the theoretical 6 dB/octave/reactance limit for image-impedance designs.

These trades are made by designing each separate section of the filter for a different cutoff frequency; the complex math involved in the design procedure specifies the particular cutoff frequencies to be used.

Regardless of the design procedure, a filter may be built to operate in either a balanced or an unbalanced condition. These terms are not limited to filters – they apply to all signal transmission circuits, and affect filters only because filters are used in signal circuits.

The most conventional practice for any kind of signal transmission is to ground one side of the transmission path, and then work a hot line against ground throughout

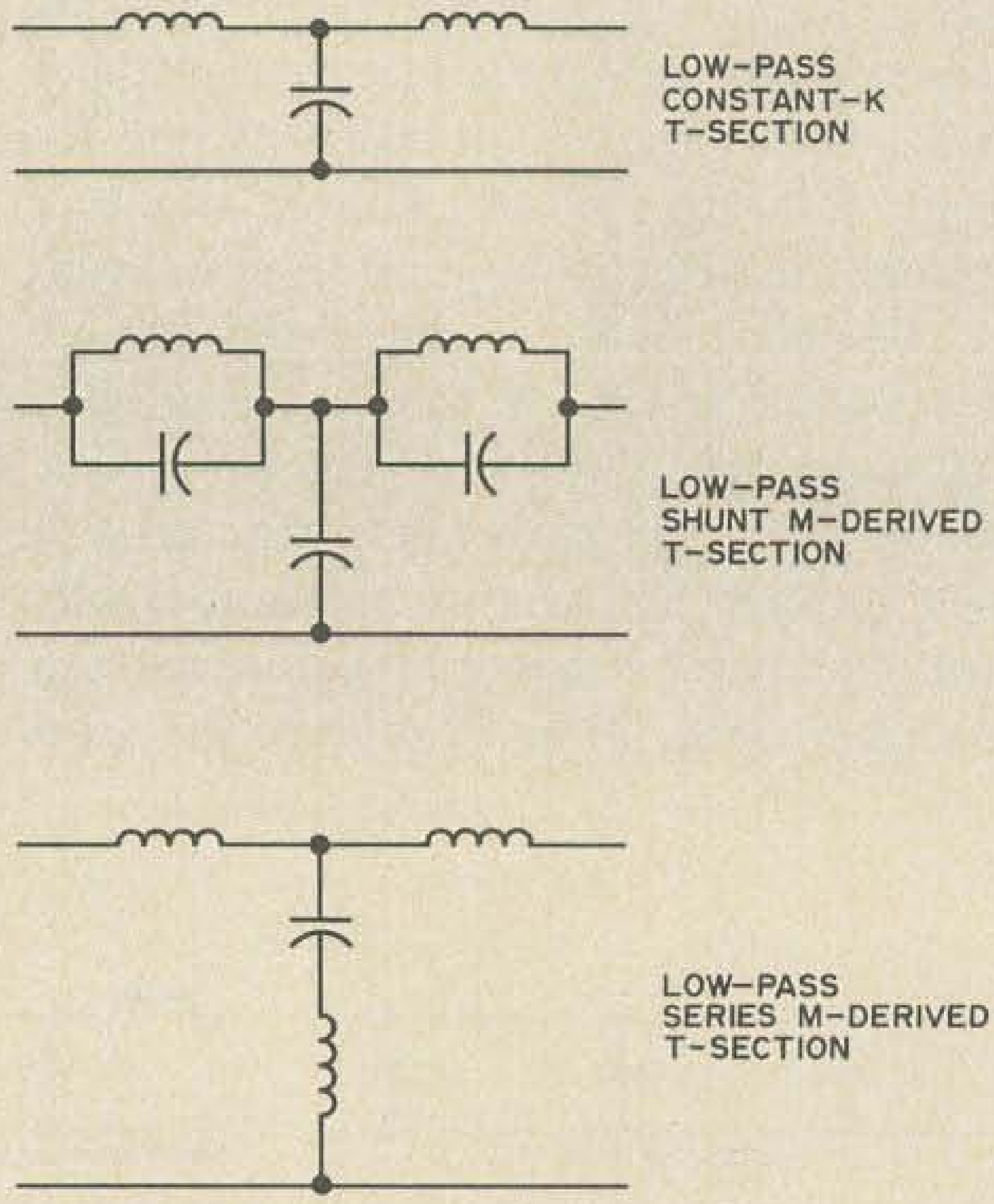


Fig. 8. Differences between "constant-k" and "m-derived" filters are apparent when the schematic diagrams are examined. Any "m-derived" filter contains resonant circuits replacing simple reactances. "Series" and "shunt" portions of names refer to type of resonant circuit, either series-resonant or parallel (shunt).

the resulting system. This is unbalanced operation.

It's equally feasible to keep both sides of the path separate from ground. If the circuit is arranged so that both sides of the path are separate from ground, but so that one is always above ground level when the other is below and vice versa, the circuit is said to be balanced. A push-pull amplifier is a good example of a "balanced" circuit. So is the industrial circuit known as a "differential" amplifier, in which the signal is the *difference* between the individual signals on each input line.

In an unbalanced circuit, any accidental stray coupling between circuits cannot be readily corrected since there is no way to distinguish between desired and undesired signals. Most of the undesired signals are inherently unbalanced in nature.

The balanced circuit permits such a distinction, because it is possible to reject any unbalanced signals appearing in a balanced path. Commercial telephone circuits are all balanced for precisely this reason; it permits the reduction of cross-talk to acceptable levels.

A filter for use in an unbalanced line must be itself unbalanced. The sample circuits we've been examining are all unbalanced; the series element appears in only one side of the filter, and the input and output terminals have a common or ground reference.

To convert such a circuit to a balanced filter for use in a balanced line, the series elements are divided between the two signal paths (Fig. 9). Then half of each series element appears in each side of the line. The total series impedance is unaffected by this change, but there is no longer a common terminal between input and output.

What Is Amplification?

In all the circuits we've looked at so far, we have had only one generator or power source and all the rest of the circuit has been composed of passive components that dissipate energy or convert it from one form to another, but which have not added any additional energy.

In practice, radio deals with extremely small amounts of energy. It's necessary to boost the energy levels while retaining the major characteristics of the original energy. Any device which does this job is known as an amplifier.

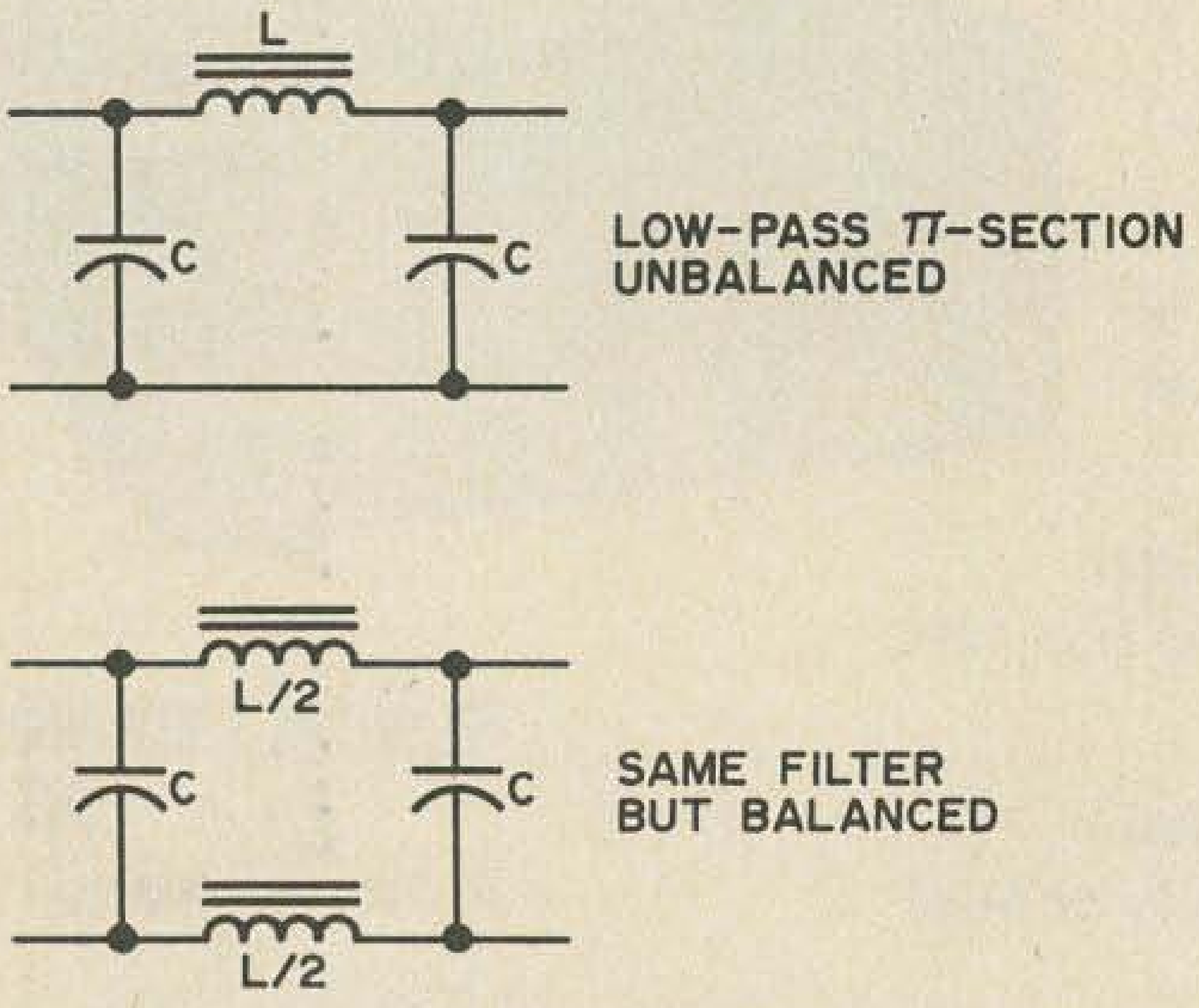


Fig. 9. Most conventional circuits are unbalanced in nature, as at top, with both input and output circuits sharing a single common ground line. If balanced circuit (bottom) is in use, input and output circuits have no terminals in common. Any design may be converted from unbalanced to balanced operation by splitting series elements between the two signal lines.

