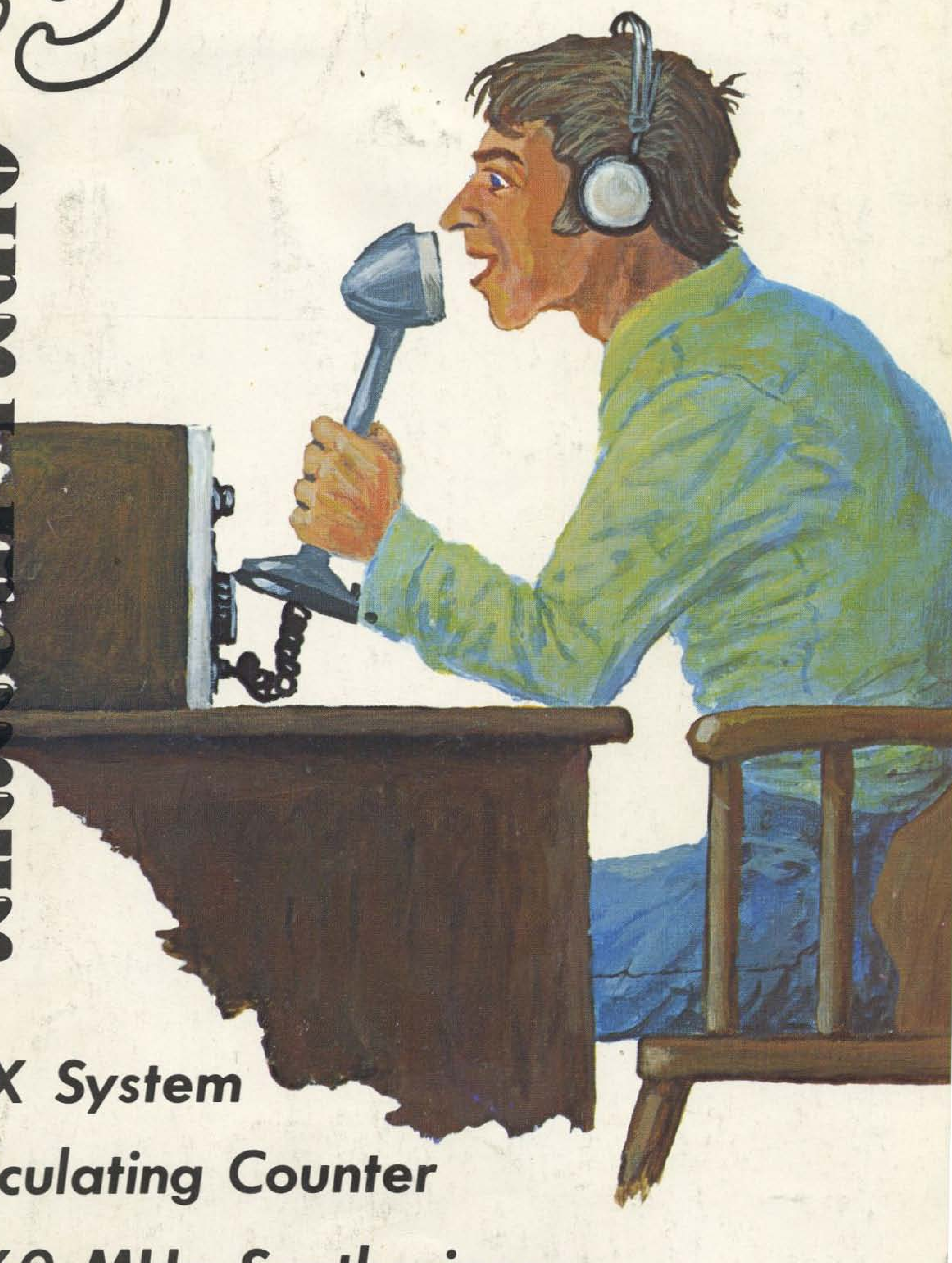
SEPTEMBER 1975
ONE DOLLAR

73 amateur radio



FAX System

Calculating Counter

0-60 MHz Synthesizer

73 amateur radio

#180 SEPT 1975

COVER: Oils on Masonite, by Jerry W. Geiger, Delafield WI.

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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

SECRECY

Amateur and broadcast radio are the two major exceptions to the communications secrecy laws. This means that it is legal to tape record amateur transmissions and retransmit them or play them for others, while it is illegal to do this to CB transmissions, even illegal CB transmissions. Keep in mind that if you ever get involved with recording CBers, that it is illegal. Tapes sent to the FCC, if they have your address on them, can get you in a lot of trouble.

If you happen to hear emergency traffic on other radio services, remember that this is secret and you can't repeat what you've heard.

Section 605 of the Communications Act of 1934, as amended, reads, in part, . . . "no person not being authorized by the sender shall intercept any radio communication and divulge or publish the existence, contents, substance, purport, effect, or meaning of such intercepted communication to any person. . . ."

HOTLINE BYTEN

The first tip of the iceberg for me was the response when we published anything having to do with computers in 73 . . . instant massive reader enthusiasm. Hmm. I started trying to get more articles and also began asking around for information so I would know something about this new field. I found that there are a number of small newsletters for computer hobbyists, but not much else. Information was definitely hard to get.

In January this year MITS announced their Altair 8800 microcomputer with a big cover story in Poptronics. I knew right away I wanted one of those . . . it took a while, since several thousand other people had the same idea. A microprocessor for $439 in kit form was a real breakthrough.

The more I was able to learn, the more I could see ahead . . . without turning 73 into a computer magazine there just was no way to cover all of the aspects of this new field. It would take a whole magazine devoted to the subject to do it justice. Hmm, again.

One of the most interesting computer hobby newsletters was being produced by Carl Helmers who, in addition to working full time for a computer firm, was also busy designing and building his own computer system and publishing the data on it. After a couple of talks with Carl the decision was made to go ahead and start a small magazine called BYTE. We thought we might give it a try with perhaps 24 pages and 1000 copies, something we could handle in our spare time.

We started talking it up with possible advertisers and sending out subscription letters on labels they provided. As the response grew, so did the plans for BYTE . . . to 5000 copies, then to 10,000 . . . 15,000 . . . 25,000 . . . and still growing! We had enough advertisers to put out a 100 page first issue, and that meant an enormous amount of work for the whole staff. It also meant that something had to give, for we are working out of a big old colonial mansion and there are just so many offices available . . . and they were all full.

Since Hotline was published more for fun than profit, and since it took an inordinate amount of time for much of the staff to put it out, we reluctantly decided to end it. It was a lot of fun and we'll miss it.

Continued on page 12

RULE CHANGE FOR DEAF PETITIONED

The Mount Diablo Amateur Radio Club has petitioned the FCC to modify part 97.29 of the rules to permit deaf persons to copy code by some method other than ear, as specified in the rules. They suggest receiving via the fingers on a speaker cone or light flashes as viable alternatives. They point out that the present rules discriminate against deaf persons.

Since many of the pioneering developments in RTTY were done by Bob Weitbrecht W6NRM, a deaf amateur, it seems reasonable that this discrimination should be eliminated.

FOR YOUR EYES ONLY

Required reading —

by Calvin McCarthy and Eric K. Albrecht K8BFH/1.

THE MOTHER EARTH NEWS HANDBOOK OF HOMEMADE POWER

Bantam Book Y8535, $1.95.

Amateurs today are as concerned about our depleting energy resources as many other people. The sensitivity of a crystal set is limited and it is very difficult to transmit radio energy without a source of electrical power. For the portable and mobile operator this problem is not somewhere over the rainbow, but right beside him. Where will the power come from to talk to the world?

Do you live by a stream? You could power your station by the running water. Do you operate from a windy location? With a six foot propeller in a 15 mph wind you could be extracting 140 free Watts to charge batteries. Do you live on a farm? A South African farmer found in the pig manure all the energy he needed to power his whole farm.

Interested? The HANDBOOK OF HOMEMADE POWER, a pocket book published by the MOTHER EARTH NEWS, gives very detailed and yet readable information on all these subjects. The editors received permission to reprint a five part article from *Popular Science Monthly* on building a stream powered generator. This includes information on calculating the power available in the stream, damming the stream, choosing the water energy to electrical energy transducer, building an impulse wheel, and building an overshot wheel. I can imagine an enterprising amateur building a small portable system for camping trips.

A section devoted to wind powered generators is just as comprehensive, discussing the amount of energy available in the wind, the various styles of windmills with their advantages and disadvantages, circuits, and pitfalls to avoid in setting up a wind generator.

I must confess that the section about methane was the one which compelled me to buy the book in the first place. Every couple of years I would notice a little article of interest in a newspaper or magazine telling of someone running an automobile or motorcycle on gas from animal waste. But how? There never seemed to be mention of how until this book appeared on the book racks with seventy-five pages devoted to the subject. Facts and figures on materials and conditions needed, as well as informative interviews with two men deeply involved with methane production, move the subject out of the realm of magic into the area of practicality. If a pig farmer can get more energy than he needs for his farm, then an amateur should find a way to get enough for a small station.

The most valuable twelve pages of the book contain its bibliography. Here are listed hundreds of sources of information, such as university papers and government publications, plus almost as many sources of hardware with company names and addresses. You will not be at a loss for information. The book was written as a guide, not as the end of Knowledge, and what an exciting sourcebook it is. Read it!

. . . McCarthy

73 solicits reviews of current titles having to do with amateur radio and its periphery. While payment varies according to the size and quality of manuscripts, it is nonetheless uniformly generous. Contact Book Reviews, 73, Peterborough NH 03458.

ACTIVE FILTER COOKBOOK, by Don Lancaster, Howard Sams, $14.95.

For this kind of price, you expect a book to be complete, well written, and practical. This one definitely is. Not only does it tell all about active filters — what they are, how they work, and how to design and use them — it also explains operational amplifiers completely. Aside from being the heart of active filters, op amps are very useful devices themselves, and this book will give you a solid background in using op amps, even if you never build an active filter. But if you do plan to use active filters, this book is a must. As for the math, complete mathematical derivations of each and every type of filter are provided, for those who want it. For those who don't, with the aid of this book you can design your own filters with simple algebra. (Even the "heavy" math derivations are done in high school algebra.)

Not only does the author tell what you can do with active filters, which is a lot, but also he plainly states what you cannot do. For instance, you cannot build a stable, high-Q, easy-to-tune bandpass filter with one op amp. Little pointers like this will keep you out of trouble, while the last section in the book stimulates your imagination, listing a wide variety of applications such as brain wave research, music synthesizers, speech therapy equipment, and touchtone decoders. The ACTIVE FILTER COOKBOOK is a welcome addition to 73's technical library, and it belongs in yours, too.

. . . K8BFH/1

BE MY GUEST

Visiting views from around the globe.

Frankly, my dear...

I know that anonymous communication is not generally well regarded, but in this instance I hope you will permit me to make a few good faith comments without identifying myself. At this point I will feel more comfortable about what I want to say.

I am a non-ham reader of your magazine. I regularly buy QST and 73 every month and enjoy them both, although I find more enjoyment in 73 than any other ham publication I have read. You may not realize that there are a good many of us aspiring hams who read your magazine and, although I try to learn and understand the terminology, I am lost by a good deal of it. Some of the technical articles are far beyond me. I know these articles are important and essential, but I would like to see more articles emphasizing the fun of radio as a hobby. I am always interested in the "personal experience" articles. For some of us who will never be electronic technicians it is a great incentive just to read about the enjoyment that hams have and, believe me, incentive is needed if you have no close ham friends to help you along.

My interest in amateur radio began when I was about twelve years old and I cut yards in the summer. One of my yard jobs was for a ham (now silent key) who was one great guy. He always asked me into the shack (in his attic) where I would sit silently and listen in amazement to the wonders of radio. I am sure that with his help I could have entered the ranks many years ago; however, my parents moved to another town and I lost contact with the ham world. Some time ago my interest was rekindled, and I decided to make a try for a license, but I have met with a good deal of disappointment and discouragement and, at the moment, I suppose I feel my prospects are not too good.

I know there are some people who can buy a license manual and a code record and have their General in three months. Unfortunately, I work long hours, have no background in electronics, and find the going a little rough to handle by myself. I wish I had someone to talk to once in a while, and I would also enjoy sitting in the shack now and then and listening. In spite of all the complaints about the ham population diminishing, however, I find most are not willing to get personally involved. I know one very active ham with whom I have had a casual but friendly acquaintance for a number of years. I wrote a letter to him a few months ago and told him how interested I had become and that I would appreciate talking to him and would love to visit sometime, see his rig and to see him in operation. I made him a little gift which I knew he would enjoy and had it ready to take with me when I got his call. The call never came.

I have tried to meet a few other hams and have probably been a little too forward at times, such as, "Say, I notice by your license plate that you're a ham . . ." or "Isn't that a ham antenna in your back yard . . ." So far everyone has smiled, shaken hands, and been friendly, but the most encouragement I have gotten for the effort has been, "Lots of luck to you, fellow." Gee, thanks.

My ego suffers every time I read about one of those eight or ten year olds who has just gotten his license. But if the truth were known, I'll bet everyone of them had a dad, or a brother, or at least a good friend who gave them a little guidance and encouragement. It helps to be around someone who can talk the lingo. Right now I'm among the uninitiated which is somewhat akin to an Englishman trying to carry on a conversation with a Ubangi.

I am surprised with all of the tremendous mass of material available on technical advancements that so little has been done toward leading the prospective amateur in a systematic way into the ranks. There are thousands of people who would like to join the great amateur fraternity (and I am talking about responsible people who play by the rules, not the ones who enjoy hollering "Super Chicken" and "10-4"), but there is no organized step-by-step procedure awaiting them. I am sure that the manufacturers would like a larger market for their products, but what have Drake, Swan and Yaesu done to provide theory instruction or training for aspiring hams? Look at the advertising in your own magazine. How many ads do you carry of training courses which would lead one to his General license? What I am saying is this, the ham industry has done a much better job in servicing the existing ham market than it has in developing the untapped potential market. Take a realistic look at the figures — CB sales are booming while the amateur ranks are thinning. Many hams seem to take an elite view of their status and to look condescendingly on outsiders. I guess they have nothing to lose . . . but their frequencies.

Don't misunderstand me . . . I am not asking for a lowering of standards. I like the high standards of amateur radio. I agree with many hams that the floodgates should not be opened to a rush of frustrated CBers who will desecrate the airwaves as they have their own (remember that not all CBers fit into this category). I don't mind working to get a ticket. All I'm saying is, I sure could use a little help and a lot of encouragement. If someone would just give me a push once in a while, I could get the theory — and I am not even griping about the 13 wpm. I don't really know any hams, I can't seem to get acquainted, and it's awfully hard for a guy like me, with no helpful background to draw on, to get it all on his own. I plan to keep on trying. But it sure takes guts to work so hard to get into an organization which epitomizes the immortal words of Rhett Butler.

service after the sale

I enjoy your magazine as an "outsider", whose interest is in good writing, state of the art and some day possibly even joining the amateur ranks. I am a Civil Air Patrol "button pushing" communicator who enjoys being of service.

My reason for writing is to tell Mark Poss (*Be My Guest*, July), et al, why we outsiders don't swarm into the amateur ranks. I must say that Mr. Poss sets out an outstanding public awareness program which, if done as he states it, will probably work well. But I am afraid his blueprint stops short of the real problem — which I refer to as the Ham Mystique.

Many of us non-hams have the bug but find it impossible to get reliable advice. I encourage you to try to put your ham jargon out of your mind and wander in to an amateur radio store. Unless you speak the language you probably will not get waited on — and if business is slow and someone does stumble across you he might do you a favor and talk *at* you. Unless you are ready to plunk hundred dollar bills on the counter your average ham hardware store is the best place ever devised in which to be ignored.

Hams continually put down Children's Band operators and clubs — but this group has one big advantage over your average amateur group — they will talk with anyone. When on the airwaves this is one of their big problems, but that's not what I want to talk about.

My point to Poss and company is that you do not need to interest more people in amateur radio. If hams would genuinely open their hearts, minds, clubs and associations to that great mass of people who are anxious to join them, the FCC would be issuing WZ calls within a year.

Be open about your hobby, remember that there once was a day when you didn't know a resistor from a carbon mike and offer your aid to people who seek you out.

It's tough being out here looking in when everyone on the inside has an elitist attitude. As a group, hams and ham hardware houses turn off more potential associates than they could ever hope to attract by the most fantastic public relations programs. It is not enough to simply sell your hobby to the public — you must also provide "service after the sale."

We're out here waiting for your help — what are you going to do about it?

Glenn B. Knight
Milwaukee WI

there's always Hope

Outsiders looking in at amateur radio raise valid points about the seeming indifference of some hams to the plight of the thousands of help-seekers who need aid and can't seem to get it. One YL — Hope Cliver, 10, of Joshua Tree, California — didn't need to go looking around for help: All six members of her family are hams. — Ed.

Hope Cliver, 10, of Joshua Tree, is the youngest General license amateur radio operator in the world, according to the American Radio Relay League.

Hope took the Federal Communications Commission examination in Los Angeles. She passed the radio electronic theory with excellent grades, and the code test at 13 words a minute.

It started for Hope at the Radio Amateurs' Transmitting Society, Palm Desert, headed by Hal Kapp W6WLU. The society initiated an amateur radio class which she attended. Bill Ellis, who drove from Culver City each week, was the instructor for the class.

Hope is the daughter of Betty and Ed Cliver, whose family of six are all radio operators, having held Novice licenses for a year.

She plans to work for her Advanced license while she is still 10, and take her Extra Class examination at the FCC when she is 11.

Hope will work 2, 10, 15, 20, 40 and 80 meters phone and code on her Kenwood TS520 transmitter. She will communicate with thousands of other amateur radio operators located in every nation of the world, including air and sea mobile stations.

With this early beginning she has considerable promise, according to Dr. Fern Stout, president of the College of the Desert, who praised Hope's progress at a recent luncheon of the Desert RATS, a local amateur radio group.

Kelly Shugart

Reprinted from Hi Desert Star, *Yucca Valley CA, June 26, 1975.*

LETTERS

HOW "HOW GATES WORK" WORKED

My thanks to Larry Kahaner WB2NEL for the July article, "How Gates Work" – it makes sense to an old tube man. When I can see the why and how something takes place, the rest is easy. Let's have more.

Earl L. Wiederhold K6SMT/WB6JOC
Bonita CA

Re "How Gates Work": Yes! We need more articles like this one – even giving very simple applications circuits that don't actually *do* much, except work – for those of us who want to learn more.

Phil Morrison, M.D. WA4AXO
Bristol VA

I am writing to compliment you on the article concerning TTL ICs. I found the article interesting and most stimulating to the ole gray matter. Yes, indeed, I feel that there should be more articles printed on the subject of ICs. It seems that in practically every electronic circuit one looks at these days, there is one type or another IC involved. There are quite a few devices printed about in 73 that I and others may like to build, but are held up due to lack of knowledge about ICs. Once again tnx.

Bruce M. Burkhardt WA3MAS
St. Michaels MD

Thanks for the "basics" on TTL ICs in your July issue. Textbooks assume that you know these things – so you duplicate their work without really knowing what's going on. Hope others liked the article, too, so that we can have some more basics from WB2NEL.

V. M. Shaw WA6BTA
Chatsworth CA

Was glad to see the article by WB2NEL, "How Gates Work." Hope he writes another.

Randy C. Withers ex-WN8OQA
Kettering OH

The article in the July issue by Larry Kahaner WB2NEL was excellent and informative. Kindly "cajole" him into doing another similar exposition.

Jerry Hargest WA5ERG

WB2NEL will attack op amps in the October issue. – Ed.

FISHING

I would appreciate your help. The Fisher Scientific Company and its subsidiaries are attempting to compile a roster of ham employees. We are interested in handle, call, branch, position held, and address of home QTH, and ask that Fisher ham employees please contact me at the address below.

Fred Shetler K3VMS
Fisher Scientific Company
Instrument Manufacturing Division
Indiana PA 15701

LOOKING

I am writing on behalf of our newly-formed Lawndale A.R.C., which is in need of transceivers (both VHF and CW/SSB). New or used contributions would be appreciated in order to help our young amateurs get on the air, and any help your readers could offer would certainly be welcome. Please contact: LARC, c/o WA3SZD, 321 Stevens St., Philadelphia PA 19111. Thank you.

Dennis J. Gazak WA3SZD
President, LARC
Philadelphia PA

DOOMSDAY?

Back in my college days, my fraternity decided to do away with a part of the initiation ceremony concerning paddling of pledges. This decision was greeted by a lot of us as a lowering of our standards and with thoughts of the imminent demise of our fine old fraternity.

Naturally none of these dire prophecies came to pass. I find something of the same "Doomsday" concept in comments now being made by hams writing to you concerning the proposed Communicator class license. All because the code requirement is absent they are all up in arms because they took it, and therefore, everybody should in order to get in the "club".

With the Communicator licensed for 144 MHz and above there seems little need for a code requirement as one rarely, if ever, hears it at these frequencies. I've read and heard all the comments about the need to get new blood in the hobby and now that a way exists a great many seem to be saying, "Hey, let's keep it small and cozy." This kind of an attitude is going to lead to even more stagnation than exists right now.

I am not a ham nor am I in CB, but I've listened to both for enough years to know the difference. With a properly formulated and enforced licensing structure most of the idiots on CB will stay there. A little self-policing on the hams' part will take care of those who do manage to get a ticket.

I agree with many of the remarks you made in the June issue and I can understand the attitude that no one wishes to be inundated by a flock of ex-CBers, but not all of us who may get the Communicator license are of this category. There's a lot of good responsible new blood out here who, given the chance, will prove willing and able to uphold the high standards that hams have enjoyed through the years.

Zachary Thomas Taylor
5410 Canal #4
Memphis TN 38118

P.S. If the Communicator fails, at least now we would-be hams know we can get our code practice by listening on 144 or 220! RIGHT?

MANAGING

I would like to inform you that I am the QSL manager of stations A4XFV, DK7PF/HBØ, DK7PV/HBØ, and DLØKJ, for their DXpedition to Liechtenstein (Sept 1-16, 1975, all bands CW/SSB, 10-80m). QSL via DJ7OM. Calls: DK7PF/HBØ, DK7PV/HBØ.

Paul Schmitt DJ7OM
D-657 Kirn
Ubergasse 20
Germany

REALLY GREAT

I started practicing with your 13 wpm cassette and found the transition between it and the 6 wpm cassette quite easy. I plan to go up for my Advanced in 6 weeks or so. I'm still in favor of a reduced speed requirement, but these cassettes are really great!

Fred Findling
Bethlehem NH

WARNING

Your article, "The Ultimate in Variable Selectivity?" (July), prompted me to warn about an often ignored problem when using VC diodes.

What is usually overlooked is that if the signal voltage is a significant percentage of the VC diode bias voltage, the VC diode capacitance is modulated by the signal in an unsymmetrical (and distorting) manner.

Examine the accompanying diagram of a typical FET Hartley oscillator. It is not at all unusual to find several volts of signal at the FET gate. On positive peaks the signal is series opposing to the VC diode bias; on negative peaks it is series aiding. This means that the VC diode capacitance is modulated by the signal in an unsymmetrical manner, producing a frequency (or phase) shift.

A similar effect could occur in your variable selectivity filter if the signal is a significant percentage of the VC diode bias voltage. Hence, the safest place to put the filter would be immediately after the converter stage.

In an FM receiver this could cause audible distortion, and you may never guess what is causing it. I'm not sure what the effect would be in an AM or CW receiver, but it could hardly be desirable.

Searching the literature carefully will lead to the discovery that some (Motorola for one) have published articles on how to compensate for this effect. These circuits usually involve two VC diodes arranged so that the capacitance modulation is cancelled out.

Clyde E. Wade, Jr.
312 S. Cedar
Little Rock AR 72205

Mr. Wade's "The Beauties of Shunt Regulation" will be appearing in an upcoming issue. Editor

MY KIND OF S.O.B.

There are many things that you write in your editorials that I don't agree with, but many times you point out things that I haven't considered – it makes me think again. If you *ever* change your editorial policy, you can cancel my subscription and keep what's left over.

Keep saying it – it needs to be said. I'm saying nothing you don't already know – but keep that needle sharp.

You're right about training the young people. I'm in two radio clubs now, and training is a major topic and effort – there's much talk on the bands about the young people, too. We have to (attract them), Wayne – they're our only salvation for hanging on to the bands we have now. Expansion, at present, is out of the question; we have to first hang on to what we have. Given population, then *maybe*.

One last comment: You're two (2) years too early on *BYTE – it won't make it.* My business is computer engineering, and you're going to sail over the heads of those people you're trying to address. I personally have great difficulty in communicating with a *savvy* electronics guy about logic, microprocessors and stored programs. You're idea is good, but you're too early – too early. If you can eat the losses for two years, OK, but it's going to be tough sledding. Anyway, you're a hard head – you enjoy the invitation to fail – that's the way we all got where we are. *73*, when it started, was pretty shaky, too.

Last thought: Why in the world would QST want to go to an 8½x11 format? It boggles the mind.

Thanks for hearing me out, Wayne. You may be an S.O.B., but you're my kind of S.O.B. Keep plunging.

David R. Halliburton WA3ZOR
726 Tiffany Court
Gaithersburg MD 20760

ROTATING

Your most attractive July cover is even more interesting if one rotates it clockwise 90° and then views it in a mirror. One can make out Saudi Arabia, the Red Sea, Gulf of Aden and the east coast of Africa, including the Nile River. Even the island of Madagascar is visible in the lower central portion of the picture.

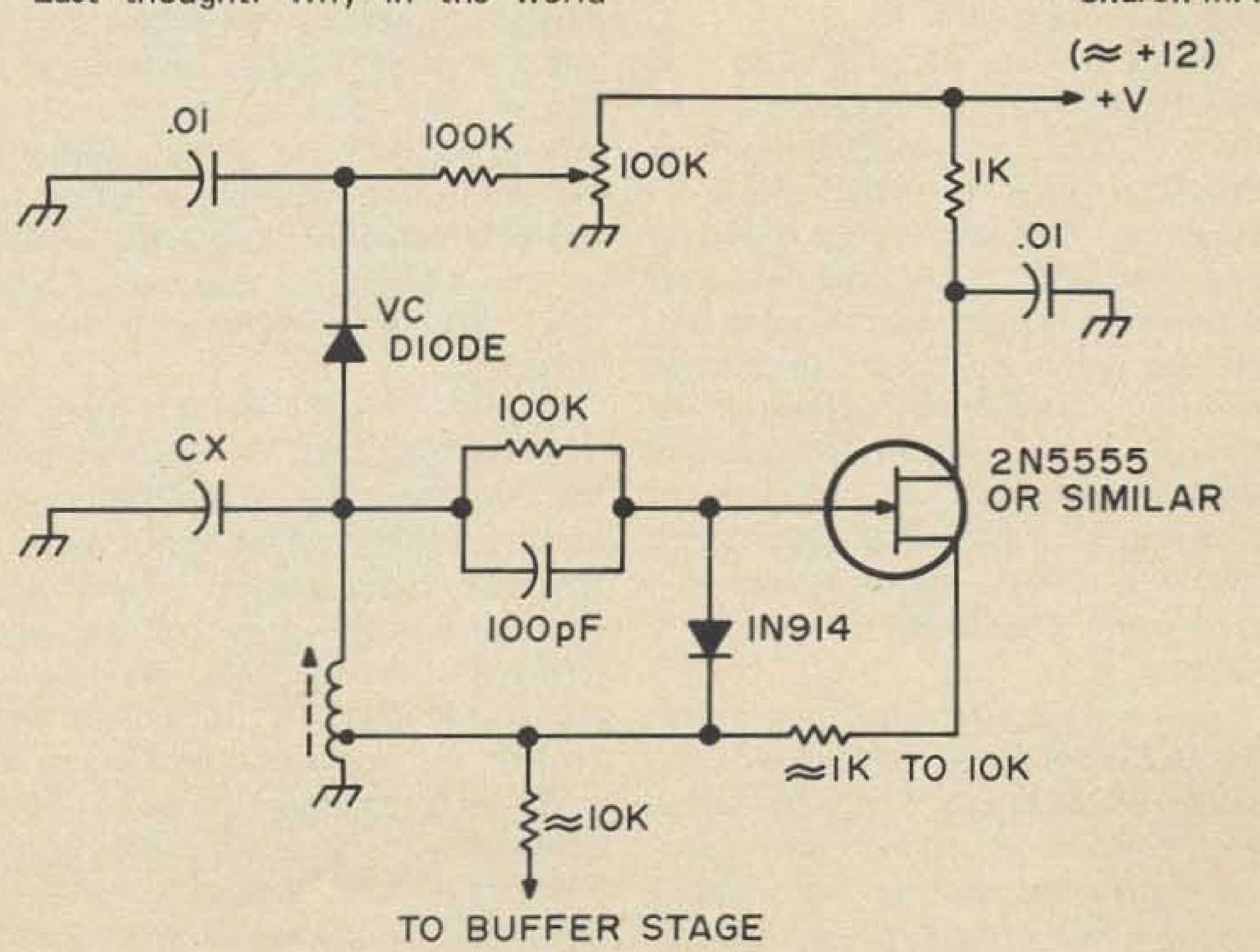
Lloyd Ferns VE3BZF
Orangeville, Ontario

GOOD-BYE Q-STREET

After receiving a bargain rate offer to subscribe to 73, and get a nifty code practice tape to boot, I decided to once again get a ham magazine. After only two issues, I am hooked. Your special July Oscar issue was long overdue. After reading it, I finally had all the info I needed in order to get started, and I hope to be on soon.

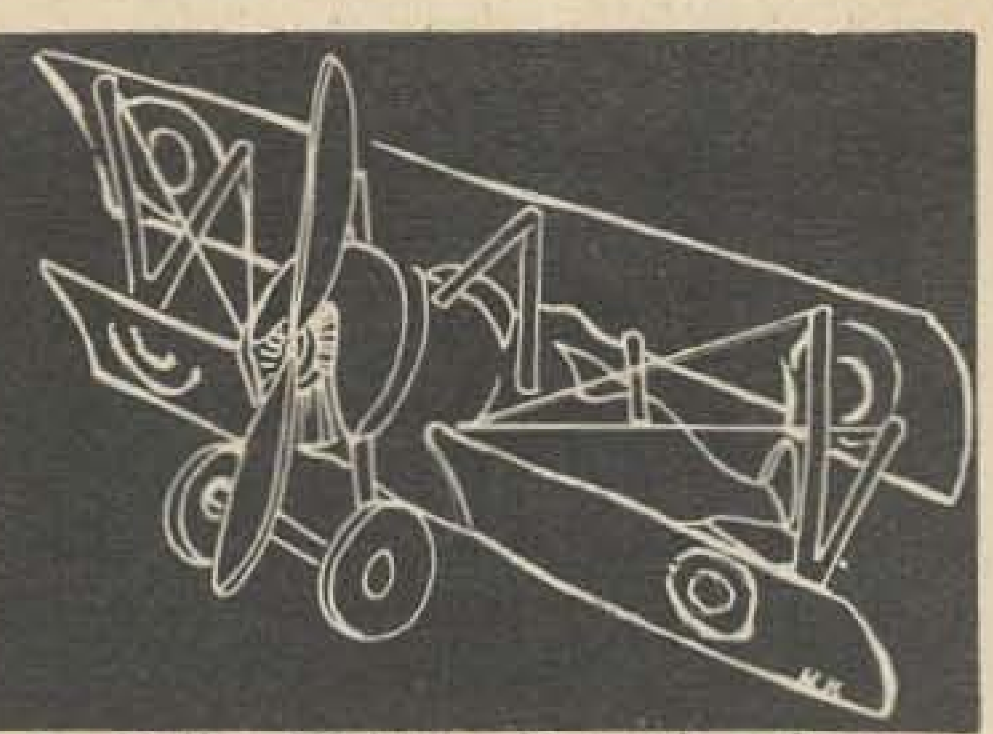
I quit subscribing to Q-Street because most of the articles were geared toward only those with degrees in engineering. (Besides, your covers are better!) So congrats on an FB publication – I'm eagerly awaiting the next issue!

Jeff Kline WA1RFF
Sharon MA



Autobiography of an Ancient Aviator

W. Sanger Green
1379 E. 15 Street
Brooklyn NY 11230



GOOD BYE KELLY
HELLO BROOKLYN

Graduation from the Air Service Advanced Flying School was on December 17, 1922. Forty-one cadets from the combined classes received their "Airplane Pilot" rating and their A.P. wings. All were commissioned 2nd Lieutenants in the Air Service Reserve Corps. All except myself had to buy officer's uniforms. Fortunately, I was able to have my father send me my WW1 uniform so all I had to do was to replace the Infantry Collar insignia with the Air Service prop and wings and pin my A.P. wings above my WW1 medal.

Lt. Chauncy asked Munson and I if we would mind staying over a couple of days to do an artillery adjustment mission that had been requested for December 19th. We agreed, if he would arrange a lift to Dallas for me on the 20th. (Better train service to New York out of Dallas.) We spent half a day near Fredericksburg telling an artillery battery what poor shots

We spent half a day . . . telling an artillery battery what poor shots they were. They had no anti-aircraft guns so we were safe.

they were. They had no anti-aircraft guns so we were safe.

Along in late October Cleo and Wayne had moved from her parents' farm in N.H. back to their home in Brooklyn, N.Y. I arrived there on December 23rd, just in time to put up and decorate the Christmas tree. Wayne was almost four months old. He had grown quite a bit since I had seen him in September. However, he was still small enough to fit nicely in the temporary crib Cleo had made for him out of a bureau drawer with a pillow in it for a mattress. We had a marvelous Christmas — our first together.

A few days after Christmas I went out to Curtiss Field, near Garden City, Long Island, to see if any flying job was available. I talked with Casey Jones and he said he had nothing available but suggested that I go over to Heller Field in Newark, where an outfit called Federal Aviation had a hangar full of boxed LWF planes. He said he understood that they were assembling them for sale and that possibly one of their customers might want a pilot. Mitchel Field was nearby so I went over there to check in with operations for some army reserve flying.

Next day I went over to Newark and found my way out to Heller Field. Sure enough there was the hangar and I found Mr. Gillespie and his son in a lean-to with a potbelly stove going to keep the place livable. Yes, they owned the crated LWFs in the hangar but had no definite orders with deposits at that time. However, they had several warm prospects and were going to assemble a ship for display and would need some help for that. They explained that LWF stood for laminated wood fuselage (not loose, wobbly and frail as some people thought). The LWFs were originally equipped with a Sturtevant engine that was supposed to put out 200 horsepower. However, these engines had so thoroughly demonstrated their unreliability that Federal was junking them and installing 220 HP Hissos instead. (There is some question as to which of the two was more unreliable.) Gillespie said there was no problem in getting 220 Hissos if you had a case of whiskey to trade at a nearby Air Service depot. They offered me $8 a day to help assemble the ship. Since my transportation to and from Brooklyn and lunch would be only $1 a day, I told them I'd be there the next morning with my coveralls.

It took us until late February to assemble the plane. We had to remove the Sturtevant engine and install new hickory engine bearers. Then we got the new Hisso engine, cleaned the cosmoline preservative off it and installed it in the ship. We had to remove all controls from the front cockpit and cut away the fuselage to make seats for four (midgets). This, together with some soft places in the laminated wood fuselage (a result of rain water from a leaky roof), made it advisable to reinforce said fuselage. This was taken care of by bolting a two by four on each side of the fuselage all the way from nose to tail. Well, it looked like an airplane, anyway.

There was no such thing as flight testing the plane from Heller Field. It may have been a flying field at one time but by 1923 there was barely enough cleared field to take off with no passengers and only enough gas to get to Newark Airport. There was no coming back into Heller, so the ship had to be rigged accurately enough to enable the pilot to get it to a larger field and land it.

By the end of February the LWF was finished but still not sold, so I got a part time job selling Hupmobiles in Brooklyn on salary and commission.

As a reserve officer I was able to get enough flying time in Jennies and DHs

Gillespie said there was no problem in getting 220 Hissos if you had a case of whiskey to trade at a nearby Air Service depot.

to keep my "hand in" at Mitchel Field, Long Island. I'd get out there almost every week and put in an hour or so.

Around the middle of July, Gillespie phoned and told me that the ship we had put together was sold to Hal Bazley of Everett, Mass. Delivery was to be at the East Boston airport and would I be interested in flying it up there? I had just finished a two week tour of active duty at Mitchel so I had some catching up to do on my Hupmobile prospect list. Gillespie offered $150 plus expenses for the job so I told him I'd be over on July 27th to take the ship out of Heller.

On July 27th we gave the ship a final check and put ten gallons of gas in the tank. I got over the wires at the end of the field by about ten feet on my way to what is now Newark Airport. The ship handled very well with only a few minor adjustments to be made at Newark the next day. On the 30th I took the ship over to Mitchel and let some of the fellows over there look at it and shiver. Then on the 31st I flew her to Boston in two hours and forty-five minutes. Hal Bazley was there to meet me and take over ownership. I came back to New York that night on the "Old Fall River Line".

Next month I'll give you an account of my first experiences with an underpowered seaplane and with a Curtiss R4.

Repeater Temps Rising in 'Hot' SoCal

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Let's begin this month's report by clearing the air as to what you are about to read; it will be, I hope, as objective a report as is possible on a rather controversial subject: that of the confrontation between proponents of repeaters and their counterparts favoring simplex operation on 146.76 MHz. To begin, a look back is definitely in order. If one is a traditionalist, and believes that the past must govern the future, then there is no question that "squatters' rights" prevail and that 146.76 must be reserved for simplex operation in the Los Angeles area. The many inhabitants of .76 simplex trace their heritage on that channel back to the late 1950s when they were just about the only occupants of what is today the repeater sub-band. As I understand the story, during the late fifties and early sixties the "in" channel was 146.755, due to the fact that everyone had the same surplus crystal. It was in the early sixties, and no one is quite sure as to why a move was made, that everyone QSYed up to .76 – and they have remained there ever since. Most, though not all, of the .76 simplexers live in the San Fernando Valley area, slightly northwest of L.A. proper.

While most stories have two sides, this one is rather unique in that it has four: that of the simplex inhabitants of .76, that of the Southern California Repeater Association, and that of the two repeaters accused by the simplex users of causing interference to .76 (WR6AJL, Mt. Laguna, in San Diego and WR6AFX on Table Mountain in the Antelope Valley area). As to the latter, WR6AFX, by far they have shown the most cooperation in this matter to date. As I stated in an earlier column filed in very early April, at that time I had yet to hear any signal from WR6AJL while at this QTH WR6AFX was definitely audible. Though I am not a .76 user, I do happen to live right smack in the middle of the San Fernando Valley and therefore decided to monitor the entire situation for myself.

There were two reasons for this. First, when tempers are running high, I tend to take much of what is told me with the proverbial grain of salt. The thought always goes through my mind at these times, "Wouldn't Joe Blow just love to convince me that he was right and the rest of the world was wrong and then make use of this column to plead his case to the nation?" The day I let that happen is the day when Wayne has my permission and support to pull this column from publication, and that gives you the second reason, to report one must deal in facts and supportable evidence – not heresay and innuendo.

While things grew worse to the south, the people responsible for WR6AFX, working with members of the SCRA Technical Committee, found that by re-orienting their antenna system most if not all of their signal leaking into the San Fernando Valley could be eliminated. At least in the eyes of the non-repeater simplex operators, WR6AFX was no longer a source of interference to them. If you don't mind my digressing for a moment, I wish to publicly express my appreciation in the name of the Southern California amateur radio community to WR6AFX, its owners and its users, for proving that the concept of mutual cooperation can and does work. As your editor noted in an earlier column, WR6AFX provides a rather invaluable service to those traveling the desert route between L.A. and points east.

During the time that a solution to the AFX vs. .76 simplex problem was being found, the SCRA was also trying hard to solve the Mt. Laguna issue. WR6AJL, Mt. Laguna, was operating under a 90 day temporary SCRA sanction and had specifically stated that its purpose was to provide desert coverage east from San Diego toward Yuma, Arizona. On countless occasions the San Diego Repeater Association (SANDRA) stated publicly that its purpose in erecting AJL was to provide open radio relay coverage to the aforementioned desert area and to Imperial County and that they, SANDRA, would take whatever steps were necessary to insure that there would be no interference to any Los Angeles operations. As early as

"Mr. Chairperson" Dick Flanagan W6OLD presides over June SCRA meeting at JPL in Pasadena.

October 1974, in meeting notes published in SANDRA's *Squelch Tales* newsletter, in discussing the merits of a .16/.76 repeater, it was stated as point #8 on page 17 of that publication that, "Our repeater should not interfere with Los Angeles, since our antenna will be east-west." In the monthly listing of SANDRA-sponsored repeaters appearing in *Squelch Tales,* WR6AJL is listed as "desert coverage". Yet WR6AJL, sitting atop an 8000' mountain, utilizes a Stationmaster antenna with a 3 degree downtilt that effectively aims it at the "radio horizon" in a 360 degree pattern. The radio horizon to the north for Mt. Laguna is Los Angeles!

SANDRA claimed and continues to claim that it has done and will continue to do all that is possible to eliminate the problem; however, it is evident that their words don't at this time fully align with their deeds. At the June 21 SCRA General Membership Meeting, it was announced that due to what was felt to be a total lack of cooperation on the part of SANDRA officials to work with the Technical Committee in solving this ever-worsening problem, their failure to file the required 75 day operational test report to the SCRA Technical Committee, and on other documentable matters in regard to this situation, that the temporary authorization (sanction) for WR6AJL had been terminated as of June 17th and that they were being requested to cease operation at once. Rather than adhere to this decision of the SCRA, the representatives of SANDRA withdrew en masse from SCRA membership, stating that they felt SCRA did not properly represent the interests of San Diego area FMers, and that they would go it alone. It was also stated by SANDRA representatives that their reason for not filing the aforementioned 75 day test report was that, due to the installation of the new Stationmaster antenna, any data contained in the report (data gathered before the new antenna was erected) would be outdated. (Of note, the test report is a necessity according to SCRA rules regardless of what type of modifications are taking place during an initial test period. Data contained therein can always be updated by amending such a report at a later date.) Also of note, though I have made it known publicly that I am following developments in this matter for publication in this column, and while both the SCRA and the simplex users have been most cooperative in furnishing data on this story, I have yet to hear anything from the San Diego Repeater Association. That is all that is necessary to have their side of the story expressed from their viewpoint.

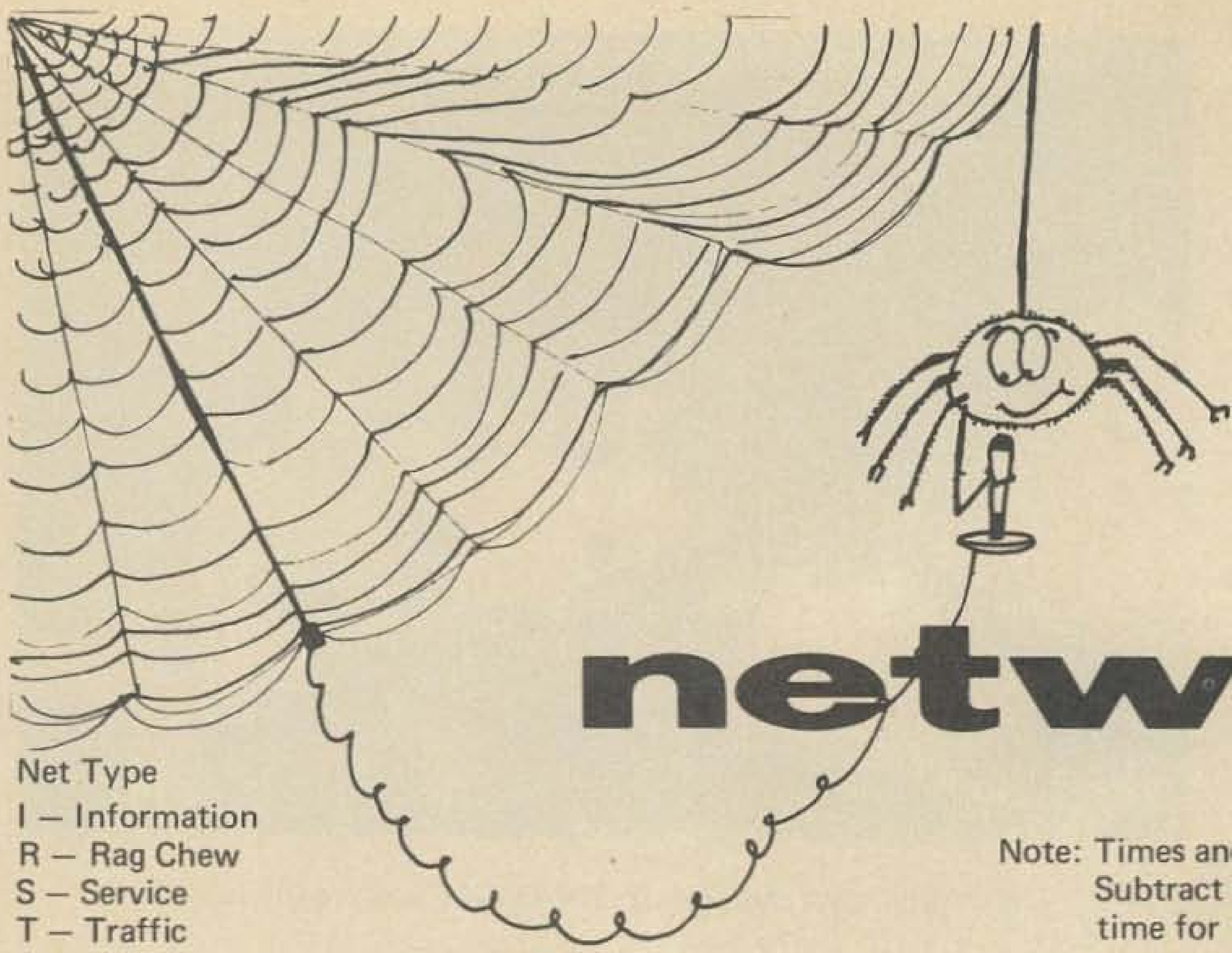
Table Mountain responds to Technical Committee report.

In the interim, WR6AKC, the Valley .76/.16 "in band talk back", a non-SCRA sanctioned or coordinated repeater, is busy at work locking up WR6AJL (or is it WR6AJL that is locking up WR6AKC?). Frankly, I don't give a damn which machine is doing what to which. I do care, however, about the loathsome creature who has apparently decided to expand this confrontation to include one of our local repeaters here in L.A.: WR6ABN. Of late, the "grunge" from .76 is appearing on the ABN .84 – .24 system and I guess the assumption must be made that due to the fact that ABN's owner supports the L.A. simplex activity, his repeater must be included in the confrontation. How utterly childish and asinine can people who are supposedly competent individuals and licensed amateur radio operators get? When will they ever learn that violence only breeds violence and that acting in such a crass manner can only bring the total wrath of both fellow amateurs and the FCC upon their heads? I for one want to know the individual responsible for this hideous act against the Southern California amateur radio community, so that he or they can be exposed to their peers for the sick malcontents that they are! If you want to fight over .76 then keep your fight on .76 or risk the wrath of your fellow hams nationwide – I will see to it that such is sent your way!

Skip Clark WB6TXX, SCRA Vice Chairman, responds to responses, as Sybil Albright W6GIC, SCRA Secretary and SANDRA Board Member, looks on.

Continued on page 162

E. H. Barnett WB0IIX
Route 1
Ashland, Missouri 65010



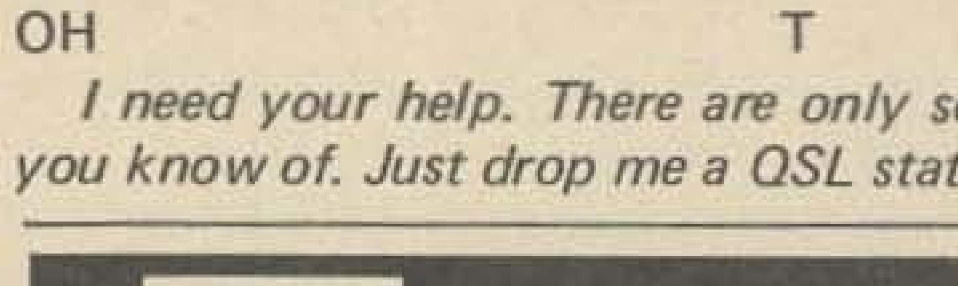
networks

Net Type
I — Information
R — Rag Chew
S — Service
T — Traffic

Note: Times and Days are given in GMT. Subtract one hour for nets changing time for Daylight Savings Time.

Service Area	*Net Type*	*Name*	*Time*	*Days*	*Freq*	*Mode*
INTERCONTINENTAL						
North & South America	T	Intercontinental Net	1200	Daily	14313	USB
North & South America	T	Americas Net	1800	Mon &Fri	14205	USB
North & South America	T	Intercontinental Net	2300	Daily	14313	USB
NATIONWIDE						
U.S.	S	Eyebank Net	0100	Daily	3970	LSB
U.S.	S	Eyeband Net	1200	Daily	3970	LSB
REGIONAL						
Gulf Coast U.S.	T	Gulf Coast SBN	2330	Daily	3925	LSB
East U.S.	S	ECARS	Cont.	Daily	7255	LSB
Midwest U.S.	S	MWARS	Cont.	Daily	7258	LSB
Southeast U.S.	R	Corncobbers	1130	Mon - Fri	7274	LSB
Mid U.S.	S	Recreational Vehicle Net	1130	Mon - Fri	7280	LSB
STATEWIDE						
NJ	T	NJ Net	0000	Daily	3695	CW
MO	T	Missouri SBN	0000	Tues - Sat	3963	LSB
IA	T	Iowa SBN	0000	Daily	3970	LSB
KS	T	Kansas SBN	1245	Mon - Sat	3920	LSB
IN	T	Indiana Traffic Net	1330	Daily	3910	LSB
FL	R	Florida QCWA Net	1700	Sun	7247	LSB
SC	T	SC Emergency Net	2300	Daily	3907	LSB
IN	T	Indiana Traffic Net	2300	Daily	3910	LSB
KY	T	Kentucky Traffic Net	2345	Daily	3955	LSB
OH	T	Ohio SBN	2345	Daily	3972	LSB

I need your help. There are only so many nets that I can discover for myself. Help me by telling me about nets that you know of. Just drop me a QSL stating: Name, Area served, Time (GMT), Days (GMT), Freq. & Mode.



EDITORIAL BY WAYNE GREEN

from page 2

TIME TO SUBSCRIBE?

There is a lot to dislike about the larger size format for the ham magazines . . . and one of the worst aspects is that, despite what anyone says, it is a lot more expensive than the smaller magazines . . . and this means a higher cost to you.

The new cover price for 73 will be $1.50, starting with January, which comes out to $18 per year on the newsstands. The subscription price will go up, first to $10 a year . . . more later on. Add to this an extra $2 for a special secret giant bonus issue which is in the works and you will spend $20 on the newsstand for the year! That makes the present $8 per year, $16 for three year rate look pretty good. These rates will hold until October 15th, then it's up they go. October 15th is the last minute for getting a subscription into the blasted computer system for the December issue . . . which is mailed in early November.

Over a three year period you save about $44 by spending $16 now.

BOX SCORE

Readers might not notice, but advertisers and other publishers (particularly) notice little things like the number of pages in a magazine or the number of pages of ads in an issue. You've probably been vaguely aware that it takes longer to read 73 these days and it's a little heavier to prop up in bed.

During the last quarter the ad pages worked out like this . . .

Continued on page 168

The TEMPO line . . . commercial quality at amateur prices

Compare this equipment with any other available. Compare their performance, their quality of construction, their ease of maintenance, and then compare prices. Your choice will have to be TEMPO.

new!

TEMPO/CL 146A

. . . a VHF/FM mobile transceiver for the 2 meter amateur band. It is compact, ruggedly built and completely solid state. One channel supplied plus two channels of your choice FREE

144 to 148 MHz coverage □ Multifrequency spread of 2 MHz □ 12 channel possible □ Metering of output and receive □ Internal speaker, dynamic microphone, mounting bracket and power cord supplied. A Tempo "best buy" at $239.00.

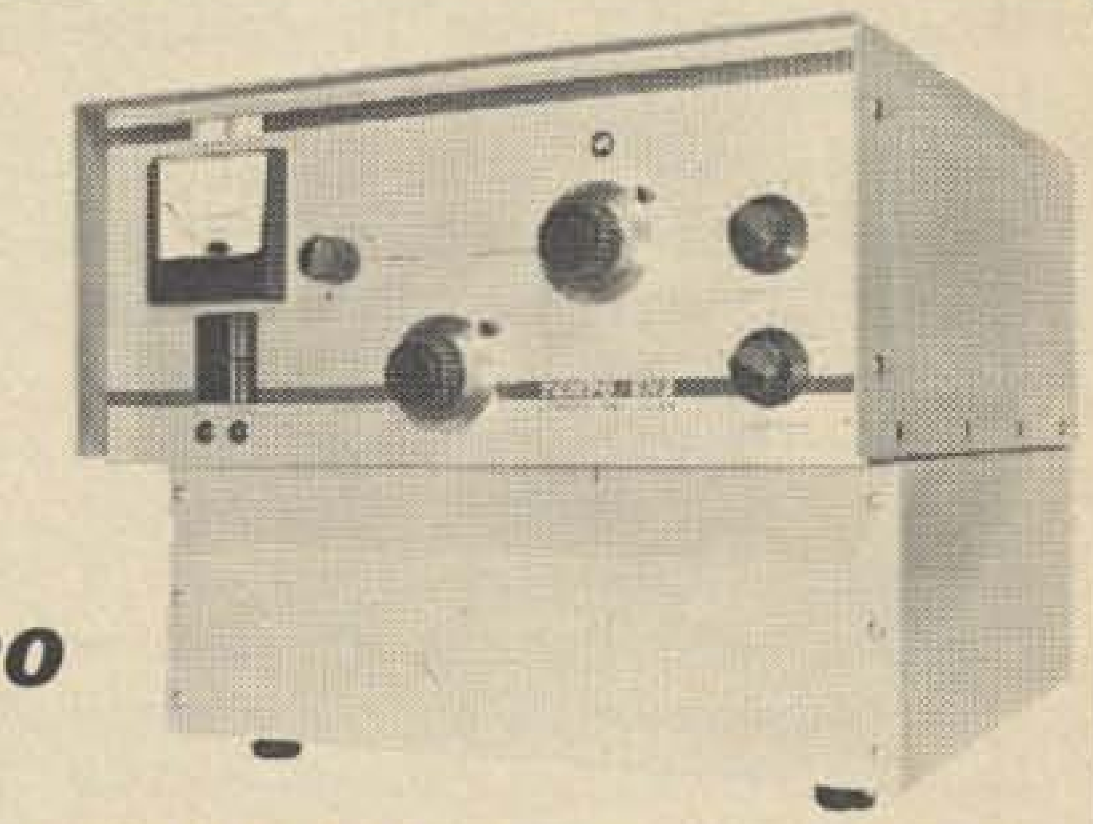
TEMPO/fmh

So much for so little! 2 watt VHF/FM hand held 6 Channel capability, solid state, 12 VDC. 144-148 MHz (any two MHz), includes 1 pair of crystals, built-in charging terminals for ni-cad cells, S-meter, battery level meter, telescoping whip antenna, internal speaker & microphone. $199.00

FMH-MC for Marine & Commercial service also available.

TEMPO CL 220

As new as tomorrow! The superb CL-220 embodies the same general specifications as the CL-146A, but operates in the frequency range of 220-225 MHz (any two MHz without retuning). At $299.00 it is undoubtedly the best value available today.



TEMPO 6N2

The Tempo 6N2 meets the demand for a high power six meter and two meter power amplifier. Using a pair of Eimac 8874 tubes it provides 2000 watts PEP input on SSB and 1000 watts input on CW and FM. Completely self-contained in one small desk mount cabinet with internal solid state power supply, built-in blower and RF relative power indicator. $795.00

The Tempo 2002.. 2 meters only $695.00
The Tempo 2006.. 6 meters only $695.00

TEMPO VHF/UHF AMPLIFIERS

Solid state power amplifiers for use in most land mobile applications. Increase the range, clarity, reliability and speed of two-way communications.

VHF (135 to 175 MHz)

Drive Power	Output	Model No.	Price
2W	130W	130A02	$199
10W	130W	130A10	$179
30W	130W	130A30	$189
2W	80W	80A02	$169
10W	80W	80A10	$149
30W	80W	80A30	$159

UHF (400 to 512 MHz)

Drive Power	Output	Model No.	Price
2W	70W	70D02	$270
10W	70W	70D10	$250
30W	70W	70D30	$210
2W	40W	40D02	$180
10W	40W	40D10	$145
2W	10W	10D02	$125

FCC Type accepted models also available.

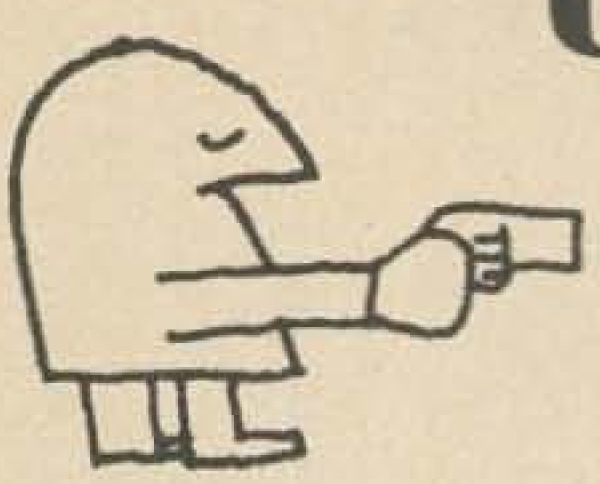
Available at select dealers throughout the U.S.

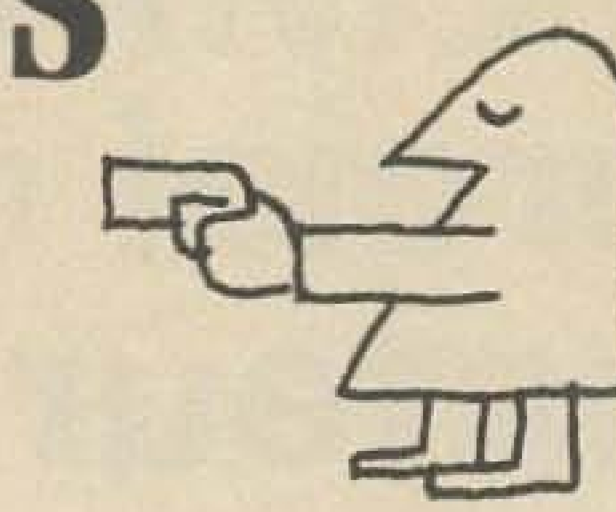
Henry Radio

11240 W. Olympic Blvd., Los Angeles, Calif. 90064 213/477-6701
931 N. Euclid, Anaheim, Calif. 92801 714/772-9200
Butler, Missouri 64730 816/679-3127

Prices subject to change without notice.

CONTESTS





Editor:
Robert Baker WA1SCX
34 White Pine Drive
Littleton MA 01460

OHIO INTERSTATE QSO PARTY
1900 GMT Saturday
August 30 to 0300 GMT
Sunday, August 31
1500 GMT to 2300 GMT
Sunday, August 31

All amateurs are invited to participate in the Ohio Interstate QSO Party sponsored by the Ohio Council of Amateur Radio Clubs. There are no restrictions on operating time, power or number of operators or transmitters. Each station can be worked twice on each band: once on phone, and once on CW. Ohio stations may contact any other station for credit. Non-Ohio stations may contact only Ohio stations for credit. To encourage emergency preparedness and provide contacts from rare Ohio counties, portable stations operating from any Ohio county EXCEPT Butler, Cuyahoga, Franklin, Hamilton, Lorain, Lucas, Mahoning, Montgomery, Stark, Summit, and Trumbull may multiply their final score by 1.5. Portable operation is defined as operation outside the county in which you are licensed and signing your call as /8.

EXCHANGE:

Send QSO number, RS(T), and ARRL section or Ohio county. Stations operating on a county line may issue more than one multiplier, but not more than one QSO number, to an individual station per band per mode.

FREQUENCIES:

1805, 3575, 3975, 7075, 7275, 14075, 14285, 21075, 21375, 28075, 28575, 50.15, and 145.10. Try phone each even hour GMT and CW each odd hour GMT. Try 160 at 0200 GMT August 31.

SCORING:

QSO points are 1 per completed exchange on 80 through 10 meters, and 2 on 160 and all frequencies above 50 MHz. As a bonus, a complete exchange with the Ohio State Fair special event station is 5 QSO points on 80 through 10 meters. For Ohio stations, the final score is the total number of QSO points multiplied by the number of ARRL sections worked, including Ohio. DX stations may be worked for QSO points but do not count as additional sections. For all others, the number of QSO points is multiplied by the number of Ohio counties worked. Portable stations changing counties during the contest may repeat contacts for QSO points, but multiple contacts may not be claimed by operating on a county line. Stations outside Ohio may claim both QSO points and counties.

AWARDS:

First, second and third place awards will be given to the highest scoring stations inside and outside Ohio, and to the winners in each ARRL section and Ohio county, providing at least 10 different stations are contacted. Separate awards to stations using frequencies above 50 MHz exclusively.

LOGS

Logs showing time, date, stations contacted, QSO exchange, band, mode, location and score must be received by November 1, 1975, by: OHIO QSO Party, 6470 Penick Drive, Reynoldsburg OH 43068. Contest package of log, Ohio County and ARRL section list, and summary sheet will be sent by the OHIO QSO Party upon receipt of SASE.

EUROPEAN DX CONTEST
– PHONE
Starts: 0000 GMT Saturday,
September 13
Ends: 2400 GMT Sunday,
September 14

DARC is sponsoring the 21st annual European DX Contest this year. Use all bands, 80 to 10 meters. Only 36 hours of the 48 hour contest period may be used by single operator stations. The 12 hour rest period may be taken in one but not more than 3 periods, anytime during the contest. Single operator-All Band and Multi-operator Single transmitter are the only 2 classes.

EXCHANGE:

Five or six digit number, RS(T), QSO Number (start at 001).

SCORING:

One point per QSO and one point for each QTC reported.

MULTIPLIERS:

Multiplier for Non-Europeans is number of EU stations worked on each band. Europeans will use ARRL list and call areas: JA, PY, VE/V0, VK, W/K, ZL, ZS and UA9/UAØ. In addition, the multiplier on 80 meters may be multiplied by 4, on 40 meters by 3, and on 20 to 10 meters by 2.

FINAL SCORE:

Final score equals total QSO points plus QTC points, times the sum total multiplier from all bands.

QTC – TRAFFIC:

Additional QSO point credit may be realized by reporting a QTC. This is a report of a QSO you have made earlier in the contest and later sent back to an EU station. One point is earned for each QSO reported. A QTC can only be sent from a non-EU to an EU station. A QTC contains the time, call and QSO number of the station being reported. Example: 1432 – G4JZ – 157. It may be reported only once and not back to the originating station. A maximum of 10 QTCs are permitted to the same station, and the same station may be worked several times to complete this quota. However, the original QSO is all that may be counted toward QSO points. Try to keep a uniform list of QTCs sent. QTC 4/6 indicates that this is the 4th series with 6 QSOs now being sent.

AWARDS:

Certificates will be awarded to the highest scorers in each country and call area listed above. Continental leaders, and stations having at least half the score of the continental leader, will also be awarded certificates.

DISQUALIFICATIONS:

Violation of the rules, unsportsmanlike conduct, or taking credit for excessive duplicate contacts or multipliers will be deemed cause for disqualification. Decision of the Contest Committee is final.

LOGS:

It is suggested that you use the official DARC log and summary forms. An SASE with sufficient postage or IRCs should be sent to the Contest Committee (or to W1WY or WA3KWD for W/K and VE stations). If making your own logs, use 40 contacts to the page and use a separate sheet for each band. Mailing deadline for logs is October 15, 1975, to the WAEDC Contest Committee, D-895 Kaufbeuren, P.O. Box 262, West Germany.

EUROPEAN COUNTRY LIST:
C31, CT1, CT2, DL, DM, EA, EA6, EI, F, FC, G, GC Guer, GC Jer, GD, GI, GM, GM Shetland, GW, HA, HB9, HBØ, HV, I, IS, IT, JW Bear, JW, JX, LA, LX, LZ, M1, OE, OH, OHØ, OJØ, OK, ON, OY, OZ, PA, SM, SP, SV, SV Crete, SV Rhodes, SV Athos, TA1, TF, UA1-3-6, UA2, UB5, UC2, UN1, UO5, UP2, UQ2, UR2, UA Franz Josef Land, YO, YU, ZA, ZB2, 3A, 4U1, 9H1.

PENNSYLVANIA QSO PARTY
Operating Periods:
1600 to 2100 GMT Saturday, September 13
2300 GMT Sat., Sept. 13 to 0500 GMT Sun., Sept. 14
1300 to 2400 GMT Sunday, September 14

All amateurs are invited to participate in the 18th annual Pennsylvania QSO Party sponsored by the Nittany Amateur Radio Club. Pennsylvania stations may work both in-state and out-of-state stations.

EXCHANGE:
Send QSO number, RS(T), and PA county or ARRL section.

FREQUENCIES:
1810, 3560, 7060, 14060, 21060, 28060, 1815, 3980, 7280, 14315, 21380, 28560. Novice: 3715, 7160, 21115, 28115. Try phone on EVEN hours, 160 meters at 0300, and 10 meters at 1900 GMT.

SCORING:
Pennsylvania stations score 3 points per out-of-state QSO, 1 point for PA QSOs multiplied by the number of ARRL sections worked (EPA & WPA may be counted as sections). All others score 1 point per QSO times the total number of PA counties worked. Stations may be worked once on each CW band and once on each phone band. A bonus of 100 points is offered to each mobile for each county activated during the contest.

LOGS:
Send log and summary sheet including number of QSOs, total number of counties or sections, QSO points, final claimed score, rig description, number of hours operated, comments, gripes, and suggestions by October 15, 1975 to: W3HDH, Douglas Maddox, 1187 S. Garner Street, State College PA 16801. Results will appear in the January issue of the Nittany Amateur Radio Club Newsletter, which will be mailed to all entrants.

YL HOWDY DAYS CONTEST
Starts: 1800 GMT Wednesday, September 17
Ends: 1800 GMT Friday, September 18

Only contacts with licensed women operators count. All bands and modes of emission may be used. No cross-band operation and net contacts do not count. Only one contact with each station will be counted.
SCORING:
Score two points for each YLRL member worked and one point for each non-YLRL member worked. There are no multipliers.
AWARDS:
Top scoring YLRL member will receive her choice of a YLRL pin, charm, or stationery. Non-YLRL member will receive a one year membership in YLRL.
LOGS:
Logs must be received no later than October 19, 1975 by Mrs. Myrtle Cunningham WA6ISY, 1105 East Acacia Avenue, El Segundo CA 90245.

DELTA QSO PARTY
Starts: 2000 GMT Saturday, September 27
Ends: 0200 GMT Monday, September 29

The sixth annual Delta QSO Party is sponsored by the Delta Division of the ARRL and all amateurs are invited to participate. There are no operating or power restrictions. Amateurs outside of the Delta Division will attempt to contact as many amateurs inside of the Delta Division (Ark – La – Miss – Tenn) as possible. Delta Division stations will attempt to contact as many amateurs as possible both inside of and outside of the Delta Division. The general call will be "CQ Delta QSO Party" on SSB and "CQ Delta" or "CQ Test" on CW.
EXCHANGE:
Send QSO number, RS(T), and QTH (ARRL section for non-Delta Division stations – county and state for Delta Division stations). Portables and mobiles may be reworked on the same band/mode if they change counties.
FREQUENCIES:
CW: 3550, 7050, 14050, 21050, 28050. SSB: 3990, 7290, 14290, 21390, 28590. Novice: 3725, 7125, 21125, 28125.
SCORING:
Delta Division – number of QSOs times the number of ARRL sections (max. 75) equals final score. Outside Division, number of QSOs times the number of counties worked (max.

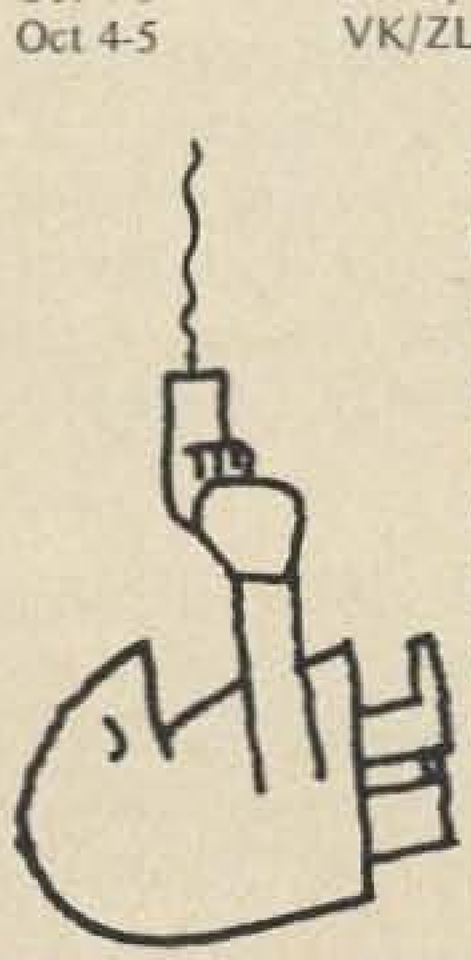
Continued on page 166

CONTEST CALENDAR

Aug 30-31	Ohio Interstate QSO Party
Sept 6-7	ARRL VHF QSO Party
Sept 6-7	Savaria CCS Contest
Sept 6-8	Four Land QSO Party*
Sept 6-8	Maryland/D.C. QSO Party
Sept 7	Tu-Boro RC 2m RTTY Contest
Sept 13-14	CLARA Day Contest
Sept 13-14	European DX Contest – Phone
Sept 13-14	Pennsylvania QSO Party
Sept 13-15	Washington State QSO Party*
Sept 17-19	YL Howdy Days
Sept 20-21	Scandinavian CW Contest
Sept 20-21	VE/W Contest
Sept 27-28	Scandinavian Phone Contest
Sept 27-29	Delta QSO Party
Oct 1-Nov 30	RTTY Art Contest
Oct 4-5	California QSO Party
Oct 4-5	Rocky Mountain QSO Party
Oct 4-5	VK/ZL/Oceania Phone
Oct 11-12	CD Party – Phone
Oct 11-12	VK/ZL/Oceania CW
Oct 15-16	YL Anniversary Party – CW
Oct 18-19	CD Party – CW
Oct 19-20	Manitoba QSO Party
Oct 25-26	CW WW DX Phone Contest
Nov 1-3	North Carolina QSO Party
Nov 6-7	YL Anniversary Party – Phone
Nov 7-10	IARS/CHC/FHC/SWL-CHC/HTH QSO Party
Nov 8-9	European RTTY Contest
Nov 8-9	ARRL Sweepstakes – CW
Nov 22-23	ARRL Sweepstakes – Phone
Nov 29-30	CQ WW DX CW Contest
Dec 6-7	160 Meter Contest
Dec 6-7	TOPS CW Contest
Dec 13-14	10 Meter Contest
Dec 31	Straight Key Night

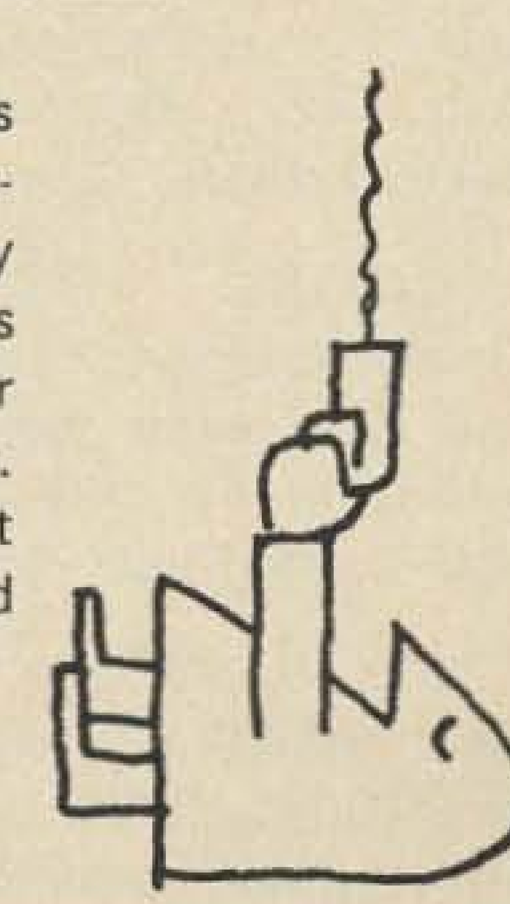
* = described in previous issue.

SPECIAL REQUEST



Now that this contest calendar is underway, I will attempt to list information each month on as many different contests and special events as I can. I will also be listing results for various contests, as space permits. Please send all information on contest announcements, special events, and results directly to me:

Robert Baker WA1SCX
34 White Pine Drive
Littleton MA 01460 USA



Caveat Emptor?

PRICE – $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agency discount. 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.

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.

WANTED – Make, Model and Serial number of stolen ham gear for big list. W7UD, 3637 West Grandview, Tacoma WA 98466.

NEW VHF Engineering RPT 144-Kit for sale first $300 takes it. (I won it at Dayton) 419 447-2212 or R. Wright, 185 South Washington, Tiffin OH 44883.

HEATHKIT SB-303 receiver, very good condition, no modifications. Factory-aligned and includes CW filter. $275 or best offer. Kurt Nilles, 115 Nevada, Dubuque IA 52001.

VERY INTERESTING! Next 5 issues $1. "The Ham Trader," Sycamore IL 60178. (Ask about our "HAM EQUIPMENT BUYERS GUIDE" covering receivers, transmitters, transceivers, amplifiers 1945-75. Indispensable!)

CINCINNATI HAMFEST: 38th annual – Sunday, September 21, 1975 at the New Stricker's Grove on State Route 128, one mile west of Ross (Venice), Ohio. Flea market, contests, model aircraft flying, food and beverages all day. Advanced tickets $7.00, covers everything; $8 at gate. For tickets or further information: Carl J. Dettmar W8NCV, 8630 Cavalier Drive, Cincinnati OH 45231.

CLEANING SHACK – HW-101, Gonset Communicators, Old QST, 73 and CQ, many more goodies. Send SASE for list. K8ILR, 257 National NW, Grand Rapids MI 49504.

FREE: 8 EXTRA CRYSTALS of your choice with the purchase of a new ICOM IC-22A at $249. With the 10 crystals which come factory installed in the IC-22A, this gives you a total of 18 crystals! For equally good deals on Kenwood, Drake, Collins, Ten-Tec, Swan, Atlas, Midland, Standard, Regency, Tempo, Alpha, Genave, Hy-Gain, CushCraft, Antenna Specialists, Hustler, Mosley, and others, write or call HOOSIER ELECTRONICS, your ham headquarters in the heart of the Midwest, and become one of our many happy and satisfied customers. HOOSIER ELECTRONICS, P.O. Box 2001, Terre Haute, Indiana 47802. (812) 894-2397.

HP-65 USERS exchange ideas, programs, methods. Monthly newsletter. Request information and sample newsletter. Richard Nelson, 2541 W. Camden Pl, Santa Ana CA 92704.

HEATH SB-301, SB-401, factory aligned. Motorola 6/12 V 2-meter mobile (T43GGV-5) all w/manuals, extras. Make offers. Charlie Wood, 1963 Douglas Dr., Tawas City, Mich., 48763.

SWAN 250C, 6-meter transceiver with P/S speaker, remote VFO, noise blanker & TV2D 2-meter transverter. Mint condition. K3IPM 215 355-2867.

CRUNCHER!! 300 Watts output on 2 meter FM. Motorola AM-494/GR amplifier with T43 transceiver and supplies. Offers? Trades? W9HAJ, 1200 Arundel, Kokomo, Ind. 46901. (317) 452-8971.

FREE BARGAIN CATALOG. LEDs, Xtals, Microphones, Headsets, ICs, Relays, Ultrasonic Devices, Precision Trimmer Capacitors, Unique Components. Low, Low Prices! Chaney's, Box 15431, Lakewood, Colo. 80215.

COLLINS: 30S-1 2KW amplifier excellent operating and physical condition, trade for Bendix R-1051B/E receiver same condition. Sid Sidman, 3571 Gresham Court, Pleasanton, California 94566.

HW-12 $90; HW-22 $95; HP-13 P. supply $45; SR42 $60; BC-221 $35; TS-175 $60; "LDS" mobile ant $18; F.O.B. Yoakum, Texas 77995, K5QJS.

AMAZING, NEW, UNIQUE, EASY, method of mastering the Morse Code. Fully guaranteed. Send $5.95 to GENERAL, Dept-978, Box 137, Northridge CA 91324.

SELL: G.E. Voice Commander on 31-91. New case, spare nicad pack, charger. Best offer over $50.00. P. Smith WB9JSE, 7723 W. Bender Ave., Milwaukee WI 53218.

MEMPHIS is beautiful in October! The Memphis Hamfest, bigger and better than ever, will be held at State Technical Institute, Interstate 40 at Macon Road, on Saturday and Sunday October 4 and 5. Demonstrations, displays, MARS meetings, flea market, XYL entertainment, prizes. Informal dinners Saturday night. Dealers and distributors welcome. Talk-in on 3980, .34-.94 and MARS. Contact Harry Simpson W4SCF, Box 27015, Memphis TN 38127 or telephone (901) 358-5707.

COLLINS 30S-1, excellent, new 4CX-1000A, $1050, alpha 374, brand new, in warranty $975, Techtronics 310A with cart $250. Sid Sidman, 3571 Gresham Ct., Pleasanton, Calif. 94566.

VIDICON 7038 – $15.00; 7262A – $15.00; 8844 – $20.00; Peterson 50 MHz Scanner – $25.00. WB2GKF, Stan Nazimek, 506 Mount Prospect Avenue; Clifton, New Jersey 07012.

WALL TO WALL Drake R4-A, T4-X, AC-3, and MS-4 $675 postpaid USA, KG4CB, Satellite Communications Detachment, FPO New York NY 09593.

MOTORHOME for sale. 25 ft. Sportscoach (RB) – 1973 – excellent condition – many extras. Antennas – 2 mtr. TV, (2) HF – 4 KW generator, sleeps six. $1,500 down, assume loan. Send SASE for more info. W6KHS, 212 Magellan St., Capitola CA 95010.

MOTOROLA TWIN V: Like new, gray wrinkle finish case, output meter built-in, power supply permits use on 110VAC, 12VDC or 6VDC. 2 meter transceiver has 16/76, 22/82, 94/94. Was asking $165.00, will take $135.00. First cashier's check gets shipment same day. M. T. Henry, 5173 North Hampton Ridge, Norcross, Georgia 30071.

Continued on page 170

AMSAT CONSIDERING SHORT-LIFE HF SATELLITE

While work is progressing on a near synchronous VHF long-life satellite, AMSAT is considering a low orbiting (225 nautical miles) high frequency satellite. Basically, AMSAT would supply the command and control equipment for a bicentennial satellite which would feature a zero order magnitude flashing light prepared by the Brevard County, Florida, Bicentennial Commission. The light would be in operation July 4, 1976. Because a low orbit is necessary for the light, a VHF translator would be impractical. Tentative plans call for a translator with an input on 21.2 to 21.3 MHz and a ten meter output.

Availability in July, 1976 necessitates a March, 1976 launch, leaving precious little time for circuit development; however, it is hoped that this satellite will act as a proving ground for several sections of the next complex VHF satellite. To meet this goal, several new projects have begun, including an analog telemetry unit under design by W1GBO.

AMSAT-OSCAR 7 HAS A MIND OF ITS OWN

Occasionally Oscar 7 switches modes by itself. This causes considerable work for the command stations, as it is then necessary to reset the satellite into the correct mode and insure the internal 24 hour clock will switch modes at 0000Z.

If you are waiting to acquire the satellite's downlink and it is late, check the other downlink. You could find yourself in the enviable situation of being one of only two or three stations on the satellite. This situation provides armchair copy QSOs. If you should observe a mode switch, it would be appreciated at AMSAT if you note the time, orbit number and other pertinent conditions that might help AMSAT determine the cause of this phenomenon.

OSCAR 6 BATTERIES DROP TO LOW VOLTAGE

As the satellite sees the sun for the smallest period of its orbit during June, the battery voltage on Oscar 6 dropped dangerously low just before Field Day activities. To insure that Oscar 6 would be operational for all of Field Day, it was turned off several days prior to the event. As the summer wears on, each day the satellite will see more and more energy-giving sunlight, until the maximum sunlight per orbit is reached in February.

UNEXPLAINED NOISE REMAINS ON OSCAR 7 MODE B OUTPUT

Although the Oscar 7 Mode B translator (432.150 to 145.950) is functioning well, occasionally unexplained noise is transmitted to the ground in sections of the passband on two meters. Because the noise comes and goes during different parts of the orbit, this phenomenon has been difficult to identify with any specific cause. AMSAT welcomes your comments and observations as to the cause of the noise, as well as any data you might have which substantiates your conclusions (such as correlation to radars, solar activity, aurora, magnetic storms, etc). Write AMSAT, Box 27, Washington DC 20044.

OSCAR SLIDE SETS AVAILABLE

K6PGX is offering a set of 21 slides, which includes a photo of the launch of Oscar 7, for $5.40 postpaid. His address is Norman Chalfin K6PGX, PO Box 463, Pasadena CA 91102. All proceeds go to AMSAT and help build future satellites.

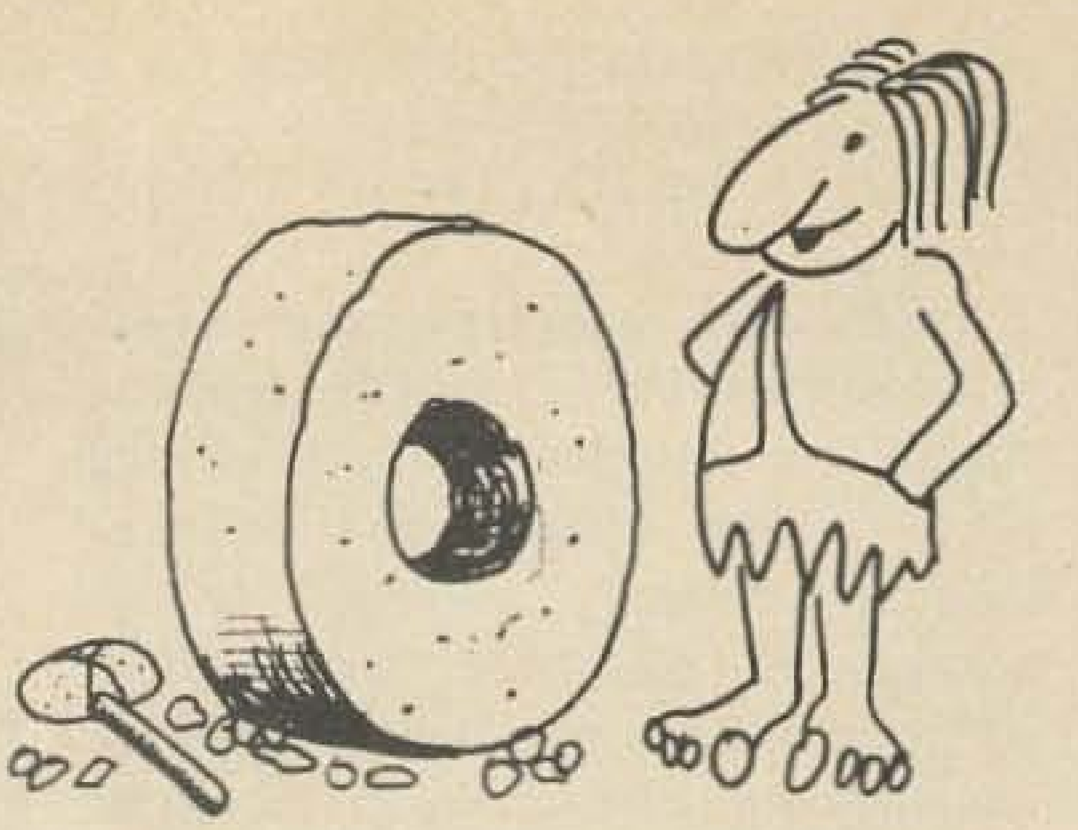
Oscar 6 Orbital Information				Oscar 7 Orbital Information				
Orbit	Date (Sept)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (Sept)	Time (GMT)	Longitude of Eq. Crossing °W
13153	1	0113.5	69.1	B	3625	1	0056.6	64.0
13165	2	0013.4	54.1	A	3638	2	0150.9	77.6
13178	3	0108.4	67.8	BX	3650	3	0050.3	62.4
13190	4	0008.3	52.8	A	3663	4	0144.5	76.0
13203	5	0103.2	66.5	B	3675	5	0043.9	60.8
13215	6	0003.2	51.5	A	3688	6	0138.2	74.4
13228	7	0058.1	65.2	B	3700	7	0037.5	59.2
13241	8	0153.0	79.0	A	3713	8	0131.8	72.8
13253	9	0052.9	64.0	B	3725	9	0031.1	57.6
13266	10	0147.9	77.7	AX	3738	10	0125.4	71.2
13278	11	0047.8	62.7	B	3750	11	0024.8	56.0
13291	12	0142.7	76.4	A	3763	12	0119.0	69.6
13303	13	0042.7	61.4	B	3775	13	0018.4	54.4
13316	14	0137.6	75.2	A	3788	14	0112.7	68.0
13328	15	0037.5	60.1	B	3800	15	0012.0	52.8
13341	16	0132.5	73.9	A	3813	16	0106.3	66.4
13353	17	0032.4	58.9	BX	3825	17	0005.6	51.2
13366	18	0127.3	72.6	A	3838	18	0059.9	64.8
13378	19	0027.3	57.6	B	3851	19	0154.2	78.4
13391	20	0122.2	71.3	A	3863	20	0053.5	63.2
13403	21	0022.1	56.3	B	3876	21	0147.8	76.8
13416	22	0117.1	70.1	A	3888	22	0047.2	61.6
13428	23	0017.0	55.0	B	3901	23	0141.4	75.2
13441	24	0111.9	68.8	AX	3913	24	0040.8	60.0
13453	25	0011.9	53.8	B	3926	25	0135.1	73.6
13466	26	0106.8	67.5	A	3938	26	0034.4	58.4
13478	27	0006.7	52.5	B	3951	27	0128.7	72.0
13491	28	0101.7	66.2	A	3963	28	0028.0	56.8
13503	29	0001.6	51.2	B	3976	29	0122.3	70.4
13516	30	0056.5	65.0	A	3988	30	0021.7	55.2

amsat

Gary Tater W3HUC, 7925 Nottingham Way, Ellicott City MD 21043

TM

NEW PRODUCTS



The New Clegg

Clegg's response to the encroaching competition is to give more – a lot more. This may be a winning philosophy.

With the filling up of the 146-148 MHz bands, there is more and more interest in being able to flip down below 146 for simplex operation – with the Clegg FMDX you can do this, for it not only covers the two meg repeater band, but also the MARS bands on either end of the two meter ham band – and the MARS chaps have been setting up repeaters too, you know. The FMDX will take you from 143.5 to 148.5 MHz, giving you just about everything you could ask for, including both high and low MARS bands, CAP, the DX part of 2m, and even the Oscar band.

If you are into repeaters at all, and the odds are that you are since over 50% of the active amateurs are using 2m at least part of the time today, you've probably wanted to be able to call in on all of the repeaters in your area . . . and perhaps all those in areas you may visit. This means today that you must be able to have a good deal of flexibility, and it certainly means synthesis. The growing number of "splinter" channel repeaters . . . using the 15 kHz splits . . . has created some problems for early synthesized rig owners where it takes special crystals to hit these channels, and the front panel readout is, to be kind, cryptic. The FMDX covers every 5 kHz of the band, thus giving you all of the splinter repeaters . . . and it will permit you to work those which are avoiding the interference from adjacent channels by being on reversed pairs.

The Clegg system for setting frequency is simple and effective. There is one rotary switch for the megahertz, one for the 100 kHz, one for 10 kHz and a +5 kHz bat handle switch. The readout is like a frequency counter – bright red LEDs indicating the receive or transmit channel. The readout is large enough so you can read it at a glance while driving – this is one of the easiest rigs yet for mobile use.

The FMDX is set up for 600 kHz splits, but if you have a weirdo in your area with 990 kHz or 1 meg split you can adapt to it by buying a crystal for the new split. The FMDX has a switch on the front panel to permit up to three different extra splits. There's a lot of that wide split stuff going around in New York.

While the chances are that you can do just fine with a ten Watt rig, the fact is that most repeaters run a good deal more than that and you need a little extra zap if you are going to get into downtown areas or out in the country in the valleys. The Clegg runs about 35 Watts output (with a switch for one Watt) and this does a good job of equalizing repeater coverage for you. With ten Watts you often find yourself dropping out and wish for a little more signal, but you may be reluctant to go the price of an amplifier . . . and they aren't cheap.