This definition of "amplifier" is intended to make it plain that every amplifier provides a source of new or added energy to a circuit. In addition, it must control this added energy in such a way as to make it conform to the desired (or major) characteristics of the original energy in every way except strength.

An amplifier, then, is a device for adding energy while controlling its characteristics – and amplification is the process of doing this.

One way of adding energy is to introduce a generator into the circuit. Another way is to add a battery. Unfortunately, while the energy from a battery is plentiful enough, it's difficult to control.

However, we have been making much use of the voltage-division capability of series circuits composed of resistors. If we have two resistors in series with our battery, one of them fixed in value and the other variable, we can control the added energy by varying the resistance of the variable resistor.

We now have the basics of a rudimentary amplifier – a source of energy to be added, and a means for controlling the energy. It may come as no surprise to find that almost all practical amplifiers boil down to this simple basis – a battery and a variable resistor. (See Fig. 10.)

The variable resistor, though, seldom looks much like what you would expect. Conventional variable resistors achieve their variations by mechanical means, and cannot exert control rapidly enough to follow all the gyrations of an ac signal. The variable resistors we find in practical amplifiers to control the added energy achieve their variations by *electronic* means rather than mechanical. We call them vacuum tubes and transistors.

We'll examine the actual methods by which vacuum tubes and transistors achieve variable resistance later; each does it differently. The important point at this stage is that so far as the electrical circuit itself is concerned, they do act as variable resistances, whose resistance depends in some way upon the input signal. The British term for the vacuum tube – valve – is highly descriptive of the function. A small input signal controls the resistance which the tube offers in the energy-adding circuit, and thus produces an output signal which matches the input in every desired way.

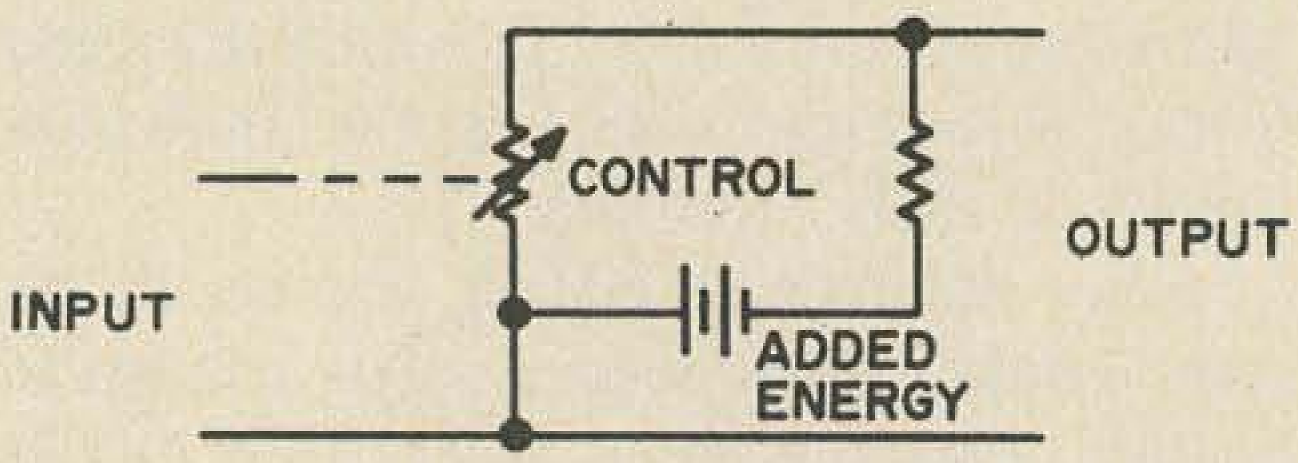


Fig. 10. Basic amplifier circuit consists of source of added energy and variable resistances controlled by input signal which together permit input signal to control amount of energy added. Schematic diagram shows the principle involved, but no real amplifier looks much like this. Control function is usually provided by either transistor or vacuum tube, which is acting as electronically variable resistance.

By proper circuit design, we can make the output signal's characteristics match all of those of the input signal, or we can select only a few features of the input signal and eliminate the rest from the output. The ability to do this makes it possible for us to modify signals in just about any way we like – for instance, we can preserve the frequency characteristic while eliminating any changes in strength, and this is what makes FM so much more free of atmospheric noise than AM. We can preserve the variations in strength while changing the frequency, and this makes today's sensitive receivers possible by permitting the "superhet" receiver design. Or we can preserve all the original characteristics, boosting only the strength, and we have full fidelity sound systems. All of this depends upon the control inherent in the amplification process.

How Do Transistors Amplify?

At the moment, we're interested primarily in transistors and how they amplify. We'll wait until later to approach vacuum tubes, which operate rather differently although they do the same basic things.

The name transistor itself comes from a blend of *transfer* and *resistor*; before the transistor, few persons thought of amplification in terms of variable resistances and steady energy sources. Instead, they thought in terms of imaginary "generators" of ac inside the amplifier – and many of today's engineering textbooks adhere to this concept.

But the transistor has nothing in it which even remotely resembles a generator, and it does its job precisely by controlling series resistance, so the "steady energy source/variable resistance control" is a direct picture of how transistors operate.

A transistor consists of three distinct regions of semiconductor material joined into a single crystal. It's something like a sandwich, except that the "junction" regions which separate the different types of material are actually part of a single continuous structure. The two outer regions are of the same type of material, and the inner part is of the opposite type.

The semiconductor materials used are primarily either silicon or germanium. Both these are metallic elements, and both of them, in an absolutely pure state, are rather good insulators. If very small amounts of specific kinds of impurities are added, however, they become rather good conductors. One kind of impurity (donor) puts an excess of electrons into the crystal structure, while the other kind (acceptor) doesn't have quite enough electrons and so produces "holes" where electrons can rest but cannot quite fit permanently.

Semiconductor material containing donor impurities is called N-type material, and that containing acceptors is known as P-type.

A transistor, then, consists of either two regions of P-type material separated by a region of N-type, or of two regions of N-type separated by P-type. The first is called PNP, and the second NPN. Since they are mirror images of each other, we'll look only at the operation of an NPN transistor. To apply this to a PNP unit, simply reverse all the polarities involved.

Before we get inside a transistor, though, let's see what happens at a single junction (Fig. 11). Such a junction, P-type on one side and N-type on the other, is widely used; we call it a diode.

If we connect a diode into a dc circuit with the P-type material connected to the positive side of the power source and the N-type to the negative side, then we find that the excess of electrons at the negative side of the power source meets a similar excess of electrons in the N-type material, and the resulting repulsion between electrons must be overcome before any current can flow. The resistance is rather high.