In operation, the Clegg is a dandy. There is none of the lock-up delay that one popular rig has, so you go from receive to transmit instantly. The receiver has enough power to drive your regular car loudspeaker if you like (plugs into the back and thus disables the built-in smaller speaker). The four pole i-f filter keeps the repeaters from coming in from adjacent channels. The mike gives you excellent quality reports (and some rigs are incredibly bad). The S-meter/power output indicator lights up for mobile use . . . and an S-meter is handy in that it gives you a good indication of how great your chances are of being heard by the repeater.

In order to keep the price on this fantastic package at a level where amateurs can afford it, Clegg has gone to factory-direct sales . . . and the FMDX is certainly an excellent buy at under $600. You can bet that there will be a lot of the Clegg FMDX units around very quickly.

LINEAR AMPLIFIERS

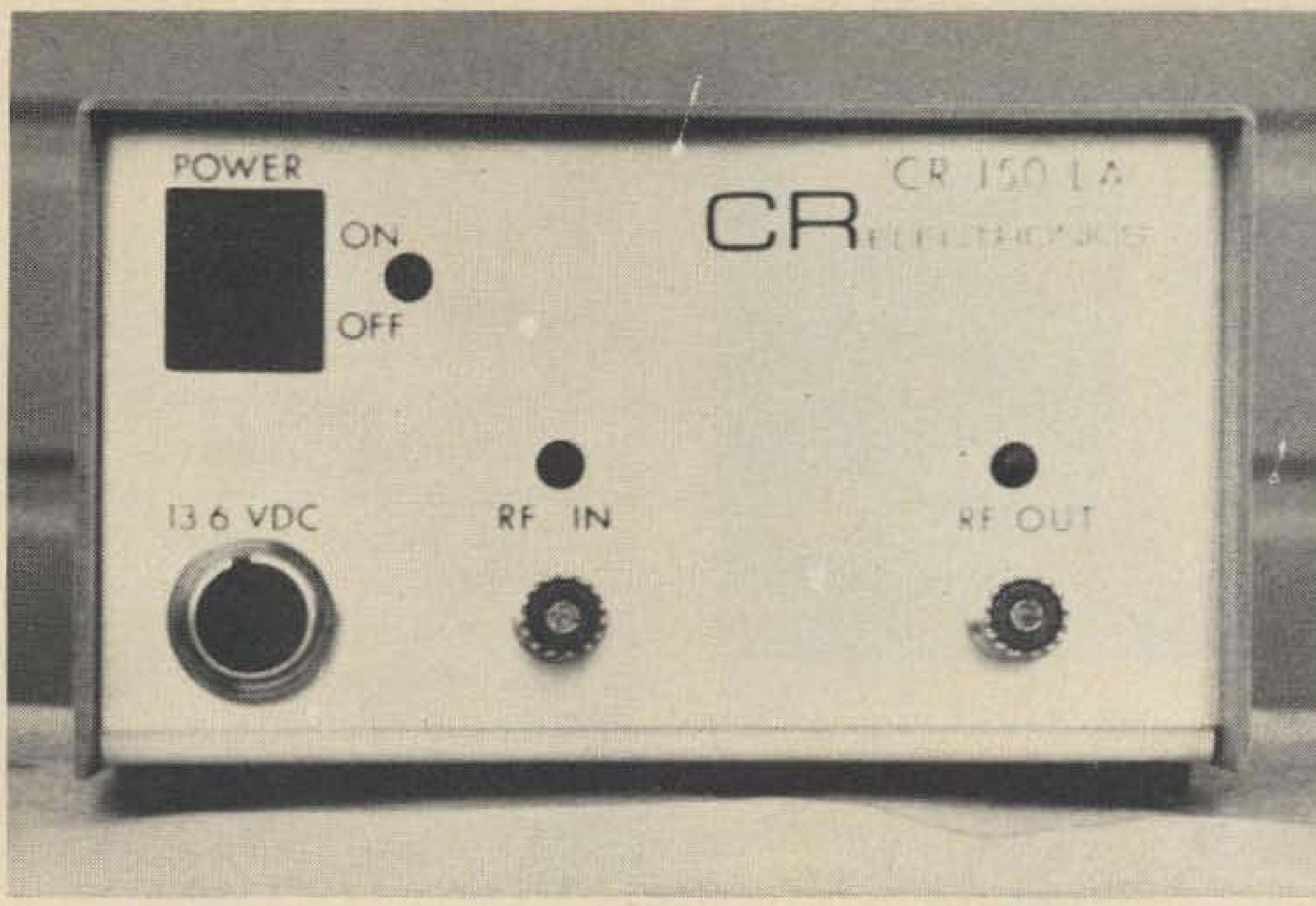
CR Electronics, in Foster City, California, has introduced their new series of linear amplifiers, which are fully solid state. Two models are available, the CR-150LA, 200 Watt PEP output and the CR-300LA, 400 Watt PEP output. These amplifiers have a frequency range of 1.6 to 30 MHz and they only require a 3-5 Watts drive. Both models are available for amateur use on 80, 40, 20, 15 and 10 meter bands.

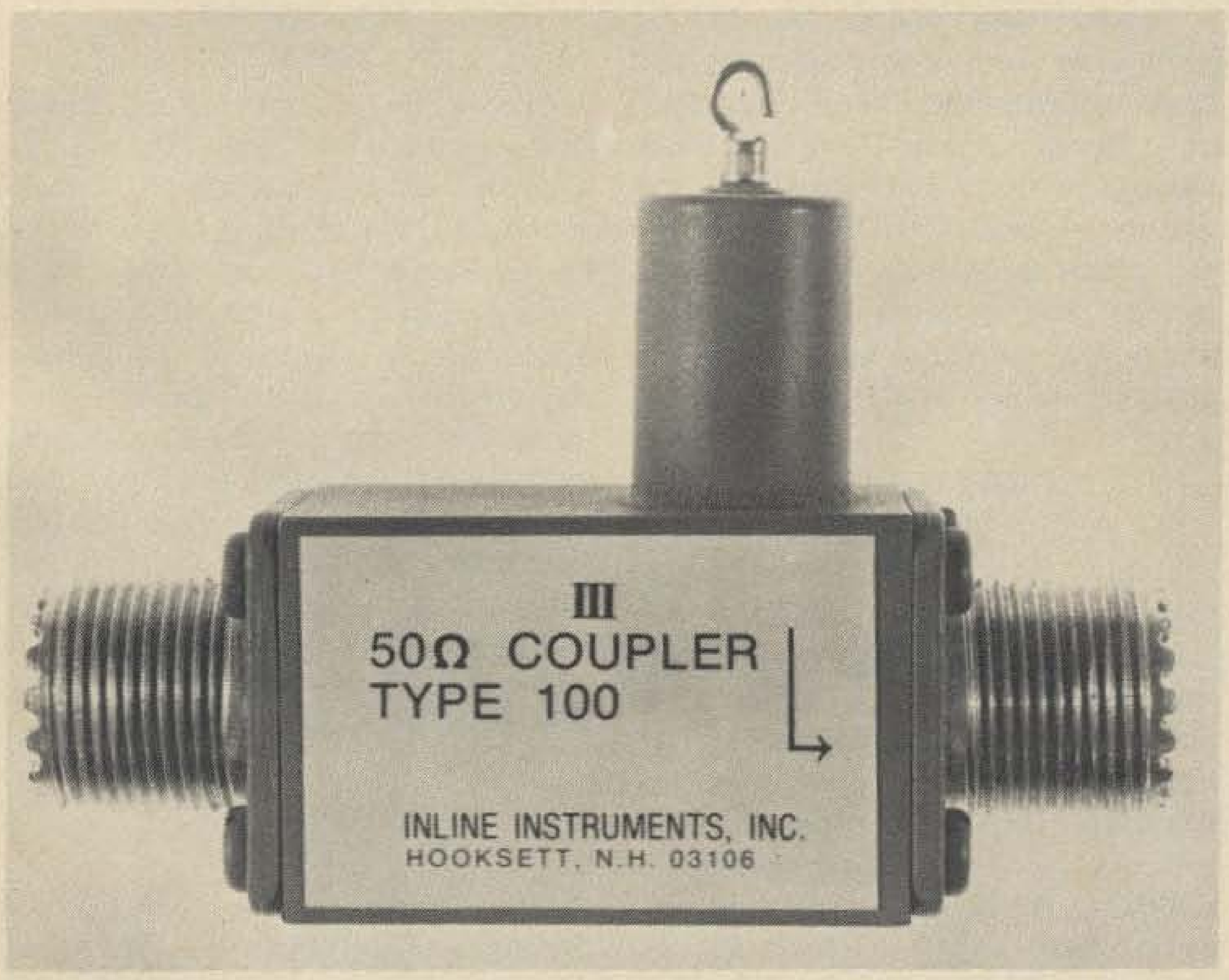
COAXIAL COUPLER POWERS ACCESSORIES VIA CABLE

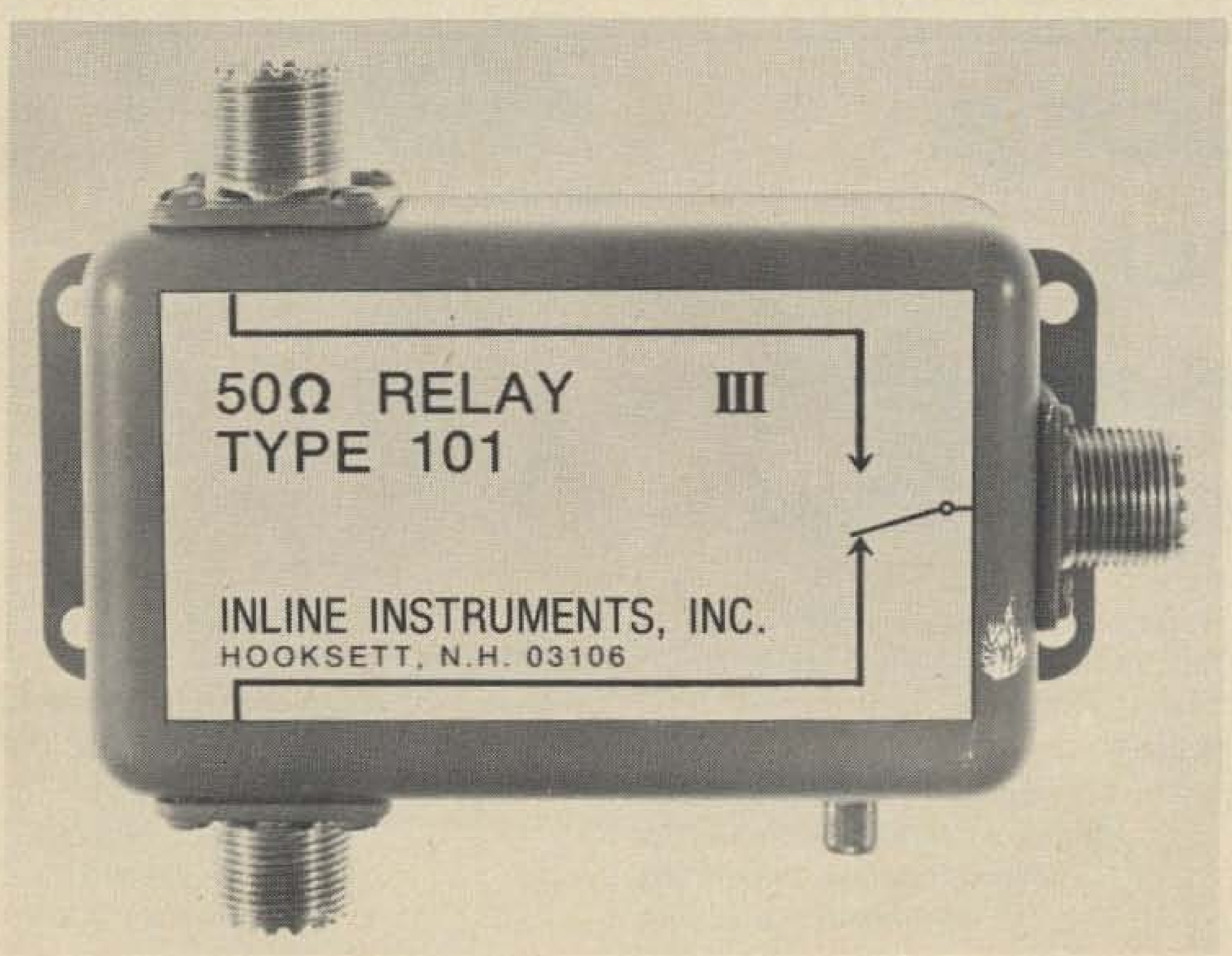
When installed inline on a coaxial cable, Inline Instrument's Type 100 Coupler allows relays, amplifiers, etc., to be powered via the signal cable. Ac, dc, or both simultaneously, may be injected locally and utilized remotely without affecting the original signal characteristics of the coaxial cable. Features include: multi-octave bandwidth; negligible swr and insertion loss; weatherproof construction; and no insertion noise. Two types cover the spectrum from medium frequency through UHF. Power capability is 250 W. Price $12.50. Write: Inline Instruments, Inc., Box 473, Hooksett NH 03106.

COAXIAL RELAY IS POWERED VIA SIGNAL CABLE

When used with a companion coupler, the coaxial relay derives its control power via the signal cable. Typically, it can be installed on a tower or pole to switch two antennas. Features include swr under 1.1, insertion loss under 1 dB, and weatherproof construction. Selectable control polarity permits multiple relays on a single coaxial line to change antenna patterns or rf loads. Frequency coverage is available from medium frequency through UHF. It will handle minus dBm levels to 150 W. Price $24.50. Write: Inline Instruments, Inc., Box 473, Hooksett NH 03106.







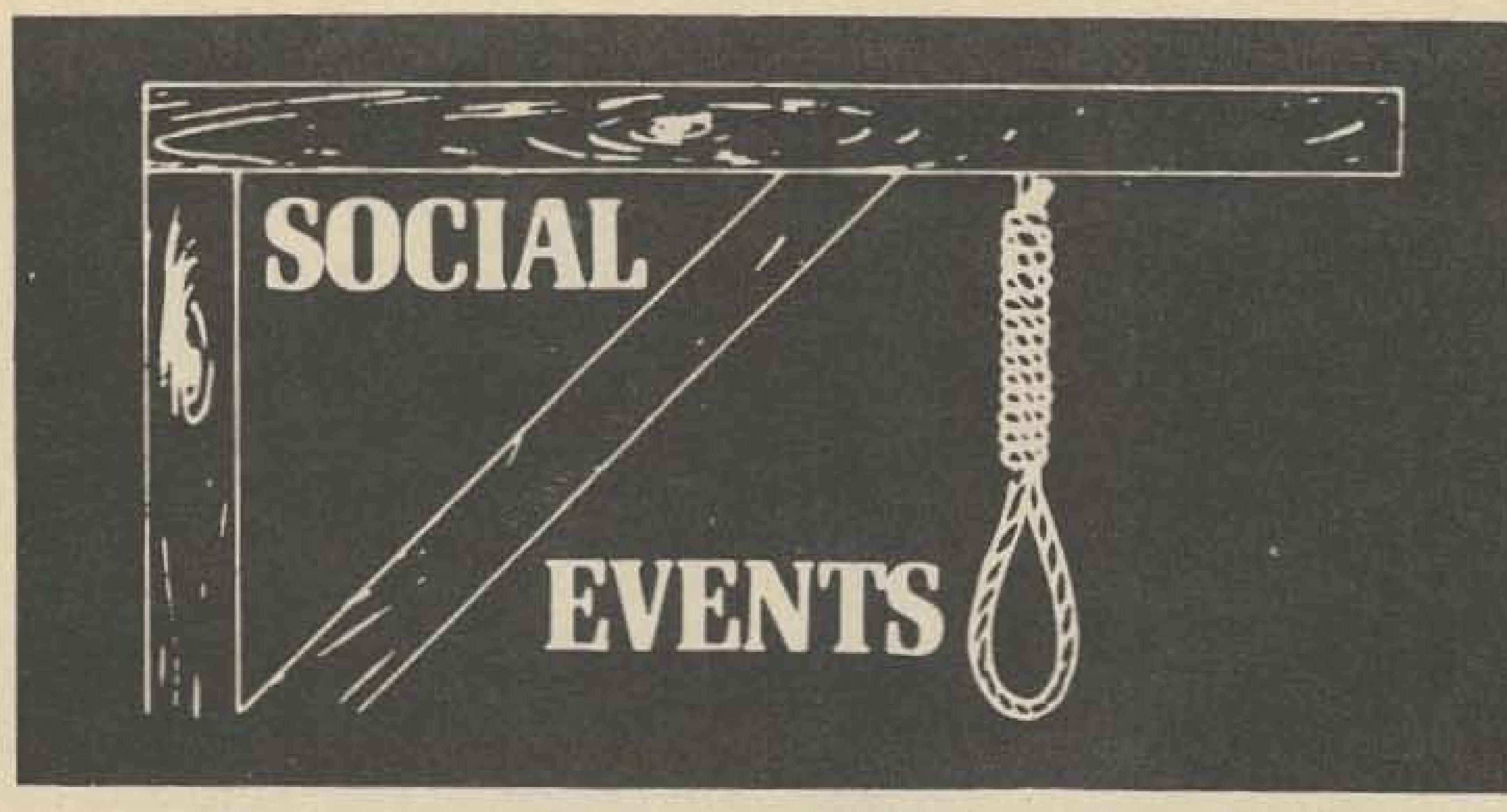
NEW LEADER 5" HORIZONTAL DUAL CHAN/DUAL TRACE SCOPE

The LBO-552 is a solid state dual channel/dual trace oscilloscope/vectorscope which provides a simultaneous left/right wave form display to make general purpose measurements and audio testing easier than ever, according to the manufacturer, Leader Instruments Corp., Plainview, NY.

This new 20 mVp-p/cm sensitivity dual channel instrument permits the user to view 2 independent signals simultaneously — and side by side on a bright CRT display. It provides 2 separate vertical gain controls for independent and joint operation and also features a single channel display for conventional testing. Vertical bandwidth is dc or 2 Hz to 1.5 MHz. Sweep speeds are from 10 Hz to 100 kHz in 4 ranges, with an input impedance of 1 mΩ shunted by 40 pF. Phase differences on the X-Y axis are below 2° at 20 kHz and below 8° at 100 kHz. Left/right channel accuracy level is ±3%.

Among its many uses, the LBO-552 is said to be ideal for inspecting and aligning sophisticated stereo equipment including amplifiers, receivers and tape recorders as well as car stereos. It is also useful for on-line production and quality control testing. It measures 9-5/8"H x 6-7/8"W x 15"D and weighs approximately 15.5 lbs. Selling for $399.95, it operates on 100, 115, 215 or 230 V power, as specified, 50/60 Hz; approximately 20 VA.

Continued on page 160



MONCTON NEW BRUNSWICK
AUG 29-SEPT 1

The Moncton Area Amateur Radio Club will sponsor the Atlantic Canada ARRL Amateur Radio Convention, August 29 – September 1, 1975 at the Hotel Beausejour, Moncton, New Brunswick. Exhibits, technical forums conducted by ARRL Headquarters personnel, VHF forum, swap shop, buffet Saturday night followed by dance, dinner and entertainment Sunday night, hidden transmitter hunt, etc. Talk-in on 146.28 – 88 and 146.52 simplex. For full information, write: Moncton Area Amateur Radio Club, P.O. Box 115, Moncton, N.B.

SAN FRANCISCO CA
AUG 29-SEPT 1

The Quarterly NORCAL DXers (Northern California DXers) gabfest will be held Labor Day weekend at the El Rancho Inn, 1100 El Camino Real, Millbrae CA 94030. $1 reg. at door. Emphasis on SWL DXing. Technical sessions, displays, quiz, auction and free refreshments. Door prizes. For more info write NORCAL, Rick Heald, 17412 Rolando Avenue, Castro Valley CA 94546.

MELBOURNE FL
SEPT 6-7

PCARs 10th annual Hamfest at Melbourne Auditorium, Saturday and Sunday, September 6 & 7, 9 am to 5 pm. Prizes galore, exhibits, swap-tables, auction, Floridora's, QCWA and much more. First prize complete 40' crank-up tower, tri-band beam, rotator and coax and many more prizes. For more info write Box 1004, Melbourne, Florida 32901.

GRAYSLAKE IL
SEPT 6-7

Radio Expo '75 will be held September 6-7 in Grayslake, Illinois at Lake County Fair Grounds, Intersection Rts. 45 & 120. Thousands of dollars in door prizes, state of the art displays by major manufacturers, spacious, all-weather flea market, informative technical movies and seminars. Acres of free parking, free camp area and full food service. Tickets – $2 for both days, $1.50 in advance. Children under 12 free. Write to: Radio Expo Tickets, Box 1014, Arlington Hts. IL 60006.

MENA AR
SEPT 6-7

The Queen Wilhelmina Hamfest '75 is Saturday and Sunday, September 6 & 7 at Queen Wilhelmina State Park, Rich Mountain, Mena, Arkansas. Excellent accommodations and food at newly restored historic Queen Wilhelmina castle. Door prizes hourly, grand prize, new equipment displays, flea market, camping area with utilities and rest rooms, amusements for harmonics. Talk-in 146.52-3995. For more information write WB5GZR.

MALAGA NJ
SEPT 7

The 27th annual South Jersey Radio Association hamfest will be held on Sunday, September 7, starting at 10 am rain or shine at the Molia Farms Picnic Grounds, Malaga, N.J. (intersection of Routes 42 and 47). Swap shops, electronic equipment displays, prizes, ladies' games, swimming, you name it. Family picnic area with tables and outdoor grille; food may be purchased also. Free parking. Talk-in on 146.52 MHz FM Simplex. Advance reg. $2.50; $3.50 at the gate. For info or tickets write: Jack Koch K2MZP, 1980 Greentree Rd., Cherry Hill NJ 08003, SASE please.

FINDLAY OH
SEPT 7

The Findlay Hamfest will be held September 7, 1975 at Riverside Park, Findlay, Ohio. For advance drawing

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additions and ~~corections~~ *corrections*

Please note these corrections on the item "Thirteen Billion Watts ERP?" which appeared on pages 4 and 5 of the July 1975 issue. They were pointed out to me by Lou Breetz, and have also been sent to *Auto-Call.*

The continuous rf power output should be 1 Megawatt, not 10 Megawatts, and the angular thickness of the fan pattern is 1.25 minutes from North to South, rather than 1-1/2 degrees.

Edwin P. Westbrook K3CS
Chairman, Publicity Committee
Naval Research Laboratory
Amateur Radio Club

Regarding my article, "How Gates Work" (July, 1975, page 113), many readers have spotted an error and brought it to my attention. On page 115, Table 9 *should* read as follows:

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.

My only consolation (and a slight one at that) is that the readers apparently understood the article enough to find the mistake.

Larry Kahaner WB2NEL
4259 Bedford Ave.
Brooklyn NY 11229

tickets write Clark Foltz W8UN, 122 W. Hobart, Findlay OH 45840.

PEORIA IL
SEPT 14

The Peoria Area Amateur Radio Club's 18th Annual Hamfest will be held Sunday, September 14, at the Exposition Gardens, same place as last year. The site is located on Northmoor Road just west of University Avenue, at the northwest edge of Peoria. Lunch will be available, and there are activities for the entire family. Free swap session, parking, contests, cartoons for the children and many prizes. Advance registration $1.50 ($2 at gate). Banquet on Saturday, September 13, at V. Junction, $6 per person. For banquet reservations, write Larry Pearsall W9FDY, 2224 W. Herold Avenue, Peoria, Illinois 61604. For Hamfest tickets, write Earl R. Kimzey WA9SCA, RFD 1, Hanna City, Illinois 61536.

HARRISBURG PA
SEPT 14

Hamfest, sponsored by the Central Pennsylvania Repeater Association, will be held Sunday, September 14, 1975 at the Park-n-shop Parking Garage, 200 Block Walnut Street, Harrisburg, Pa. Gates open 9 am. Registration: $3 per ham – XYLs free – no charge for tailgating. Food available. Talk-in 146.16/.76 WR3ABV .94/.94. For more information contact W3ABF or WA3AVX.

SHARON MA
SEPT 17

The Sharon Amateur Radio Association is holding its annual auction on September 17, 1975 at 1 pm. At the Sharon Community center. Free refreshments and doorprizes. 10% commission to club. For further info contact Ed Levine, 6 Carlton Road, Sharon MA 02067. Tel. 617 784-6033.

HUDSONVILLE MI
SEPT 20

The Grand Rapids Amateur Radio Association will hold its annual Swap & Shop Saturday September 20, 1975 at the fairgrounds in Hudsonville, Michigan. Food & prizes, $2.00 at the gate – no charge for tables or trunk sales. Talk-in on 16/76 or 94/94. See you there!!!

ITASCA IL
SEPT 20

The 23rd Annual W9DXCC banquet will be held on September 20, 1975 at the Holiday Inn, Irving Park Rd., at I-90, Itasca IL, noon to ?? Contact the Indianapolis DX Assoc., 7008 W 71st St., Indianapolis IN 46278 for further details.

HAMBURG NY
SEPT 20

Hamburg International Hamfest will be held September 20, 1975 at the Erie County Fairgrounds. Features giant flea market, tech forums, displays, code contest, organization meetings, picnic facilities, FM hospitality room, women's programs, $3000 in prizes. Free parking except rec vehicles $2.50 for weekend. Admission $2.50 advance, $3 gate; flea market parking (set-up) $1. Banquet separate. Directions: NY Thruway to Blasdell Exit 56. Rec vehicles turn right on Mile Strip Rd, then left on Rt 62 So. Follow signs to fairgrounds. Other vehicles turn left on Mile Strip and right on McKinley Parkway. Talk-in WR2ABU 146.91, simplex 146.94, 7.255, 3.925. Other area repeaters WR2ACA (146.40) 147.00, WR2ADR 146.73. Info write Lin Brownell, 210 Buffalo St., Hamburg NY 14075; (716) 649-3106.

EL PASO TX
SEPT 20-21

The El Paso Hamfest will be held at the Vista Motor Hotel (special rates) on September 20-21. Special guest speaker and banquet Saturday night. For information write Charlie Wood WA5KYV, 10012 Suez, El Paso TX 79925. Talk-in on 28-88.

CINCINNATI OH
SEPT 21

Cincinnati Hamfest: 38th annual – Sunday, September 21, 1975 at the New Stricker's Grove on State Route 128, one mile west of Ross (Venice), Ohio. Flea market, contests, model aircraft flying, food and beverages all day. Advanced tickets $7, covers everything; $8 at gate. For tickets or further information: Carl J. Dettmar W8NCV, 8630 Cavalier Drive, Cincinnati OH 45231.

TEWKSBURY MA
SEPT 21

The 19 - 79 Repeater Association's second annual Clambake Hamfest is being held Sunday, September 21, at the Tewksbury Rod and Gun Club, 11 Chandler St., Tewksbury MA (off route 38 across from the Tewksbury State Hospital). Talk-in 19-79 and 52 direct. Lobster dinner – $8 per

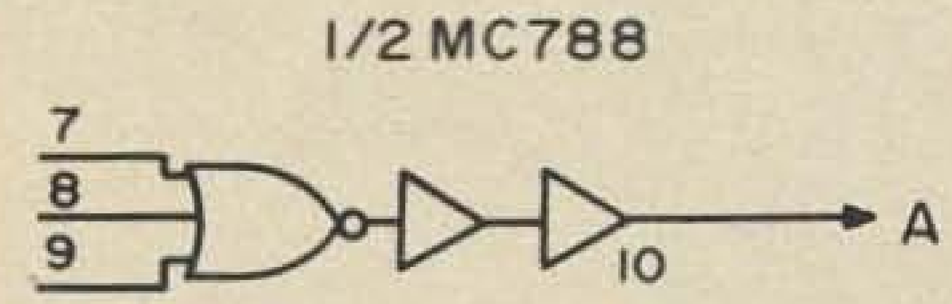
Continued on page 76

I have had a lot of response from the article "Homebrew This SSTV Monitor," which appeared in *73 Magazine*, June 1975, page 22, and I would like to add a few comments to the article.

Circuit Error:

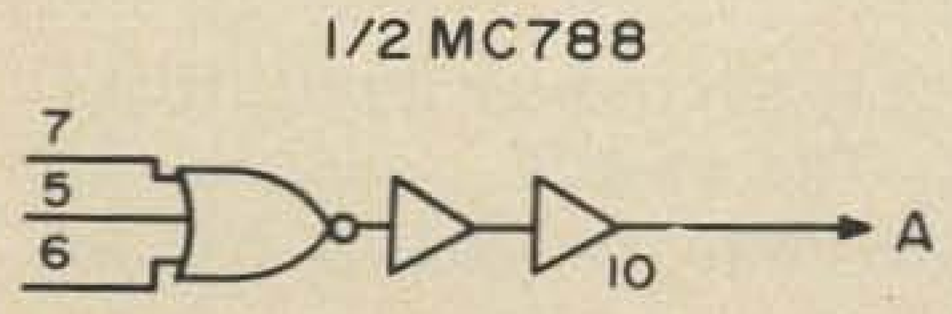
Was

1/2 MC788



Change to

1/2 MC788



Transistors:

All transistors, NPN and PNP, are general purpose, silicon type, except where noted.

Diodes:

All small signal diodes are 1N914 or equiv. Power supply diodes are 1 kV type such as 1N4007.

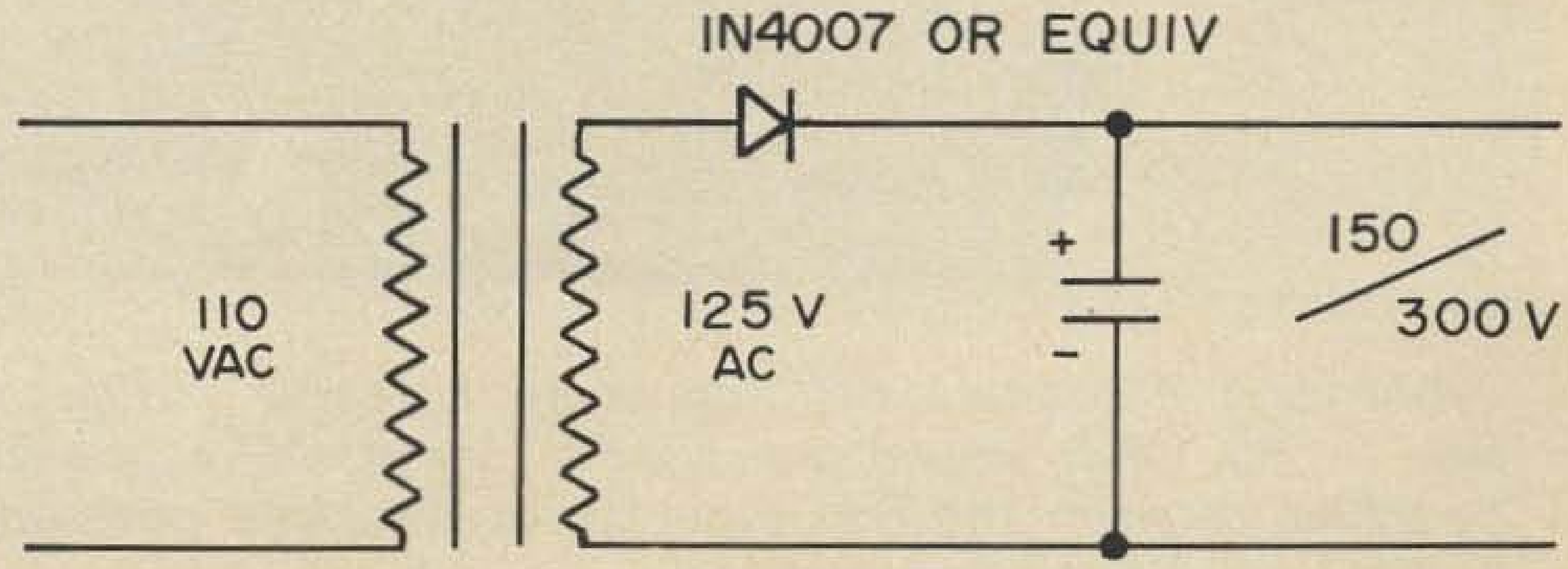
Power Supply:

Add the 150 V supply –

The 7.5 kV transformer was a one of a kind type. However, suitable power supplies can be used that deliver 5 - 10 kV. For additional schematics I would suggest consulting the SSTV handbook published by *73 Magazine.*

Larry Pryor WA9MFF
5940 Carrollton Ave.
Indianapolis IN 46220

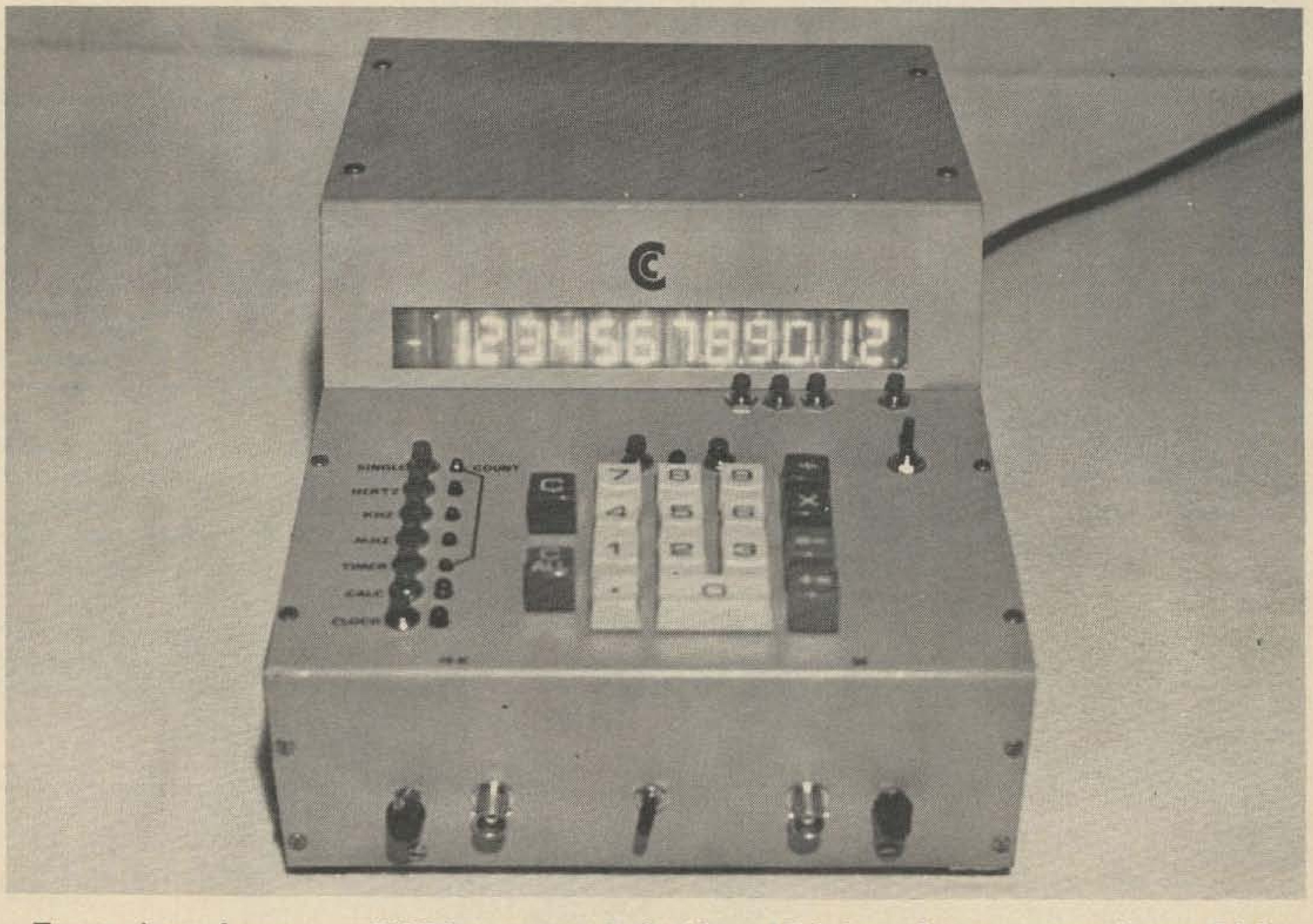
IN4007 OR EQUIV



Robert Johnson
5707 - 101A Avenue
Edmonton, Alberta T6A OL9
Canada

The Calculating Counter

And yet another electronic counter article? Yes, but with a difference. Traditional counters provide very limited resolution of audio frequencies associated, for example, with organ and piano tuning. The usual one-second gate time yields a reading varying between "59" and "61" for 60 Hz. To determine this frequency with any accuracy, you must measure the period of one cycle (16,666 microseconds), reach



Front view of counter. BNC inputs are: Left side – High impedance counter input; Right side – 50 Ohm impedance counter input, MHz prescaler. The switch transfers the prescaler between the two input jacks. The four push-buttons near the display are the decimal point setting controls.

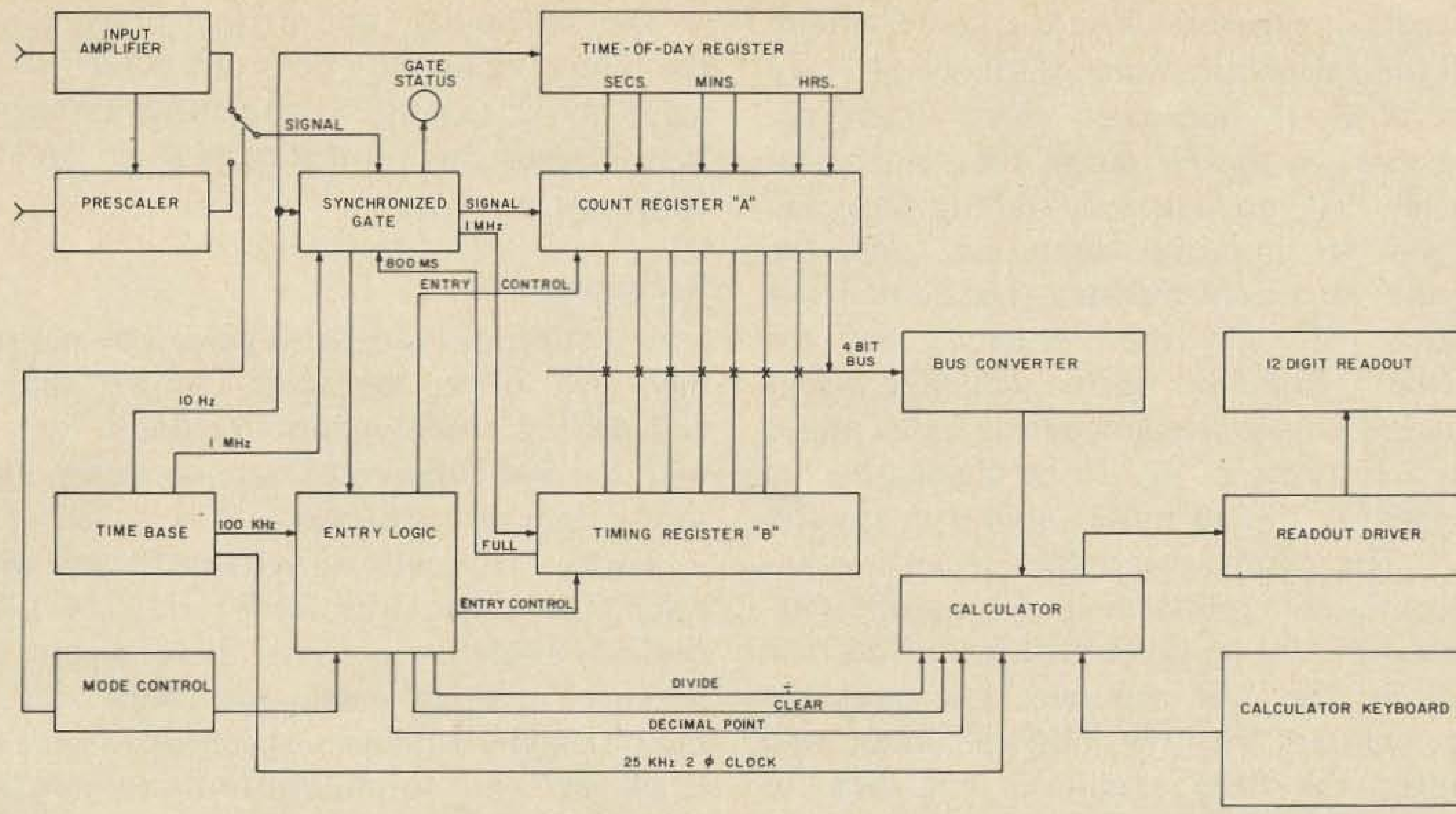


Fig. 1. Block diagram.

for your handy pocket calculator, and calculate the reciprocal (or wait 100 seconds perhaps!).

As our shack wasn't blessed with a handy pocket calculator, we decided to explore the possibility of teaching a counter to calculate frequencies from period measurements. It soon became apparent that designing a circuit to calculate reciprocals was no simple task. A ready-made solution to this dilemma presented itself in one of the "calculator chips" widely advertised at attractive prices. As a bonus, the problem of the missing "handy calculator" was solved as well. The "One-Chip Calculator" advertised as a type 5001 turned out to be both inexpensive and practical. The chip comes in one of two voltage ratings (for desk or pocket calculator use). While we used the low voltage model, which requires -8.5 and -13.5 volt power supplies, the higher voltage unit should be directly interchangeable, with minor power supply modifications.

We wished to construct an all-purpose counter, and our final design includes a basic 30 MHz counter, a high frequency prescaler, a reciprocal calculator, a desk calculator, a digital clock, an interval timer, and an incident counter. All logic circuits are TTL, except for the MOS calculator chip and ECL prescaler. Discrete devices are used for TTL/MOS interfacing and for driving readouts.

Design, construction and debugging of a project of this magnitude is virtually impossible without a test-breadboard facility. It is necessary to breadboard each function, and test it in turn. A suitable power supply is also essential, and we recommend construction of the power supply first, but note that use of different readouts or other components may require modification of the power supply.

Theory of Operation

Overall data and logic flow may be followed by reference to Fig. 1. The frequency to be counted is connected either to the input amplifier (high impedance) or directly into the prescaler (50 Ohms). The prescaler is automatically activated in the MHz mode. Note that the high impedance input may be used in all count modes, and it provides good sensitivity through the two meter band.

The synchronized input gate directs input pulses to register A, an 8 digit decade counter, and timing pulses to register B, a 6½ digit counter. Gate time in kHz and MHz modes is one second (plus or minus one input pulse period), and in the Hz mode varies between 800 milliseconds and 2 seconds (800 milliseconds plus one input pulse period).

When the input gate closes, entry logic is enabled, and in the kHz or MHz modes, the contents of register "A" are entered serially into the calculator, which displays the entry just as if it had been made from the keyboard. In the Hz mode, the contents of register "A" are entered, trailing zeros are padded to improve resolution, and the "divide" function activated. The contents of register "B" are then entered, and the "divide" function again activated. This sequence causes the number of input pulses stored in register "A" to be divided by the number of timing pulses stored in register "B." The result (with the decimal point appropriately positioned) yields the frequency of the input (with up to 4 decimal places!). The bus converter interfaces the TTL registers with the MOS calculator, and changes the BCD coding of the TTL to conform to the 5001 chip's requirements.

The time-of-day register constantly contains the time, updated each second. Register "A" utilizes decade counters with preset inputs. In the time-of-day mode, once each second, the contents of the time-of-day register are strobed in parallel into register "A" and then serially entered into the calculator as in the kHz mode.

The accumulate and period modes cause the input gate to be controlled either manually or externally, and either timing or input pulses are routed to register "A" as appropriate.

Readouts

Selection of readouts is guided by desired digit size, price, availability, power supply and driving requirements. Readouts for use with the 5001 chip must have decimal points to the right of the digit.

Various readouts are suitable for use with calculator chips. The wide array of LED devices available suggests these would be preferred. Most calculator chips utilize multiplexed readouts, where like-segments of all digits are connected to a common bus line. Each digit is selected (turned on) for a brief period in turn. This driving method reduces wiring and driving hardware, because only eight segment drivers (including the decimal point) and one digit driver per digit are required.

LED readouts may be driven by the newly available 75491 and 75492 Darlington driver arrays; however, as they are NPN

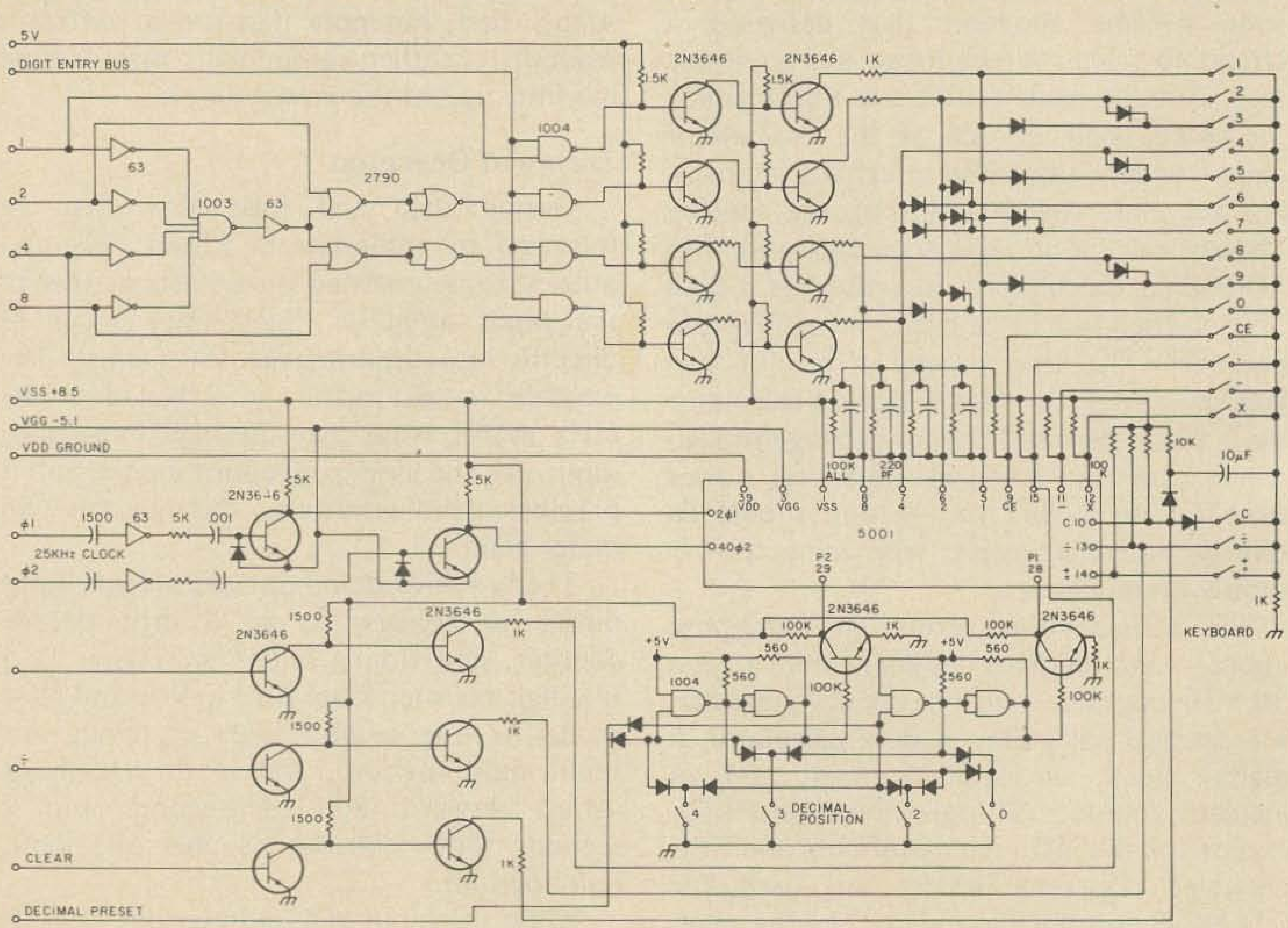


Fig. 2. Calculator Input Circuits.

devices, PNP predrivers may be required. Drivers shown in Fig. 3 are also suitable for driving LEDs, with the addition of limiting resistors.

Incandescent readouts require drivers capable of handling substantial inrush currents. Digit drivers should be selected to handle 500 mA. The author's choice of incandescent readouts was influenced by cost at the time, and size of display. Present LED prices make them much more attractive. Selection of the 2N3569 for drivers was influenced by our junkbox stock, but the 2N2905 (PNP) is probably more suitable. The calculator data sheet shows PNP drivers, and use of the 2N3569 (NPN) requires the circuits of Fig. 3 to make the NPNs think they are PNPs. Diodes are required for isolation between each segment and the segment bus. (This was rather painfully discovered by the author!)

Driving circuits for Nixie and Numitron type readouts are included with the calculator data sheet.

The 5001 chip provides 12 digits, which is handy for calculating, but not really needed for counting. Although fewer than 12 can be used, you must then either provide overflow detection or take a chance on errors. Note also that there are restrictions upon the size of the arguments that the 5001 can handle without overflow. These restrictions cause an overflow if you attempt to calculate the frequency to too many decimal places. (You have the choice of zero, 1, 2, or 4 decimals.)

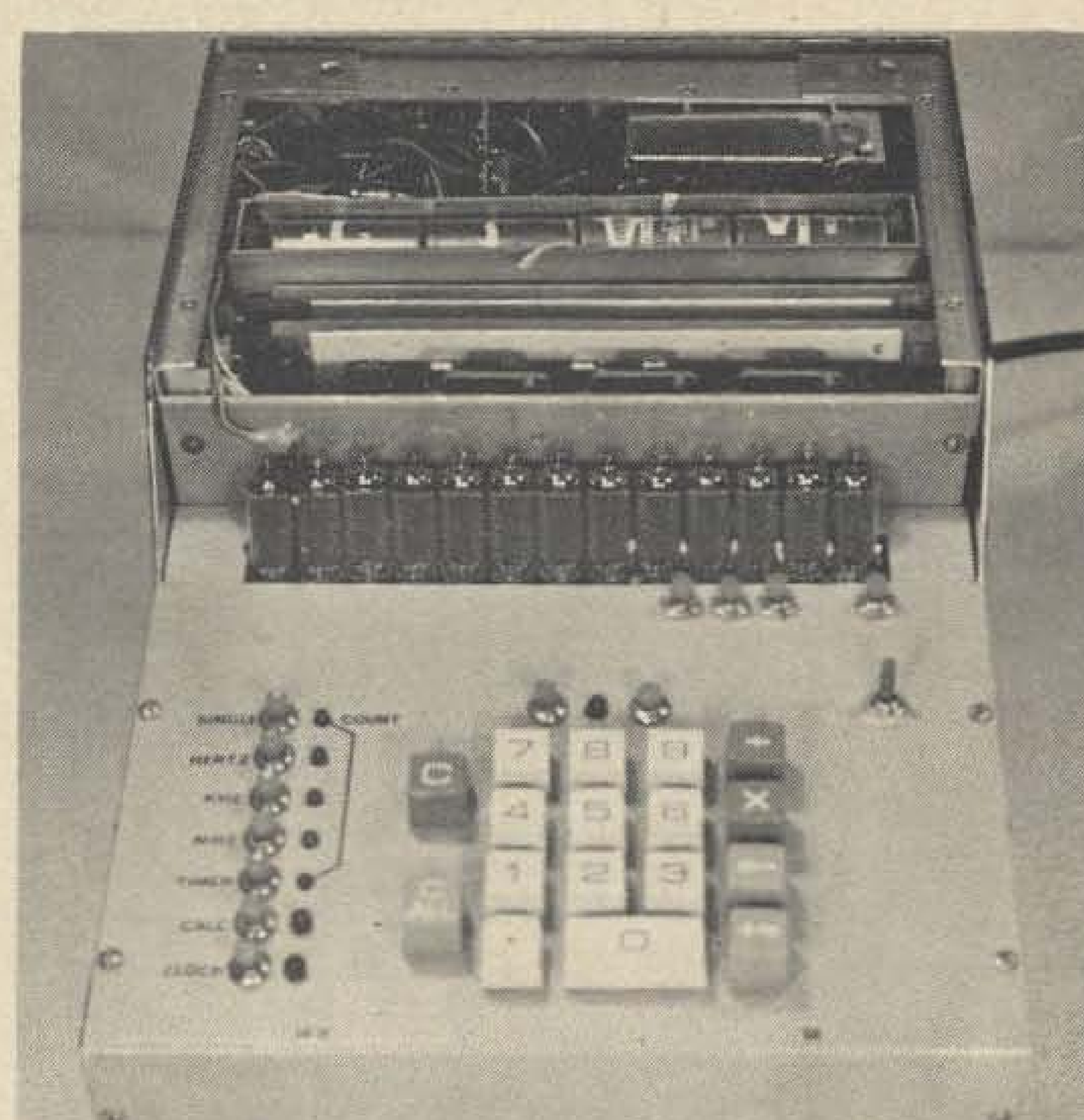
The Calculator

The 5001 Cal-tex chip widely advertised is probably the most suitable for this application. Data input is modified BCD, and is readily driven from TTL Circuits. The 5005 and several others use multiplexed inputs, which require more complex input interfacing. Although no investigating was done, the 4016 CMOS switches should be suitable for use with multiplexed inputs. The 5001 is available in 2 voltage versions. If you are not sure which version you have, it would be sensible to use the lower voltage supply to test it. Mine turned out to be the 13 volt version. If yours works at the lower voltage, it is a low voltage unit and should not be tested at the higher voltage. (Murphy's Law must have been temporarily repealed, as mine survived!)

Table 2 lists equivalents of various components used by the writer. We were fortunate to locate a supply of surplus boards, each carrying about 30 TTL NAND gates with open collectors. At about 2¢ per IC, these found favor with the pocket book. (Use of a soldering iron tip designed for their removal is recommended.)

TTL and ECL are devilish creatures unless adequate power supply by-passing is done. The surplus boards noted above also yielded some very handy power bus strips. These are composed of two 3/8" wide strips of copper foil separated by a thin dielectric. Feed terminals are provided at convenient locations which permit short leads to ICs. Even with use of these bus strips, 1.0 mF (miniature electrolytic) and .1 (miniature ceramic disc) capacitors were liberally distributed from +5 volts to ground. A .1 discap across the supply terminals of every TTL and ECL IC is recommended, if you don't use bus strips. Failure to provide these bypass capacitors will result in miscounts at best, and total non-operability at worst.

Fig. 2 shows the various input circuits required for the 5001 chip. Pins 5, 6, 7 & 8



With the top cover removed, the incandescent readouts may be seen. The four Nicad batteries may also be seen.

are 1, 2, 4 & 8 BCD lines, with the exception that a zero is read in as a "10" (lines 2 & 8 low). A low reading on any line results in a digit entry. The "digit entry" converter at the top of the diagram converts a zero entry into a "10." The "digit entry" bus is driven high whenever a digit is to be entered, opening the 4 NAND gates to the 2N3646 level converters.

Level converters are also provided for the decimal point entry, divide function and the clear function. Although non-synchronous calculator clocking could have been used as shown on the 5001 data sheets, we chose synchronous clocking to minimize cyclic errors, and tapped a 25 kHz signal from the time-base countdown chain. Electronic, rather than mechanical decimal point switching, was chosen to permit automatic decimal point placement when selecting functions. (And after all, who wants a rotary switch in a project like this?)

Fig. 3 shows outputs from the calculator chip. A Quasi-Darlington connection is used for digit drivers. The digit drive transistors must be maintained in full saturation, otherwise an "8" display will result in a dimmer digit than a "1," not to mention possible destruction of the transistor. Digits 3 & 6 (from right) are blanked in the time-of-day mode.

Segment drivers need not be high current devices as no more than one digit at a time is turned on (which means segment drivers only carry the load of one segment). Remember, however, the substantial inrush current if incandescent readouts are chosen.

Mode switching uses 8 NAND gates connected as 4 flip-flops. These gates serve as an instruction register and their outputs control the various logic circuits. LEDs are provided near each mode switch to indicate which mode has been selected.

Input Gating

A simple gate which opens for a fixed period of time is not adequate for use when calculating frequency from period measurements. The synchronized gate used here ensures only full pulses are counted, as opposed to a random gate which may open or close in mid-pulse. This substantially

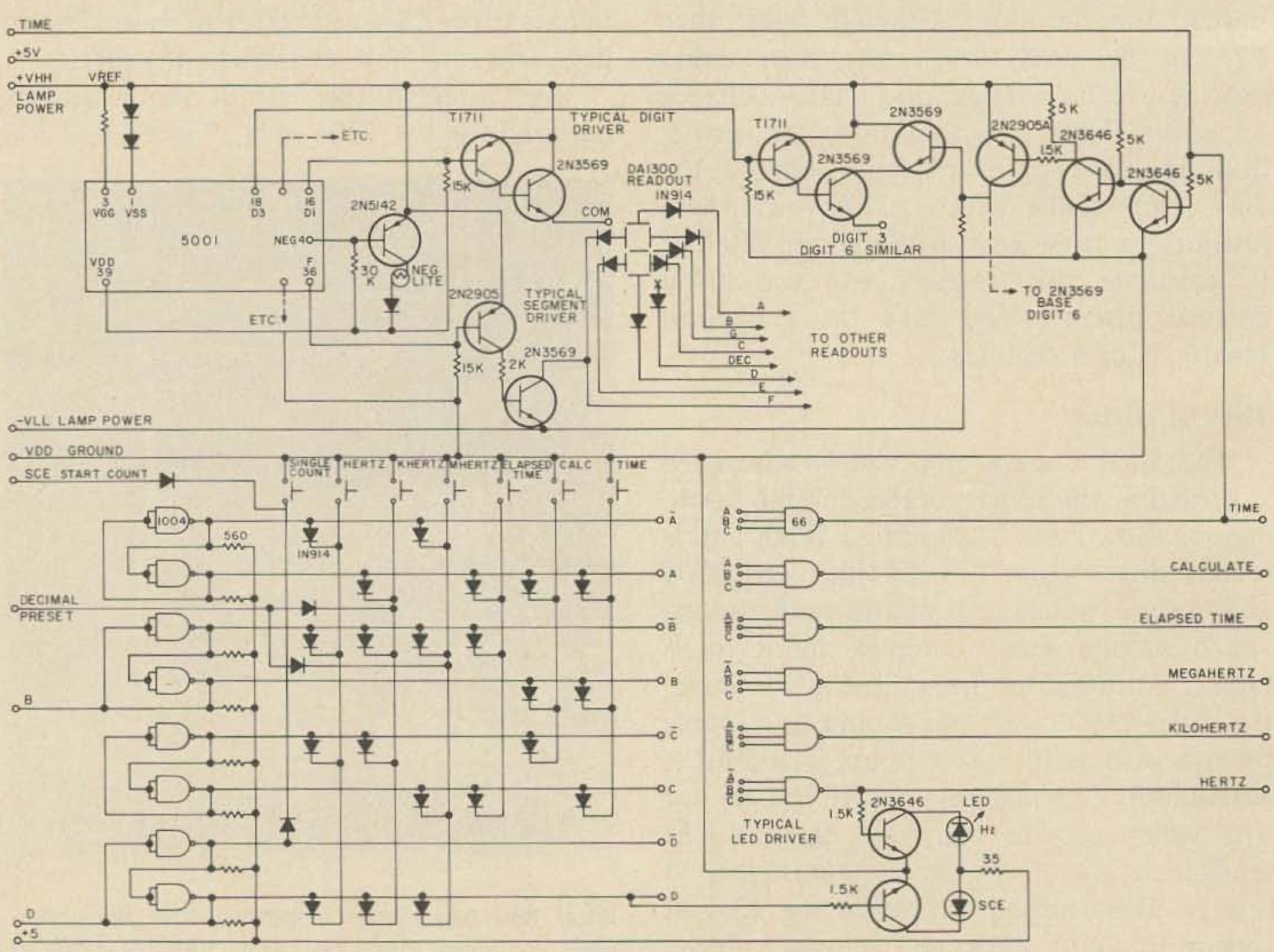


Fig. 3. Readouts and Mode Switching. The neg. light is the G-segment of the left-most readout.

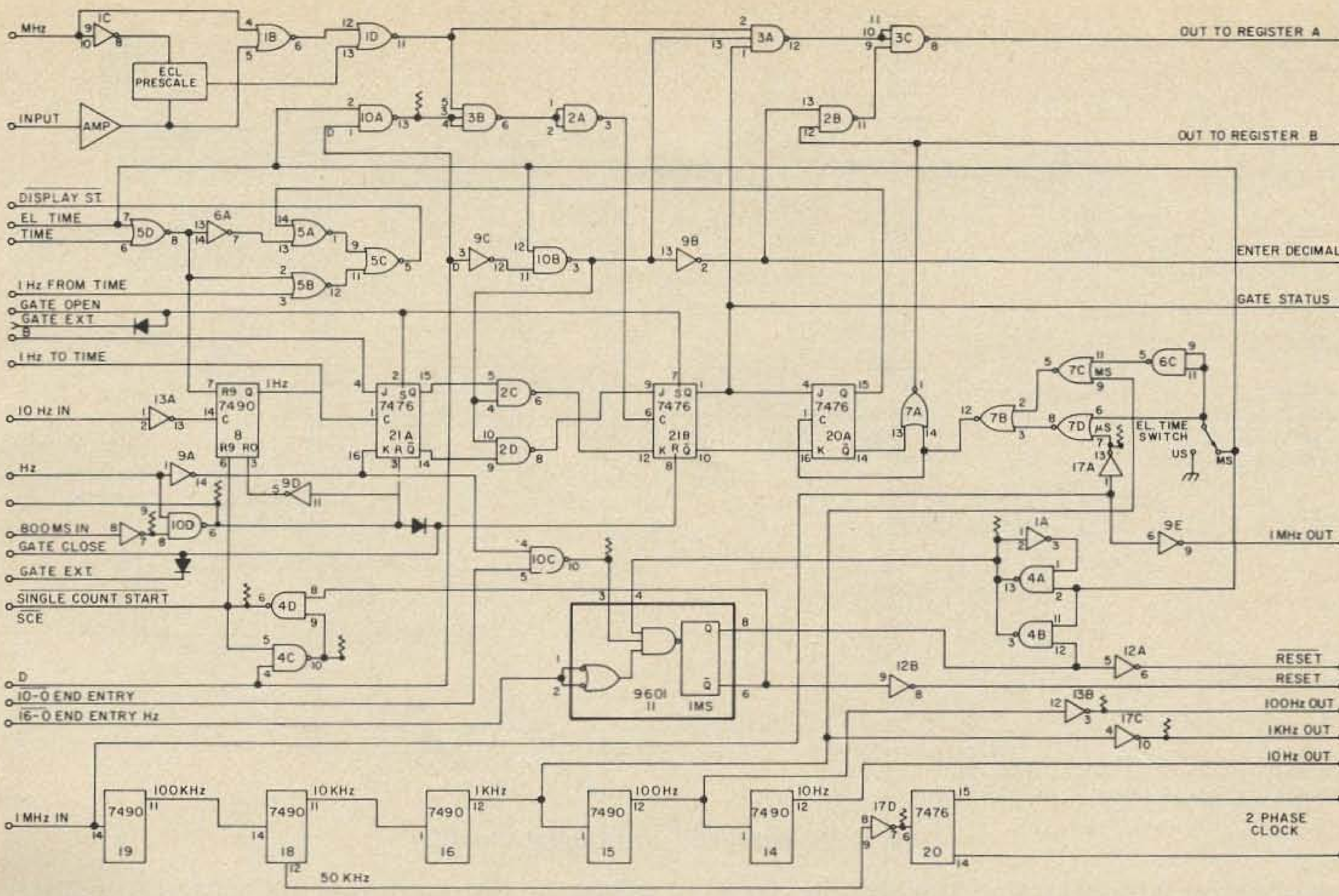


Fig. 4. Input Gate, Clock and Reset.

improves accuracy in the frequency calculate (Hz) mode, and reduces hunting of the last digit which is common to all counters.

The front end of the input board (Fig. 7) includes a wideband amplifier[4] and a high speed prescaler[2], both described later. Gates in the signal path (1D, 2A, 3A, 3B, 3C), flip-flop 21, and the input divider of register "A" should be selected for high speed performance.

Assume for the moment that decade divider 8 is enabled (Fig. 4), and we are in the kHz (Standard Count) mode. The first 1 Hz pulse arriving at the count input of FF 21A causes the Q output to go high (gates 2C & 2D are enabled via gate 10B and the J & K inputs of FF 21B are conditioned to permit it to toggle "on"). The input signal is routed to the count input of FF 21B via gates 1B, 1D, 3B and 2A and the first subsequent input pulse causes FF 21B to turn on. Gate 3A is now enabled, and following input pulses are routed to register A via gates 3A and 3C. FF 20A was also set to toggle "on" by FF 21A and the first 1 MHz pulse at the count input of FF 20A causes it to turn on, and gates 5A and 5C cause the display-start line to go high. This readies the display entry logic. (1 MHz pulses are routed to register "B," but are not used in this mode.)

After exactly 1 second, FF 21A switches off, and conditions FF 21B to switch off. The next input pulse causes FF 21B to switch off, and gate 3A closes. Register "A" now contains the count of input pulses during a one second interval. FF 20A promptly switches off (about 1 microsecond later), the display-start line is brought low, and the digit entry logic is initiated. When all digits have been entered (about ¼ second), the 10/0 line goes low, and the one-shot generates a 1 ms reset pulse, which clears registers "A" and "B," and simultaneously sets decade divider 8 to a count of 9, through gate 4D. About one tenth of a second later (in the continuous count mode), divider 8 reaches a full count, transmits a pulse to FF 21A, and a new count cycle begins.

Single Count

When line D is high, after the count/display sequence, gates 4C and 4D are locked up by the reset pulse, and divider 8 is held at a count of 9. The start (SCE) line is brought down each time the single count

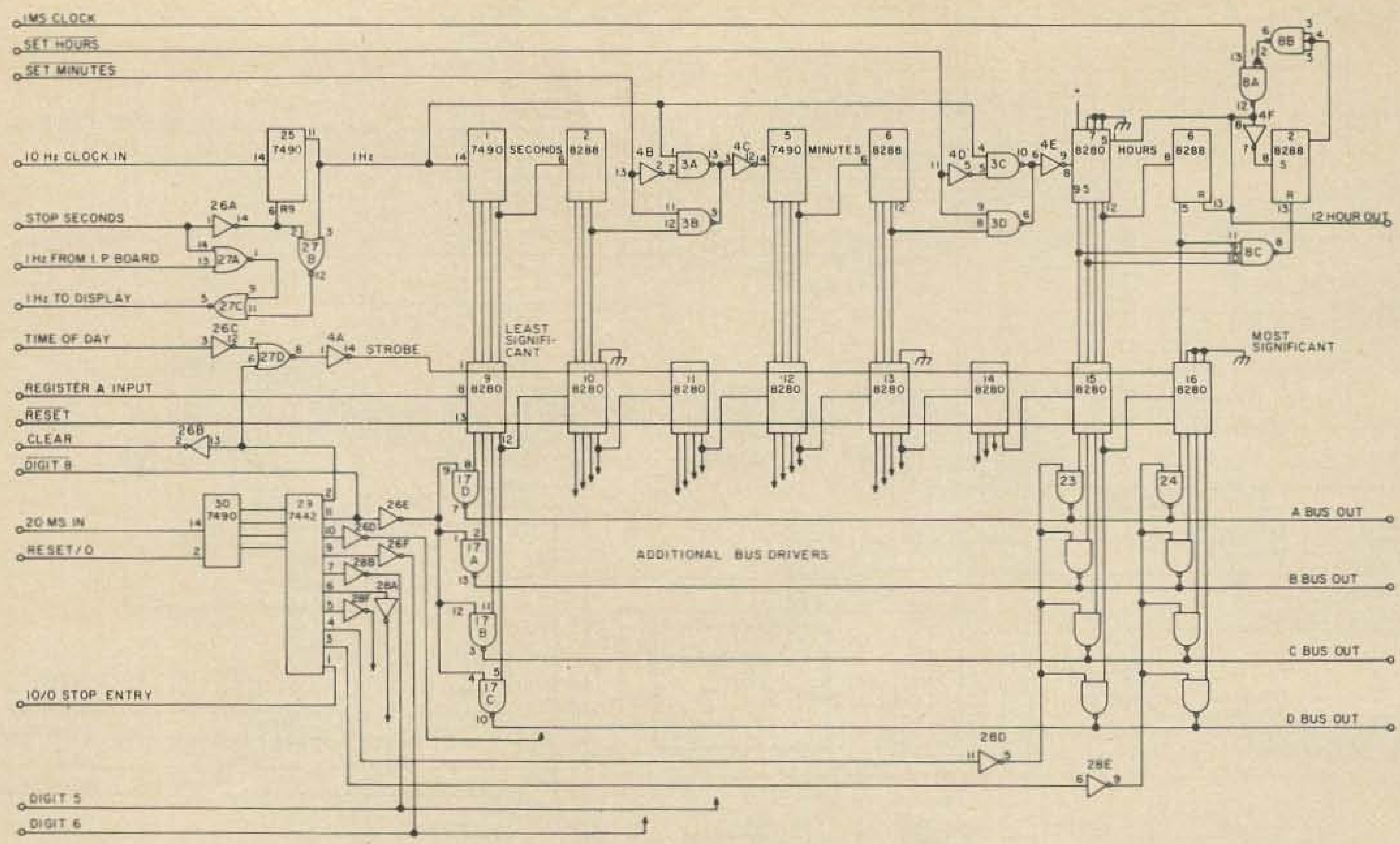


Fig. 5. Register "A" and Digital Clock.

push-button is operated, restarting divider 8, a new count, and resetting gates 4C and 4D.

Calculate Frequency (Hz) Mode

A logical 1 on the Hz line enables gate 10D, prevents FF 21A from resetting from its count input, and prevents (gate 10C) the 10/0 line from initiating a reset pulse. Gate 3A is enabled via FF 21A and FF 21B, similar to the kHz mode. It should be noted that FF 20A (which follows gate 3A by 1 microsecond) routes 1 microsecond pulses via gate 7A to register "B" in all count modes. In the Hz mode, when register "B" has counted 800 milliseconds, it sends a pulse via gate 10D to reset FF 21A. The next input pulse closes gate 3A via FF 21B, and gate 7A closes about 1 microsecond later. Register "A" now contains the number of input pulses which were counted during the time (in microseconds) stored in register "B." The display-start line causes entry of the number stored in register "A," a "divide" function, the period measurement in register "B," and a second divide (equals) function (which calculates the frequency), and initiates a reset pulse via the 16/0 line.

Elapsed Time and Event Counting Modes

When the elapsed time line is high, divider 8 is disabled via gate 5D, and either input pulses or timing pulses are routed to register "A," depending upon the status of "D" (gates 9B, 9C and 10B). Microsecond or millisecond timing pulses may be selected by a back panel switch. In the elapsed time mode ("D" is low), the gate may be operated via the regular counter input, or via the manual or external gate inputs. Pressing "Single Count" and "Elapsed Time" together selects event counting, and input pulses are routed to register "A" when the gate is opened manually or externally. In these modes, display-start occurs once each second (gates 5D & 5B), and the reset generator is disabled via gates 1A, 4A and 4B. A single reset pulse is generated each time this mode is selected, which permits each count to start from zero.

Clock and Countdown Chain

In order to assure count accuracy, the clock oscillator must have high stability. The circuit chosen[6] has proven to be very stable. There is little sense in providing 7 or 8 digits of readout unless the clock oscillator is stable to 10^7 or 10^8 or better.[4] When the digital clock is adjusted to keep time to ½ second in 10 days, accuracy is better than 10^6. Methods of obtaining better accuracy are available, but are beyond the scope of this article.[3] The oscillator is further discussed later.

All devices in the clock chain, and the time-of-day register are provided with battery standby. Interfacing between these devices and other logic devices was made via open collector buffers. Provision of pull-up resistors to the regular 5 volt line, and powering these buffers from the battery, avoids the possibility of glitches when the counter circuits are switched off.

Registers

Data registers and associated logic are diagrammed in Fig. 5 and 6. Referring first to Register "A," it can be seen that pulses presented to the input are counted during the interval the input gate is open. When the gate closes, counting stops and Data Entry Logic is enabled. Divider 30 (Fig. 5) is caused to count up, at a 20 millisecond rate, from "zero" through 8, and then resets to "zero." Decoder 29 changes the BCD output of divider 30 to a "one of ten" output. Each group of 4 gates to the data bus is enabled in turn, which causes the BCD output of the associated decade counter (high order first) to be presented to the BCD data bus (gate 24 presents divider 16, gate 23 presents divider 15, etc.). When divider 30 reaches the count of 8, a signal on the "stop entry" line stops further counting of divider 30, resets it to "zero," and in turn prevents further data entry.

At this stage, the calculator is displaying the contents of register "A." In the kHz and MHz modes, no further data entry occurs, and a new count cycle begins. Data Entry Control Logic will be discussed more thoroughly later.

The time-of-day register utilizes decade and divide-by-twelve dividers to determine the current time. Gates 26A, 27A, 27B, 27C and divider 25 are provided to permit setting the clock. Dividers 1 and 2 divide the 1 Hz pulses by 60, providing one minute output pulses, and storing the "seconds" of the time. Dividers 5 and 6 similarily divide by 60 providing "minutes", and an hourly output pulse. Divider 7 and the divide by 2 (flip-flop) portion of divider 6 provides a 12 hour count register. When a count of "13" is sensed by gate 8C, the hour register is preset to 1 through the action of FF2 and gates 8B and 8C.

The 8280 dividers used in register "A" have a very valuable feature. When the strobe input is raised to logic "1," the divider is preset to the value found on its BCD inputs. This feature permits parallel loading of time-of-day data into register "A" simply by strobing the 8280 dividers.

Time-of-day can then be entered into display, just as if it were a "count." Note that the digits between the "seconds" and minutes, and between the "minutes" and

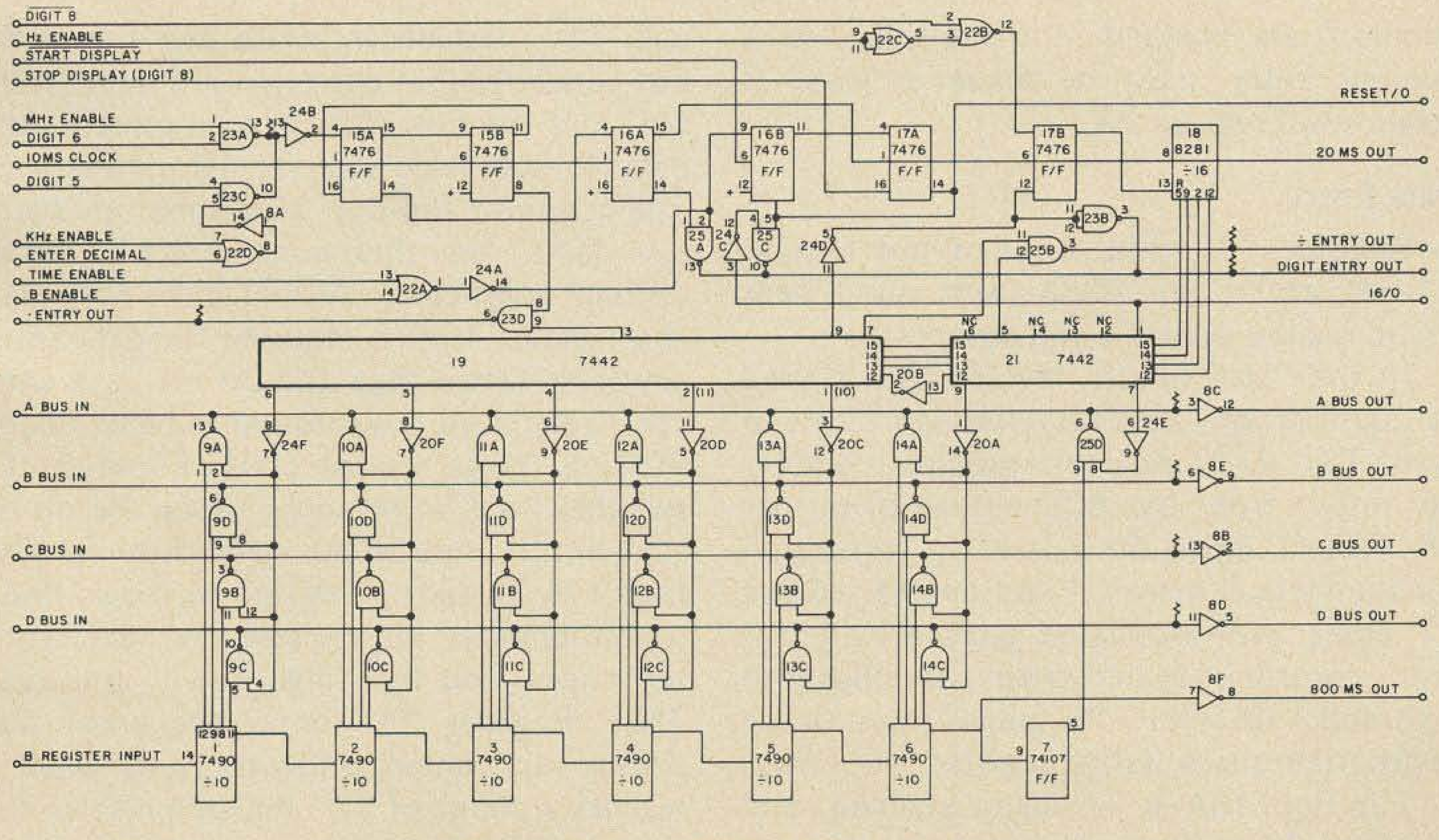


Fig. 6. Register "B" and Entry Logic.

Count Mode - kHz

Decimal Point Preset at "3"

1. Open Input Gate
2. Close Input Gate (1 second later)
3. Clear Display (CE)
4. Enter 5 High Order Digits From Register "A"
5. Enter Decimal Point
6. Enter 3 Low Order Digits From Register "A"
7. Clear Registers

Count Mode – MHz

Decimal Point Preset at "3"
Prescaler Activated

1. Open Input Gate
2. Close Input Gate (1 second later)
3. Clear Display (CE)
4. Enter 6 High Order Digits From Register "A"
5. Enter Decimal Point
6. Enter 2 Low Order Digits From Register "A"
7. Clear Registers

Count Mode – Hz

1. Open Input Gate
2. Open Clock (Register "B") Gate
3. Close Input Gate (When Register "B" Full)
4. Close Clock Gate
5. Clear Display (CE)
6. Enter 8 Digits From Register "A"
7. Enter Three Zeroes
8. Enter "Divide" Command
9. Enter 4 High Order Digits From Register "B"
10. Enter Decimal Point
11. Enter 3 Low Order Digits From Register "B"
12. Enter "Equals" ("Divide") Command
13. Clear Registers

(Delay New Count Cycle to Provide 2 Second Update)

Elapsed Time Mode

Route Clock (MS or uS) Pulses to Register "A" (gated)
Route Input to Control Input Gate
Update Once Each Second
Clear Register "A"

1. Clear Display (CE)
2. Enter 5 High Order Digits From Register "A"
3. Enter Decimal Point
4. Enter 3 Low Order Digits From Register "A"

Accumulate Count Mode

Route Input Pulses to Register "A"
Update Once Each Second
Clear Register "A"

1. Clear Display (CE)
2. Enter 8 Digits From Register "A"

Time-of-day Mode

Blank 2 Digits
Update Once Each Second

1. Clear Display
2. Load Register "A" From Time-of-Day Register
3. Enter 8 Digits From Register "A"

Calculate Mode

Lock Out Data Entry Sequencer
(Keyboard Always Live)

Continuous Count Mode (Hz, kHz, MHz)

Enable Automatic Count Restart (input gate) on Register Clear Signal

Single Count Mode (Hz, kHz, MHz)

Manual Count Restart (input gate)

Table 1. Calculate/Count Program.

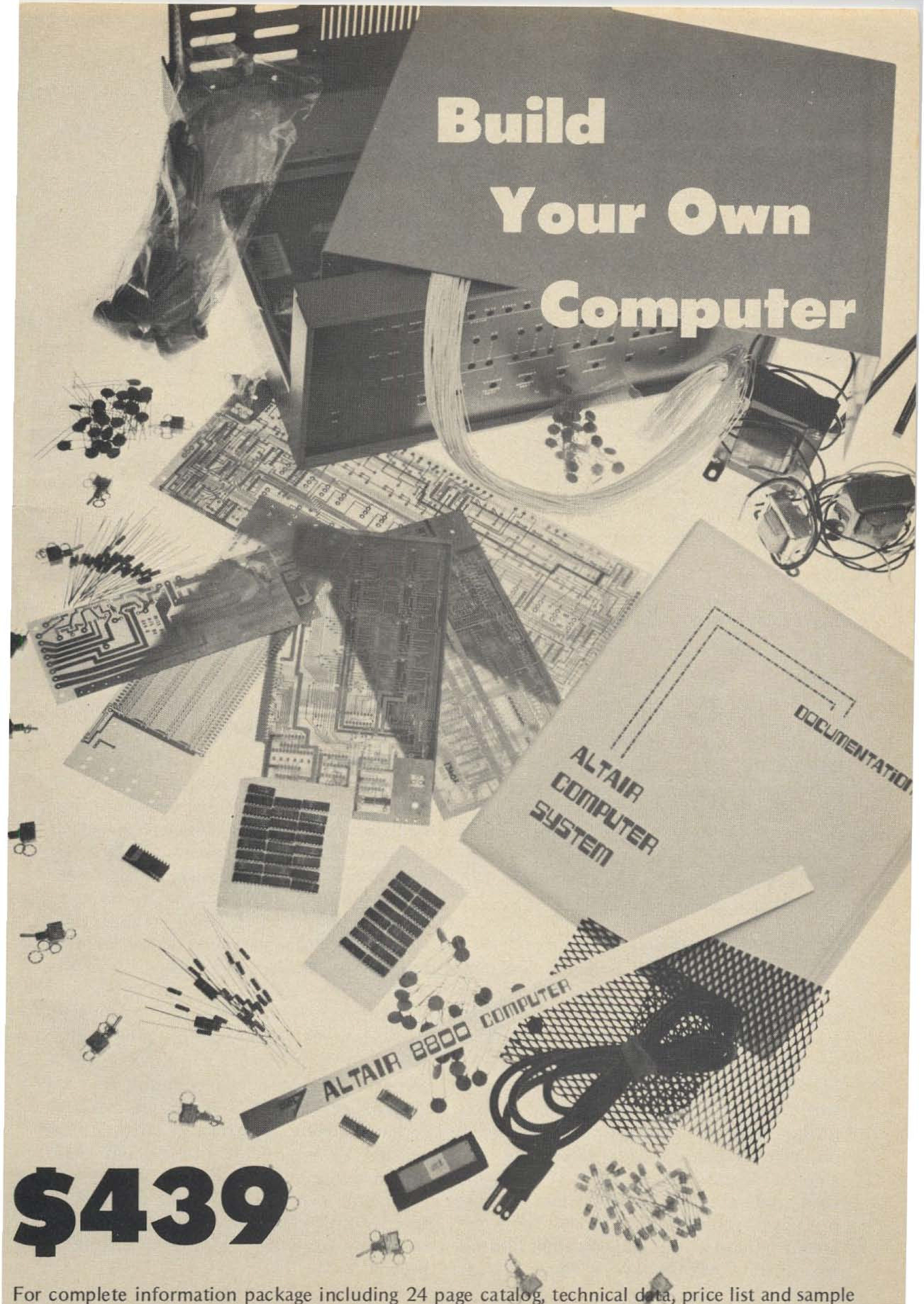
"hours," are blanked in the display, so a dummy entry must be made in these 2 positions of register "A."

Data Entry

Register "B" (Fig. 6) does not require parallel entry, so 7490s were used here (more readily available and cheaper).

In the "Hz" modes, divider 18 is caused to count from "zero" up through "15" to zero. Two 7442 decoders provide a one-of-16 output from the BCD output of divider 18. Table 1 shows the data entry "program" for the various modes. Flip-flops 15, 16 and 17, along with associated gates, provide for entry control of both registers, and flip-flops 15A and 15B enter a "decimal" point in the appropriate place during register "A" entry.

Flip-flop 16A is normally enabled, and provides 20 millisecond pulses to the two data entry sequencers. Gate 25A signals the bus converter that there is valid data on the bus, and the converter in turn presents this data to the calculator for 10 milliseconds. The action of flip-flop 16A is inhibited (and no digits are therefore entered) during decimal point entry. Although the 5001 data sheet states 4 ms is required for data entry, anything faster than the 20 ms data entry cycle rate chosen was found to be unreliable with my bargain price 5001. Flip-flop 16B switches "on" in response to a pulse on the start-display line (input gate closure). Flip-flop 17A is then permitted to toggle "on," which unlocks the register "A" data entry sequencer, and the "digit entry" line (gate 25C). Register "A" entry sequencer then counts up (entering digits), and when it reaches a count of "8" the stop-display line permits flip-flop 17A to toggle off, which


Build
Your Own
Computer
ALTAIR
COMPUTER
SYSTEM
DOCUMENTATION
ALTAIR 8800 COMPUTER
$439

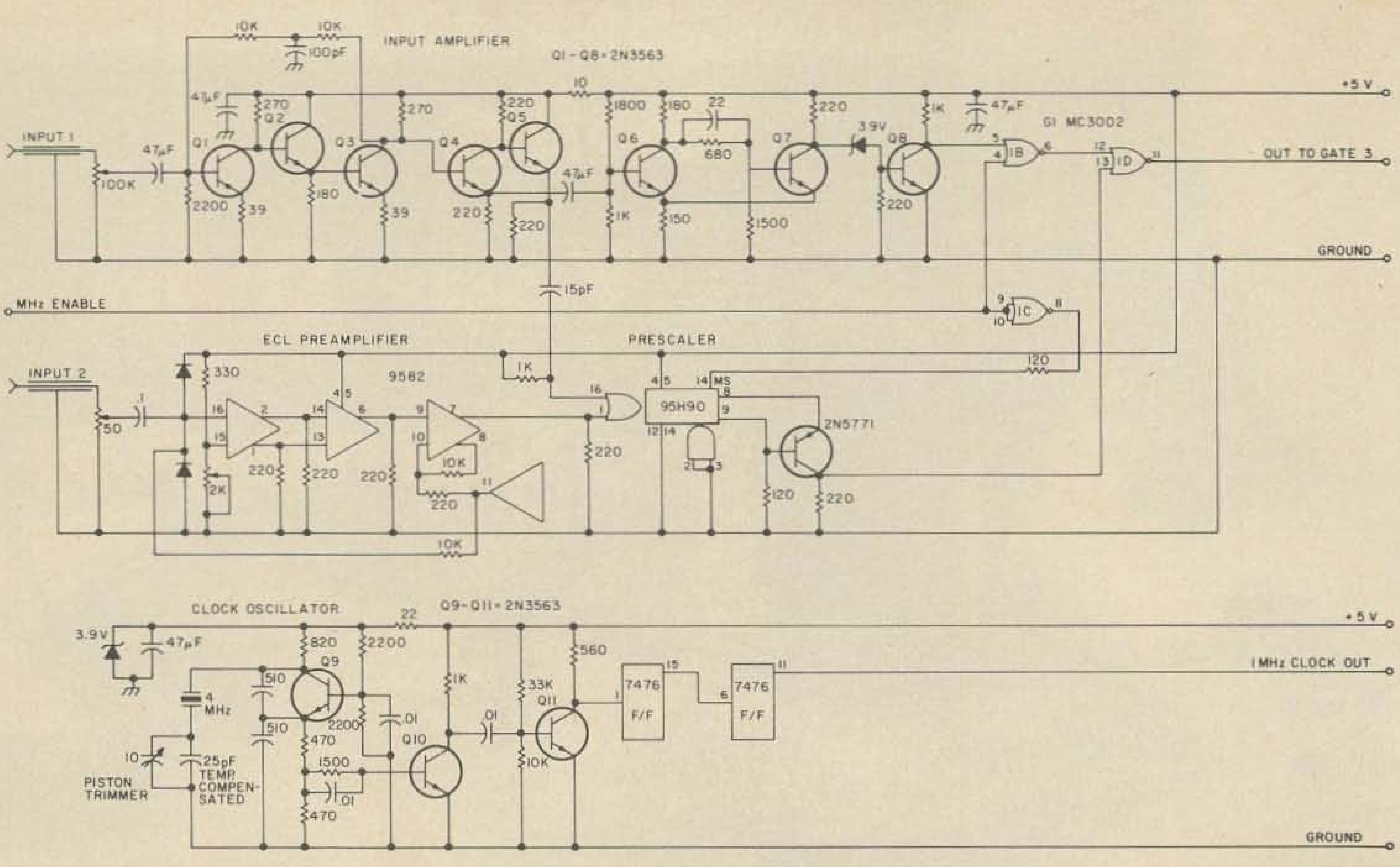


Fig. 7. Details: Input Amplifier, Prescaler, Clock Oscillator.

resets the entry sequencer to "zero" and stops further entry of register "A."

In the "Hz" mode, a count of "8" on the register "A" entry sequencer permits flip-flop 17B to toggle "on" which enables the 8281 register "B" entry sequencer (18) and unlocks the digit entry line at gate 25C. Register "B" entry sequencer then counts up, entering register "B," and at count 15 gate 24D enables the flip-flop 17B "K" input. The next count pulse causes sequencer 18 to return to a "zero" count, and simultaneously toggles flip-flop 17B "off," which disables divider 18.