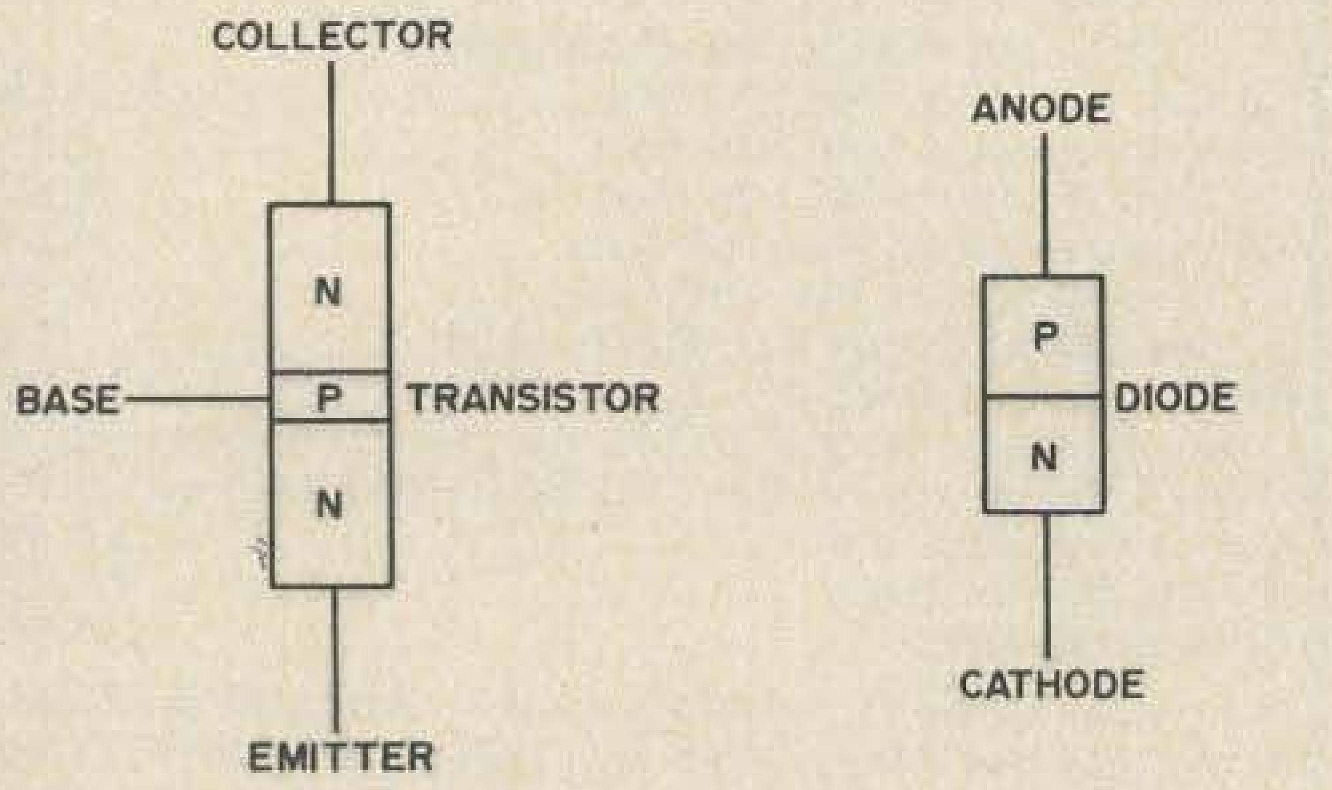


Fig. 11. Transistors and diodes consist of slabs of semiconductor material formed into a single structure. Differences in atomic characteristics between crystal in N-type region and that in P-type region provide required control actions.

If we reverse polarity of the connections, then the excess of electrons at the negative side of the power source find room to move into the "holes" of the P-type material, displacing the excess electrons from the N-type material across the junction and sending them on to fill the shortage of electrons at the positive side of the power source. Current flows readily. The resistance is low.

The diode, then, has low resistance for current flow in one direction, and high resistance to current flow of the opposite polarity.

When we add a second junction to put the third region into our device and change it from a diode into a transistor, each junction still retains this one-way characteristic. However, events at the two separate junctions interact with each other.

We call one of the outer regions the emitter, the other outer region the collector, and the inner region the base. The junctions are known as the base–emitter junction, and the base–collector junction. In practice, we apply the input signal into a circuit which includes the base–emitter junction, and it controls the resistance of the base–collector junction. Fig. 12 shows the arrangement.

The interaction between junctions is such that the base–emitter junction must be operating in its low-resistance condition (forward biased), and the base–collector junction in its high-resistance condition (reverse biased) for the control to occur.

In essence, what goes on is this: Some of the electrons moving in the base region as a part of the base–emitter current escape from the base by way of the base–collector junction, instead of through the base–emitter junction. In the base–collector junction, these "injected" electrons are going the wrong way on a one-way street. That is, they are going in the opposite direction, and so tend to *reduce* the amount of reverse bias maintained on the junction. This reduction of reverse bias amounts to a decrease of resistance.

If only a small portion of the electrons injected into the base–emitter circuit escaped into the collector circuit, the effects would be correspondingly small. However, the geometry of the regions is such that *most* of the current in the emitter region goes on through the base into the collector. Only a small fraction of

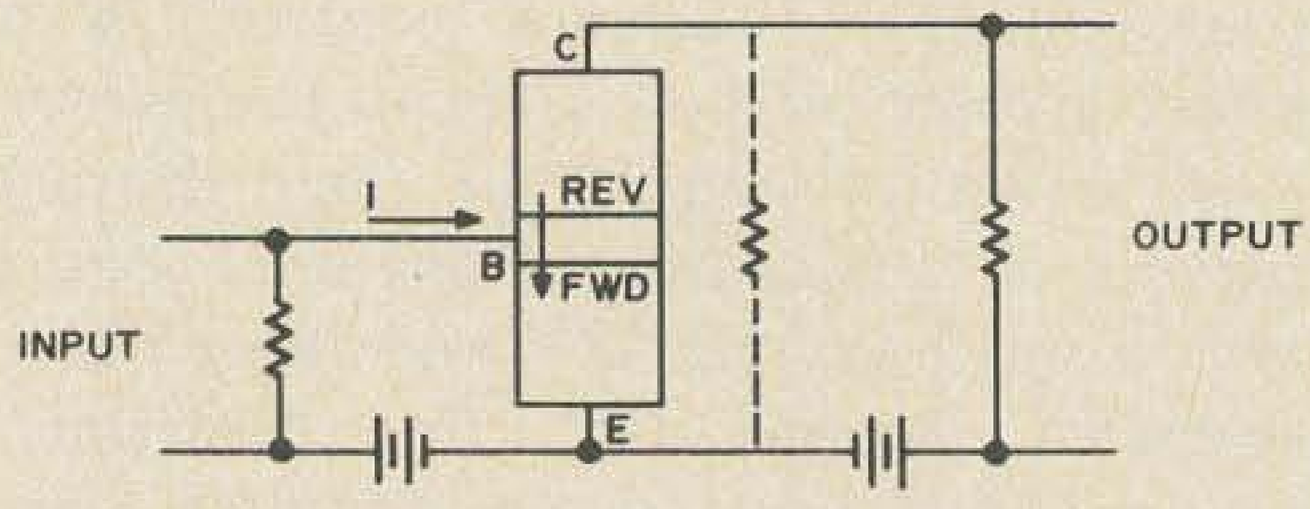


Fig. 12. Current flow through base–emitter circuit controls that in collector–base circuit by interaction in base region. Shown here is common–emitter circuit arrangement.

the emitter current appears in the base circuit. The result is that the effects are correspondingly large. A current of only a few millionths of an ampere in the base–emitter circuit controls currents thousands of times larger in the collector circuit, and we have amplification.

Something similar goes on in tubes, but the control action is different. In a tube, electrons boil off of the cathode and travel to the plate, passing the grid in the process. The voltage level on the grid controls the number of electrons which get through, and so controls the plate current.

That is, the cathode in a tube corresponds to the emitter of a transistor, the grid corresponds to the base, and the collector to the plate.

The major factor used to rate transistors for "gain" currently is a ratio known as *beta*. A transistor's beta is the ratio between base current and collector current; if a specific transistor will permit a collector current of 50 mA to flow with a base current of 1 mA, it has a beta of 50/1 or 50.

The beta of an individual transistor depends upon many factors. The voltage applied to the collector is one such factor. Another is operating temperature (the hotter the unit, the less control the base current has over collector current). In general, however, beta depends primarily upon the internal design of the transistor, and remains relatively constant. Modern transistors range in beta from around 10 to over 500.

Neither transistors nor tubes are all-purpose amplifiers. Each has its own area of application, but the two areas overlap rather widely.

Transistors are used in almost all commercial audio amplifiers; they are also used as rf amplifiers at lower power levels. (High power, high frequency transistors exist, but they are expensive.)

This examination of transistor action and how it compares with that of tubes has of necessity been kept brief; you can find more details in our previous study courses for the Advanced and the Extra license examinations. While we have included here enough to meet the current General study list, it's likely that as time passes the General examination also will concentrate more and more upon transistors and less and less on vacuum tubes. When that happens, the additional information will probably be necessary – so if you can, do some additional studying about transistors. It may not be needed to get your ticket, but it will definitely help you understand the equipment you'll be using afterwards!

. . . Staff ■

Leaky Lines *(cont. from p. 12)*

depend upon it, but who are now unable to make full use of it. It would bring hundreds of thousands of nonhams to a logical "jumping-off" place from which to advance themselves into our ranks, thus promoting a healthy growth for the hobby. This would provide us with a source of raw ham material for many years to come, and we could certainly use more hams, if we are to continue growing. The band which has been proposed is not widely used; consequently, its restructuring would not impose any inordinate hardship on its present users to any great extent.

For these reasons I have come to the conclusion, and I think that many others will too, that this proposal is a good one, and should be adopted in the near future.

Technicians

All right: granted... I have been belaboring the question of Technicians and the proposed allocation of additional frequencies sufficient unto the gravity thereof. And surely, by this time all who have been alerted and alarmed by the sounding of the tocsin will have made their opinions known to the ARRL directors, the FCC, all their friends and colleagues on the air, and anyone else who would listen, and thereby be convinced. I have nothing to add to my fundamental objections. But there are some afterthoughts which, while not speaking directly to the question per se, do bear upon it somewhat.

Any casual survey of the equipment market, both new and used, will disclose that there are very few transmitters or transceivers which are limited to 10 meters alone. Almost every piece of gear on the market includes the other so-called "low bands." Presumably, the Techs, if and when the new allocation becomes a reality, would acquire equipment that would cover not only the segment granted, but all five bands. And on thousands of shack desks, from coast to coast, constituting an ever-present Lorelei, will be sitting, as big as life, a shiny new Whatziss Mark Four, with a couple of hundred watts PEP under the hood, just rarin' to go. Hopefully, most of the fellows will resist the temptation successfully.

Now, I beg of you...don't get me wrong. All you Techs who have absolutely no eyes to exceed your frequency allotment...that is *not* what this piece is all about. I am not interested in condemning anybody before the fact. I would not dream of indicting anyone of "conspiring to advocate the overthrow of the FCC regulations by force or violence," and so I hope that I will not be smothered in a deluge of angry denunciations, and I trust that 73 will not be on the receiving end of any premature and precipitate cancellations of subscriptions. Please have the patience and forbearance to hear me out before you bite your pipe stem in two.