Input Amplifier and Prescaler

Details of the input amplifier and prescaler are shown in Fig. 7. The input amplifier uses low-cost high speed 2N3563 transistors throughout. The input amplifier has a passband from ½ Hz through at least 150 MHz. This amplifier is described elsewhere[4] and is highly recommended. (Some resistor changes were found necessary to optimize response.) The 9582 ECL preamplifier was found to have less sensitivity than the discrete preamp, and stability proved a problem. In retrospect, the writer would eliminate the ECL preamp, and use the discrete preamp for all input signals. (Reference 14 discusses improvements to the prescaler.)

The 95H90[2,11] prescaler functions exactly as expected. Again, power supply impedance is critical[2] and .01 discs must be used liberally to ensure stability. The output transistor as recommended is a 2N5771.

Clock Oscillator

Time base stability is very important if accurate counts are to be expected. The oscillator circuit[6] was chosen after much experimentation. The crystal is a 4 MHz HA type (high accuracy) ordered for room temperature use. This frequency seems to be about optimum for thermal stability, and use of a series/parallel combination of NPO and negative temperature capacitors for the crystal series capacitor permits stability to be adjusted.[3] The 10 pF capacitor is a glass piston trimmer and can be anything smaller than 10 pF (4 pF probably is about right if you can find one). Q9, Q10 and Q11 are 2N3563 or 2N4274. Use of this oscillator permits stability to 1 part in 10^7 or better without an oven. The author's unit keeps time to better than ¼ second to WWV over a two-month period. Only a very slight difference in time-keeping ability was noted when the unit was run "warm" for a similar period.

Mode Switching

Use of 8 open collector TTL 2 input NAND gates (or inverters) connected as 4 S/R flip-flops permits a completely electronic mode switching system. The configuration of these flip-flops is set by pressing one of the mode push-buttons. The flip-flops then "remember" what mode switch was last pushed.

Outputs at the first three flip-flops are decoded by six 3-input NAND gates. The fourth flip-flop is used to control the single count function, and also, together with the "elapsed time" mode, to provide an "accumulate" mode. LEDs indicate the mode presently in use. Operation of either the kHz or MHz button presets the calculator to 3 decimal places. This permits display of the decimal in the appropriate location. An extra decimal point LED was mounted between the 5th and 6th digits (from the right) and connected via a driver to the MHz function. This provides a reading of xx.xxx.xx in this mode. (Although it might appear that the MHz function should preset 2 decimal places, the decimal point is entered in the proper place by the data entry logic.) Germanium diodes should be used in the "decimal preset" line to ensure that TTL inputs are brought below their switching thresholds.

Power Supply

In order to avoid loss of power to the digital clock, a battery standby has been provided for the clock circuits. Referring to Fig. 8, a constant current regulator, comprised of a 2N3055 and a 2N3569, maintains the Nicad battery in a fully charged state. The voltage regulator using another 2N3055 and a 2N3698 is somewhat unusual. A voltage doubler driven by G1 and G2 provides sufficient current to the 2N3055 to maintain it in saturation when the input voltage drops to 5.2 volts or less. This ensures adequate output voltage to drive the TTL clock circuits until the battery voltage drops to about 4.7 volts. At this point, zener diode Z1 (with diodes D5 and D6) reduces the base current to the 2N3055, which results in a drop in output voltage. Lowered voltage to the TTL countdown chain causes a loss of clock drive to the voltage doubler, and results in a complete shut-down of the voltage regulator. Deep discharge of a Nicad

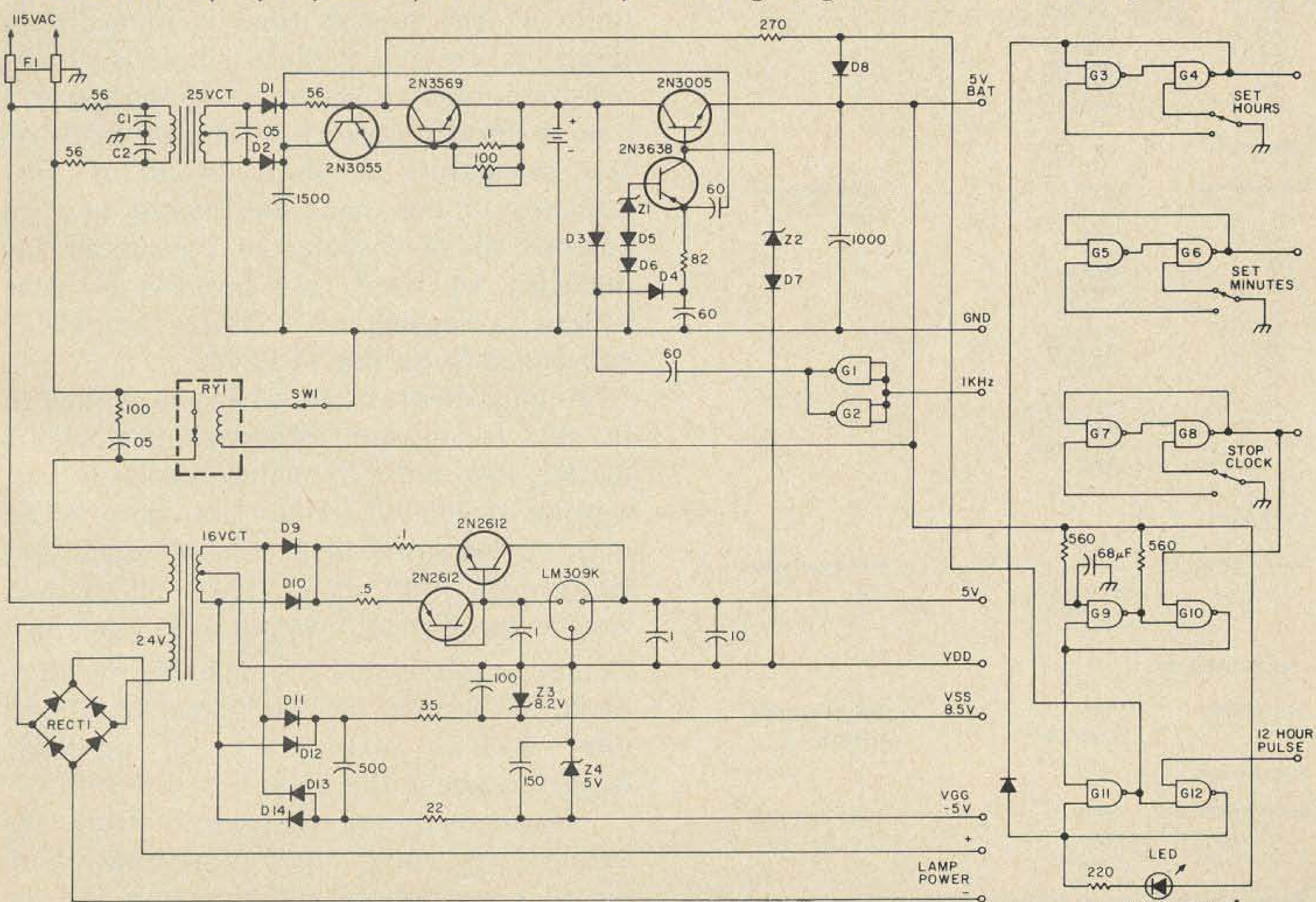


*Fig. 8. Power Supply. *This LED signals a power off condition until the clock is reset.*

battery would result in permanent cell damage.

Zener diodes Z1 and Z2 with their associated forward diodes must be chosen to provide about 5.7 volts at the base of the 2N3055, and about 5 volts at the base of the 2N3638. (Note that throughout this project transistors were chosen mostly for their ready availability in the writer's junkbox, and suitable substitutions are in order.)

REGISTER "A"

Device Number	Device	Similar Equivalent
1	7490	
2	Signetics 8288	74193, 74161
3	RM1004D	7401, 7403
4	F3005663	7404
5	7490	
6	8288	
7	8280	74160, 9310, 74192, 8310
8	7410	
9 – 16	8280	
17 – 24	RM1004D	
25	7490	
26	F3005663	
27	SN2790N/F3005664	7402
28	F3005663	
29	7442	
30	7490	

REGISTER "B"

Device Number	Device	Similar Equivalent
1 – 6	7490	
7	74107	
8	F3005663	
9 – 14	RM1004D	
15 – 17	7476	
18	8281	74161, 9316, 8316
19	7442	
20	F3005663	
21	7442	
22	SN2790N	
23	RM1004D	
24	F3005663	
25	RM1004D	

INPUT SYNC

Device Number	Device	Similar Equivalent
1	MC3002	7402
2	7400	
3	7410	
4	RM1004D	
5 – 7	SN2790N	
8	7490	
9	F3005663	
10	RM1004D	
11	MC9601	
12	7440	
13	RM1004D	
14 – 16	7490	
17	RM1004D	
18 – 19	7490	

READOUTS

Device Number	Device	Similar Equivalent
1 – 2	RM1004D	
3 – 4	F3005666	

INPUT CIRCUITS

Device Number	Device	Similar Equivalent
1	RM1003D	MC3007

POWER SUPPLY

Device Number	Device	Similar Equivalent
G1 – G8	7400	
G9 – G12	RM1004D	

Table 2. Devices and Equivalency. Duplications not listed.

The main 5 volt supply[13] uses a PNP 2N2612 transistor to provide about 4 Amperes of regulated dc, controlled by the 1 Ampere LM309K. The second 2N2612 is diode connected to provide a voltage drop similar to the base-emitter drop of the pass transistor, and as it is mounted on a common heat sink, provides thermal stabilization. MOS voltage levels are provided by simple zener regulators. Note that Vdd is grounded, whereas the 5001 data sheet references voltage levels to Vss. Lamp power is unfiltered, which reduces readout brilliance changes with the widely varying readout load.

Three bounceless switches are provided for setting the time. Gates G9, G10, G11 and G12 increase the battery charge rate upon restoration of power after discharge. The high rate continues until first the "stop clock" (set seconds) switch is operated, and then a 12 hour pulse is received at midnight or noon. (That is, the high rate stops at noon or midnight after the time has been reset.)

Using the Calculating Counter

The completed counter has proven to be a very useful tool. By merely switching the unit on, the precise time is immediately displayed. Instead of those laborious parallel resistor computations with pad and paper, a precise calculation can be quickly made on the calculator. A short piece of wire attached to the input and placed near an antenna allows checking of transmitter frequencies. (A hand held business portable yielded a reading of 155.610.15 MHz – authorized frequency 155.610.)

As indicated earlier, while we wished to be able to measure frequencies through 2 meters, low audio frequency resolution was a prime target. All frequencies above 10 Hz may be measured to 5 or more significant figures. (A sixth digit shows, but as previously mentioned, hunting in the last digit cannot be eliminated.) Frequencies down to about ½ Hz may be determined to 3 (plus one) decimal places, if your obsession happens to be in this area.

Measurement of frequencies from the author's electronic organ proved easy with use of a microphone and a preamp, but the piano proved to be a little more challenging.

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4. Icom/VHF Eng.
5. Ken/Wilson
6. Regency HR-2A/HR212/Heathkit HW-202
7. Regency HR-2B
8. S.B.E.
9. Standard

The first two numbers of the frequency are deleted for the sake of being non-repetitive. Example: 146.67 receive would be listed as – 6.67R

1. 6.01T	9. 6.13T	17. 6.19T	25. 6.31T	33. 6.52T	41. 7.06R	49. 7.18R	57. 7.30R
2. 6.61R	10. 6.73R	18. 6.79R	26. 6.91R	34. 6.52R	42. 7.69T	50. 7.81T	58. 7.93T
3. 6.04T	11. 6.145T	19. 6.22T	27. 6.34T	35. 6.94T	43. 7.09R	51. 7.21R	59. 7.33R
4. 6.64R	12. 6.745R	20. 6.82R	28. 6.94R	36. 7.60T	44. 7.72T	52. 7.84T	60. 7.96T
5. 6.07T	13. 6.16T	21. 6.25T	29. 6.37T	37. 7.00R	45. 7.12R	53. 7.24R	61. 7.36R
6. 6.67R	14. 6.76R	22. 6.85R	30. 6.97R	38. 7.63T	46. 7.75T	54. 7.87T	62. 7.99T
7. 6.10T	15. 6.175T	23. 6.28T	31. 6.39T	39. 7.03R	47. 7.15R	55. 7.27R	63. 7.39R
8. 6.70R	16. 6.775R	24. 6.88R	32. 6.99R	40. 7.66T	48. 7.78T	56. 7.90T	

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Supplied with 2 channels:	146.94Tx/Rx (national calling channel)	Input voltage (negative ground):	12.5V dc ±20%
	146.34Tx/146.94 Rx (repeater channel)	Circuitry:	All solid state
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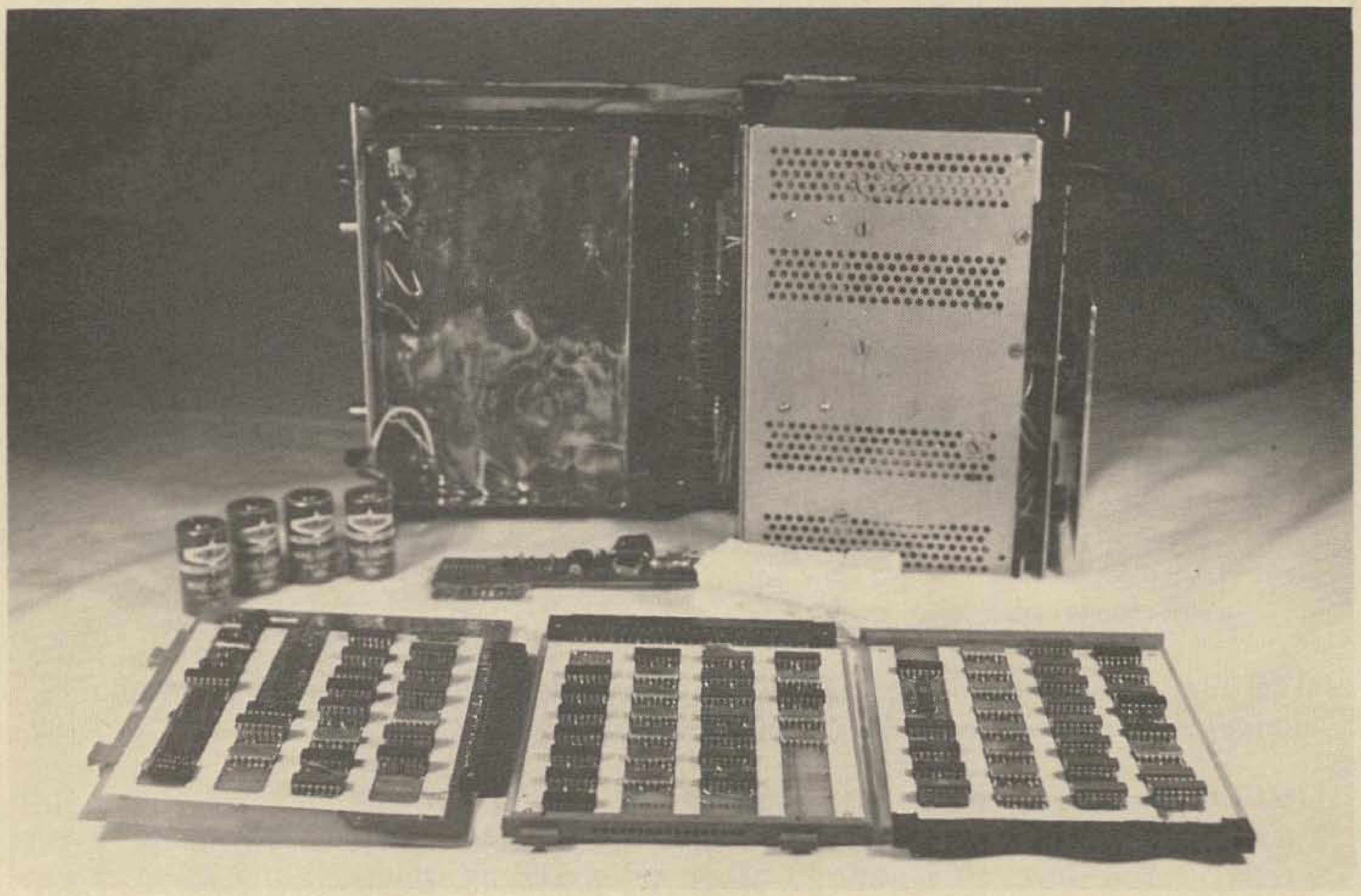

Bottom view of counter. The shiny surface on the left is a copper shield between the input board and the calculator boards. The oscillator board is in the center. Left is the input board, and the other two boards contain the time-of-day register and the count logic and registers.

A recent article[15] described a combination oscillator/tunable filter. When connected between a microphone preamp and the counter, the filter permitted a fundamental to be isolated from its harmonics. Furthermore, the high "Q" of the filter acts to sustain the note long enough to permit measurement. When a piano key is struck, and the single-count button operated immediately, a count may be accurately obtained before the note decays. It is said that a mechanical tuner cannot properly tune a piano, as octaves are not precise multiples, and multiple string notes have delicate differences in the tuning of the individual strings. One might nevertheless learn much by exploring a tuned piano.

It is the writer's hope that this article may evoke an interest in the many MOS devices currently on the market at most attractive prices.

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. . . JOHNSON

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A Satellite Fax System You Can Build

Part One

One of the more persistent questions which I encountered in correspondence regarding my previous articles on weather satellite picture displays is why I didn't work up something for facsimile display of satellite pictures. I have always had a certain attraction to facsimile and the only thing that kept me out of that particular ball game was sheer mechanical ineptitude. I felt that I was at my limit using a simple chassis punch, and the thought of trying to construct a piece of "precision" facsimile equipment seemed a little more than I was willing to try. Prodding by Lindsay Winkler W6WMI, the author of the interesting article on an SSTV FAX machine (73, March 1973) was constant. Wink kept sending me some excellent pictures produced by Virgil Neher W6KT using a homebuilt photographic facsimile system and I finally had to give it a try – if only to retain my charter membership in the Lost Order of Home Brewers. The present project, which represents the illicit union of integrated circuits, some tried and tested tube circuits (you do remember tubes, don't you?), miscellaneous plumbing fixtures, and a kitchen rolling pin, was the final result. As it turns out, both CRT and FAX systems have strong points and shortcomings, which I will detail later. An active weather satellite station should have capability for both modes.

The circuit details described here assume that you will be starting from scratch. The electronics are very straightforward, with the main challenge being the mechanical tinkering to arrive at optimum performance. No fancy machine tools are required – I don't have any and if I did I would probably only maim myself – so rest assured that you can Rube Goldberg yourself into the ballpark with nothing more than normal workshop tools. The project uses tubes in some parts of the circuit, so you will be able to justify having kept all that junk around if the XYL is still asking.

The first question that might occur is why build from scratch? Why not modify a commercial machine? The answer is that a photographic system, printing directly on photographic paper, is not only fast and cheap, but gives the best possible picture quality. Very few photographic facsimile machines are available and all would require extensive modification to the point where it's easier to start from ground zero. Similar systems can be worked up from machines using Teledeltos papers (Deskfax) or the better Alden machines and papers, but the results achieved, while adequate, will suffer in comparison to either a CRT or photographic facsimile system.

Principles of Operation

Fig. 1 shows a block diagram of the FAX system. There are two ways to look at the

NOAA satellite video format. It can be considered at 48 line per minute format, in which half the line represents IR data and half visible light data. Alternatively, the format can be viewed as a 96 line per minute system in which alternate lines of visible and IR data are displayed. On this run through we will use the first of these. If satellite video is arriving at the rate of 48 lines per minute, we have to rotate the drum of the facsimile recorder at 48 rpm, in order that one revolution of the drum corresponds to one line of video. A light gun, containing a high intensity modulated light source focused to a small spot, will paint the picture on the photographic paper as the drum rotates. The light gun must be slowly pulled (or pushed) along the length of the drum to provide "vertical" scanning as the image is built up. This is accomplished by a small slow speed motor operating a threaded rod which engages a nut on the carriage assembly for the light gun. Proper operation of the system requires that the drum operate at precisely the line rate of the satellite video, so a synchronous motor is required. Although there are 48 rpm synchronous motors, they are difficult to obtain so a 60 rpm motor is operated on 48 Hz ac (instead of the normal 60 Hz) to obtain 48 rpm output.

During reception of a satellite signal, the satellite video is recorded on the right channel of a stereo tape deck while an accurate 4800 Hz tone, derived by a digital countdown chain from a 4.8 MHz oscillator, is recorded on the left channel. During picture display the satellite video from the right channel of the tape deck is filtered and amplified, and routed to a high level video driver to modulate the light gun. Output from the light gun is highest in black areas of the picture and lowest in white areas so the processed photographic paper will have a positive image. The 4800 Hz tone on the left channel is used to lock a phase locked loop (PLL) to 4800 Hz. The PLL output is divided to 48 Hz by a digital countdown chain and this 48 Hz signal is amplified by a high level class AB_1 amplifier to provide 48 Hz ac at 120 V to operate the drum motor at 48 rpm. Since the crystal controlled 4800 Hz tone was recorded simultaneously with the satellite signal, any variations in tape speed during playback will be "tracked" by the PLL and the ac driving the drum motor will shift in frequency to compensate, resulting in the maintenance of a stable sync condition despite flutter and wow in the recorder.

A word here about the recording process. Many of the earlier articles on satellite picture reception stated that "live" display was preferred to a recorded signal, in that the recorded signal was rarely equal to the "live" version. This may well have been the case several years ago but is no longer. Modern recorders of the "hi-fi" type, and integrated circuit PLL and digital countdown chains, result in a situation where there is no observable difference in quality between recorded and "live" picture display. Working from recordings is infinitely easier and will have no effect on picture quality.

Up until this point we have not mentioned picture phasing – alignment of the synchronized picture with the edge of the paper wrapped around the drum. The complete NOAA data display contains two areas of potential interest, the earth scan picture in the visible light channel and an identical

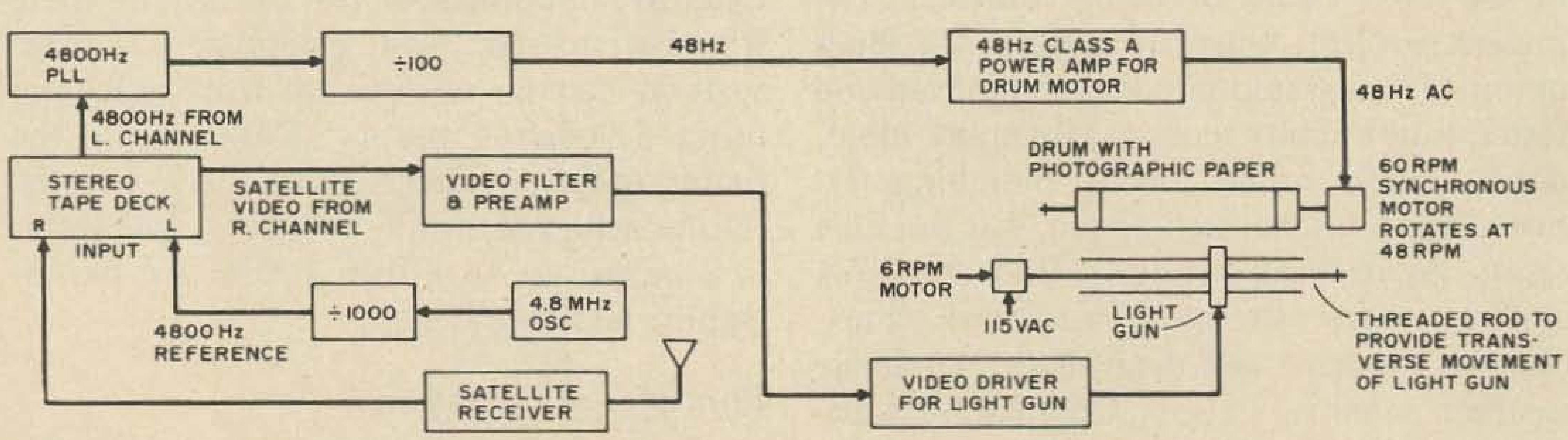


Fig. 1. A block diagram of the weather satellite facsimile system.

view as produced in the infrared waveband. Each of these earth scan images occupies 30% of the total length of the scanning line (circumference of the scanning drum). The remaining 40% of the line is taken up by space scan, telemetry, grey scale, instrument restore periods, and timing data, much of which is of little interest to us. At any given time we are usually interested in only one of the two images – visible channel during daylight passes and IR channel during evening passes. Thus, the image of interest on any particular pass occupies only 30% of the line length. This means that if we randomly slap paper on the drum, fire up the recorder, and print a picture, with no attention to phasing at all, the chances are 70% that the desired image will not fall on the point where the paper overlaps. This means that 70% of the time a usable picture could be printed with no attention to phasing. The other 30% represents situations where you would have to repeat runs or tape the complete picture from the overlapping paper ends.

There are two general situations where phasing is required. First, if you are a purist and want all the satellite data printed out neatly and uniformly, phasing will be required to correctly "place" the image on the photographic paper. Secondly, if you are using an oversize drum to increase picture size, and the stock paper size will not fit completely around the drum, you must phase to accurately align the desired part of the satellite image onto the portion of the drum which is covered by paper. The end of the construction phase will outline a very simple phasing system to accomplish precision alignment. The major disadvantage of phasing is that an external oscilloscope, or other CRT display, is required.

Solid State Module

The most critical functions in the system are performed by a simple module using ICs and other solid state devices. The circuit (Fig. 2) is simplified considerably by the use of several devices in more than one function,

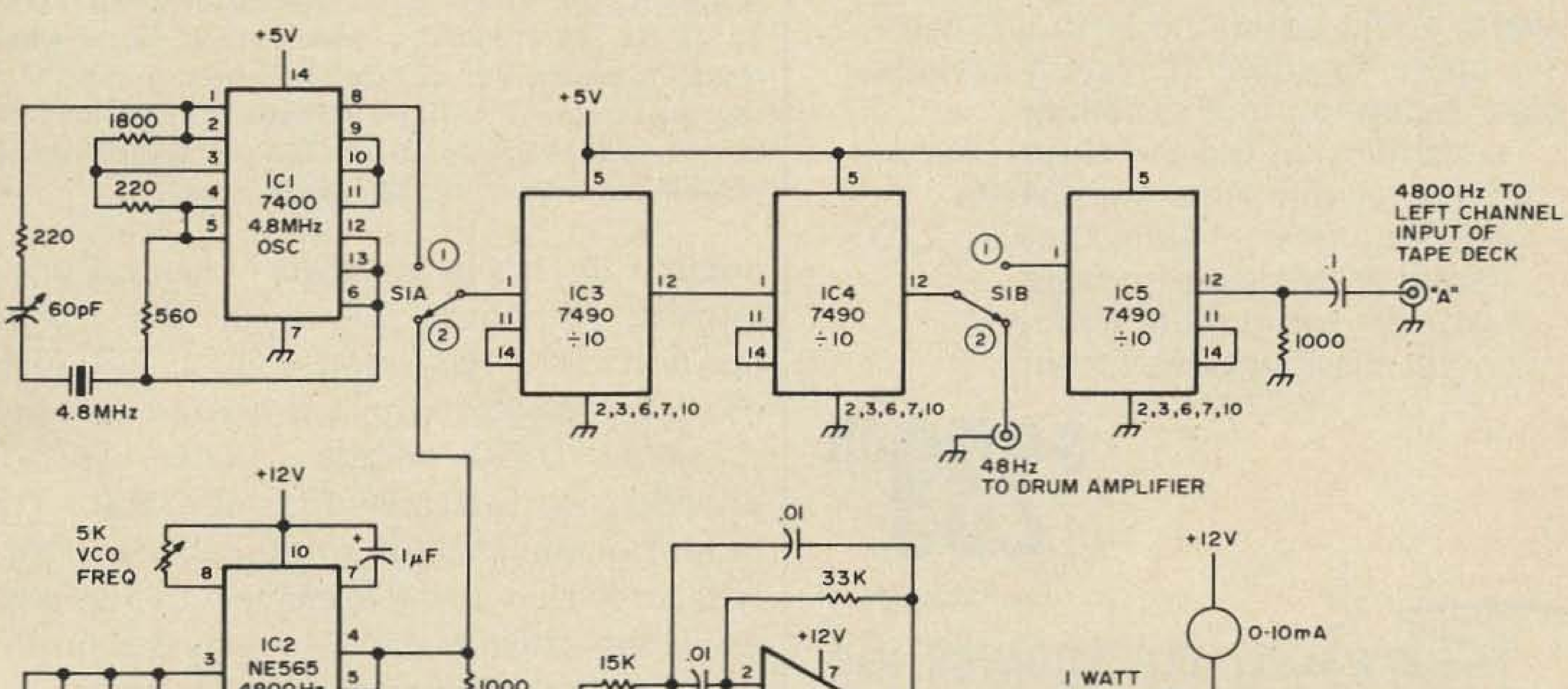


Fig. 2. Solid state module. All resistors ¼-½ Watt; capacitors are 1 V mylar. S1 – DPDT; pos. 1 for receive, pos. 2 for display. S2 – SPST for phasing, open for phase, close for lock and run. VCO frequency adj. should be set for a free running frequency (S2 open) of 4700 Hz at pins 4 and 5 of IC2. The 60 pF capacitor in the 4.8 MHz oscillator circuit (IC1) should be set for an oscillator frequency of 4.8 MHz or exactly 4800 Hz at output jack A with S1 in position 1. The 4.8 MHz crystal should be a precision series resonant AT cut – send the oscillator schematic with the order. Surplus crystals might be suitable provided you can get them on frequency. The better the crystal the better the long term stability of the reference source.

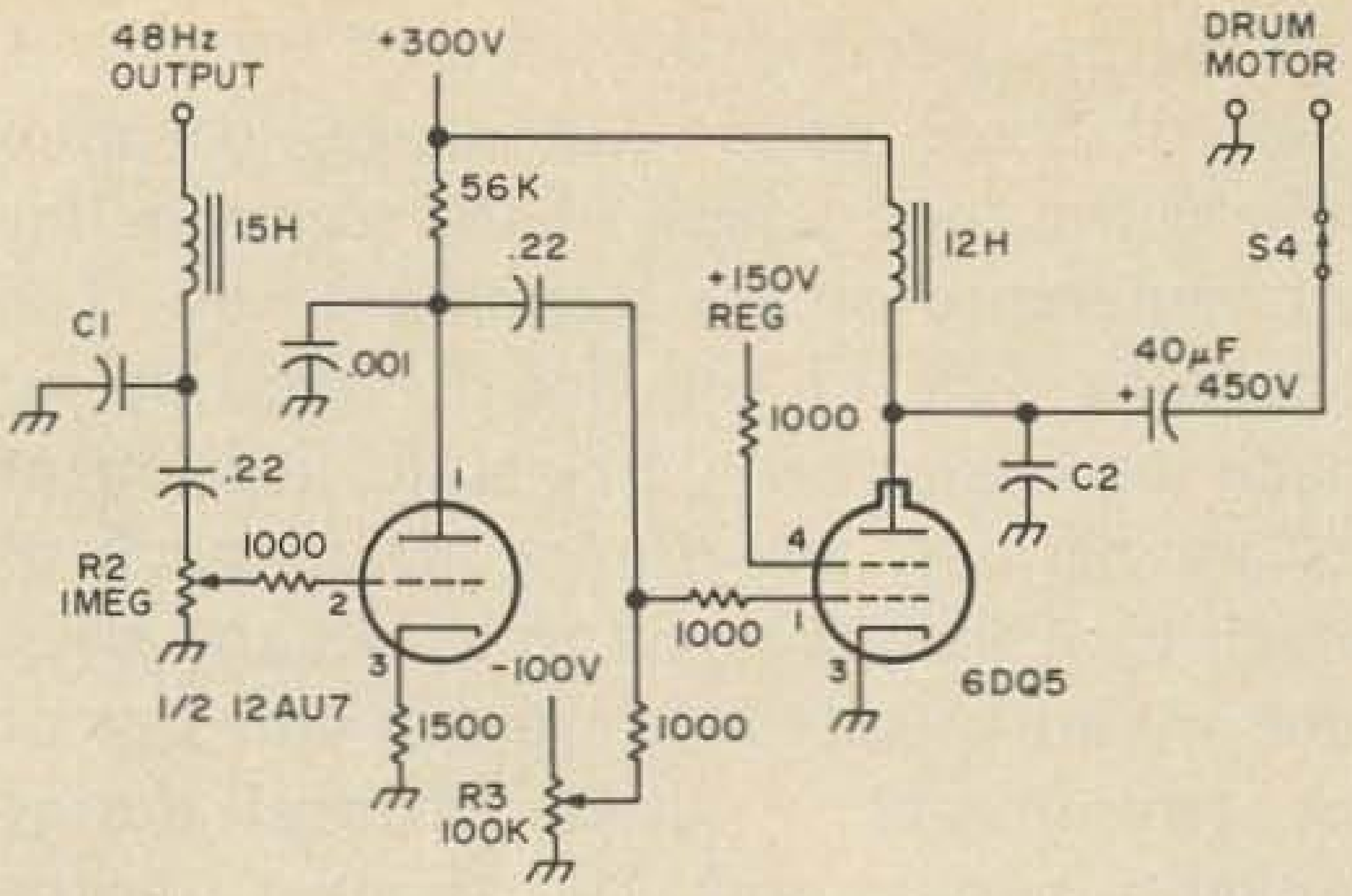


Fig. 3. Drum amplifier. Unless otherwise noted, fixed resistors are ½ W 10%; capacitors are disc ceramic; pots are 2 W composition. Within reason, any inductance can be used with the input and output chokes, as long as a suitable value capacitor is used to bring the tuned circuit to 48 Hz resonance. C1 and C2 should be mylar units and the required capacitance can be obtained by paralleling smaller values. With the choke values shown, C1 should be 0.7 mF and the individual capacitors may be 100 V units. C2 should be 0.9 mF, and 600 V units should be used. If other chokes are used, an LC of 1.1×10^{-5} at 48 Hz may be used to calculate the value of the capacitor required. The input choke may be relatively high resistance but the output choke handles power and thus should be as low a resistance as possible. Adjust R2 for 120 V ac at the motor when driven by 48 Hz. S4 – SPST – open to stop motor while changing paper, etc. R3 should be set for -50 V at the center arm. A fixed voltage divider may be substituted; calculate on the basis of the fixed bias voltage available from the supply in use.

notably the ICs in the divider chains. During satellite reception, S1 is in the receive position (1). IC1 serves as a 4.8 MHz oscillator whose output is routed to three successive 7490 decade counters (IC3-5) providing a total division of 1000. The output of the chain is a 4800 Hz signal that is recorded on the left channel of the deck while the satellite signal is recorded on the right channel. During picture readout S1 is in the display position (2). IC2 is an NE-565 PLL with a free running frequency near 4800 Hz. The pre-recorded 4800 Hz reference signal locks up the PLL, whose square wave output is routed through a divide by 100 countdown chain (IC3 and 4), providing a phase locked 48 Hz output which will be used to drive the drum motor amplifier. Satellite video from the right channel of the tape deck is routed through IC6 which serves as a 2400 Hz bandpass filter with a bandwidth of 1000 Hz and unity gain. The filtered video signal is then routed to a small IC or transistor amplifier which serves as a preamp to drive the video amplifier circuits for the light gun. Any small 1 Watt audio amplifier will work here, including any of the many small transformerless IC circuits. I use a small discrete component amplifier from Radio Shack. Very little output is required into the coupling transformer (T1), and a small 0-10 mA meter in either the + or - supply line to the amplifier will provide an indication of video level. Virtually all of the small amplifiers available, whether IC or discrete, are class B, drawing very little current when idling and, when driven, having current roughly proportional to the drive level. Few devices are required for this module, and the whole circuit can be assembled on a small piece of perf board with 0.1" hole spacing to accommodate the ICs. Sockets are recommended for the integrated circuits so they will not be damaged in wiring up the unit. I have my module mounted in a separate cabinet because it is part of the CRT system

The main chassis of the FAX unit. The 12AU7 and 6DQ5 in the drum amplifier circuit are toward the back of the chassis, with the lamp driver circuits (12AU7 and 6CL6) along the front edge. T2 in the lamp driver chain is mounted below the chassis. The front panel meter (M2) monitors lamp current. The three toggle switches on the front of the chassis control the on/off functions of the drum motor, traverse motor and lamp. The cable to the light gun plugs into the top of the chassis near the 6CL6, while the power cables for the FAX recorder motors plug into connectors on the rear apron.

as well, but if FAX alone is desired it can be mounted on the same chassis as the tube circuits to be described.

Drum Motor Amplifier

Fig. 3 shows the class AB_1 amplifier used to power the drum motor. Although a solid state circuit could be used for this purpose, I decided to go the tube route and use an existing supply. There is nothing original about the circuit – it's cribbed from marginal notes on a letter from W6WMI. The circuit is straightforward and trouble free. A 15 H choke and capacitor, resonant at 48 Hz, distorts the square wave (from the solid state module) to a good sine wave, and drives ½ of a 12AU7 and a 6DQ5. The 6DQ5 output stage is resonant at 48 Hz and drives the drum motor windings through a 40 mF coupling capacitor. The input level to the 12AU7 is adjusted to provide 120 V ac to the motor windings. The filament voltage, bias voltage and 300 volts are obtained from my SB-102 power supply. You can build a separate supply of course, but if a suitable supply is already available a new power cable is certainly cheaper then what they are asking for power transformers these days. The regulated +150 volts can be obtained from the 300 volts via a 5k Ohm 8 Watt dropping resistor and an OA2 regulator.

Lamp Driver

Fig. 4 shows the lamp driver circuit which operates a glow modulator tube in the light gun. The circuit is a modified version of a circuit described by Ruperto in a recent Amateur Scientist section of Scientific American (Jan. 74). The original circuit was designed by W6KT. In my version, the filtered hi-Z video from the solid state module is fed to a 12AU7 with its triode sections in parallel. The 12AU7 drives T2 with the full wave diode detector circuit in the secondary. The detected video is filtered to remove 4800 Hz components (resulting from full wave detection of the 2400 Hz satellite video subcarrier) by the 88 mH toroid and associated capacitors. The filtered waveform, now containing only video components, is fed to a 6CL6, which drives a Sylvania R-1168 glow modulator tube in the light gun. A meter in series with the lamp provides an indication of lamp current. The polarity of the video detector diodes results in maximum amplitude from the glow tube in black picture areas and minimum amplitude in white areas. The black level, maximum lamp current with no video input, is set by the 250 Ohm pot in the cathode circuit of the 6CL6.

Both the drum amplifier and the lamp driver can be assembled on a single chassis (see photo) along with the 150 volt VR tube. The modest power requirements of the unit are easily met with a transceiver power supply.

Drum Size and Motor Requirements

Synchronous motors are used in the facsimile recorder to achieve the required accuracy in all of the phases of picture display. Such motors are available in a

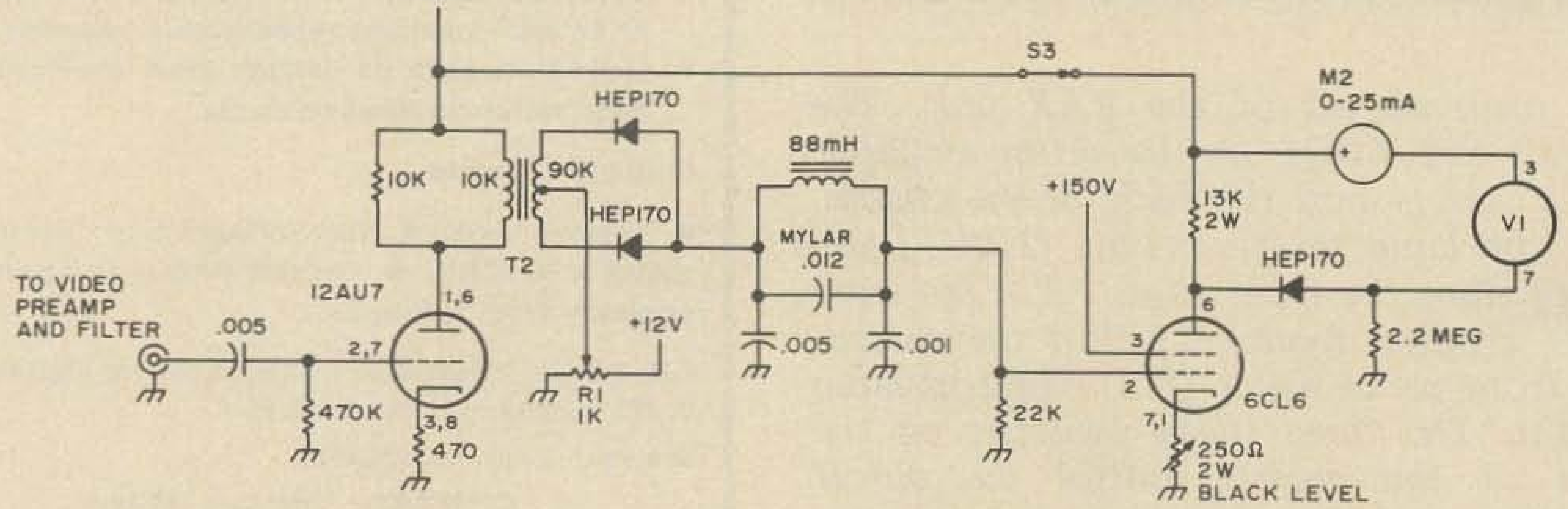


Fig. 4. The lamp driver circuit. Unless otherwise noted, all fixed resistors are ½ W 10%; capacitors are disc ceramic; pots are 2 W composition. R1 – start with +2.4 V on T2 centertap. Black level – adj. for 10-20 mA of lamp current (M2) with no video input. Exact level depends on paper used (see text). The 0.012 mF capacitor can be made up by paralleling 100 V mylar units of .01, .001, and .001 mF. See set up instructions for input level adjustment. S3 – SPST – turns off the lamp on standby.

Drum Diameter (inches)	Design rpm	Drive Motor Selection	Earth Scan Width (")	Picture Length (10 min. display)
2.0	6.9	6/60	1.9	3
2.25	7.7	8/60	2.1	4
2.5	8.6	8/60	2.4	4
2.75	9.5	12/48	2.6	4.8
3.0	10.6	10/60	2.8	5
3.25	11.0	10 or 12/60	3.0	5 or 6
3.5	12.0	12/60	3.3	6
3.75	13.0	12/60	3.6	6
4.0	13.8	12/60	3.8	6
4.25	14.7	20/48	4.0	8
4.5	15.5	20/48	4.3	8
4.75	16.4	20/48	4.5	8
5.0	17.1	20/48	4.7	8
5.25	18.0	20/60	5.0	10
5.5	18.9	20/60	5.2	10
5.75	19.8	20/60	5.4	10
6.0	20.6	20/60	5.7	10

Table 1. Traverse drive motor requirements and picture geometry for various drum sizes. The design rpm is the calculated rpm, driving a 20 turn per inch threaded rod, to achieve the proper aspect ratio. The drive motor selection shows the stock motor speed and drive frequency (Table 2) that comes closest to the design figure. The picture width indicates the width of the earth scan image in either the visible or IR channel, and the picture length is based on a ten minute pass. A 15 minute pass would result in an image 1.5 times longer, 20 minutes, 2x, etc.

variety of sizes from small units of 3 Watts or less, used for timing devices such as clocks, to very powerful units. We want motors with sufficient torque to carry out the operations required, but it doesn't pay to go to excessively large motors, particularly in the drum drive, since they would put too high a load on the drum amplifier. Motors rated between 100 and 150 inch/oz. of torque (ratings based on 1 rpm) are about right. It is also desirable to have motors that are reversible. With the recorder built according to the diagram in Fig. 5, if the drum motor turns the drum counterclockwise the light gun should move from the right end of the drum to the left in order to print out the picture. With a standard right hand thread on the lead screw rod this means the traverse motor should also turn

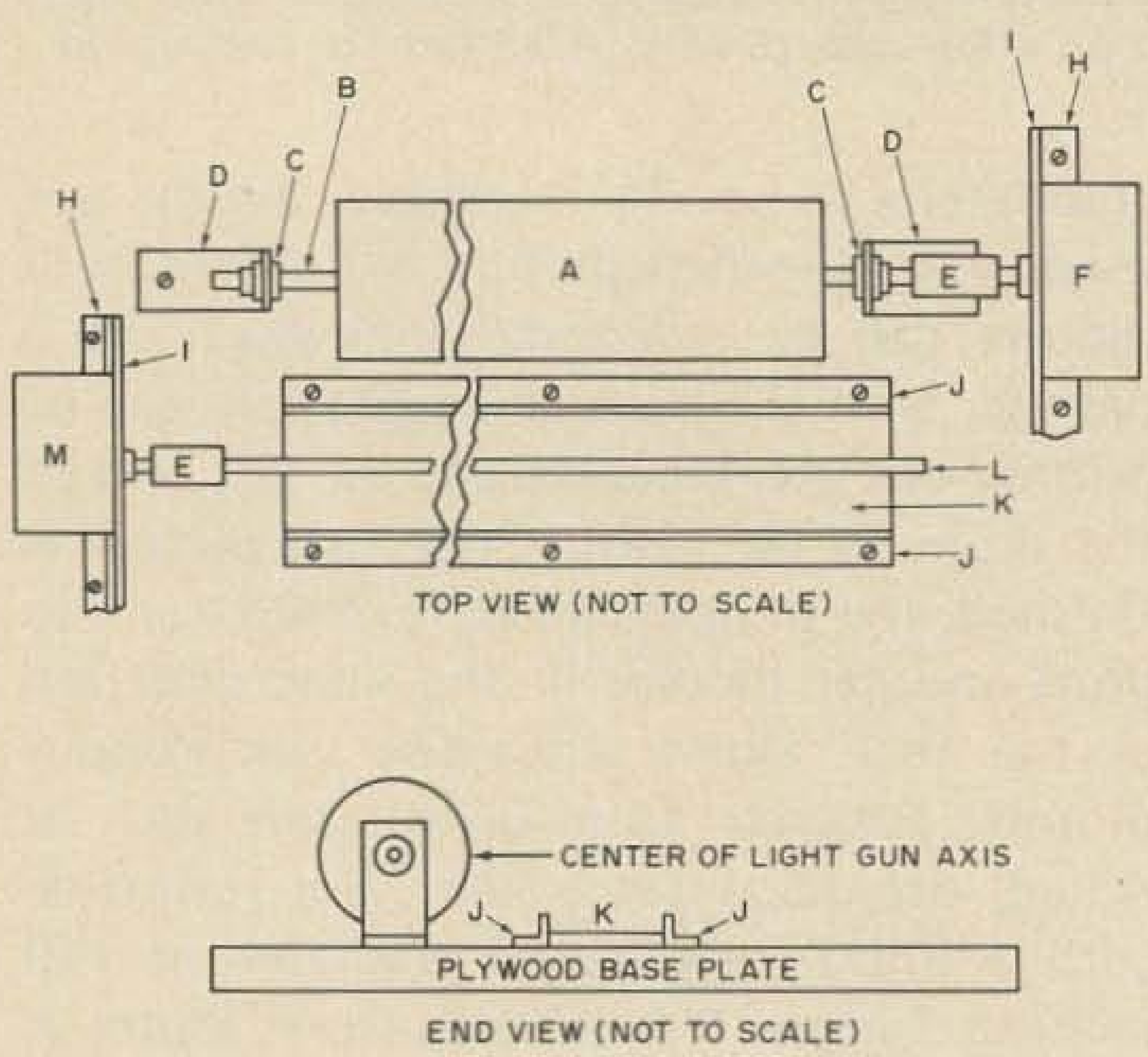
60 Hz rpm	48 Hz rpm
6	.4
8	6.4
10	8
12	9.6
20	16
30	24
60	48 (use for drum drive)

Table 2. Standard Hurst DA series, 150 inch/ounce synchronous motors (reversible) showing their operating speeds (rpm) on 60 Hz (normal) and 48 Hz ac. When ordering, specify the 60 Hz speed.

counterclockwise. If reversible motors are used, once the first picture is finished both motors can be reversed (clockwise) and a picture, with the correct orientation, can be printed out going back from the left end of the drum to the right. Once that picture is finished, the motors can be reversed again to print another picture in the same direction as the first. Hurst series DA synchronous motors, available from distributors such as Allied, are ideal since they are reversible with a SPDT switch and are rated at 150 inch/oz. torque. If a 60 rpm Hurst motor is operated on 48 Hz ac, the drum will turn once for every line of video, causing the visible and IR images to be displayed side by side. The drum size is all important in defining the remaining parameters of the system for in order for the picture to have the proper appearance the light gun must traverse the drum at a speed proportional to the drum diameter. If the traverse rate is too slow for the drum size in use, the picture will be too short in relation to its width, distorting clouds and other features. If the rate is too fast the picture will be "stretched" vertically, again distorting the proper aspect ratio. Since we standardize on the use of a 20 turn per inch threaded rod in the traverse assembly, the only variable in achieving the proper traverse speed with any particular drum size is the rpm of the traverse motor.

Without going into the calculations (which I will gladly supply to anyone who sends an SASE), Table 1 shows the design rpm required for different drum sizes so the resulting pictures will have the proper aspect ratio. Let's say you pick up a nice rolling pin from your local store and find that it measures 2.5" in diameter. According to Table 1, the proper rpm for the traverse lead screw would be 8.6. Fine, now just try to find an 8.6 rpm synchronous motor. As we can see in Table 2, the standard Hurst speeds (available from Allied) are 6, 8, 10, 12, 20, 30 and 60 rpm. No 8.6! The closest we can come is the 8 rpm unit (listed in the motor selection column of Table 1), which will do the job without producing enough distortion to notice. Let's take another example. Assume a drum diameter of 2.75". The proper design value is 9.5 rpm. If we look at Table 2 we see that a 12 rpm motor, operated on 48 Hz instead of 60, will give an output speed of 9.6 rpm; the motor selection column in Table 1 thus calls for the 12 rpm motor operated on 48 Hz. We would simply hook the motor to the output of the drum amplifier, just as we do for the drum motor. If the motor selection column calls for the use of 48 Hz with any particular motor, the drum amplifier should be used as the ac source, while if 60 Hz is required the normal ac line may be used. Table 1 should be used to pick the proper traverse motor for the drum size you plan to use.

The additional factor which is determined by drum size is the final picture size. The



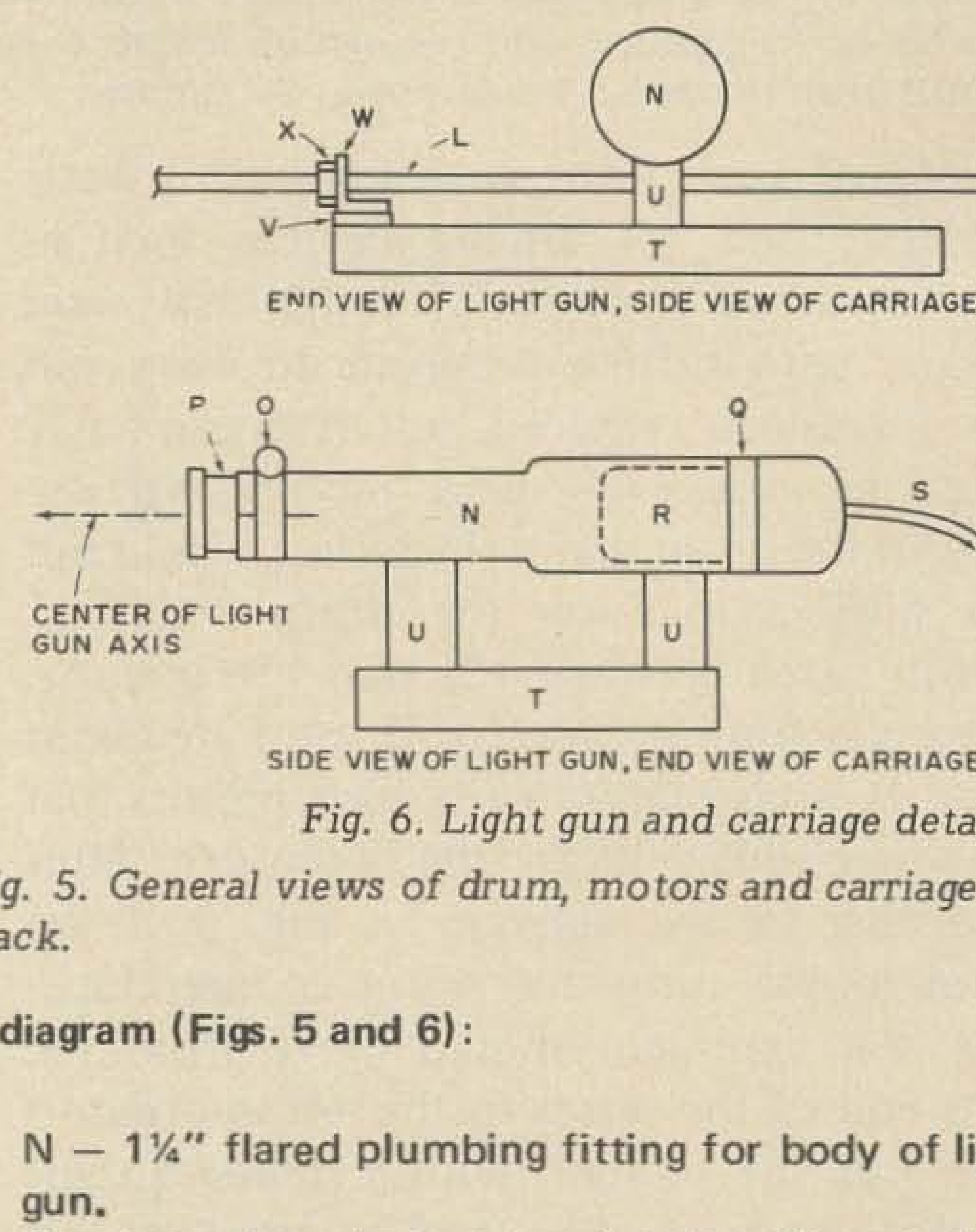


Fig. 6. Light gun and carriage details.

Fig. 5. General views of drum, motors and carriage track.

Key to elements of FAX diagram (Figs. 5 and 6):

A – drum, plastic rolling pin, or other material.
B – ¼" steel rod – epoxied to drum.
C – cut down (shortened) 3/8" panel bushing for ¼" shaft, used as bearing.
D – steel angle brackets mounted to base plate.
E – stiff rubber coupling from drum shaft to drive motor.
F – 60 rpm synchronous motor for drum drive.
G – not used.
H – ½" aluminum angle bracket to fasten motor mounting plate to base.
I – 1/16" fiberglass PC stock for motor mounting plates.
J – ½" aluminum angle stock screwed to base to form carriage track.
K – glass plate epoxied to base between rails.
L – ¼" 20 threaded rod for carriage drive.
M – synchronous motor for carriage drive (see text for speed).
N – 1¼" flared plumbing fitting for body of light gun.
O – hose clamp to lock lens into the slit end of the light gun.
P – standard 1¼" telescope eyepiece for focusing light beam.
Q – octal socket and shell for glow modulator tube.
R – R-1168 glow modulator tube, slide fit into large end of flared tubing.
S – flexible leads from glow tube socket to main chassis.
T – wooden base of carriage assembly.
U – wooden supports for light gun – epoxy to tube.
V – double stick foam mounting tape.
W – ½" aluminum bracket stock to support traverse nut.
X – ¼" 20 hex nut epoxied to support bracket.

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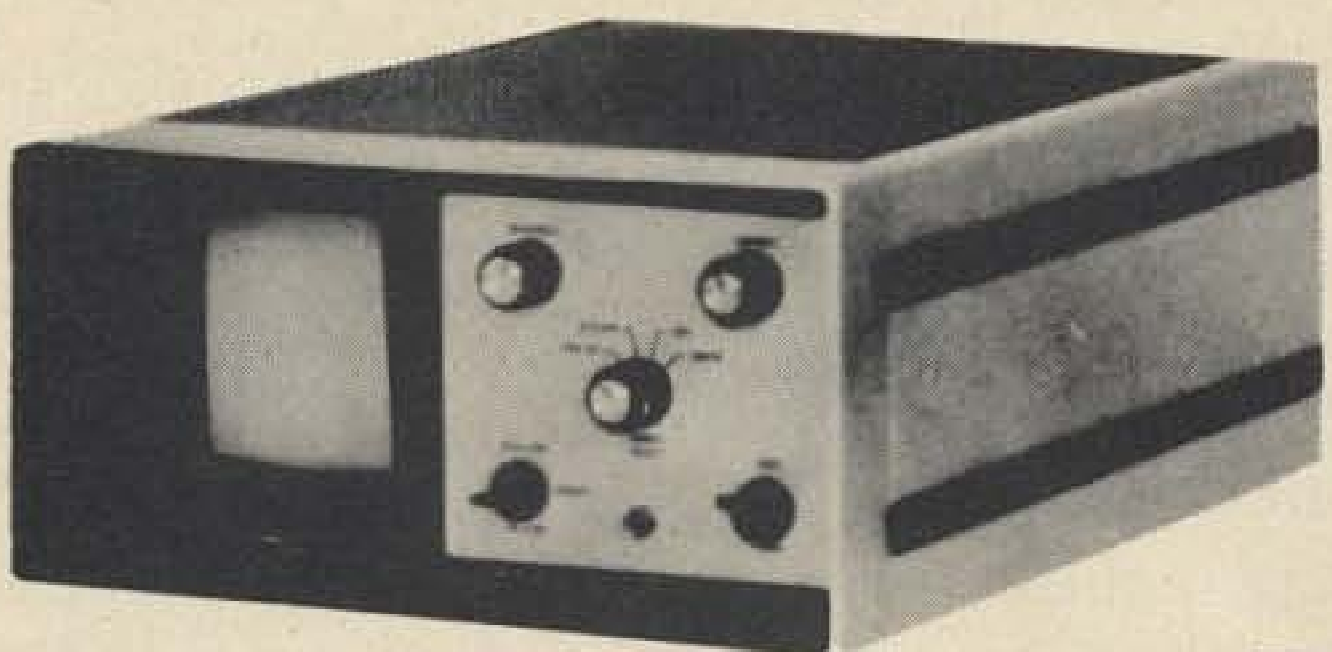

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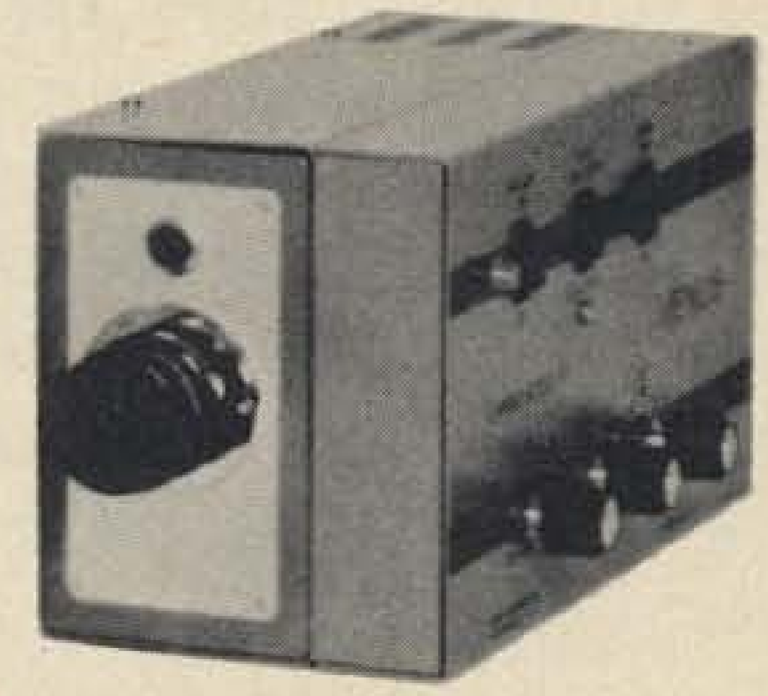

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2.5" diameter drum mentioned previously will print out an earth scan image in both the IR and visible light channels that is 2.4" in width. The length of the image will depend on how much of the pass is displayed – Table 1 assumes 10 minutes. For a 10 minute pass with the 2.5" drum, both the IR and visible channel images would measure 2.4 x 4 inches – about the size of a Polaroid print. With the light gun system described, the images should be perfectly clear with well defined line structure under high magnification. Rolling pin style drums permit two passes (10 minutes each) to be displayed on a single 8x10" piece of photographic paper.

If you simply must have larger pictures, there are two ways to go about it. The first involves running the drum at 96 rpm (a 120 rpm motor on 48 Hz) and electronically blanking out alternate lines of video so that only the visible or IR image is displayed. The traverse motor speed for the lead screw must also be doubled for this approach but the picture comes out twice the size. If only visible channel data are desired, the line blanking is not required due to the pronounced level difference between the visible and IR channels, and you will obtain a larger picture with the small drum format. The second method is simply to use a larger drum. The largest size covered in Table 1 is 6" in diameter. The image width in this case would be 5.7" and its length, for ten minutes, would be 10", about as much picture as can be packed in an 8x10" sheet of photograph paper. With a drum this large the paper will no longer cover the entire surface, so in effect, depending on how you phase the picture, you will be printing only the IR or visible image unless you use oversize paper. Larger drums can be made from almost any cylindrical material including metal juice cans, cardboard tubes, or custom fabricated assemblies. The height of the drum bearings and the height of the light gun must of course be adjusted to your drum size. The only requirement in fabricating a larger drum is that it must turn true when mounted on its shaft; otherwise, portions of the paper will be out of focus as the drum wobbles. Fig. 5 shows a diagram of

The author's FAX recorder. The relationship of the various parts should be clear. The reversing switches and capacitors for the Hurst motors are mounted on the motor mounting plates. The reed switch and battery used for picture phasing (see text) are also shown.

the drum and traverse assemblies and Fig. 6 the details of the light gun and carriage.

Next month: Construction and set up.

...WB8DQT

D. A. Bundey G3JQQ
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Where is *your* simplified, sensitive millivoltmeter?

Here's a practical instrument suitable for home construction which is based upon an integrated circuit (NATIONAL type LM 4250 C). Switched ranges of 5 mV to 500 V are provided.

Construction

Layout has not proved to be critical in the prototype but input leads and associated switching have been kept compact; 2% tolerance resistors have been used throughout. Initial zero adjustment on the 5 mV range is set by selection of Rb in association with potentiometer R2 which is used for fine control. No zero drift has been observed on the prototype even on the most sensitive range.

An internal calibration check is provided on the 5 V and 50 V ranges by a push-button connection to the positive supply rail. This facility is used to adjust the meter deflection initially to 1.4 V on the 5 V range by means of pre-set resistor Rm. The value of the associated fixed resistor rf may also be varied if found necessary to suit the internal resistance of the meter used.

A miniature main switch serves to reverse the input polarity when required. The power

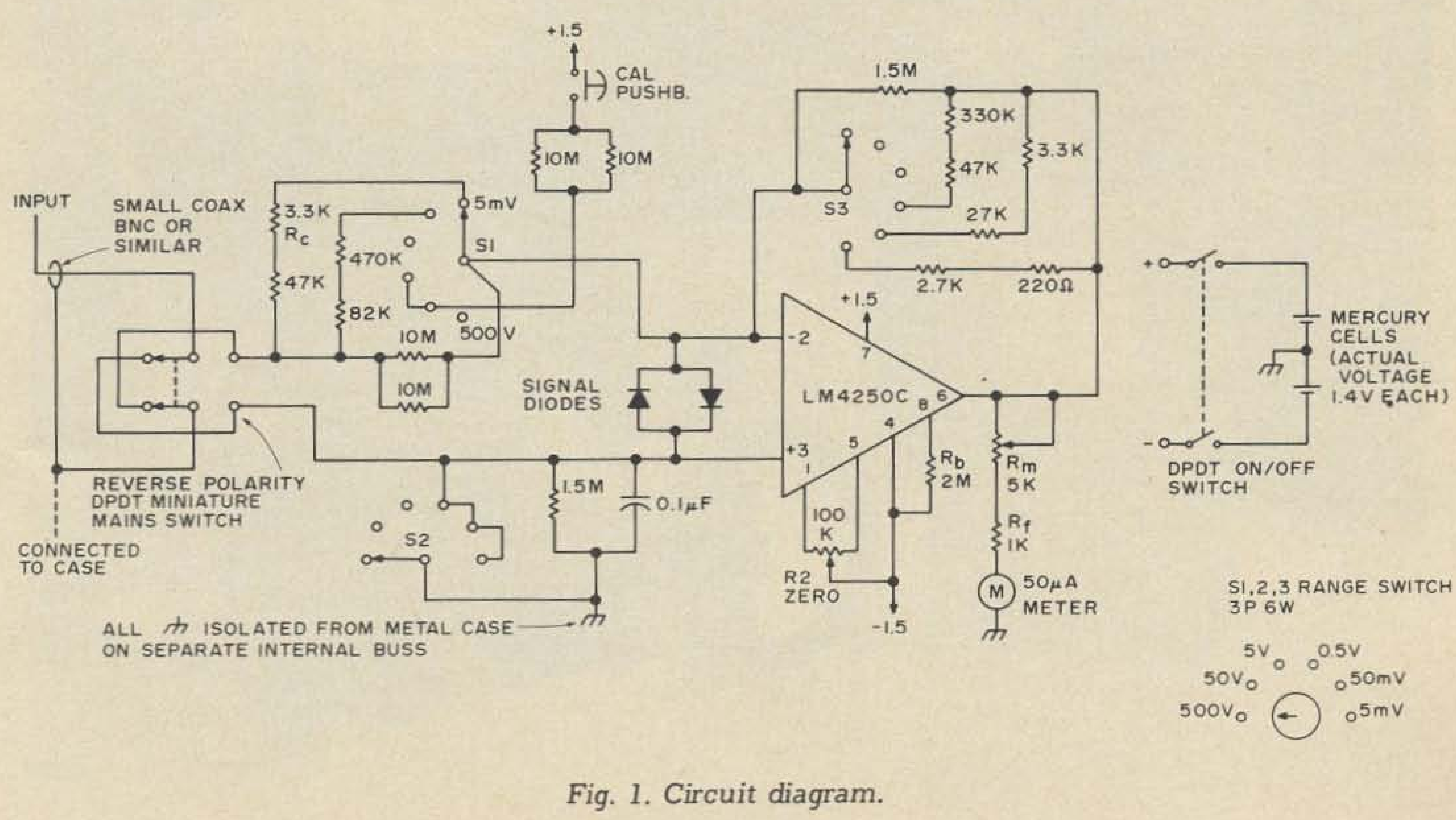


Fig. 1. Circuit diagram.

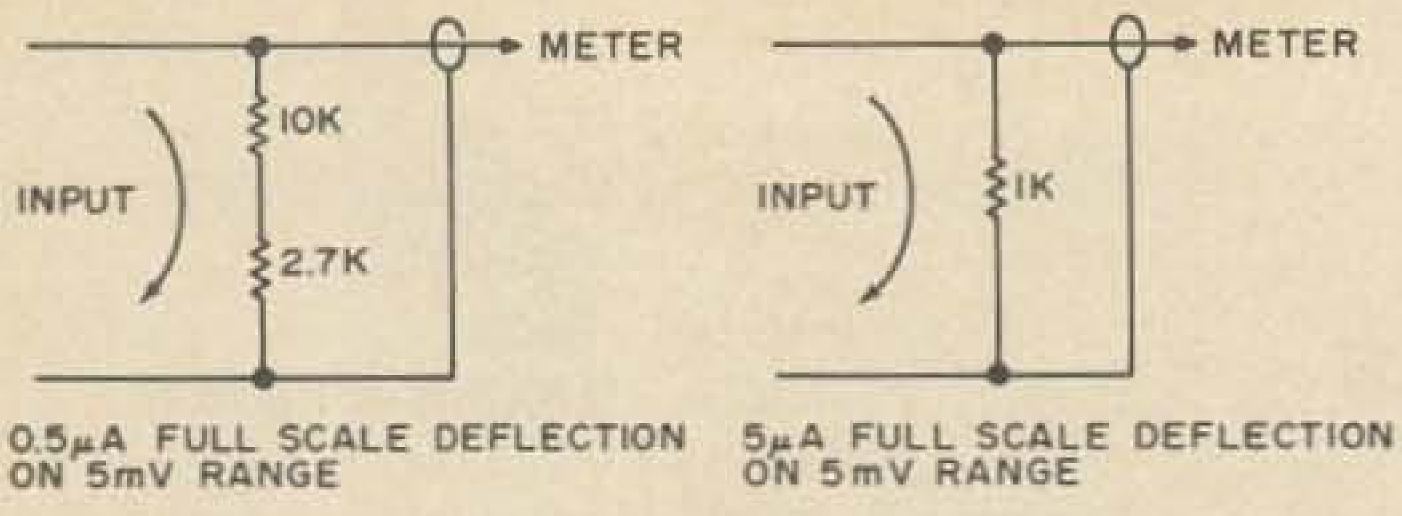


Fig. 2. External shunts.

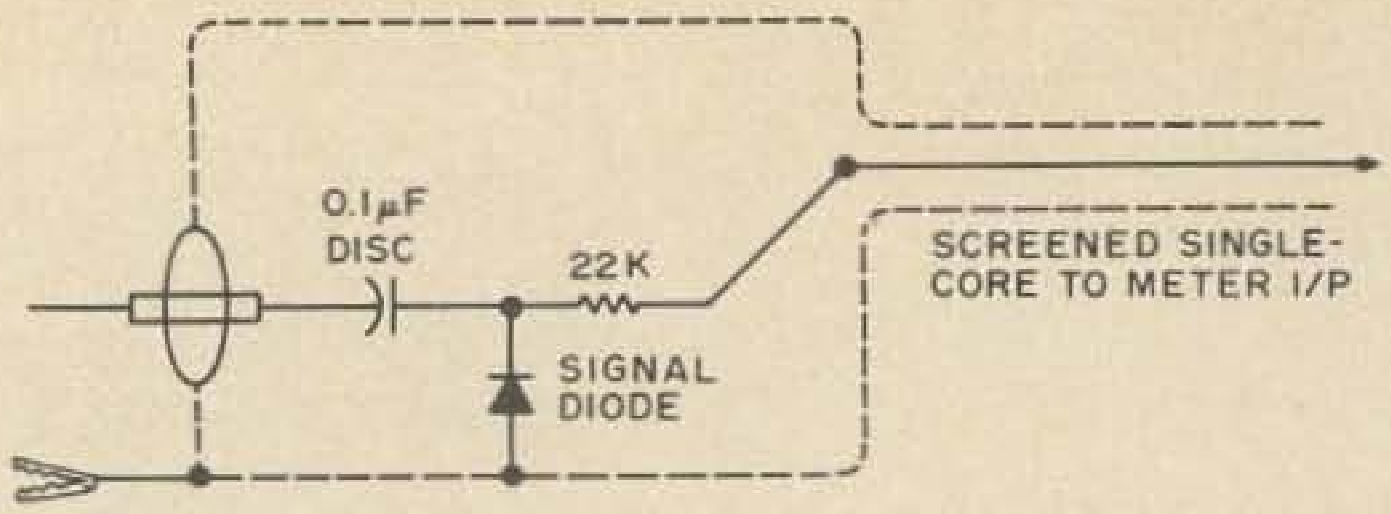


Fig. 3. Rf probe.

supply comprises two mercury-button type cells (ER 675) contained within a small paxolin tube, spring loaded to maintain contact pressure. Other options are possible, of course. Consumption is minimal, being approximately 60 microamps for full-scale deflection. The unit is housed in an aluminum die-cast box.

Input impedance is approximately the value of Rc for the range concerned, shunted by the input-lead capacitance (approximately 50 k to 5 megohms, according to the range used). Overload protection is provided by two back to back signal diodes. Repeated application of 30 V dc on the 5 mV range has had no detrimental effect on the prototype. External shunt resistors may be used to monitor dc currents down to quite low values. Fig. 2 gives examples scaled for measuring 5 microamp and 0.5 microamp full scale deflection on the 5 mV range.

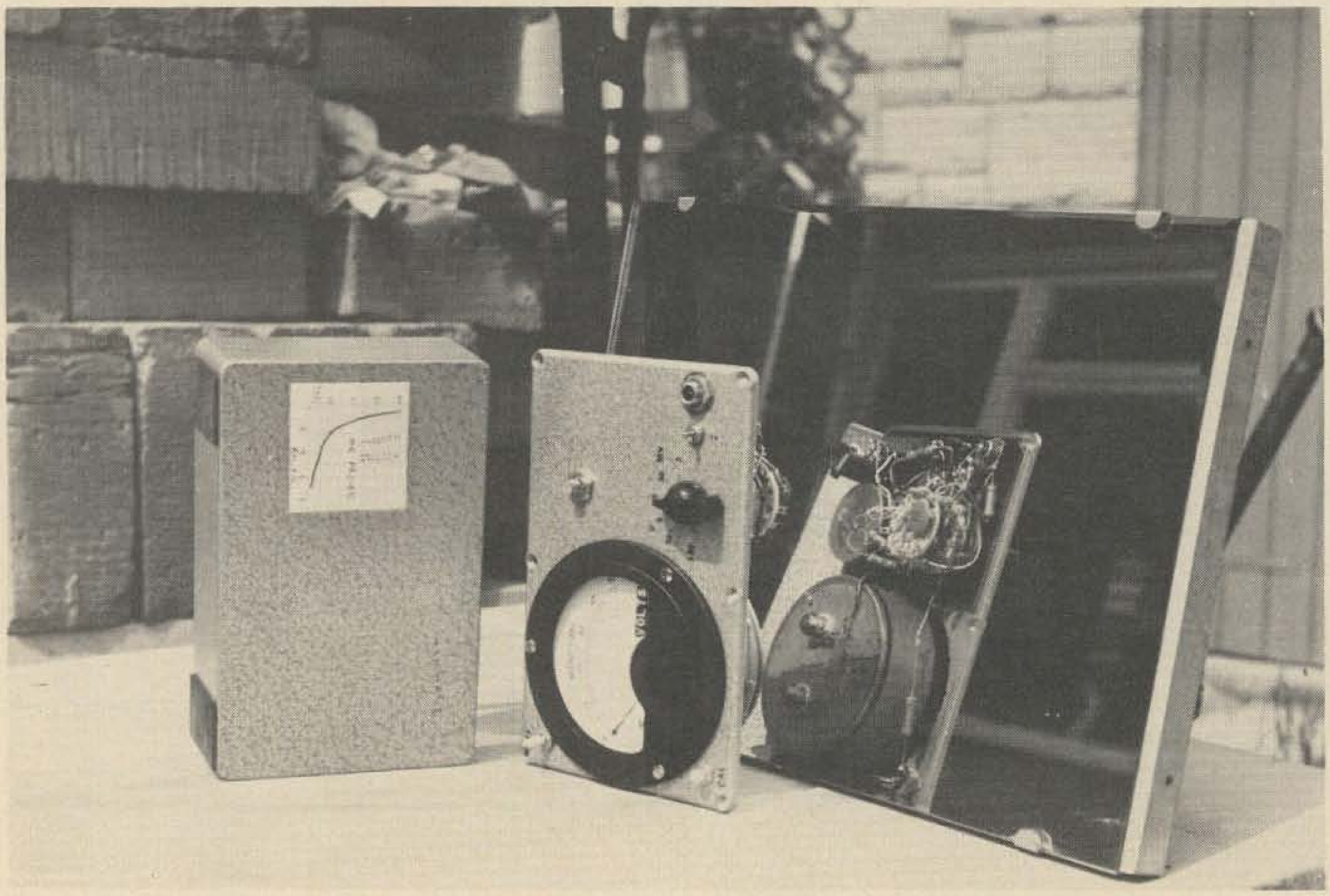
Rf may be measured by the use of a suitable probe (see Fig. 3). The approximate input impedance of this device is 6 k at 2 MHz falling to 1 k at 25 MHz. The probe is usable to about 100 MHz.

Application

Since the instrument is sensitive and self-contained, it lends itself to a variety of tasks, some beyond the means of conventional multimeters. The very low power consumption means that battery life is very near shelf life.

The ability to read currents of less than a microamp enables diode and semiconductor device reverse and leakage currents to be read. With the millivoltmeter suitably insulated EHT tube currents can be measured (CRTs).

. . .G3JQQ



Rolland D. Cummings WAØEDA
510 West Fifth Street
Pittsburg KS 66762

Three Button TT Decoder

In the process of designing a digital control system for our Touchtone entry repeater, it became necessary to come up with a simple system to recognize Touchtone groups. I decided upon a three button code for all functions as a compromise between ease of "dialing" and number of operations possible. The system described here is very simple and allows automatic cancelling as well as security for the control functions.

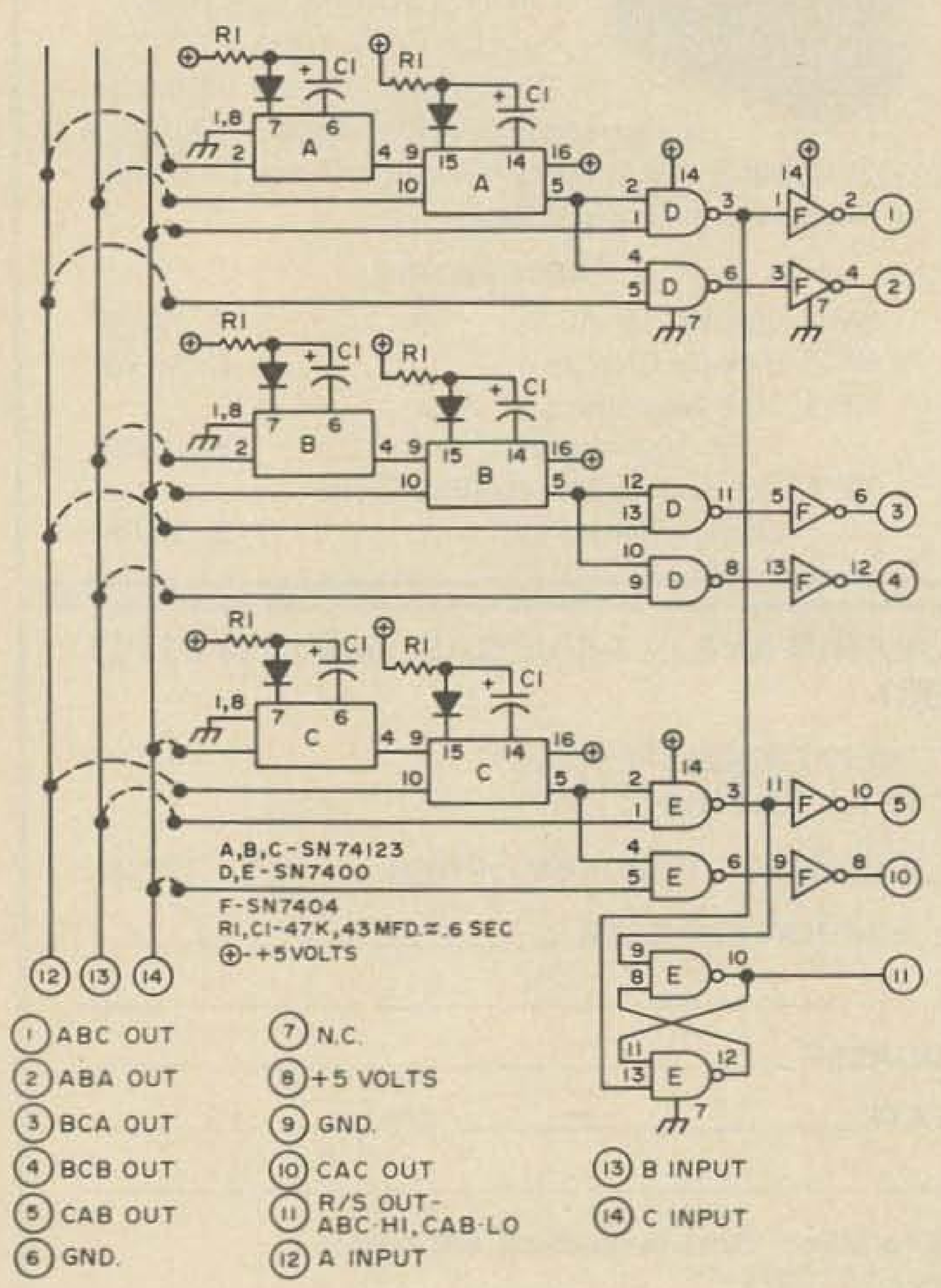


Fig. 1. Schematic.

The building block of this system is the TTL dual monostable multivibrator, SN74123. With only three external components each monostable yields a pulse of predetermined length for a short pulse initiated by the Touchtone decoding system.

Two of these monostable multivibrators (one IC package) plus two dual input NAND gates can be used to produce an output pulse upon the reception of the correct three Touchtone signals. My needs for the rest of the control circuits force me to include an inverter after each output yielding an output of a positive (TTL level) pulse whenever the correct combination is received.

There are 3 sets of decoders on each card in my control system. The whole card diagram is seen in the schematic diagram, Fig. 1. There were two dual input NAND gates leftover in the packages required so they are wired as an r/s flip flop. As shown in Fig. 1, the output from this flip flop will be positive upon receipt of a combination in the order of A–B–C and will remain positive until a combination in the order of

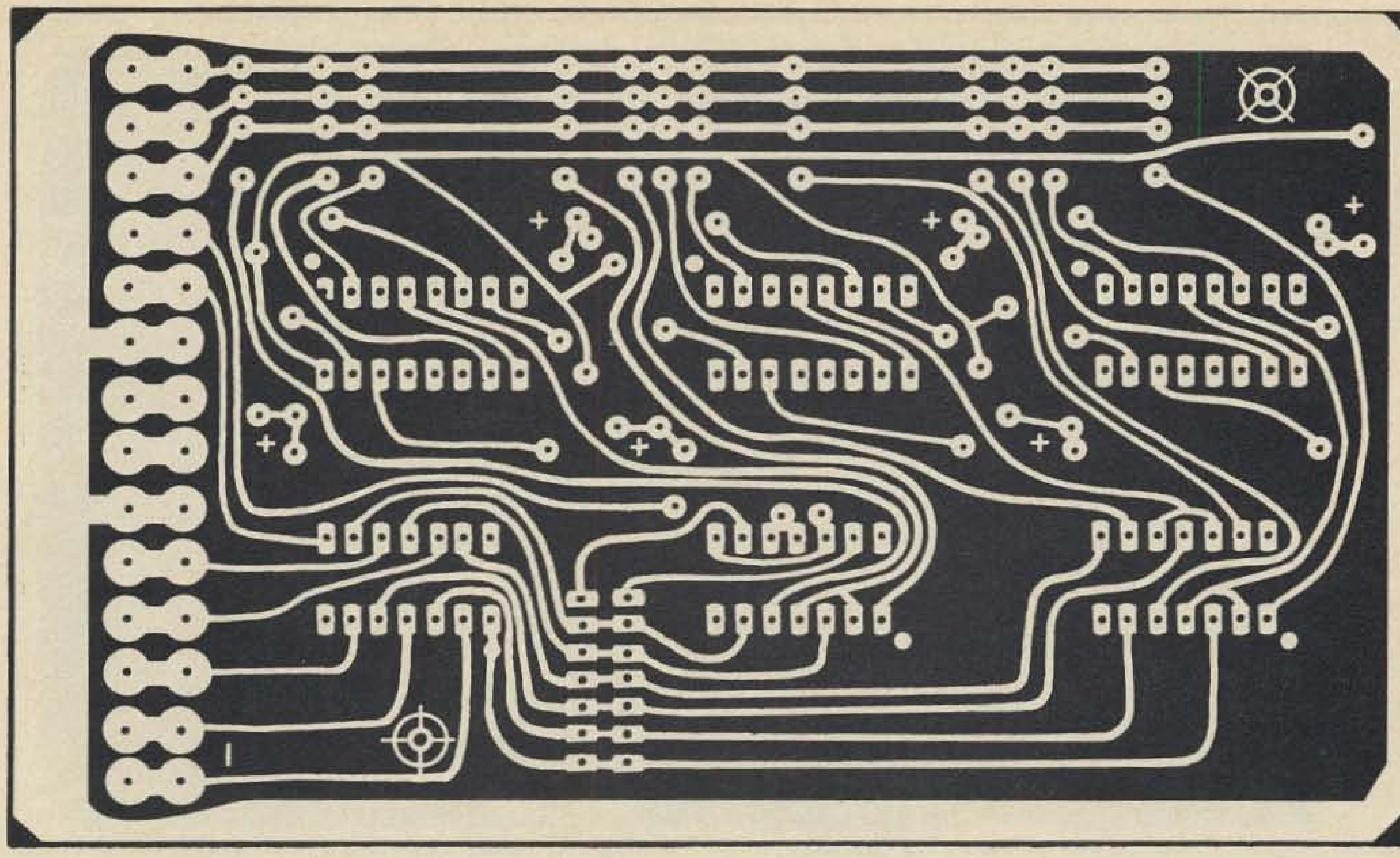


Fig. 2. PC board, foil side (full size).

C–A–B is received. Its state will then change to near ground and remain there until A–B–C is again received.

In our repeater system the tone entry is opened by transmitting 4–8–#. Therefore, the 4 = A, 8 = B, # = C. We can see from this that the r/s flip flop will give a positive output when the tone entry has been opened and will return to the ground state when #–4–8 has been transmitted. While the tone entry automatically closes after one minute of inactivity, it can also be manually closed using this code.

By changing the three inputs to this card and the jumpers to individual decoders, any combination of three may be selected with one exception, which is that no two adjacent inputs may be the same. In our example, #–#–8 would not be an acceptable combination, but #–8–# would be perfectly OK.

If we look at one of the sections of the decoder we may be able to get a better understanding of its operation. The monostable multivibrators, as mentioned before, will give an output for a predetermined length of time when they receive a change of state of their input. They have provided inputs of both polarities and outputs which are complementary. The first monostable, in this system, must give an output when a transition from ground to positive is received. Therefore, the inverting input to the IC, pin 1, must be grounded and the non-inverting input, pin 2, is connected to the A input of the decoder. Pins 6 and 7 are connected to the timing components. The normally positive output, pin 4, is needed as an input to the next monostable. This output will remain low for a fixed period of time (about .6 second for the example shown). During this time the next input must have been selected. If it has not been, the process is automatically cancelled and must begin again if an output from this decoder is to be indicated.

If the second input, B, is selected during the low time, the inverting input, pin 9, of the second monostable is held low by this output from the first monostable and its non-inverting input, pin 10, is raised to positive by the B input. This will permit a change of state at its outputs. The timing components are the same as the first monostable. This output, the normally low one this time, pin 5, can only result when the first two numbers have been transmitted within the preset length of time. This output also will remain for only about .6 second. So the final tones must be transmitted within this time period or the operation is cancelled and must begin from the beginning.

If the C or A is received within this final period, its respective NAND gate will see

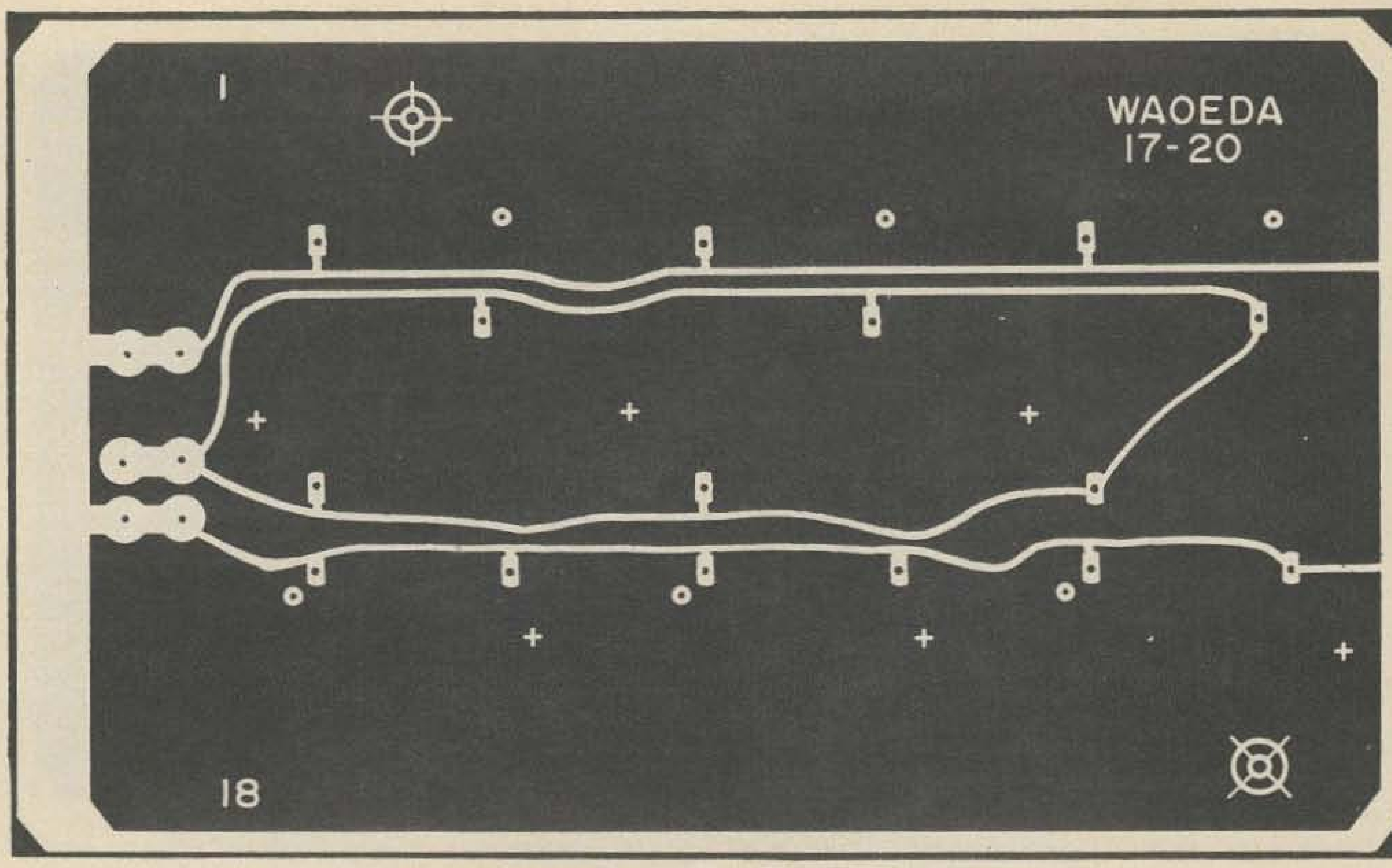


Fig. 3. PC board, component side (full size).

two positive inputs and will give a resulting low output while the second monostable remains in its ON state and the final input is being received. The second NAND gate was used as a cheap and easy way of getting two control functions with only the addition of one NAND gate. These outputs are inverted and are used to control the repeater functions.