I state now, without any qualifications whatsoever, that I am certain that the overwhelming preponderance of the Tech group, if granted the ten meter segment, will use it precisely in the manner prescribed, and will not make any excursions into portions restricted to them. If there do happen to be any violations, well, they will most probably occur to no greater extent than they do right now, and which originate among all classes from Extra right on down the line. The proportion of law breakers and miscreants holds pretty consistently, no matter what stratum of society (or hamdom). People are people!

Idle curiosity prompts me to ask how the FCC proposes to monitor all the frequencies to see that the occasional "poacher" will be detected. It is surely unrealistic to imagine that an agency with severe shortages of funding and an insufficiency of manpower, which is having trouble policing the presently constituted bands, could suddenly develop the additional capacity to do so under that added workload which is bound to ensue with any change.

I am a devout believer in the honor system. I have seen it work in many fields. Because I hold affirmative views with respect to the inherent honesty and integrity of the individual, I feel confident that we hams are completely capable of policing our own bands for ourselves. And since FCC could not begin to do an adequate job in this connection, it is absolutely imperative that we all feel a sense of urgency toward this problem. It is important that every ham who participates seriously in this hobby makes it his personal business to continue to be vigilant in protecting our bands from deviations from the regulations, by Techs, *or anyone else*.

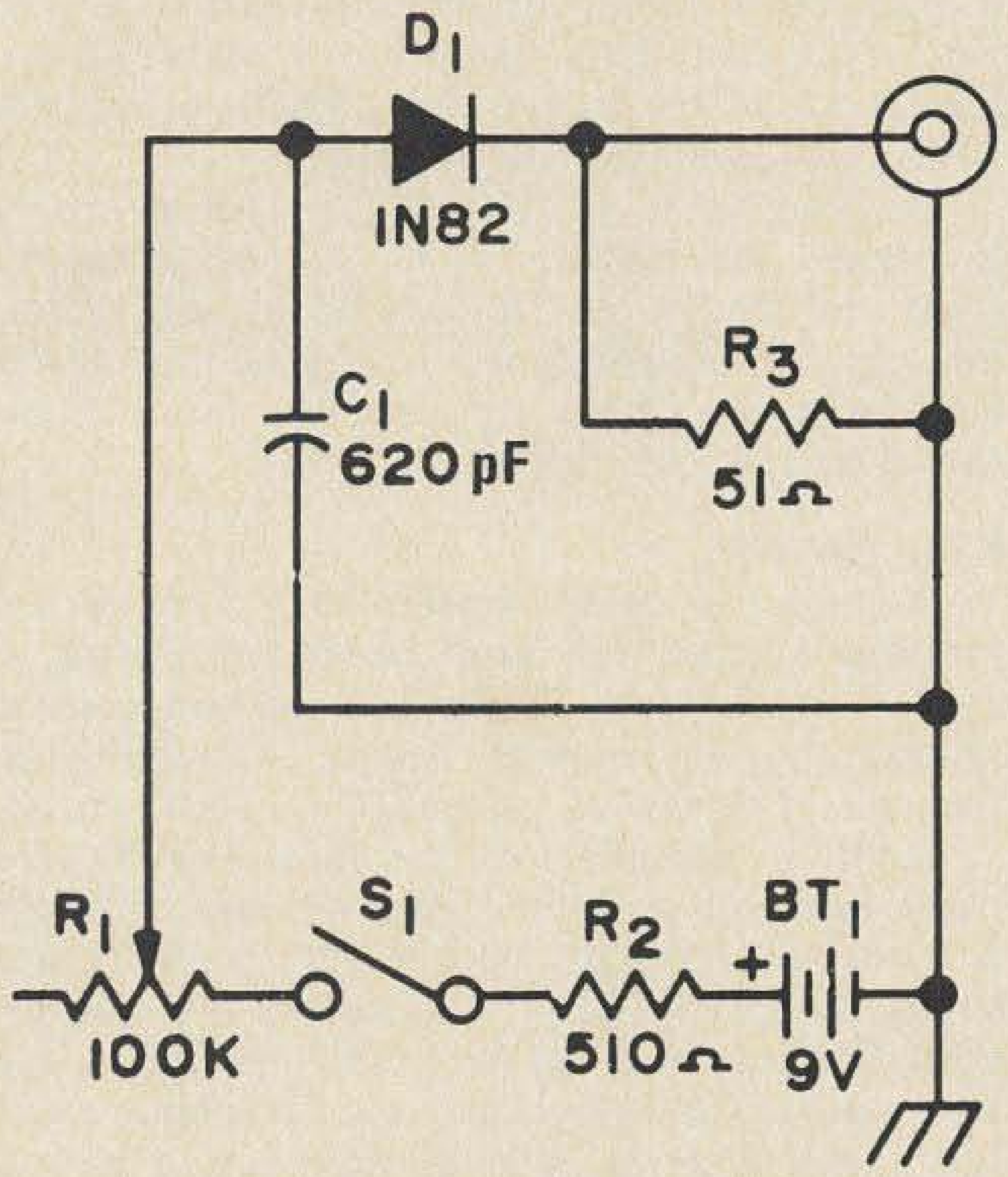
If we fail to do this, it is possible that the entire image of ham radio will suffer irreparable damage, to the ultimate detriment of our privileges. We must not allow the existence of any condition to which outsiders may point, in their constant efforts to preempt or commandeer our frequencies.

I am not advocating an era of tattletale activity in amateur radio. This would engender an atmosphere of distrust and fear which might be worse than the situation it sought to remedy. But conscientious amateurs are urged to bring their influence to bear upon their associates and friends, in a determined effort to try to prevent wholesale frequency violations. There is sufficient evidence to indicate that only a negligible minority attempts to flout the rules. But we know from recent political history just how much damage a small minority can cause if its activities are not detected and circumvented.

Using Ten for CW

While discussing this matter of the possible change of 10 meter allocations, I have another idea to advance. While it is certain that most of the operators will be utilizing their new segment for phone operation, I should like to remind you and emphasize that operations will not be limited to this mode. The proposal calls for "... voice (or other) emission." There is a golden opportunity here, which for the first time makes it possible for Techs to obtain actual on-the-air experience toward genuine upgrading. There has been no marked attraction for Techs in the practice of MCW on 2 and 6 meters. This poor substitute for CW never approached a status of universal acceptance among them. And this deficiency of means is one of the important reasons why Techs have always had trouble with the code. Now, however, there will be a very convenient avenue through which this discriminatory deficiency may be offset...through which the obstacle may be attacked and overcome. It is to be hoped that many Techs, not content merely with the gain of a small phone segment,

A $1.40 NOISE GENERATOR



There are probably many hams who have at one time or another built a receiver or converter. And probably many of these devices have a less-than-enviable noise figure. With a noise generator, one can work on reducing inherent noise. The noise generator described here is not the best that can be built, but it is probably the least costly thing around in these days of inflation.

The components for this device cost about $1.40. (I scrounged the hardware.) The diode is a 1N82, although almost any UHF or microwave diode could be used. The 51Ω resistor is approximately equal to the receiver input impedance. It will take about 10 minutes to wire this up. Have fun with the noise!

Stephan Goldstein ■

Leaky Lines *(cont. from p. 96)*

will rise to the challenge, at last, and use the band for CW, in order, finally, to go for the General ticket, and negotiate the exam successfully.

If you agree with this premise, and I hardly see how you can fail to, why not devote a portion of your schedule to regular operation on the segment, for the purpose of assisting Techs in their quest for CW proficience. We can be of great help if we extend the same traditional cooperation we have always given to the Novices on their CW segments.

If we fail in this we may foster twin evils. First: we might simply isolate the Techs into just one more "solitary confinement" situation. Second: we will be neglecting an opportunity to promote the growth of amateur radio through advancement. Let's make sure that not a single Technician who expresses a desire to build his speed and CW savvy fails to find a willing hand among us.

This is a two-way street. We can learn much more from some of the Techs than many of us are willing to admit. They have become specialists and experts in the fields of VHF, ATV, RTTY, FM, and UHF, and remote control. Their participation in the fields of amateur satellites and moonbounce are worthy of recognition and praise. The percentage of Technicians who design and build their own gear is far larger than anything we could match.

The anticipated revision of the amateur spectrum, while it does incorporate some dangers and disadvantages about which I have previously written, possesses some very positive values also. It will present an opportunity for vital interchange and meaningful development in ham radio. Ideally, we will make the most of this chance.

73. . .K2AGZ■

Mr. Virgo Himself *(cont. from p. 14)*

purchasers. If we had shared this concern we would not have introduced the 1011.

However, despite our conviction that the 1011 is a useful addition to the Swan line, we have decided to defer to our critics and curtail future production of this unit.

Since we have completed one production run of the 1011 we can fill most orders from our dealers promptly, but because of the existing controversy we will not solicit additional orders for this unit.

Well, how about it, fellows? Are we going to leave Swan with this stigma or are we going to outvote the lunatic fringe? Please – for ourselves – write Swan and ask that the Model 1011 not be canceled. That piece of equipment is sound in design and workmanship and it can ideally perform the functions for which it has been engineered. Can we really expect more?

. . . K6MVH ■

(W2NSD cont. from page 10)

This book is so important that I have made arrangements for our Radio Bookshop to handle it. This book should be in every ham's car and handy for every ham's wife too. I just don't see how it is possible to ever lose a traffic ticket case when you have this book in hand.

Do you know what to say and what *not* to say when the traffic cop hands you a ticket? Send $2 today to Radio Bookshop, Peterborough, N. H. 03458 for a copy of this invaluable book. This book can save you future fines, loss of license and a lot of headaches.

King Hussein

As this is being written the Syrians are invading Jordan, the Iraqi troops are poised in Jordan, threatening to support the commandos against the government troops, Amman is in flames and things are generally in an awful mess.

Right in the midst of the furor His Majesty made news all over the world by turning to his ham rig and relaxing with a few contacts. He called Mary WA3HUP, who visited him shortly after I left Amman in May and just before the first serious battle between the government and the commandos in June. He also talked with a few hams in the midwest and talked a bit about the situation in Amman.

CBS news (and others) were on the phone immediately, pressuring Mary to try and contact His Majesty for an interview. Mary, figuring that if the king wanted an interview he would ask for it, declined. They called me to see if I could help them. I agreed to ask if the opportunity arose, but pointed out that I had no intention of putting pressure on him because I was afraid that he might do it for me rather than because he wanted to do it.

It was with relief that I did not hear His Majesty on the bands for the next couple of days. I wanted to help CBS if I could, but I didn't want to create any problems for the king.

There is no way to describe my feelings as I read the papers day by day, following the terrible situation in Jordan. The hotel where I stayed four months ago was being shelled. Commando snipers were shooting at anyone seen peeking out of the windows. Fire and smoke lay in clouds over the city. The commandos held a roadblock at a circle where I had walked and taken pictures a few weeks before. Hummar, the lovely summer palace where His Majesty has his ham station, was shelled by the commandos.

How had the Arab-Israeli situation come to this? Who was to blame? Those of you who have read the Quaker booklet (available from 73 for $1.00) know that there are no angels and no devils, just an unfortunate and really quite logical course of history. A good deal could have been done to keep the situation from getting as bad as it has, to be sure. The booklet points out the best courses of action, all things considered, and with no sides taken.

Naturally I feel empathy for King Hussein and the people who were so nice to me in Jordan. I also feel a great sadness at the loss to the commandos – they feel that they are doing what is best for Palestine and their future. And I respect the Israelis who have done such a tremendous job of building up their little piece of desert into a modern thriving country. I agonize over their impossible decisions as well as I do over the Arabs who demand that the impossible decisions be made. Though I have visited Syria and Iraq and was treated graciously in those countries, it is difficult for me to feel any sympathy for their invasion of Jordan.

With no possible good solution to the worsening situation in sight, we go to press. If any readers do contact His Majesty on the air please give him my best regards and, I hope, the warmest feelings of brotherhood from all amateurs in his time of greatest trial.

Three New Ones

While I am by no means near the top of the DX hierarchy, I have worked enough countries so that a new one is rather hard to come by. Thus it was quite a surprise to me the other day when I managed to snag three new ones all in one evening.

It started off easily. I was heading for the kitchen when the thought struck me that I should check the band, just in case. I didn't know in case of what. The only DX that had been scheduled to show was Frank DL7FT who was reported on his way back to Berlin after an unsuccessful attempt to get on the air from Albania. I tuned twenty meters and there it was – a pileup! I tried to hear who they were calling, but everyone was just giving his own call. Finally one chap let it out of the bag by standing by for Frank. Hmmm, he must have made it after all. The fellows calling him were spread out over the bottom part of the band so I knew Frank must be out of the band. Sure enough, there he was down about 14,192 or so, giving out reports as fast as he could. I checked for a relatively lightly used frequency and gave him a quick call. "The portable one, come again." I'd done it! We exchanged reports and calls and I had a new one.

A couple of days earlier I had gone over to visit editor Ken to try out a beautiful little FM rig that had just arrived from Regency. After giving it a workout we got going on a game of chess and it was 2:30 before I threw the game to Ken in desperation so I could get away. Being a better than average player he probably would have won anyway, so it was no sacrifice. I got back home well ready for bed . . .hmmm, better check the band.

It didn't take long to hear ZK1MA working a list supplied by a W6. I listened for a bit and heard it come to an end. Then fellows started calling in to get on the list for two days later. I entered my call on the list.

Sure enough, right on schedule, not too long after my ZA2RPS contact, list time arrived and I called as my call came up. Nice report from Manihiki and another one in the bag. He gets on for about an hour a day with his battery powered rig and works a list for the hour. He then spends a day recharging the battery for the next bout. Without the list very few fellows would ever get the country, even so you will probably not be surprised to know that some chaps get on there and intentionally interfere.

After the ZK I tuned up the band and heard a beautiful signal signing off after a short contact. It was too loud to be anyone of great rarity, surely. Wrong. It was VR6TC on Pitcairn Island. When Tom signed and asked for calls the whole band seemed to answer him. I called him a couple times . . .twice more . . .twice more . . .nothing. No answer to anyone. I broke in and talked to a friend for a moment who was coming through on backscatter from New York, then stood by for Tom, just in hopes. And there was Tom coming back to me! It was probably four or five minutes after he had started listening and everyone else had long ago given up and started looking for him up or down the band, figuring that the pileup had discouraged him.

That was a very satisfying evening.

$50 Reward!

Frankly I would like to have some gorgeous girls on the cover of 73 – and it isn't as if we don't have a good supply of 'em in or near the ham ranks. You photographers out there, get your lovely wives, daughters, mistresses, or even neighbors into the shack, up on your tower, or somewhere that will make a good picture for our cover. If the fems have a call, so much the better and extra points from our picture editor. Send in some glossy 8 x 10s. Let your imagination run wild, please. Shoot black and white until our advertising picks up to the point where we can run color covers again.

You can't think of any ideas for pictures? Good grief! Maybe she is helping you put up a beam, a tower, or bringing your dinner to the operating desk while you are in a contest. Perhaps she is just building a kit. Maybe she is operating and you are bringing the supper tray. She might be looking very perplexed at a study manual . . .etc. You can do better than any of those ideas, surely.

Think PR

The Dave Bell Ham's Wide World film is great for us, but it can't carry the entire load of promoting amateur radio forever. Most television stations will show it once and that is it. We do need follow up programs to keep amateur radio in mind as a good thing when those same television viewers start getting interference or see a particularly big beam sprouting in their neighborhood.

The normal ragchew contact does not have much grist for the PR grill, admittedly, but then all of amateur radio is not trivia . . .just most of it.

What can you do to help promote amateur radio? You can keep your ears open for PR possibilities. Then, when they occur, you can arrange for the news to get out.

For instance, suppose you have a friend who is talking of a DXpedition to an island somewhere. If he goes to the island, works a thousand or two amateurs and then comes home, the news will hit the ham magazines and that is about all. Big deal! But if he lines up a partner for the trip with a reasonably good movie camera and some experience with it, he can end up with à documentary film of the Dxpedition that will be of interest to dozens or even hundreds of television stations, radio clubs all over the world, and might even pay for itself.

Perhaps you have a friend interested in moonbounce work. Great PR here! Again arrange for a documentary film of the fellow or fellows who set it up, the operation, and pictures of the fellows on the other end of the bounce. You can put in some shots of the moon, the world, and such to explain what is happening. Aerial shots of the layout at VK3ATN would be wonderful for a film on this subject. And shots of the big dish at Arecibo would be interesting too.

Even a short documentary of a local ham building a piece of equipment would fit in the picture. Plan ahead on this and show the unit in its various stages of being built and tested. Other local hams can get in the act, helping with the work or the testing.

Fox hunts can make wonderful movies. Start with a shot of the committee planning the hiding place, then show the rig being hidden. Finally off go the hunters and hidden cameras can record their wanderings. A good director will enact the whole thing rather than doing it from life. This way you can set up for some great shots such as the hunter passing the fox rig and the loop antenna suddenly spinning around. Don't forget close-ups of the gear used for hunting down the fox plus smiling winner pictures.

A repeater group could turn out an interesting film showing their operation, complete with handi-talkies, mobile units, base stations, control units, maps, the works. While this might not be of as much interest to TV stations, it would be wanted by clubs and would fit in a TV series if enough individual amateurs turn out ham films.

Any special club efforts are worth filming, whether it be Field Day or phone patches for a local army hospital.

If film is too much for you to manage, then at least think in terms of slide shows with tape cassettes that can be used by clubs. Most clubs of any size have at least one film nut, complete with, hopefully, a 16 mm camera. Few amateurs have sound film systems yet, but they are coming, either via sound on film or video tape. Even super-8 is better than nothing. Let's get the effort started now and work toward more professional results later.

Lastly: please let me know what you are doing so I can help spread the word to encourage others. And if you need any help in locating TV stations or clubs that would like to see your films just write and then wait for me to eke out an answer. 73. . .Wayne ■

LETTERS

That "Fringe"

You fool very few readers with your sly way of trying to subvert the minds of your readers with an attempt to dismiss lightly the role your pal Hussein plays in the Mideast.

His country is used as a haven for terrorists with his permission.

His country is governed by a military dictatorship; he as its head as king.

His country is allied to all intents with Russia.

He has allowed the Palestinian guerilla forces free rein in Jordan – as a militia with armed parades, etc.

He has now even allowed plane highjackers to land in Jordan and transmit their demands for the liberation of captured assassins.

That is your noble host, your ham pal, whom you feel obligated to pay off for a pleasant visit. I reiterate, you have fooled no one, and as others have said, your editorials stink especially when they dabble in politics outside the field of ham radio. Please omit call and address; I don't need assassins on my tail.