This system was designed by me and has been in operation in our 13/73 repeater, WRØABO, since we received our license in July, 1973. It is the only part of the system which operated perfectly from the first and has developed no problems. The .6 second dialing requirement has caused few problems and is very convenient when a wrong number is pressed. The operator must only wait for a second and then begin to dial again. The control functions which must remain secure are protected by the fact that anyone pushing buttons at random must press the correct combination in a very short period of time. Also, the system is easily changed to a different combination in case any unauthorized person learns the control codes.

A printed circuit layout is included and does require a dual sided circuit board. Many methods of decoding patterns of dialed digits exist but this seems to be the most practical for a reasonable number of functions. I would guess the price of components to decode two combinations (e.g., A–B–C and A–B–A) to be less than $2. All components are readily available from distributors advertising in 73.

. . . WAØEDA

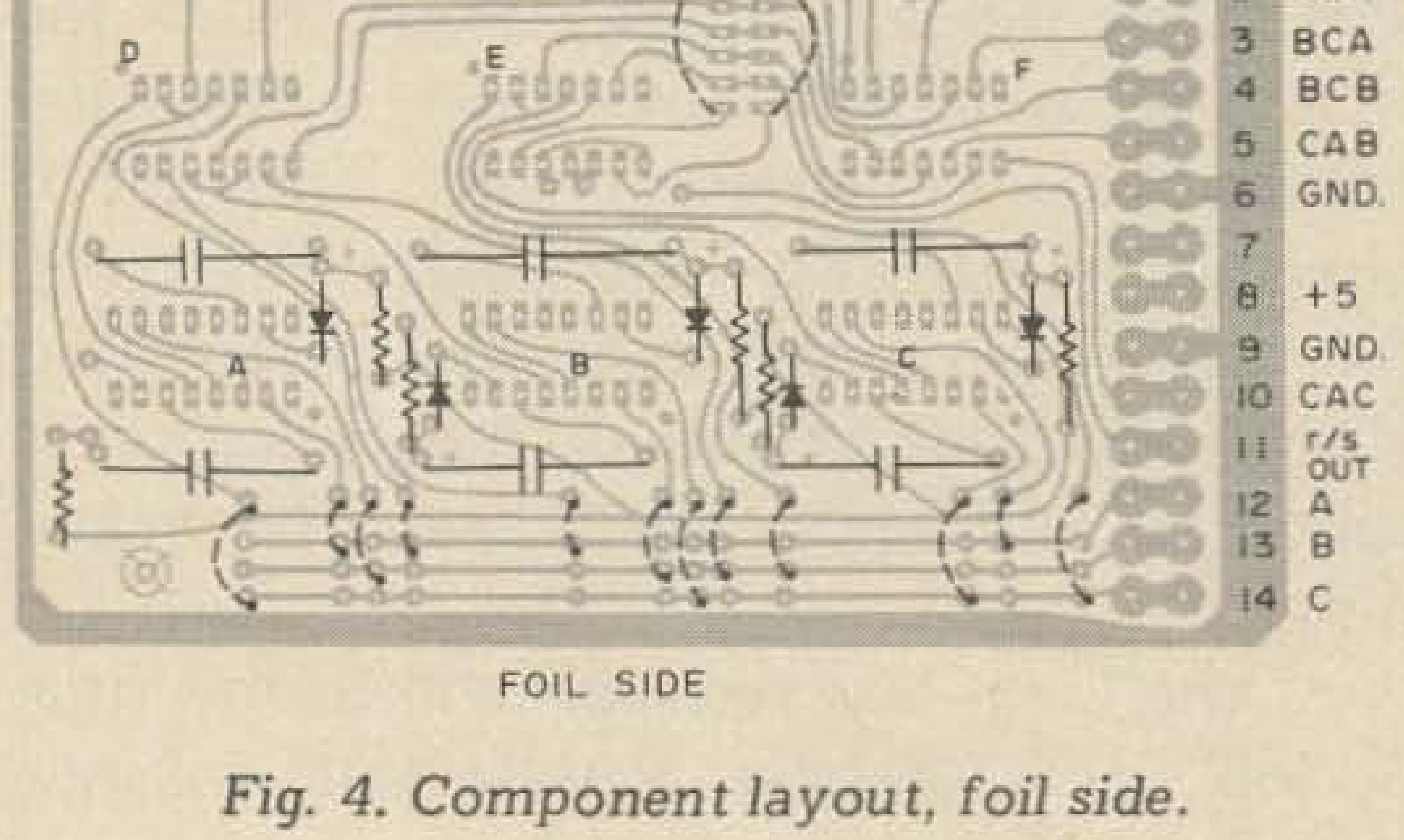


Fig. 4. Component layout, foil side.

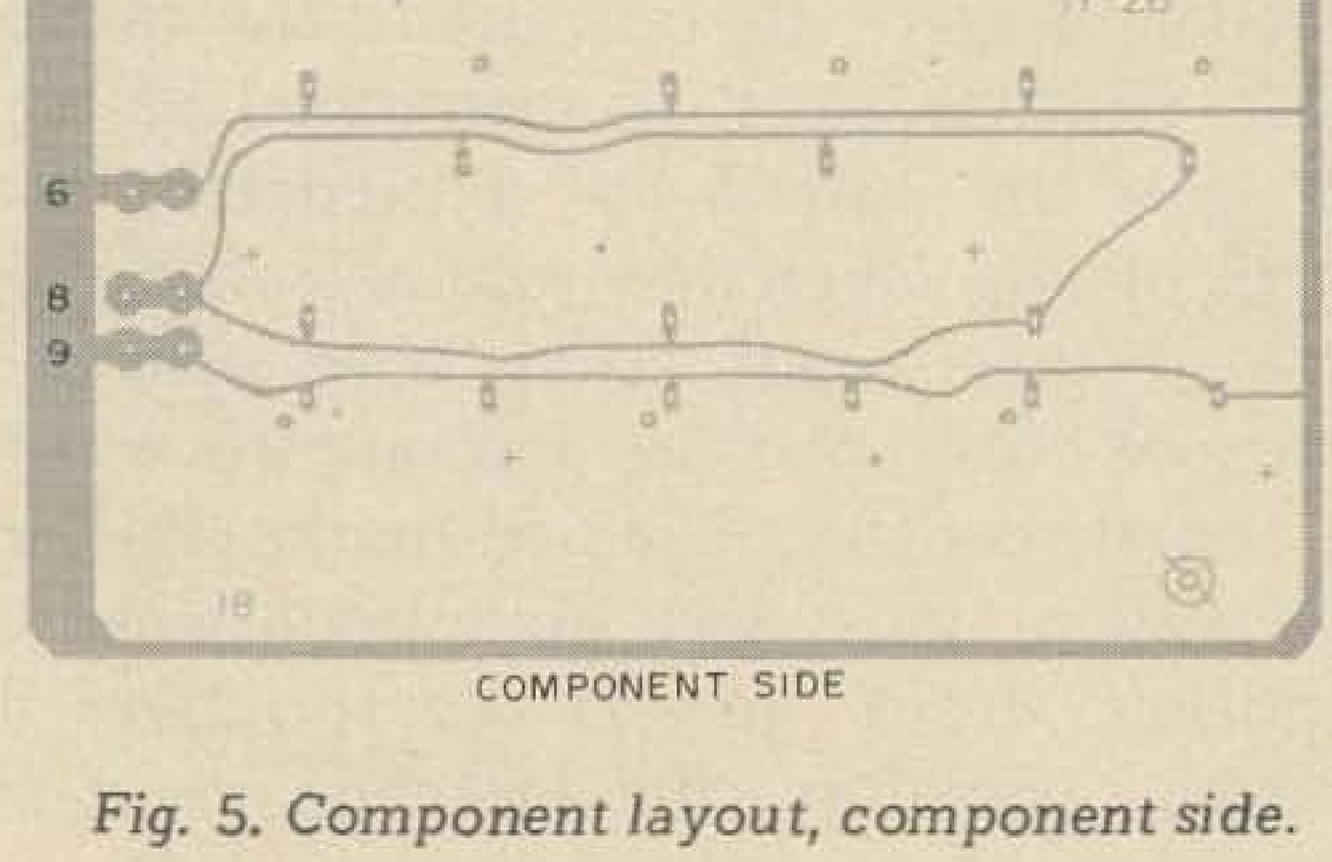


Fig. 5. Component layout, component side.

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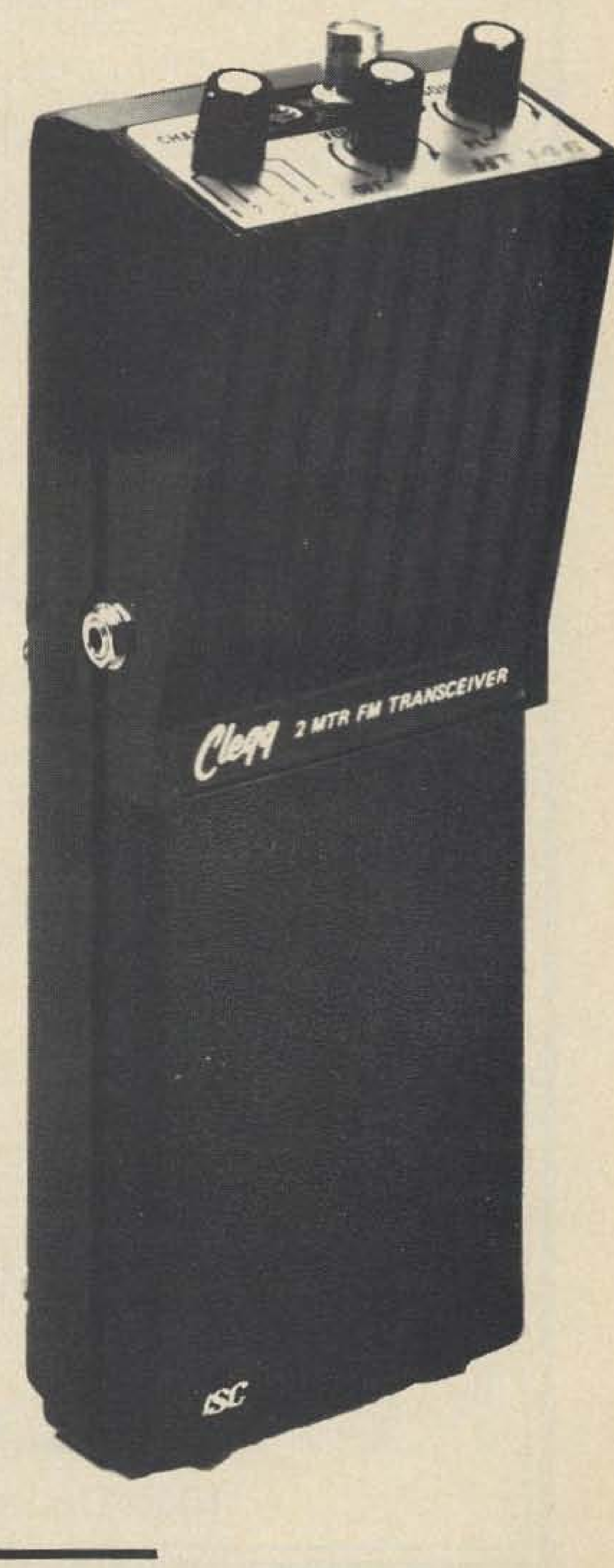

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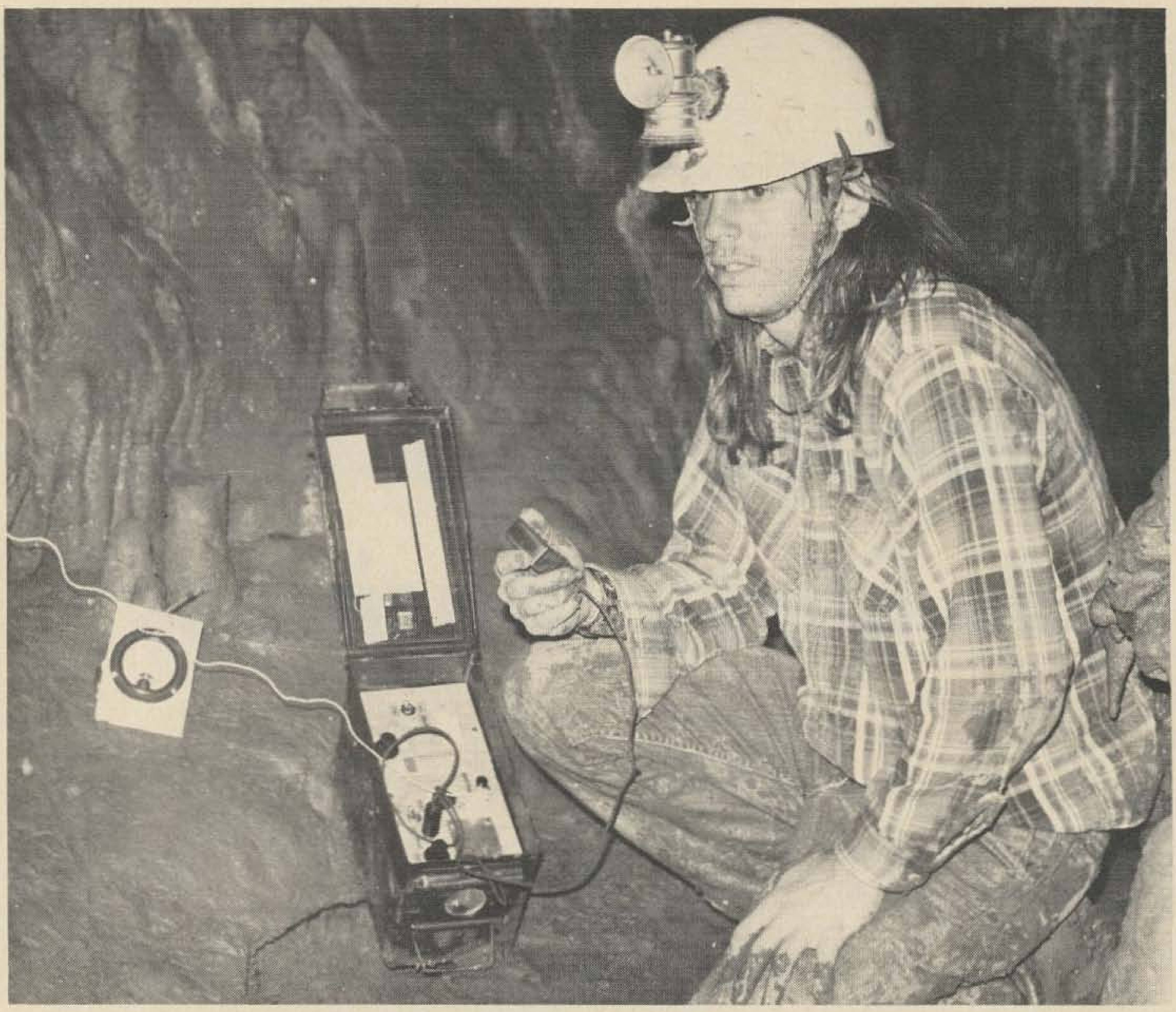
Underground Radio is Dirty Business

Can radio really work underground?

An underground radio system, one that can be used to communicate in caves, has fascinated me for a long time. Out of this fascination grew the basis for this unique experiment. A cave presents difficult barriers to overcome in its exploration. Tight crawl-ways, pits, mud and water are only a few. Many cave passages are measured in miles, with hours being required to explore them.

While many explorers or "cavers" will disagree as to their often masochistic reasons for enduring such sufferings required to explore caves, most will agree that one of these imposing barriers is isolation – isolation in the form of separation of an exploring party from the people back on the surface, or from another group within the cave. It is a form of isolation hard to comprehend in an age of instantaneous communications, for in a cave communications is generally only as fast as an explorer can travel. Or at least it was until we began these cave-radio experiments. But before going on, let me give you an idea what exploring a "wild" cave is like, one without electric lights, pathways or guides.

An explorer pauses a moment to smile at his companions, and then silently rappels down a rope into a deep black hole. His miner's lamp is all that relieves the total darkness of the pit. While the others watch, the light grows smaller as he descends until it is no more than a speck far below. Several hours of tortuous climbing behind them, the summer sun blazes on a hot dusty afternoon.



Operating KA2XAR mobile unit 1 in the depths of a wet, muddy cave is Bill Madden. He's operating on 1545 kHz, 10 W input, AM modulation. (Photo by James McCloud)

But deep within the cave, the explorers quietly shiver as they wait in the cold mist of a waterfall for their turns to descend. Far below a voice calls out that he is safely down. Now another explorer prepares to enter the pit.

As you can see, in a cave man is the alien in an often hostile environment. Constructing a communications system that would both communicate through rock, and withstand this environment, is quite a challenge. In the past, the systems used in caves had been almost exclusively army-style field telephones. However, the difficulty of stringing wire made their use prohibitive in all but extensive, large group expeditions. Induction radios operating in the range of a few kilohertz have been used with a varying degree of success, but their range is severely limited. What I and others wanted was a system that could be used like a walkie-talkie, one that could communicate up to several thousand yards between a "base station" on the surface, and portables located within the caves. The portable unit had to be idiot proof, for the last thing someone covered with mud and water wants to do is tune up a rig in the semi-dark. They also had to be designed to withstand being banged against rocks, pushed, dragged and tossed through mud and water as well.

In building up a system, the choice of a radio frequency was the main obstacle since experiments have shown that the lower the frequency, the better the range of a radio signal through the cave rock (in this case, limestone). Unfortunately the antenna size vs. efficiency of a portable unit makes some sort of compromise necessary. A few simple experiments convinced us that the .2 to 6 MHz region offered a good compromise frequency range in lieu of anything lower.

But just *how* good? How could the system be tested legally to see if it would work under actual field conditions?

Out of this curiosity was born KA2XAQ/KA2XAR. We were fortunate enough after exhaustive detailing of the proposed experiments to obtain an experimental license from the FCC under Part 5. We asked for and were given permission to operate on a number of frequencies from 185 kHz to 27 MHz during September and October, 1973. KA2XAQ was assigned as our "base station" call and KA2XAR was the call sign to be used by the portable units which would be carried into the cave. The FCC classified the equipment as experimental or "laboratory constructed." That is to say, homebrewed. Our surface units were conventional ham type tube equipment scrounged up and brought to operation on our new frequencies at the specified frequency tolerances. The in-cave portables were all solid state and built into surplus army 50 cal. ammo boxes to make them both rugged and waterproof. These portables ran between 2 to 10 Watts input into antennas that could vary in length from a few feet to over 60 feet in length.

The tests were carried out in a large West Virginia cave located in the northeastern part of that state. The results? Much better than expected. For one thing, it was found that the use of frequencies below 1 MHz was unnecessary. The desired communications distance could be achieved at higher frequencies, with the best between 1-2 MHz. Above 2 MHz, the distance drops off quickly until at 27 MHz it is only a hundred feet or so at best. It was also decided not to use .2 to 1 MHz range because of antenna tuning problems and general inefficiency of our portable units at these frequencies. Redesigning them might overcome this, but for the present the higher frequencies suits our purposes providing communications in excess of 1000 yards. The equipment proved to be rugged enough to withstand numerous abuses, simple enough for an inexperienced operator, and virtually 100% reliable up to its range-distance limit. We strongly feel that building more sensitive receivers and better portable antenna systems will increase the system's performance, but for now, the isolation factor in cave exploring isn't so pronounced as before.

... WA3AQS

Left to right are Gale Hiem and Lynn Wayshner, operating KA2XAR mobile unit 2 on 1545 kHz. (Photo by James McCloud)

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What's Wrong with my SSTV?

Slow Scan TV operators often have difficulty describing the various types of interference experienced in picture exchanges. This article is intended to fill that void and hopefully rectify reports of "your pictures were not very good" to more specific analysis like, "your pictures have perfect sync, but noise in the video is excessive." Also, I would like to suggest some references on picture quality so we will be closer to an established system, like the RST system is for CW. Before discussing some picture specifics I would like to point out that photographs usually show up details the eye misses. Also, since we are dependent on the relationship of monitor dot intensity to camera F stops, photographs often reveal shadows and unequal illumination not noticed when viewing pictures on the monitor. These photos will also appear more

Photo 1.

Photo 2.

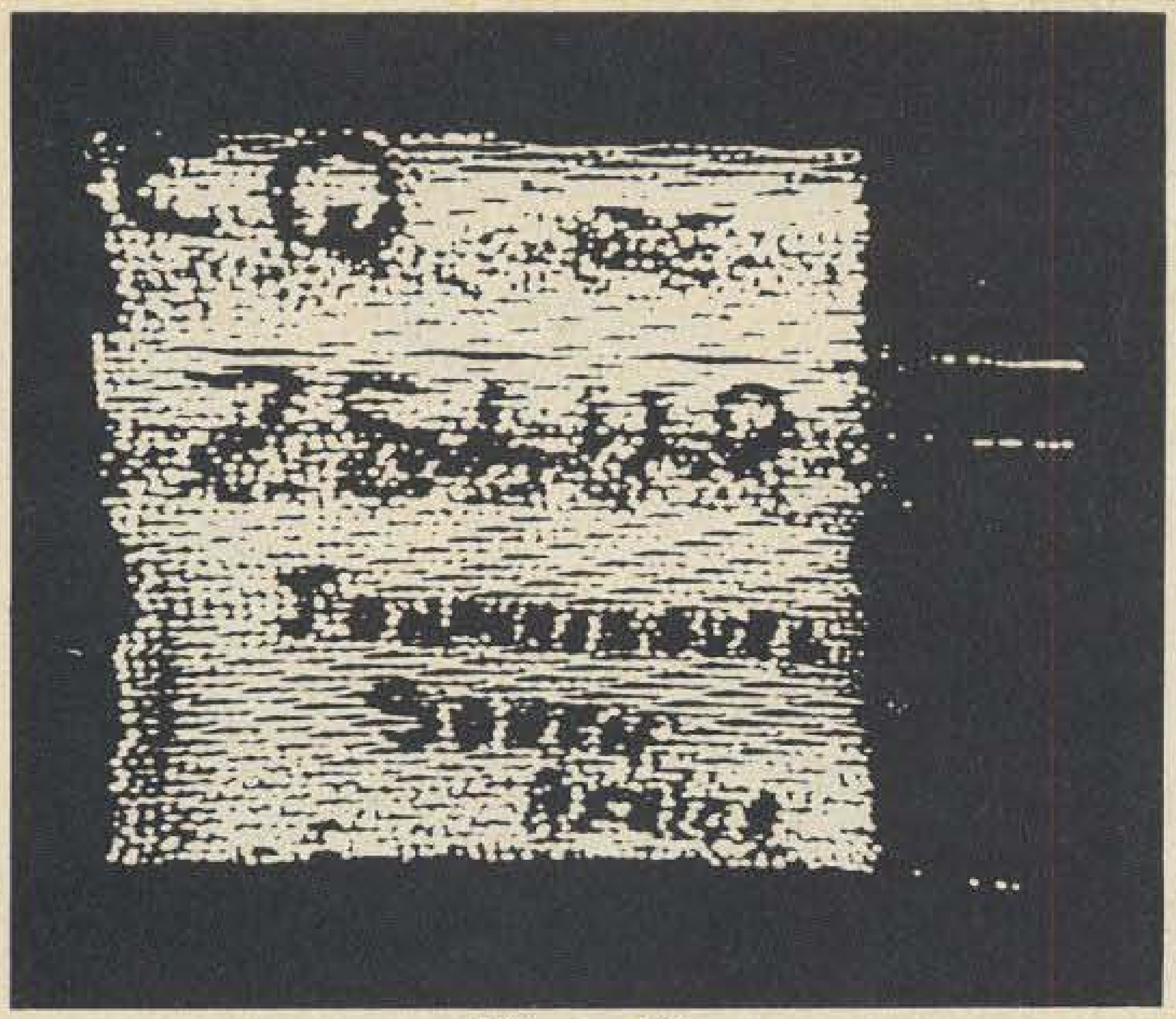


Photo 3.

natural on a monitor if you will view them at arm's length, rather than trying to "read" them closely.

Let's start our discussion with a solid "closed circuit" example as in Photo 1. Notice every line starts and stops exactly, resulting in a perfect raster. No interference of any type is evident and there are no skewed lines. The apparent gray scale limitation in the photo was only because monitor intensity was low to avoid "bleeding" on the photographs. When I made this shot, I was wearing photogray lens glasses which the monitor shows as regular glasses and the camera caught as sunglasses. (Pardon the bit of humor in the triple exposure picture.)

Next is Photo 2, which was received from FG7XT on Guadeloupe. This one may be considered very good and nearly closed circuit. There are a few missed lines right above the ID. These lost lines are due to intermittent QRM which overrode the sync pulses during that time period. Notice the otherwise perfect syncing and no noise in the video. If you look closely you'll see the circles are made up of the Slow Scan's 120 lines, not dots as one might think at first glance. The jiggled letters in "television" are due to a minute speed variation in my cassette recorder. The batteries were slightly weak and of course this is more noticeable with speeds like 1-7/8 ips (compare with Photo 1).

Now we move to Photo 3, which was received from ZS6UR in Johannesburg, South Africa, via 20m. He was only S3 and QRM was rough. QRM appears in the video as dots. This is noticeable immediately

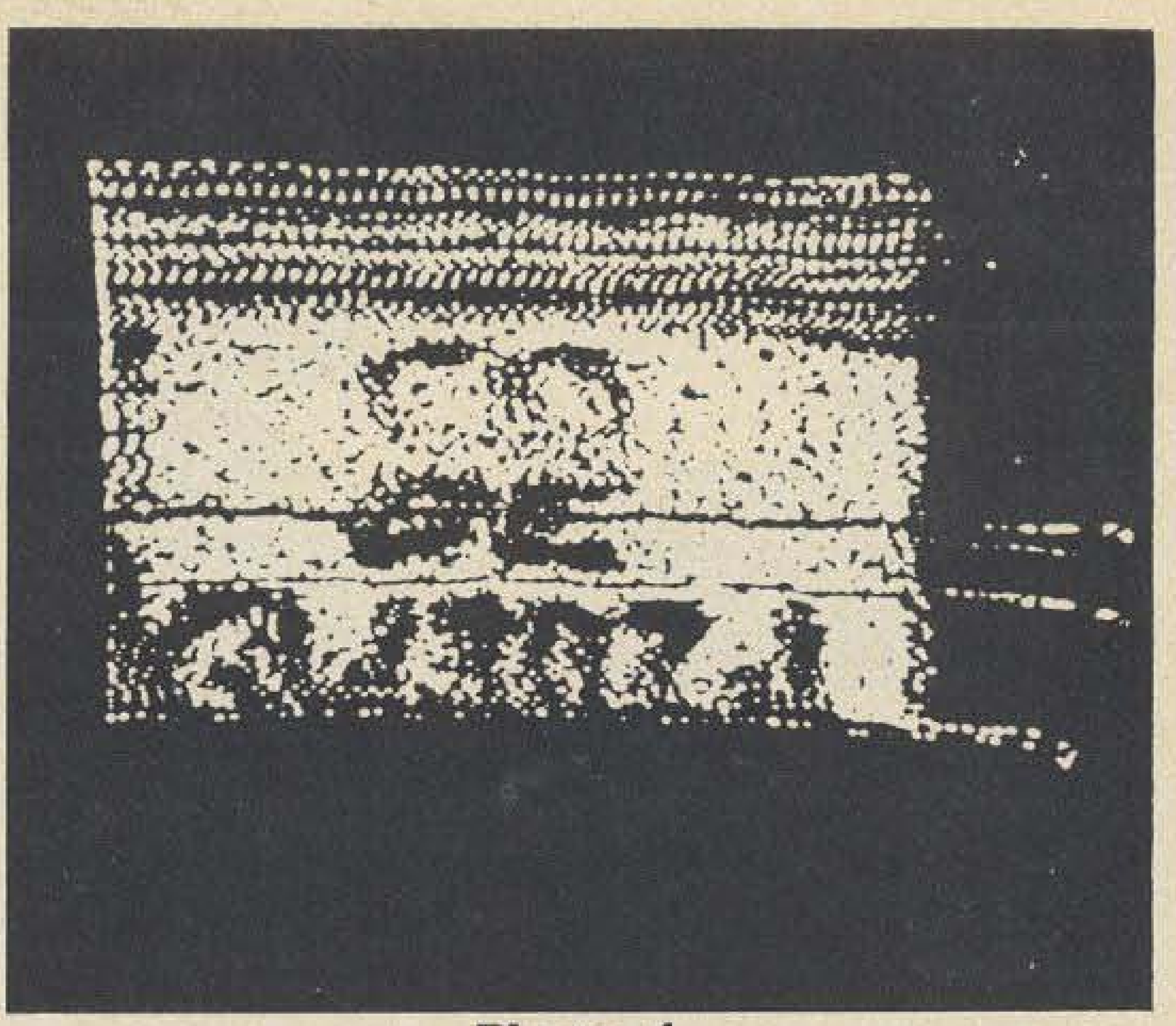


Photo 4.

below the CQ and around the UR in ZS6UR. Accurate syncing is still maintained, as noted by the neat right side. Although ZS6UR was readable on the monitor screen, the camera caught more of the white dots around the UR, making all the ID difficult to distinguish. Notice you can read the QTH, which shows fair resolution for a "long haul" QSO. This picture could probably be considered between fair and poor in picture quality.

Photo 4 is very close to nil. If you hold it back and study it carefully you can just make out CQ de GW3DZJ. QRM in the video is very predominant above CQ as are some missed lines (due to QRM causing loss of sync pulses). There are some missed lines also through the DE, and QRM completely overrode sync at the ID bottom, resulting in no trace for the remainder of that particular frame. Readable, but definitely a poor quality picture.

We should term Photo 5 an uncopyable

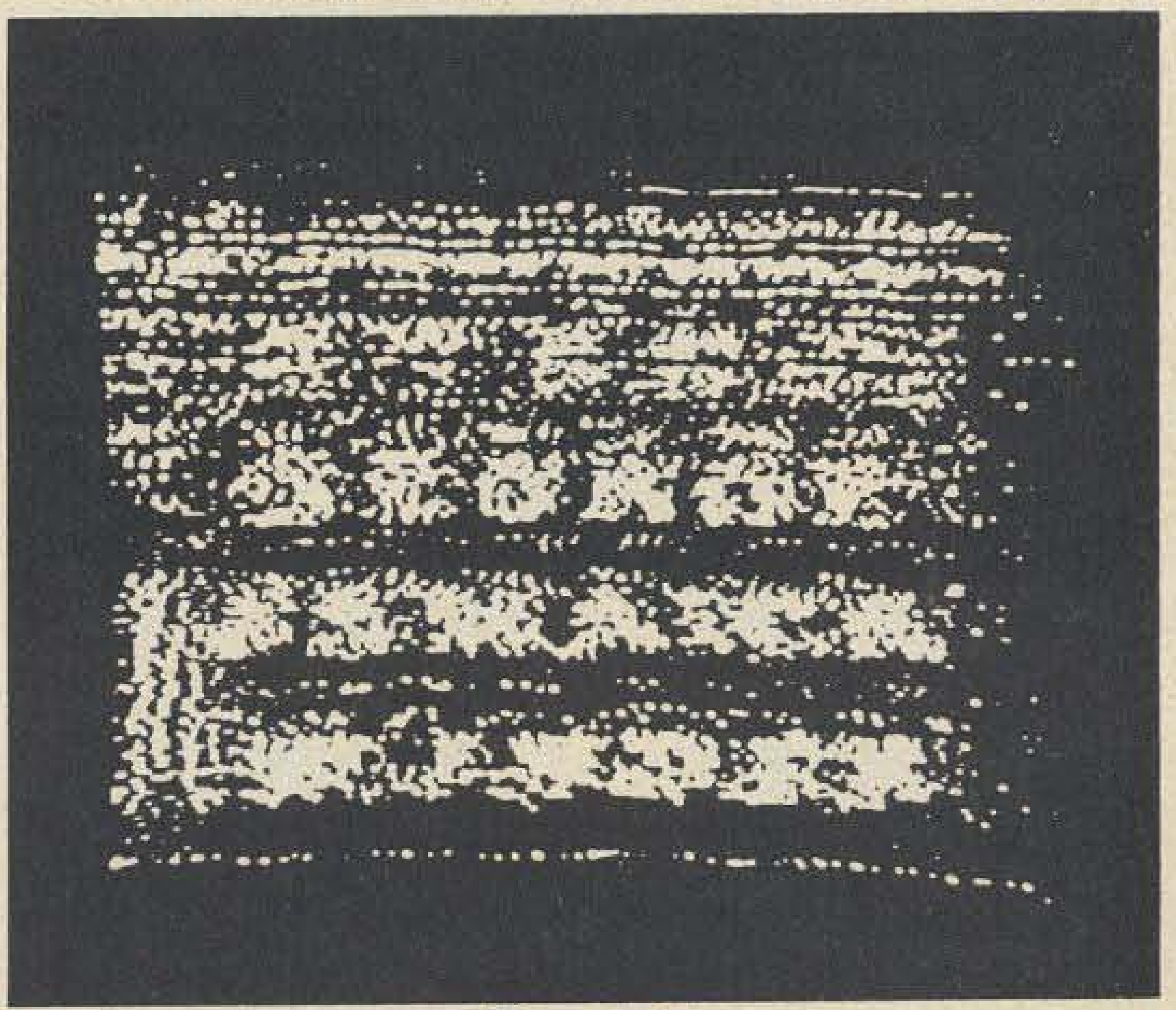


Photo 5.

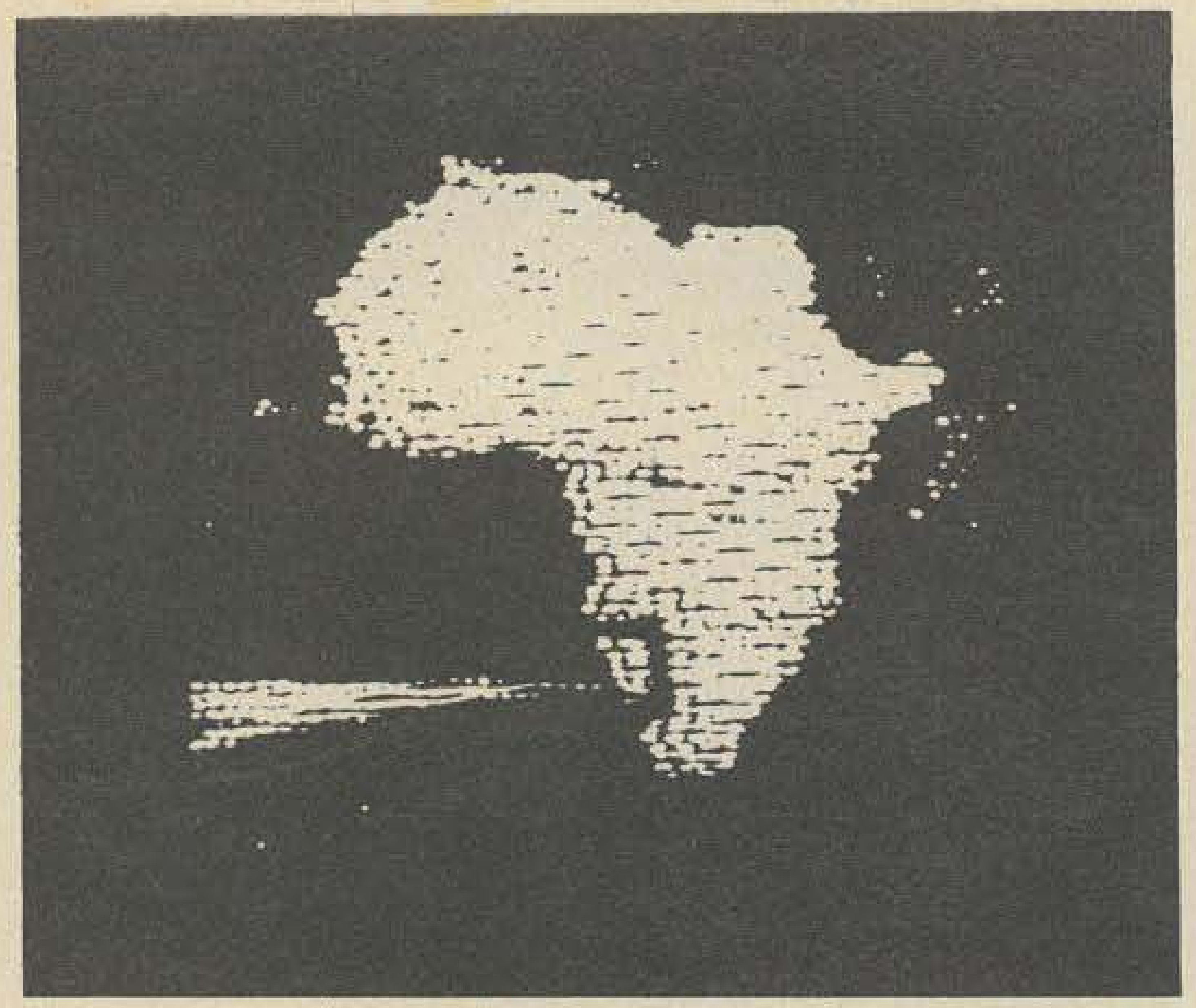


Photo 6.

picture. If you study carefully the middle of the picture, you can make out George, Jamaica. However, everything else was lost in noise and QRM, both in sync and video. This picture does point up a slight advantage when using white letters on a black background. If conditions were slightly better the picture would have made it; however, a white raster with black letters would probably still have been indistinguishable.

Photo 6 is very interesting in the fact it exhibits (among other things) an unusual form of multipath propagation. Ordinary (?) additive multipath usually appears as "ghost" in the received picture while subtractive multipath may cause a loss of part or all of the picture . . . you might hear it but not see it. Subtractive multipath is similar to an out of phase situation. If the negative phase of a signal equals the positive phase, the two cancel and no signal remains. In Photo 6, the multipath appeared to

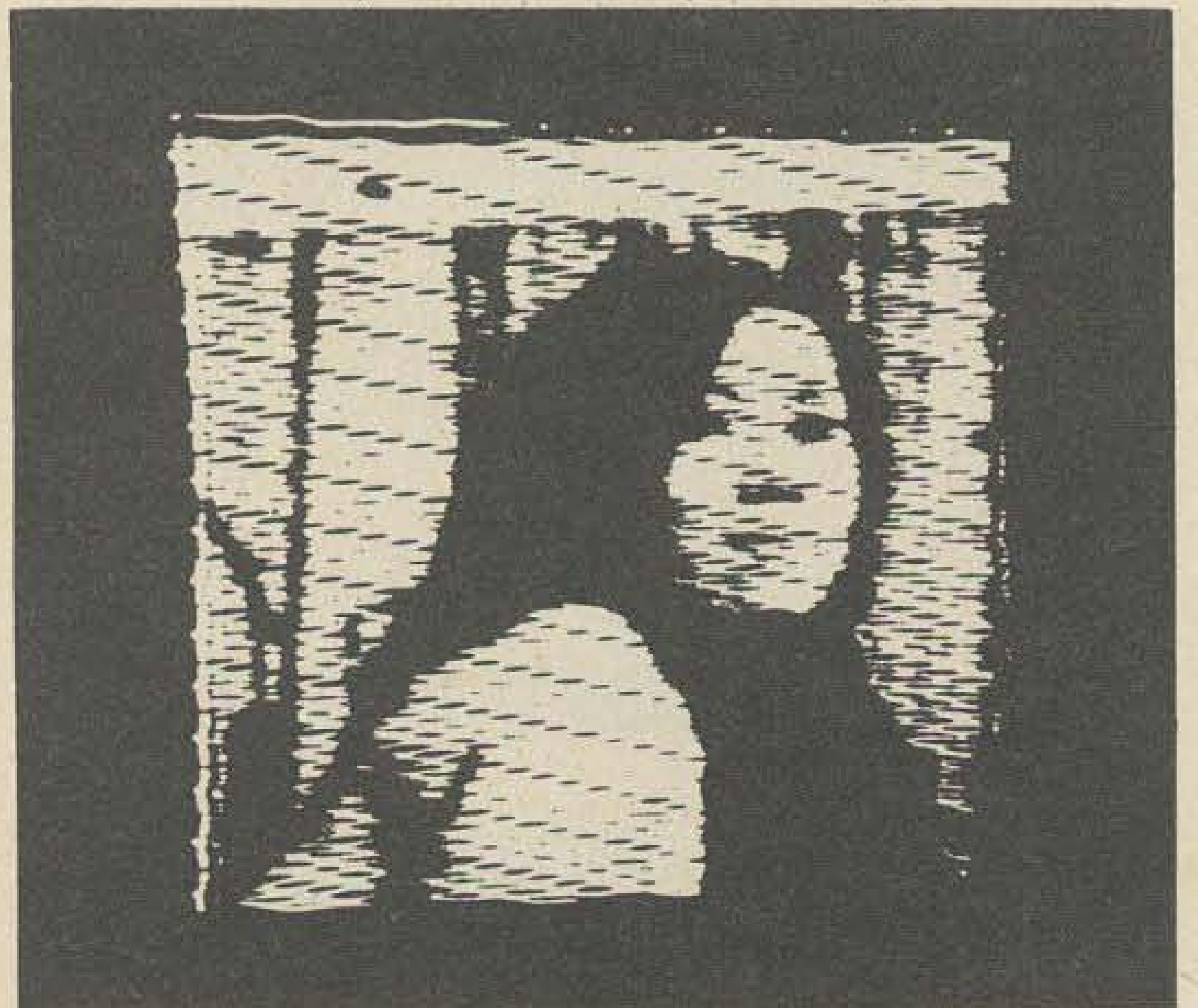


Photo 7.