Max Sherr
Jamaica NY

Since you are wrong on every count, it would seem that you have not done your homework. If you will open that vault and send a dollar we will send you the Quaker book which will give you the actual facts on all of your allegations. My "pal" Hussein has done everything within his power to stop the terrorists, to the extent of a civil war with tens of thousands of casualties. The military government was not set up until the civil war broke out as Hussein tried to curtail the commandos, before your letter was written. It is Egypt, not Jordan that is allied with Russia. Jordan has received no Russian aid that I know of. Every report of the highjacking emphasized that the Jordan army was powerless to do anything for fear of repraisals on the hostages. Don't be afraid of assassins, only hoots of derision from fellow amateurs who are less biggoted and more interested in facts than hate.

. . . Wayne

FM in New England

I own a Varitronics 1C-2F and so far have been very pleased with it. This is set up with .34–.94 simplex. This leaves four more positions left for other crystals.

I am interested in mobile through out the New England states plus N. Y. What additional crystals would you recommend to key the greatest number of repeaters in these areas?

Also I would be interested in finding out the best way to keep up with information on new repeaters. I am the proud owner of a subscription to 73 magazine and the April *repeater directory* issue is always in the car with the mobile rig.

The men at 73 should be proud of the fact that they run the finest ham magazine in existence.

Harold A. Chamberlin, Jr. D.M.D. W1PFX
2 Old Sudbury Road
Wayland MA

Best bet for frequency "sets" is .34–.94, .94–.94, .34–.76, .76–.76, .31–.88, and the last channel blank, for crystals you might need for a specific area you want to visit (such as .34–.88 for LI, .37–.88 for Staten Island, or .37–.76 for Northern N. Y.).

. . . Ken

Tech Aid Group

I'd like to become a member of the 73 Technical Aid Group. I'm a college student hoping to major in electrical engineering, and I'd like to help Novices with their trials and tribulations. If there's any other information I have to supply you to join the group, please let me know and I'll forward it.

Bob Perlman WB2VRW
3 Joslen Place
Hudson NY

Thanks, Bob. Your name will be entered in the next TAG listing.

. . . Ken

73 for the Blind

Somewhere in the September issue I read about tapes for people with poor sight, to cover the course for the General ticket. I have gone over the issue twice and do not find the article. I have a friend that has a Conditional ticket and is anxious to get the General and I would appreciate the information regarding these tapes. This man is 90% blind.

Arthur T. Becker WA4QZL
R.R. 1, Box 622
Avon Park FL

73 tapes for the blind may be obtained from "Science for the Blind," 221 Rock Hill Rd., Bala Cynwyd PA 19440.

. . . Ken

CW Simplified

Just this week I started my two sons (at their request) ages 13 and 15, on their way to a Novice license.

I had been taught the code years ago by a Navy Wave. The one thing she impressed upon the class was that code is a useful method of communication in which speed is secondary compared to good clean transmission.

The accent was on uniform dits and dahs within the character and uniformity of spacing between characters. Faithfully following rules created code that "sang."

One interesting point stressed was that in the "normal range of hand-keyed speeds, from about 7 to 18 wpm, the speed of formation of the character should never vary. What should vary from speed to speed was the length of the space *between* characters. This had the virtue of tuning the ear to a code character that did not vary with speed of transmission.

In listening with a new ear to both the Novice and regular CW segments, it is readily apparent that few people have been exposed to what I have found to be this truth: As the speed of transmission lowers the dits and dahs grow longer and longer, making very difficult copy and failing to train the ear for a true code sound.

The CW bands would clean up considerably if this point could be widely made.

Allan S. Joffe W3KBM

You're Never Too Old

My case history as an amateur radio operator: My first QSO was May 25, 1963, when my age was 74 years, and over the years since that first QSO many close friendships have developed.

In the frames below the call letters W4VGJ are licenses received from the FCC since November 30, 1967. For the reason that the size and poor quality of the picture make reading impossible, they are described.

From left:

1) Amateur Extra Class License dated September 23, 1969.
2) Amateur Extra Class Operator License Certificate, Number AE-6-432, dated September 9, 1969.
3) FCC Commercial Elements 1, 2, 5, Radio Telegraph, Number T3-6-245, dated August 6, 1970.
4) FCC Commercial Elements 1, 2, Radio Telephone, Number P3-7T-4829, dated November 30, 1967.

   and

   FCC Commercial Elements 1, 2, 9, AM-FM Broadcast Station Operator Authorization, dated August 26, 1968.

The enclosed picture was taken Aug. 20, 1970. My age is 81.

Henry B. Miller W4VGJ
PO Box 1131
New Port Richey FL

FM Anthology

On March 13th of this year, I sent 73 a check (#373, Jensen Beach Bank) for three dollars for a copy of your FM Anthology. Some time passed, and no book was received, although I did receive the canceled check, indicating it had been received and probably spent on a couple of six-packs. . .

In Orlando, at the hamfest, I spoke to you folks about it, and you said that printing had been delayed, and I should get a copy soon. Wonderful.

Now I see in this month's issue of the world's greatest ham magazine (otherwise known as Green's Folly. . .) that the books are finally off the presses. But. . .there are only 500 in print, and everybody had bette hurry and send in their three bucks, cause Wayne's running out of beer.

Now I'm worried. Maybe, I think to myself, they'll get rid of all 500 copies of the thing, and forget about me completely. It's keeping me awake nights. Every day I look in the mailbox hoping. . .but there's nothing there. Except moldy copies of other magazines containing such thrilling articles as "How to Adjust the Catwhisker on Your Receiver to Copy Sideband."

So. . .how 'bout sending me ONE copy of the thing, and end this long agonizing suspense?

Bill Britton WA4IHH
PO Box 707
Jensen Beach FL

OK. The anthology is on its way. For the hundreds of people who have been writing, the anthologies were held up, but now Volume I (at least) is printed, bound, and in the mails. Volume II is not yet printed, and will probably be delayed for another few months. Volume I is made up of the early large issues of FM Bulletin, and it covers the period from Feb 1967 to Feb 1968. The book is a verbatim reprint made by photographing the original bulletins. The price is $3 while the supply lasts.

Volume II will comprise articles from the later issues. Since it has not yet been printed, readers are requested to hold their checks for Vol. II until publication is complete.

. . . Ken

I would like to bring to your attention a possible ambiguity in the advertising of the FM Anthology in 73. I ordered my FM Anthology from the advertisement on page 71 in the May issue of 73. There, in a black bordered box, both Volumes of the FM Anthology are listed at a price of $3 for the two volumes *together*. In the order list at the bottom of the page, the two volumes are listed singularly as "FM Anthology . . .$3." However, on page 85 of 73's August issue, the black bordered box again appears, but this time the two volumes are priced at $3 *each*. Yet, in the order list at the bottom of the page, there is still the singular entry: "FM Anthology . . .$3." Finally, in your September issue, which I just received in the mail, only Volume I of the anthology is listed. My question, of course, is, just what is the price of the two volumes of the FM Anthology?

I have recently acquired two FM units and am at present holding up their conversion to 2 meters until I receive the FM Anthology for the information contained therein. Please advise regarding this confusion, for I am highly desirous of obtaining both volumes.

Gary D. Maples K9VTE
854 North 12th Street
Manitowoc WI

Confusing ain't it? When we first got started with the FM Anthology, we were going to make it one little book with a few selected articles. But we had so many requests for complete back issues of FM Bulletin that we decided to include all of them that were reproducible in a single volume (Vol. I). When Vol. II is printed, it will include all important articles from late issues of FM Magazine. Each volume sells for $3, and consists of article reprints exclusively.

. . . Ken

Repeater Improvement

The Antenna Separation article (September 1970) had the main solution to my problem about close-spaced 2 meter FM repeaters. However, it will cost us some money to get the necessary towers to get the proper antenna spacing both at the Glade Park repeater (portable) and the Redlands repeater (at my home).

Before I can put up a strong self-supporting tower at my house I will have to check with the Mesa county building Code first. If I can't put up a 50 or 60 ft tower here, all I will then be able to do is install a flea-power (up to 5 watts) repeater for the ".34–.94" combination for the convenience of the "tourist" hams on 2 meter FM. For our *search and rescue* work we will maintain the 145.32–146.94 MHz repeater(s) both at the Glade Park and the Redlands sites. I think the suggestions under "The Last Step" (page 53) are very good and regardless of the frequency spacing, we are putting those suggestions into effect. All in all, the article is *super excellent!*

Nate Bale WØPXZ
PO Box 1494
Grand Junction CO

Repeater Snobbishness

In reference to the *Mr. Virgo Himself* editorial (September 1970), regarding clubs that are slowly tightening requirements for membership in repeater groups, what exactly can I expect as a newcomer to 2 meter FM operation? I have purchased old equipment and worked like a dog to make it work, and now I hear I may expect the "cold shoulder" from repeater operators.

My chief interest is operating through the repeater located at Concord, N. H., as I live near Boston and travel every weekend to Lake Winnepesaukee. I wonder if you might be able to answer these questions: (1) Are the Concord repeater operators hostile to newcomers? (2) How can I get in touch with the operators to find out if they will accept a new membership? (3) Is this an "open" repeater?

Thanks very much for your time. I feel that you people are the only ones from whom I can hope to get honest, unbiased answers. I have, by the way, lost all interest in the ARRL, its policies, its politics, its publications, and in general, all that it stands for. Keep up the good job!

Douglas A. Chisholm WA1BLG/1

The Concord repeater is W1ALE, and it is operated by Tony (W1TNO). The fellows on the repeater are quite friendly and go out of their way to be congenial to newcomers. The repeater is open, and no strings are attached. If you wish to become a member of the local repeater association, you can usually contact Tony by calling him on 146.34, the repeater input.

. . . Ken

I sympathize with the ham in Decatur, Georgia – he got turned down by the local repeater club. I got in the local club OK – I paid up for both my wife, K4BGU, and myself, K4ETZ.

Latest development is that one of the local boys who built the Charlotte, NC repeater (W4BFB) took me to task for chewing the rag with a local friend too much. "Sounded like 75," he sez. Told the fellow that nobody seemed to want in or was using the frequency – and we were letting the repeater "tail out" on every transmission to let any possible breakers in. The upshot of the whole thing was that the Charlotte repeater was shut down, I got a letter telling me that I was about to be "tried" for various offenses, and I was about to be shoved out of the club. But for an estate settlement and an upcoming gallbladder operation, I would have looked forward to the "trial," as the whole thing looked like beautiful grounds for a libel and/or slander suit, not to mention bringing into the open the fact that the *club* had paid for the repeater, not the two who control it and it was about time we stopped bowing reverently in the direction of Myers Park every time we use it! Sure, have "private repeaters" – if the FCC will let anyone get away with it, but .34–.94 must remain open to all comers, period.

Incidentally, I wonder what would happen if someone put in a repeater on, say 146.34 to 147.3? Would a Technician transmitting on .34 wind up in the soup? FCC Rules make it look quite likely. Deliberate jamming is dirty – but a side-by-side repeater operation to another freq above 147 might be the answer to the cliques!

I am a firm believer that any club that either turns down or ejects a ham on other than bonafide legal grounds should be subject to a going over by the attorney general on the usual "discrimination" grounds. Color has nothing to do with it – if the club is to be tax-free, it also must be nondiscriminatory.

F. C. Hervey K4ETZ/Mob 9
%848 E. Frances Street
(Geo Merkl W9GYQ)
Appleton WI

An Orchid or Two

As the author of "The Consummate Console," it was certainly a pleasure to see how very professionally 73 produced the final article and the results certainly justify my time invested in both the building of the unit and the writing about it.

Thanks for doing a fine editorial job. The magazine is improving with each issue, and I'm happy to be associated with it.

Dee Logan WB2FBF
21 Judith Street
Nanuet NY

Your technical articles are *the best* that I have ever seen and your theory series is superb! I'm too broke to have a subscription to 73 but I buy old copies and read them cover to cover – especially Wayne's editorials.

Bill Kresl WB9BBC
1109 Sherman
Janesville WI

My subscription to 73 should precede this letter by a day or two and I thought I might include a thought or two on becoming the proud owner of a share in what seems to me to be the most needed boost to ham morale that has appeared on the scene in a while. I think 73 is the innovation which could help to recoup and develop what would appear to be a sadly declining spirit in the ham fraternity All we need is a new national organization, for which 73 could be the house organ, and we would be ready to go down the road.

Congratulations to Dave Mann for an outstanding bit of editorializing (*Leaky Lines*, issue 118). I wonder how many of us medium-generation-gappers would have the courage to so aptly express the ideas put forth for consideration. I agree 100% with the very fine content of the material and concur wholeheartedly with the concluding paragraph. I would think that those so vehemently deny the right to dissent and the freedom to express opposing views should review the events surrounding the period centering on the year of 1620.

Raymond M. Drew K1BGT
Box 36 USNSGA
FPO NY

73 Double Bonus

I am a subscriber. I like the magazine. It is however very difficult for me to understand why you waste valuable space which could be sold to an advertiser by carrying the "73 Reader Service." Three issues ago I marked three boxes for further information on advertised products. To date I have never received anything from any of them, which leads me to believe that my request was never processed and probably went into the wastebasket. Three weeks ago I checked a single box so far I have heard nothing.

Alfred G. Waack W4YHB
Box 1909
Hendersonville NC

73 sends the names of inquirers to dealers and manufacturers. If the dealers and manufacturers really care, they send you info. If not, they don't. Often, our advertisers aren't set up to handle inquiries and thus let their correspondence build up.

. . . Ken

Hobby Band

Relating to creation of a 220 MHz beginner band, I am astounded as for years I have advocated there be some type of band for beginners. The FCC rules as now set up help create disrespect for law and order. When we have conditions which breed the CB cult, etc. and $20 filing fees which only make the CB'ers more lawbreaking (why pay when you can do it for nothing. . .) and so forth – there is something serious and wrong. However, I have never been able to get Wayne to accept this line of thinking, and for him to all of a sudden come out in favor of doing something to help ham ranks and manufacturers. . .well I am shocked and wonder more than anything else who talked him into it. And, I am also led to question Wayne's honesty in saying in print, "hey, fellows, here is this great idea I got," when in fact others have been pressing modified forms of that idea on him for so long they are tired already. . .

Art Brothers W7NVY
Box 2124
Reno NV

Wayne never claimed authorship of the idea – he claims only to back it as published.

. . . Ken

FM in Germany

Since we have tremendous ragchewing on the FM channels here in Germany with transmissions in the hours I would appreciate it if you could investigate the possibility of sending me a tape on any of the internationally used recording speeds with a typical FM channel taped in the U.S. I would return the tape as soon as possible or could also furnish you with a tape if that would be more convenient.

This ragchewing with long transmissions is also practiced on the commercial channels here (taxis, etc.), as well as by the police, so that nobody can understand here that your repeaters limit transmissions to one minute or so.

Hanno Knorr 552-56-1321
DL 1 LV
% Neckar Rod & Gun Club ECN-950
APO NY

Perhaps our readers can help. As to the ragchewing, someone should suggest the possibility of an emergency occurring in the middle of a long transmission. One longwinded ragchewer could tie up a repeater so that it would be unusable in such an event. Ragchewing is great . . .just allow a dropping of carrier every minute or so to accommodate unexpected contingencies. . . . Ken

The Great Controversy: IL

It is about time we should speak up. This applies to both oldtimers and new fellas. Rather than raise a fuss, we sit back hoping the right thing will turn up for us. I have been watching the Incentive License (IL) fracas and finally decided to say my piece!

Having been a member of ARRL for many years, I was one of those who thought ARRL was for the ham – but its manner in railroading through the licensing deal caused me to drop out two years ago. On such a serious subject an action should have called for a membership vote. Hence, I can only deduce they sold us down the river. At the same time, though, they have done some good during past years and we should recognize that for what it is worth.

I would like to suggest a plan regarding this (IL) mess we are in and hope that you will take time to evaluate with serious thought. We all know that one person or a few do not have a chance of swaying FCC and I doubt if any one portion of the IL ruling could be altered to favor one group of hams. By the same token, you can't barrel into FCC with a tirade in what we consider the unfairness they have created by their ruling and law concerning IL. They are in the driver's seat and you might as well accept the decision; however, diplomatically approach them on a different angle. "Incentive" is a word that implies something to work for, not to take away what you already have earned, and then say "If you wish to have your frequencies back – take the highest license exam there is and pay us a fee!" It was quoted in one paper remarks to the effect that FCC could gain so much money by all the hams rushing to pay their fee and get back their frequencies taken from them. What a farce! I think by now statistics will prove to them that this is not the case. IL has proved to be the saddest excuse of eliminating many oldtimers and potential hams.

Let us consider what must be done to make satisfactory changes for all without the degrading aspect. The best plan in my opinion would be for FCC to revert back to all conditions as to frequencies, allocations, etc. prior to IL. This puts us all back on an even keel. Then offer a plan that is a real incentive. Broader the phone bands since this phase of operation is jumping ahead by leaps and these boys should have additional room for expansion. After all, the Canadians' phones are messing up the Novice bands – move the Novices down 50 to 100 kHz for the phone boys on these two bands. Add to this 50 kHz phone expansion on 14 and 21 MHz. FCC could even go so far as to offer CW fellas a new 25 kHz segment (6975 to 7000 or similar) for incentive. At least offer some real incentive to hams over and above what they presently have.

Now that we know what line of thought to pursue, how does one approach FCC to get a favorable hearing? In preparation – first it will take thousands of active and inactive ham signatures who want to see real justice done. The 73 organization has taken one step with its half-sheet tearout form to be returned to 73 mag (September 1970). Now arrange for a special meeting with FCC by a group of amateurs selected by vote of U.S. hams. IL could then be planned with fairness. ARRL had this chance if only they had given their members the right to vote (along with thousands of hams who were not ARRL members).

I'm sure that proper presentation to FCC with signed statements would cause them to reevaluate their incentive licensing program.

W. Dale Marshall W7DJU
3208 Plymouth Drive
Bellingham WA

I would like to get some thoughts off my gut. First, I hate IL, I don't belong to ARRL any more because of their part in it.

I would like to see ham radio put back like it was before November 1968; it would be a lot more fun for me and those to follow us.

G. L. Burkett
311 N. Washington
Evid OK

Rudeness with Reason

I am writing to apologize for our rudeness when we walked out on your speech Saturday night at the North Alabama hamfest. My husband and I were looking forward to seeing you and when he felt slightly bad before we arrived he said he wanted to see you too much to let a little pain stop him. The pain became too much to bear so we had to leave. It turned out to be appendicitis. He's doing fine now that his appendectomy is over.

I know he was sorry to miss you, and I think he would want you to know that he left because of illness and no other reason.

Though I'm not a ham I find 73 a very interesting magazine and the editorials refreshingly outspoken.

Sally Taylor WB6BDL/4—XYL

QSY Anyone?

Both Wayne and Ken have refreshing approaches to various subjects. Much food is offered for thought. I don't always agree with the viewpoint(s), but give 73 credit for taking a stand on issues.

Rather belatedly, a reply to Dave Mann's editorial describing two OTs and their experience with W1AW coming on frequency: It seems to me that it would be rather impractical for a station such as W1AW to check *each* frequency on which it simultaneously transmits since there are so many, a problem of rather some magnitude would evolve and possibly more if transmission on any single frequency had to be delayed.

W1AW has been around a long time – as long as I can remember and longer than most of the hams today. It carries on a service for which many are grateful – when *they* can copy through the QRM. The times and frequencies of transmission are published as they have been for many years!

How quickly so many years of good are forgotten in a fleeting moment of aggravation or disagreement! Are those *particular* minutes, that *particular* frequency *so* precious they cannot be surrendered for a helpful service unselfishly given?

Paul Pagel K1KXA
4 Roberts Road
Enfield CT

What's Wrong?

Repeaters on calling, monitoring, and emergency channels such as the nationally recognized 52.525 and 146.94 MHz, in particular. These actually hinder amateur radio, as they encourage poor operating and maintenance practices, a let-somebody-else-do-it attitude, cause untold interference to simplex operations, sometimes at far greater distances than the repeater normally covers, and in the end completely discourage simplex operation and promote a "communal" type of operation.

Poor operating, maintenance, and construction practices: To go into detail, the stations that have no way to measure their deviation, so merely set it way too high to be sure; They don't seem to know that they lose, rather than gain, performance through this practice. Power in excess of that necessary to do the job at hand: Experience in this mode of operation will tell anyone who is observant that power outputs in excess of 60 to 90 watts is simply that much more useless QRM; Sure, you'll get some nice signal reports, but what good is a signal report from a station with a sick receiver? Why should he bother to repair his receiver if he can hear somebody full quieting? If you have adequate antenna height, you can cover hundreds of miles with 25 or 50 watts; if you don't have the height, why QRM stations you can't hear because of your poor antenna?

Operating practice: There seems to be more and more of the "lumbago net" type activity these days on FM; The "long talker" will always be with us, but they should be discouraged from cluttering a channel with their hems and haws for hours; The way to do this is to use terse operating procedure yourself, and don't talk with the sciatica gang; The same goes for the drunks – amateur radio can live without the stigma of alcoholism. The Senile Operator: I don't know, but it sure gets hard to listen to by the hour.

Lastly, the attitude that FM is only good for 10–20 miles; Rats! You get out of it what you put into it, just like anything else. Of course, if you can't seem to get the antenna up over 20 ft, or afford a good feedline, just crystal up for the local repeater and they'll hear you 200 miles away while you're discussing your lumbago with Joe down the road. Fine. Rental Radio – just what ham radio needs! It's the next thing to communism – but don't say that to a repeater owner or user!

Bill Harris K9FOV
414 Bomberding Ave.
Lafayette IN

You may have a few legitimate grievances, Bill, but you're living in the past if you think 146.94 MHz is nothing more than a national calling channel. Whether we like it or not, whether we agree or disagree, whether we approve or disapprove, the plain fact is that 146.94 MHz is first a national repeater output frequency. The amateurs of today have made it so.

. . . Ken

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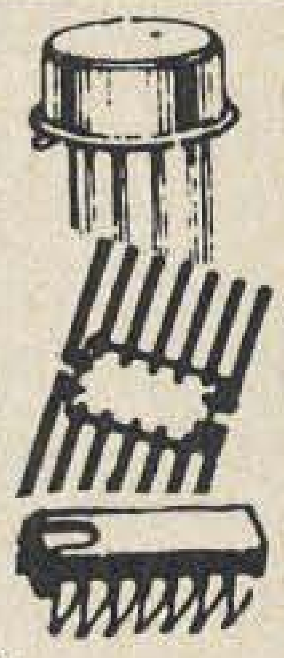

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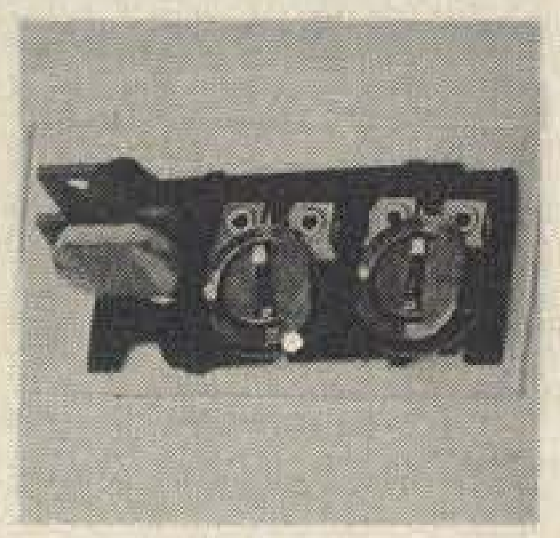

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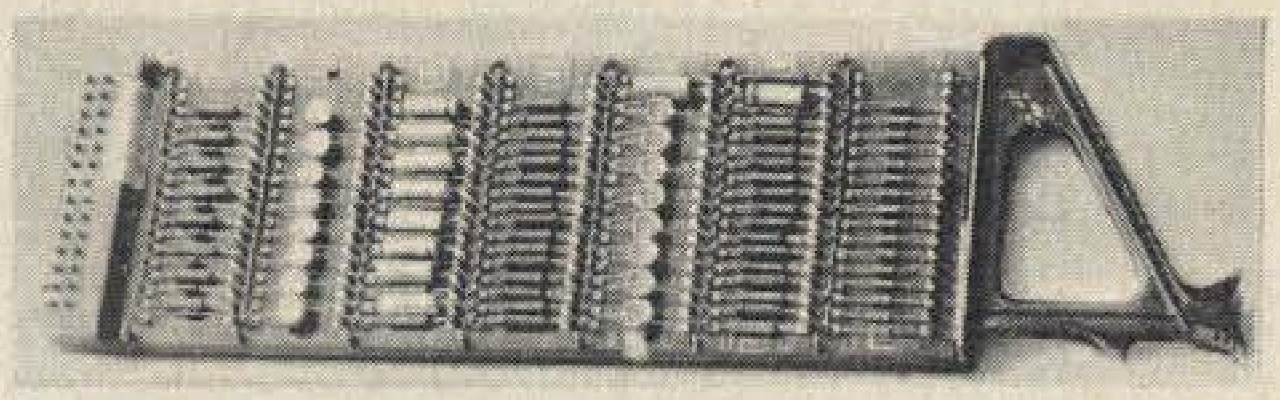

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PHILIPPINES	21A	21	14	7B	7B	7B	7	7	7	7B	7A	21
PUERTO RICO	21	14	7A	7	7	7	7	14A	21A	21A	21A	21A
SOUTH AFRICA	14	14B	7	7B	7B	7B	7B	14	21	21A	21	21B
U. S. S. R.	7B	7	7	7	7	7B	3A	7B	14	7B	7B	7B
EAST COAST	21	14	7	7	7	7	7	14	21	21A	21A	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

NCX 1000

1 kw Solid State
TRANSCEIVER
(80–10 Meters)

Here's a transceiver designed for the amateur who would rather spend his hard-earned radio dollar on performance than frills. The NCX-1000 is built to meet the demands of the operator who needs and desires a high performance SSB-AM-CW-FSK rig with solid-state dependability and plenty of power. Add to this the convenience of having your transmitter (including linear amplifier), receiver, power supply, and monitor speaker in a single, compact, smartly styled 59 pound package.

So let's look at the NCX-1000, starting with the double-conversion, solid state receiver. After the received signal is processed by a double-tuned preselector, a stage of RF amplification, and another preselector, it is applied to the first mixer for conversion to the first IF frequency. The first IF contains passband filters and a stage of amplification. A second mixer then converts the signal to the second IF frequency for additional processing by a 6-pole crystal-lattice filter and four IF stages. Finally, the signal is detected and amplified by four audio stages. The unparalleled high dynamic range lets you tune in weak stations surrounded by strong interfering signals. The result? High performance for SSB, AM, CW, and FSK. Sensitivity of 0.5 EMF microvolt (for a 10 db S + N/N ratio).

In the transmitter you'll find three stages of speech amplification followed by a balanced modulator, a crystal-lattice filter, a filter amplifier, and an IF speech processor (clipper). A mixer converts the signal to a first IF frequency for processing by two crystal passband filters, and two IF amplifiers. A second mixer converts the signal to the transmitting frequency where it is amplified in five RF stages before it gets to the grid of the 6BM6 driver. Final power amplification takes place in a forced-air-cooled 8122 ceramic tetrode which feeds the antenna through a pi network. Other features? You bet! Grid block keying for CW. Complete metering. Amplified automatic level control (AALC).

So here's a package that can give you 1000 watts PEP input on 80 through 10 meters, 1000 watts on CW, and 500 watts for AM and FSK. The speech processor lets you double your SSB average power output with minimum distortion. No frills with the NCX-1000. Just top performance.

For complete (and impressive) specifications and details, write:

NATIONAL RADIO COMPANY, INC.

NRCI 111 Washington Street, Melrose, Mass. 02176 (617-662-7700)