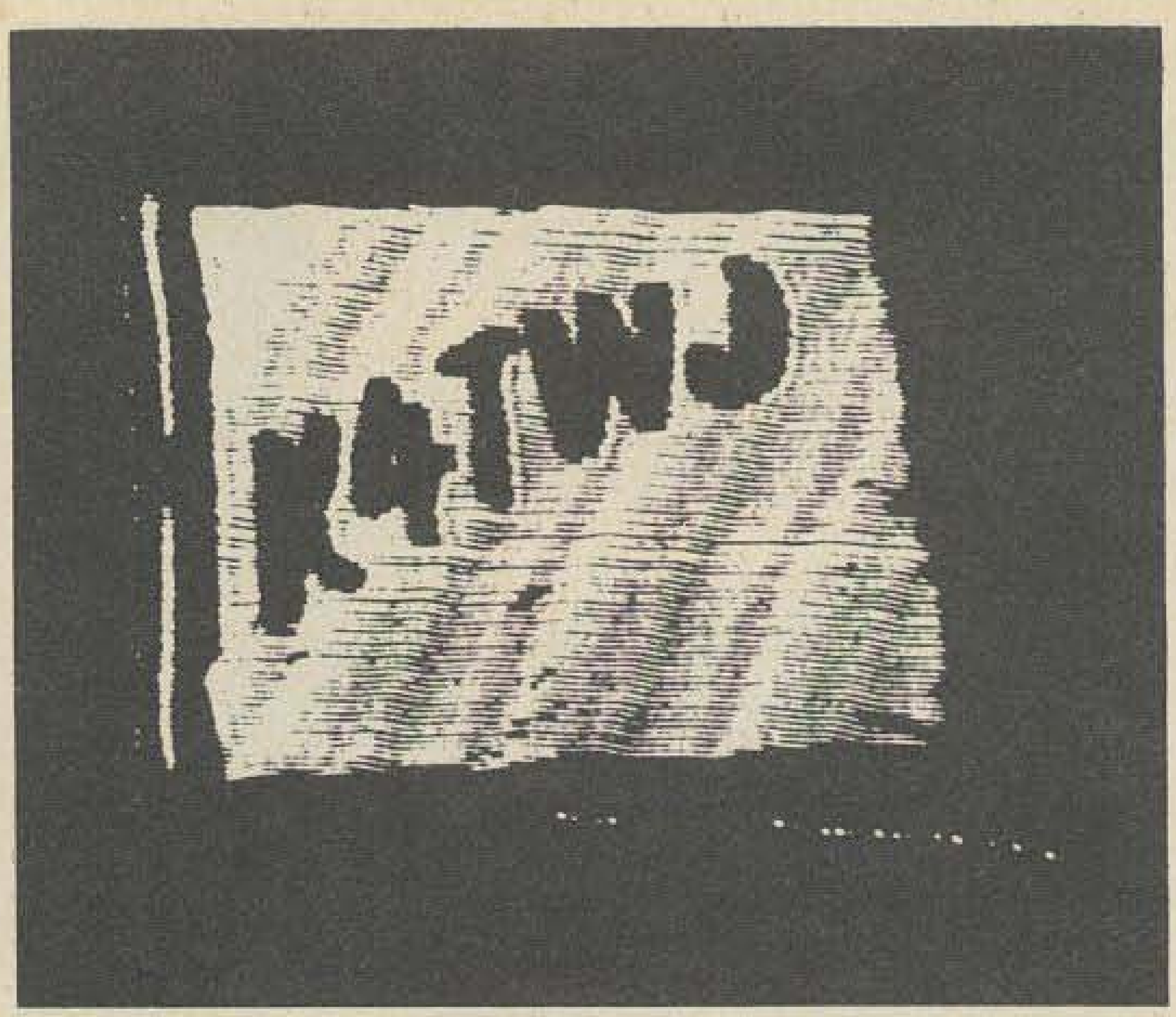


Photo 8.

manifest itself only in the higher video frequencies, causing partial cancellation in white. This is evidenced by "dots" in white (most noticeable near the bottom). This looks similar to QRM in the video. However, when this picture was received from ZS3B one night on 20m, he was the only station being heard (S8) and there was no QRM. His voice had a "DX echo" which denoted multipath, so this was the obvious answer.

Photo 7 is also "closed circuit" like Photo 1. Indeed there is nothing missing from this picture (!). Skewed lines are visible running from the top left to the bottom right and these are due to the playback tape recorder running slightly slower in speed than the recording tape recorder. If it had run faster, there would be skewed lines from top right to bottom left like Photo 8, and if the two speeds were identical, no skewed lines would be visible. If you will notice the absolute top line on your Slow Scan monitor you will see 4 very slight "waves." This is 15 cycle hum (60 cycles divided by 4). Now if speeds vary, these "hum bars" will displace on subsequent lines causing the "leaning" lines visible in Photos 7 and 8.

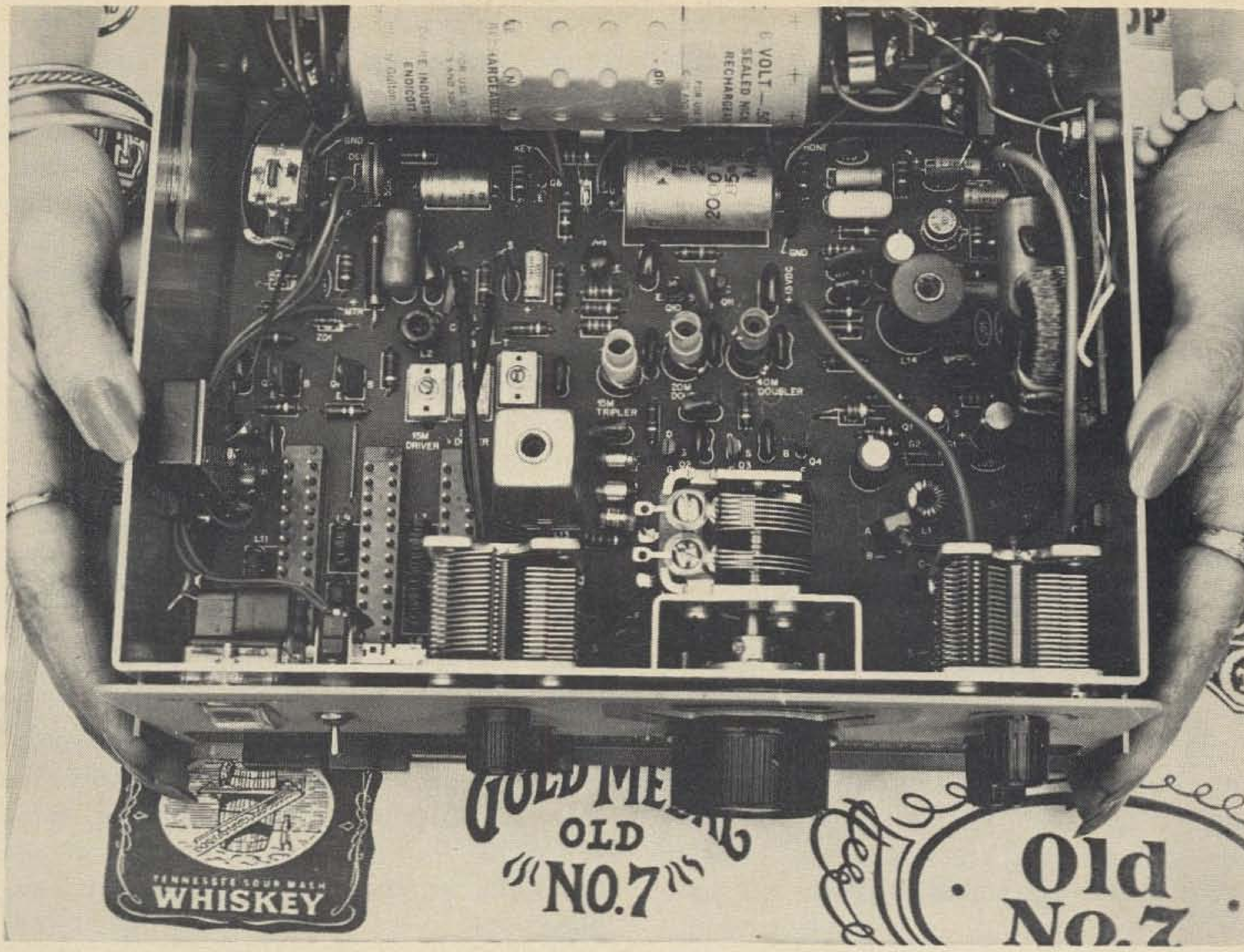
Photo 8 was accomplished by syncing the monitor externally to 15 cycles, then feeding in the Slow Scan picture. This resulted in the horizontal sync pulses being displaced just enough to be seen on the photo's left side. If you measure the sync pulse (although it is blacker than black, it only appears as black) which was approximately 6 ms wide, and then compare this with the picture's width, you will see it is approximately 1/11 the picture width, which means the picture is 66 ms wide. The approximate 6 ms is the retrace, or flyback, period of horizontal sweep, while 66 ms is the "scan" period.

It is my sincere wish that the examples in this article will be of significant value for future Slow Scan understanding and, as a result, we will be closer to an established set of SSTV criteria.

I would especially like to thank Miss Beverly Taylor for the fine photography work in this article. Beverly had a good idea which deserves mention here. She placed a light meter in front of the monitor, got a reading off the initial trace as it scanned, set the camera's F stop accordingly and shot. Every picture came out fine, with good contrast and maximum definition. The room was very dim, the camera was 35mm and the film ASA400.

Finally, the DX shown in this article is typical of Slow Scan activity today. If you're not yet on SSTV, why not join in? It's really a great new mode of communications.

... K4TWJ



Ken Cole W7IDF
P.O. Box 3
Vashon WA 98070

Queen Roger Papa From Hotel Whiskey Seven

One of the many nice things about amateur radio is its eclectic layout.

We're all licensed eclecticians – and some of us are careless punsters. Put in proper English, hamming can be snuck up on from many directions: network with MARS or RACES, heavy DX or just hands-across-the-sea, teletyping, gigacycling with horns and dishes, roundtable socializing, repeaterwork, track-a-satellite, ATV, dreamy designing and build-it-from-scratch. The list is long and getting longer. And it's inclusive – once in the ring you can rassle with everybody.

Few of us settle down for good and all with one mode or one band. Communication is dynamic, a lively art. The opportunities multiply as we exploit them. Tonight, in a little cottage in the west, a thoughtful W6 is putting dust covers on the RTTY gear to invest a few months in looking for YL's on Slow Scan. Soon he'll wonder about color.

A breakthrough in 3D may be the outcome. On a different tack, for more than a year I've been having a lot of fun with low power. The QRP fascination persists, but operating in miniature has lonely moments. It would be nice to have more company at eye-level, and that's why I'm writing this.

Homebrewers may recall that not very long ago it was so easy to end up with a (deleted) mess if you tried to design and build a transistor rig with a genuinely stable vfo, bandswitching and moderately useful power output.

Now, thanks to some of our bright and dedicated colleagues, and to the big-time R&D wizards of commercial electronics, impressive levels of solid-state rf power are within our reach. Stability is no longer a maddening problem, and components are available at prices that encourage building.

All it takes now is patient research, imagination, careful craftsmanship and lots of time. Or, if you just want to get in up to your ankles and have some QRP fun, there's this Heathkit.

The HW-7 is a three-band CW transceiver kit example of how ingenuity, careful engineering and economy can be teamed to turn out a novel and successful product targeted to a small market. Three, two and a half and two Watts on 40, 20 and 15, with sidetone and adjustable break-in. It's compact – four by nine by eight inches, plus fractions – and while the microsizing prizes may go to the two meter hand-helds, along with honors for giant-type repair and modification headaches, you don't need nerveless surgical dexterity to fiddle with the insides of the HW-7.

Every ham knows he can improve on any kit designed by the professional engineers . . .

Remove four screws, lift off the top half of the cabinet and every component is visible. Four more screws to drop the bottom shell and have at the circuit board. No cramping, layering or sequential disassembly tricks. A sturdy and attractive, truly portable, complete HF radio station for eighty dollars.

Today that's roughly the price of two steaks, a candle and a bottle of bubbly at a table the size of a bar stool – in a gloomy ambience of "Continental" fakery. By the time you read this you may have the privilege of choosing between an HW-7 and an evening of beer and pizza.

The simplicity of the front end of the receiver is breathtaking – one tuned circuit and one dual-gate MOSFET. One of the MOSFET gates looks at the vfo and the other at the antenna. You peak the tuned circuit with the "Preselector" control by tuning it to the vfo frequency, and you hear someone as the vfo is tuned to heterodyne with a signal. Audio I.F. With this type of reception selectivity and overall gain are uniquely dependent on the following audio circuitry, although somewhat less so if you want to get fancy with "Q" and amplification in an rf stage.

But simplicity and economy are important factors and the HW-7 is a workable compromise application of a clever concept. Of course there are problems, but in perspective they are acceptable. One is just a nuisance – the idling noise from the high gain audio IC – and another – microphonic sensitivity – is a real pain in the fulcrum.

If you turn up the audio (and only) gain control the footballs of a fly on the cabinet sound like drumbeats. Well, almost. You can indeed talk to the Relative Power Meter and hear yourself clearly in the phones. More about this further down the log.

Every ham knows he can improve on any kit designed by professional engineers, and I suppose a philosophical detachment about this is common in kit factories, but if Heath sees the photo accompanying this article equal time may be demanded, so I'll explain the obvious haywiring.

On the left, fingered by a thumb, a 7,000 kHz crystal market oscillator, then clockwise on the rear panel a toggle switch in the ground return to the added batteries, and underneath it a coax socket paralleling the phono type supplied for the antenna connection.

Next, two six volt nicads and a mess that includes external power terminals, a fuse holder squinched into the hole that held Heath's rather outré (how you like that?) power socket, diode polarity protection (I'm human), ceramic by-passes for insurance and an extra phone jack.

On the right side is a junk box audio filter to take the edge off the IC hiss and microphonics mentioned earlier – an 88 mH toroid in parallel with .15 mF is connected from ground to the midpoint of two .047 capacitors which are in series between the kit phone jack and the added jack.

If these additions do nothing else they demonstrate that Heath left a lot of room inside the HW-7. You can really fool around in there, and because of the wrap-around cabinet design mounting holes on the side won't show – they think of everything.

Wiring in a speaker amplifier is a temptation I've resisted so far. The manual mentions a nominal 1,000 Ohms output, so for this and other reasons I was surprised to find, after trying several sets, that the headphones I preferred are 8 Ohm (very nominal) and what you might call "bottom of the line" from Radio Shack's stereo salon. Labeled "Nova 10" and priced around four dollars, on strong signals they serve as speakers, not well, but better than you would expect.

Now about the vfo. It's stable enough that I spend too much time listening to sideband on 15, and I suppose someone will soon come up with a scheme to put the HW-7 on DSBSC. The dial is described as "virtually backlash-free" and that's close.

Good verniers are expensive. Although the catalog and manual show dial markings every 25 kHz, mine are every five. Incidentally, a later kit than mine showed another difference – heat sinks are included for the two output transistors. This is a wise precaution I've neglected to copy, although I will, and so far no dissipation problems.

After assembly, dial calibration is a simple synchrodyne two-step, about a minute per band. Checking the results around the dial with test gear did indicate gentle plate bending was in order, and this took a little patience, but once done the calibration stayed put.

It won't serve as a frequency standard, but the vfo's reliability turned out to be good enough to justify removal of that security-blanket low-edge marker oscillator on the port bulk head.

The adjustable timing on the break-in circuit works perfectly, but the sidetone had a rough edge and was uncomfortably loud. Tastes differ, but those readers who have an HW-7 and are unhappy with the sidetone can try the following: Connect a .01 ceramic from base to collector of Q10; add a 47k resistor between C45 and R34; change R35 from 1,000 to 270 Ohms. This gave me a better note, smoother and suitably attenuated, which no one else may hear as an improvement. However, as noted, adding and subtracting from the circuit board is carefree fun.

When you have tuned in a signal with the vfo, peaking the preselector precisely can be a trial. With a tiny knob you are trying to come as close as you can to the best picofarad out of 393.

A vernier here would be nice, even a large knob would help, but out of respect for the aesthete who did a nice job on the panel I just try harder, combining delicacy and expletives. By the way, this control will also, when conditions are right, bring in shortwave broadcast stations – irresponsible elements of the synchrodyne front end, operating in diodyne mode as you tune segments between the ham bands. Fortunately it doesn't do this very well, but on the other hand you may think of it as a bonus.

Relative power output is indicated by the meter, which is driven by a diode connected to a safe point on an antenna to ground voltage divider. Hardly any levity is intended – a dummy antenna provided does indeed warm up when you test the transmitter. The psychological dividend is obvious.

A reminder now that should be unnecessary – Novices are a friendly bunch who couldn't care less about your final power.

A multimeter here would be a nice frill, but, again, UP is where the price would go. However, it's easy to modify the meter circuitry to indicate normal battery voltage and, by the difference between key-up and key-down readings, when charging or replacement is due.

I connected the hot side of the meter to the arm of a miniature SPDT toggler mounted just to the right of the meter – where it neatly replaces a panel bolt. One side of the switch then goes to the normal connection and the other through a 100k resistor to the battery buss.

When the switch is in battery position the meter reads slightly above midscale for twelve volts. The simplest of mini-changes, but it's very nice to know the condition of your power source when you are operating tiny Watts.

In the beginning operating QRP instead of three or four hundred Watts was educational. It still is. The first revelation was that 40 kHz up from the bottom, a putative rallying point for minipower freaks, seemed to be a frequency with magnetic appeal for CW operators of whatever potency.

I've yet to identify a QRP station at this point on 40, 20 or 15. My fault, perhaps, for exposure atop a 2 Watt molehill tends to be diffident rather than determined.

On the other hand, as QRP experience accumulated it was cheering to find that courtesy was the rule and that, once tiny-mite status was confessed, the fellow on the other end would readily move me to a better spot, fine-tune, filter and listen harder. Courtesy is so common that the occasional put-down is only amusing.

Another lesson was that the relative quiet of the Extra-class CW slots isn't really all that promising for QRP. There's a lot of heavy artillery there, patiently awaiting DX targets of opportunity. One exotic yoo-hoo from Ruritania and you're wiped out.

A reminder now that should be unnecessary – Novices are a friendly bunch who couldn't care less about your final power. Most of them are trying to get their code speed up for the next exam, and working other novices isn't the most efficient way to do it. Working them with error-free CW just fast enough to stretch their mental muscles is of mutual benefit.

In the past I called on them fairly frequently, but not as often as a good neighbor should. The Novice bands are good places to give and get encouragement.

It's a fact of life in QRP country that you have to play your cards carefully. Just imagine throwing away 20 decibels or so of your current electronic pizzazz and then think of ways to compensate. Propagation conditions, antenna efficiency and applied psychology are suddenly very important. So is dumb luck.

The following surprises convinced me that sometimes perversity is well rewarded. Experimenting with supply voltages lower than the 13 recommended in the HW-7 manual (nine turned out to be the low limit) resulted in a childish itch to make it on 20 with six "C" cells. I was still using a 14AVQ, a good vertical but hardly the best for QRP.

One string of CQ's on 14055 and JA7AME replied. We exchanged 559 reports and chatted for about 20 minutes despite a slow QSB and some competition on the frequency, mentioned by Kan but inaudible to me. Due credit to his three element beam. Nevertheless I found it astonishing that a more or less omnidirectional trap vertical, 10 feet above the ground, would lob across the Pacific a significant fraction of my Watt or so of input power.

Kung Fu: "It is easy to push needle into wooden wall. Try it with football and you go bananas."

Considering the efficiency figure of the final, whatever that is, the anomalous losses between it and the antenna, and the wasteful distribution in azimuth, the performance surpasseth human understanding. Mine, anyway.

Satisfactory reports come in from 6's and 7's in the opposite direction, so it doesn't seem likely that the vertical installation has a freak lobe favoring the Far East. Could it be that QRP really works?

Another surprise with the same antenna was SP9PT/VE8, a peak-climbing expedition packing a transceiver and gas-engine power-plant around in the Far North. En route to Mt. McKinley, they came back to a call with 579 from somewhere near Whitehorse.

Good reports are the rule from Alaska, with KL7MF's carrying extra emphasis since Hal – now retired, I believe – was the F.C.C. at Anchorage. For some reason I seem to work a lot of R.I.'s – is there a W.A.R.I. certificate? (How NOT to QSO an R.I. was described in the March, 1966 issue of this magazine.)

The day after the SP9/VE8 contact any remaining skeptical reactance was neatly tuned out by an exchange of identical reports with an 800 Watt powerhouse a hundred miles away on 40. He read his report from a meter and mine was just a guess, and perhaps his receiver had a hot

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SPECTRUM COMMUNICATIONS

BOX 140, WORCESTER PA 19490 (215) 584-6469 front end and a low noise figure, but on 7 MHz the HW-7 is no slouch. So smile thank you and enter it in the log.

But there are hard lines too. In the beginning you find out how patient you can be. Call CQ and wait. Again, and wait. Gently rock the dial just to be sure and try again.

Oops, sounds like a station you couldn't hear has just finished a transmission – his contact is replying on the frequency but he doesn't mention any QRM. Bittersweet exculpation. Move and try again in vain.

In your mind an imp sketches cartoons: a fine mist of rf sprays out from your vertical about as far as it would go from the lawn sprinkler; a pingpong ball materializes from the Yagi, arcs gracefully and plops to the ground; electrons sliding back and forth on the long wire occasionally lose their grip and float to the grass. Images of a ruder nature bring a rueful smile. Just don't get discouraged.

If you aren't lucky with CQ's listen for some from a district at an optimal distance according to the time and band, and jump in feet first if you hear no replies. If there's competition don't move away until you hear a contact made.

Playing it cool by opening with a careful search for CQ's that are reasonably strong and unanswered may be the smart way to begin your QRP log, but it's human nature to want to call to an empty corner of space and hear an acknowledging reply.

There are times when reality is a slippery concept and it's nice to be noticed. But however you shuffle the deck, the high cards in this game are patience, determination (stubbornness?) and lore of the art.

Getting results with expertise instead of KVA muscle purchased from a power company is, besides being good ecology manners, a challenging exercise bringing many rewards. Not the least being log entries sure to elicit gasps of admiration from your skeptical Watt-rich buddies.

Snorts of disbelief are equally satisfying, and to these you can reply with a reminder that the narrow edge of the hand has been proven more effective than the blunt fist by hundreds of TV scripts. (If not by the commercials.)

Kung Fu: "It is easy to push needle into wooden wall. Try it with a football and you go bananas."

Another benefit is that competing from a position of disadvantage does discipline the mind wonderfully. Little is taken at face value: ground systems are refurbished; old connections resoldered; everything that can be tightened profitably is; antennas are re-evaluated, lowered, raised, slewed and tipped; mismatches are analyzed and corrected; slipshod and make-do are sins of the past; test gear is put to work as dust motes rise from exhumed textbooks. All that neglected ham housework gets attention and in the process your smarts multiply and amateur radio benefits.

So operating low power on the dc bands is rewarding and instructive, besides being a lot of fun. But it hasn't been a wildly popular aspect of our hobby and I think the Heath Company deserves credit for taking a chance with the HW-7. How about a minute of meditative silence in congenial tribute? I could use that.

. . . W7IDF

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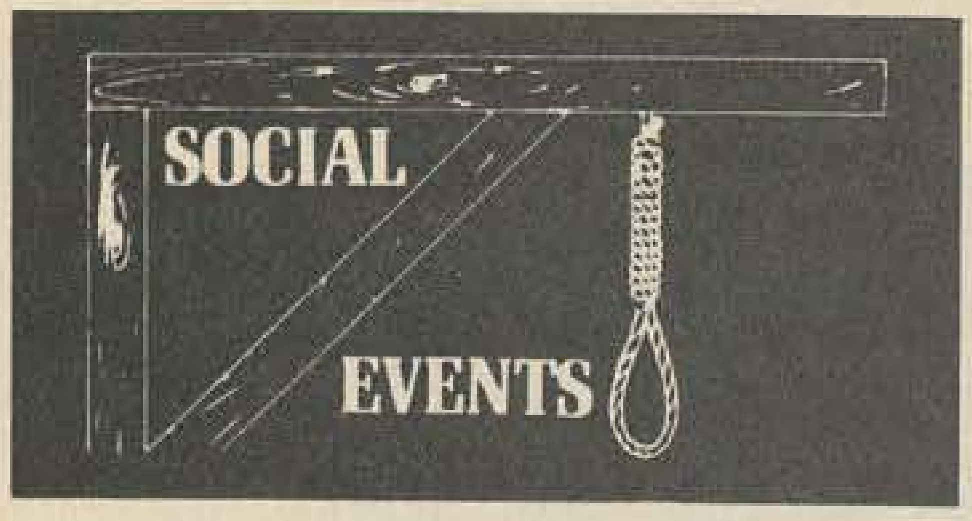


from page 21

person; chicken dinner $6 per person. Activities begin at 10 am to sunset, dinner served 1 pm to 3 pm. Program: hidden transmitter hunt, horseshoe pitching contest, ARRL forum, radio control model airplane flying demonstration and fun and games for the kids. For tickets and program send your remittance (check or money order) to 19 - 79 Repeater Association, Box 221, Malden MA 02148.

BEREA OH
SEPT 27

The Annual Cleveland Hamfest and Flea Market will be held Saturday, September 27th, at the Cuyahoga County Fairgrounds in Berea. Easy access from Hopkins Airport, Interstate I-71, I-90, and the Ohio Turnpike. Listen for the Buckeye Belles or Chix and "Talk In" from the East on 146.76, South on .82, West on .88, and locally on .52 and .94. Eastcars, Midcars on 40 and 80 M and 52.525 for farther out. Tickets $1.50 before Sept. 25th – $2.00 at 8:00 when gates open. Flea market parking earlier – bring your own tables. For early tickets and information on motels and campgrounds, send a check and SASE to: Cleveland Hamfest Association, Box 43413, Cleveland, Ohio 44143.

MADISON WI
SEPT 28

3rd Annual Dane Co. Swapfest will be held in Madison WI, Sunday, Sept. 28, 1975 at the Dane Co. Expo Center Youth Bldg, rain or shine. Sponsored by Madison Area Repeater Association. Prizes, all you can eat pancake breakfast and beef bar-b-q luncheon, family fun, commercial exhibits. Adv tickets & tables $1.50 – $2 at door. For advanced tickets write M.A.R.A., Box 3403, Madison WI 53704.

LOUISVILLE KY
SEPT 28

The Fifth Annual Greater Louisville Hamfest will be held on Sunday, September 28, 1975 at the Kentucky National Guard Armory on Crittenden Drive at I-65. There will be a large indoor exhibitors area, large paved flea market area, club meetings, technical forums, prizes for the whole family and ladies' Bingo. Admission adults $1.50 – under 12 free. Flea market pays admission plus $1 per space. For info contact K4GOU, 2415 Concord Drive, Louisville KY 40217 (502 634-0619).

ADRIAN MI
SEPT 28

The Adrian Amateur Radio Club, Inc., will hold its Fall Hamfest on Sunday, September 28 from 8 am to 3 pm at the Lenawee County Fairgrounds, Dean Street in Adrian. All buyers, sellers and visitors welcome. Cost $1 in advance. $1.50 at gate. Table size 8 ft. $1.50 per half. Talk-in on 146.46 – .52 – .94 MHz. For more information write Adrian Amateur Radio Club, P.O. Box 26, Adrian MI 49221.

OTTAWA ONTARIO
OCT 3-5

The 1975 Radio Society of Ontario Convention, hosted by the Ottawa Amateur Radio Club, will be held at the Skyline Hotel, Ottawa on October 3, 4 and 5, 1975. Programs include: 9 technical forums (including W2NSD/1, 73 Magazine's Wayne Green), commercial exhibits, flea market, technical displays, C.R.C. satellite display, major drawings and door prizes, and much more. The Skyline Hotel is located within walking distance of Parliament Hill, National Arts Centre, the Royal Canadian Mint and in a major shopping area.

EAST RUTHERFORD NJ
OCT 4

The Knight Raiders VHF Club's auction and flea market will be held on Saturday, October 4th, at St. Joseph's Church of East Rutherford, Hackensack Street, East Rutherford. Free admission, free parking, refreshments available. Talk-in will be on 146.52 and 146.94. Flea market tables: $5 for full table, $3 for half table. Reserve your tables in advance by writing to The Knight Raiders VHF Club, Inc., K2DEL, P.O. Box 1054, Passaic, New Jersey 07055.

WAKEFIELD MA
OCT 4

Quannapowitt Radio Association annual auction, greatest and oldest in N.E., Saturday, October 4th, St. Joseph's Parish Hall, Wakefield, Massachusetts, 10 am to 4 pm, doors open 9 am, 10% commission, no minimum. Door prizes, special prizes. Talk-in 146.52.

MEMPHIS TN
OCT 4-5

Memphis is beautiful in October! The Memphis Hamfest, bigger and better than ever, will be held at State Technical Institute, Interstate 40 at Macon Road, October 4 and 5. Demonstrations, displays, MARS meetings, flea market, prizes. Talk-in on 3980, .34-.94 and MARS. Contact Harry Simpson W4SCF, Box 27015, Memphis TN 38127 or telephone 901 358-5707.

LEAGUE CITY TX
OCT 5

The Tidelands Amateur Radio Society's annual hamfest is Sunday, October 5, 1975, 9 a.m. 'til-? at the Galveston County Park, League City. Advance registration $1.50; $2 at door. Free parking, refreshments available. Main drawing for door prizes will be at 3:00 p.m. Swap booths available. For information, send a S.A.S.E. to Luke Sterling, 105 Seabreeze Drive, League City, Texas 77573.

WARRINGTON PA
OCT 5

The Mt. Airy VHF Radio Club (the Packrats) are holding "Hamarama 75" at the Bucks County Drive-In Theater, Route 611 (Easton Rd), Warrington, Pa., on Sunday, 5 October 1975, 8 am to 4 pm. Registration $1.00, tailgating $2 – bring your own table. Parking for 1000 cars. Talk-in via W3CCX/3 on 52.525, 146.52 and 222.98/224.58 MHz. For information contact Lee Cohen K3MXM, 8242 Brookside Rd, Elkins Park, Pa. 19117. Phone (215) ME5-4942.

COLUMBUS OH
OCT 10-11

On October 10 and 11, 1975, the ARRL Great Lakes Division Convention will be held in Columbus, Ohio. The actual site is on the north side of the Ohio State Fairgrounds just off 17th Avenue. There will be a number of well-known personalities among the amateur radio fraternity there both as guests and as speakers. For more information contact: Ira Bickham, Chairman, Industrial Displays, 1423 Thurell Road, Columbus, Ohio 43229.

Jerrold Swank W8HXR
657 Willabar Drive
Washington OH 43160

40m DX Antennas - The Easy Way

The trouble with 40 meter antennas is that they are usually longer than city lots, unless they are verticals. Then they are dependent on hard to dig radials. That is my problem. But what if antennas were half as long, and didn't need radials?

I have a 74 ft. wide lot, and was using 40 meter phased verticals to handle phone patches for the Antarctic stations during their winter, when no mail goes in or out. My yard is full of trees, most of which are as high as the verticals, and they are in leaf during this period, when it is summer here.

After several seasons, during which I handled a lot of traffic, I decided I needed to get a better signal from down there, and as well, put in a better signal to them.

I read an article on folded half wave radiators (by William Orr, *Ham Radio*, March, 1970) and tried one out. However, a horizontal antenna must be nearly a half wave above ground, or its DX properties are no better than my verticals with no radials. Then it dawned on me that vertical dipoles need no radials, and sloping dipoles have gain off the front of the slope.

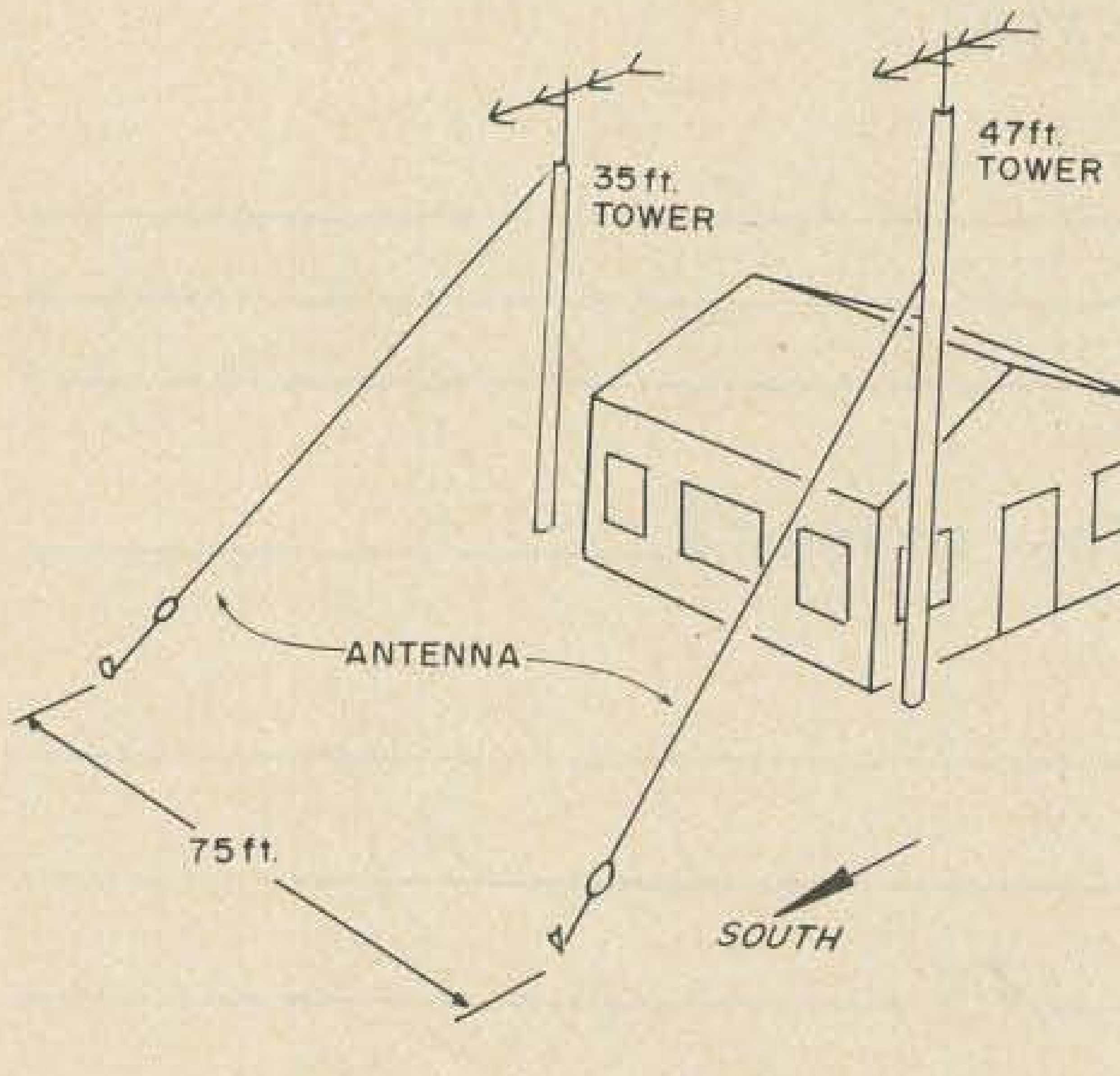


Fig. 1. Antenna layout.

My towers are only 48 ft. apart – not a half wave, but I decided to try. I sloped one dipole from the top of my 35 ft. TV tower to the southwest corner fence post at the back of my yard, and the other from 35 ft. up on the 47 ft. ham tower to the southeast corner of the yard. The antennas were pulled up by pulleys, making them easy to adjust and tune. On the southeast antenna I was 10 dB stronger in Miami (167°) than in New Orleans (211°), and vice versa when I used the southwest antenna. When I used both of them I was better in both directions than with either one alone.

When I started to handle traffic to the Antarctic I was amazed. I pinned the meter on several occasions at South Pole Station, and was 10 over 9 at McMurdo Sound. That season I ran more patches during June, July, August and September than any other station and was told by McMurdo that I ran more than one fourth of all patches in spite of the fact that I used only 40 meters and they used both 40 and 20 and 20 meter MARS. Many nights I was running phone patches when the other two "regulars" were unable to even copy the Ice stations. Fig. 1 shows the layout of the antennas. It is

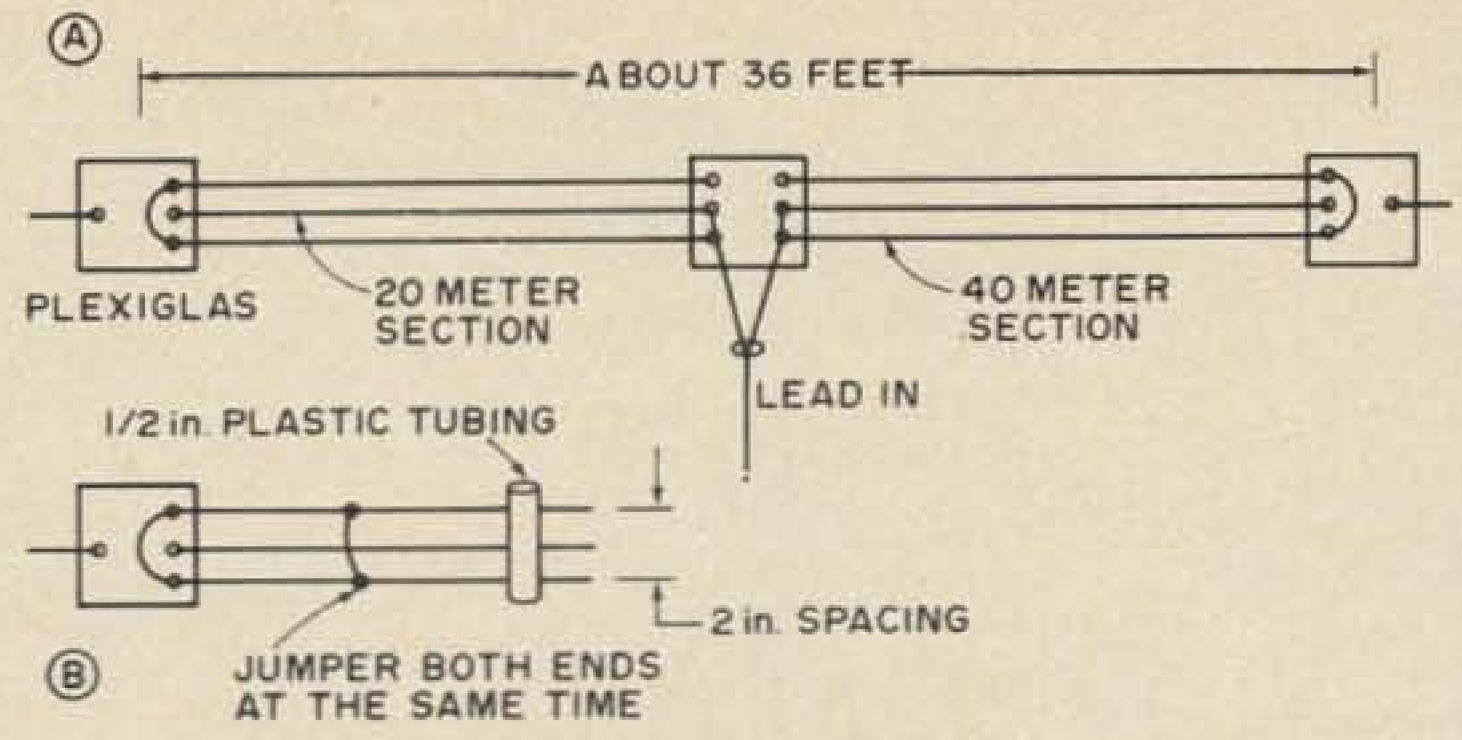


Fig. 2. (a) The design of the antenna. Cut the antennas for the low frequency of the band, and then, if necessary, tune by adding the jumper as shown. Then tune the higher frequency antenna by trimming at the ends. The antennas will cover quite a good band with low swr. (b) The 40m section can be tuned by moving the jumper.

important that both antennas be tuned to the same frequency for accurate phasing. By inserting a half wave of coax in one leg I can end fire into California and the East Coast, although the gain from the slope will be missing in these directions.

Fig. 2 shows the design of the antenna. The length of the dipole will be about the same as any other type of dipole and should be cut for the low end of the band. The 40 meter section can be tuned by moving the jumper as shown in Fig. 2b. Move both jumpers – one at each end – the same amount toward the center to shorten the antenna. To shorten the 20 meter section just trim both ends. There will be little

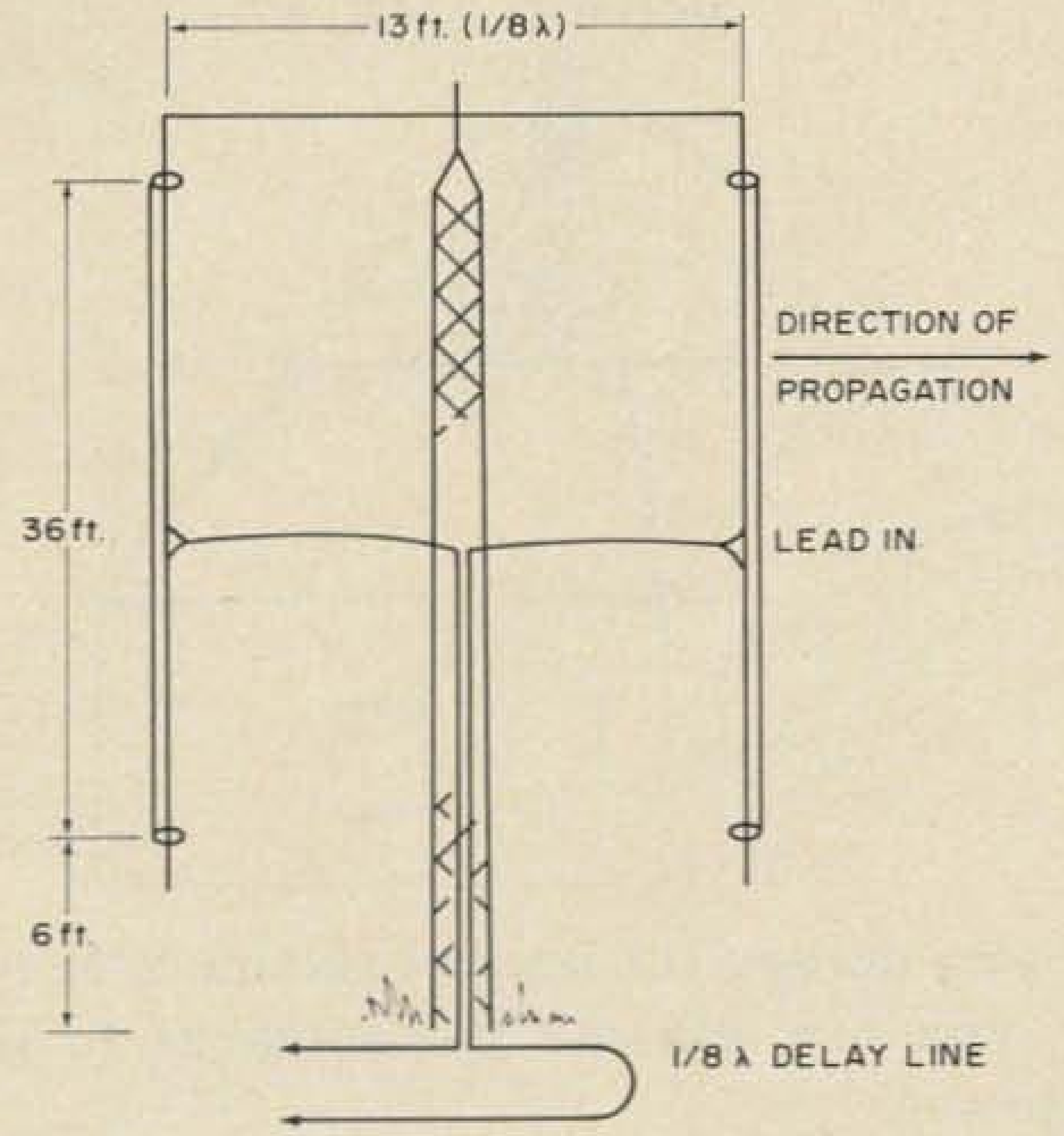


Fig. 3. Alternate antenna array for one tower. This array is 1/8 wave spacing on 40 meters and ¼ wave spacing on 20 meters – a very good combination. A little imagination would show you that this could be made to rotate.

reaction between the antennas. The spreaders can be made of 3" lengths of 1/2" plastic tubing, with holes spacing the outside wires about 2" apart, and the other antenna between them. Space the spreaders about 6 ft. apart and fasten them either with epoxy cement or by making the holes slightly small so they won't slide. The wire can be #16 or #14, prestretched.

The tops of the antennas are about 33 ft. high, and the bottoms are about 6 ft. off the ground out of the reach of children.

Do not use a balun, and connect the coax shield to the lowest side of the dipole. It is easier to understand this antenna if you think of it as a ground plane with one radial.

A prominent antenna manufacturer told me that this array with the slope probably had a gain of about 10 dB.

I used RG59 for the lead in. The current is divided between two antennas, and RG59 has ample capacity for full legal power this way. I used 3/4 wavelength in each lead in. This makes a transformer match and gives me close to unity swr. Run the lead in at right angles from the antenna as far as possible. Keep the vertical angle less than 45° if possible to get maximum vertical polarization. You will be pleased with the absence of noise because of the nulls on the side of the array, and the lack of interference.

If you do not have two towers, try Fig. 3 for a one tower array. This is a cardioid array, with no slope, but takes advantage of the shortened antenna and phasing. By changing the delay section to the other lead in the direction of the array will be reversed.

There is one more array which this combination makes possible. This is shown in Fig. 4. Going back to my comments about the directive effect on my two antennas in different directions, a new idea comes up.

How about a rotating beam made of three or four antennas sloping from the top of a 35 ft. TV tower? You can either use separate feedlines or a Dow Key relay. If you use the relay, which grounds the unused lines, make the lead from the antenna to the relay 1/4 wave. This will open the center of the unused antennas and detune them. If you have a switch which leaves the lines ungrounded, then use half wave lines and they

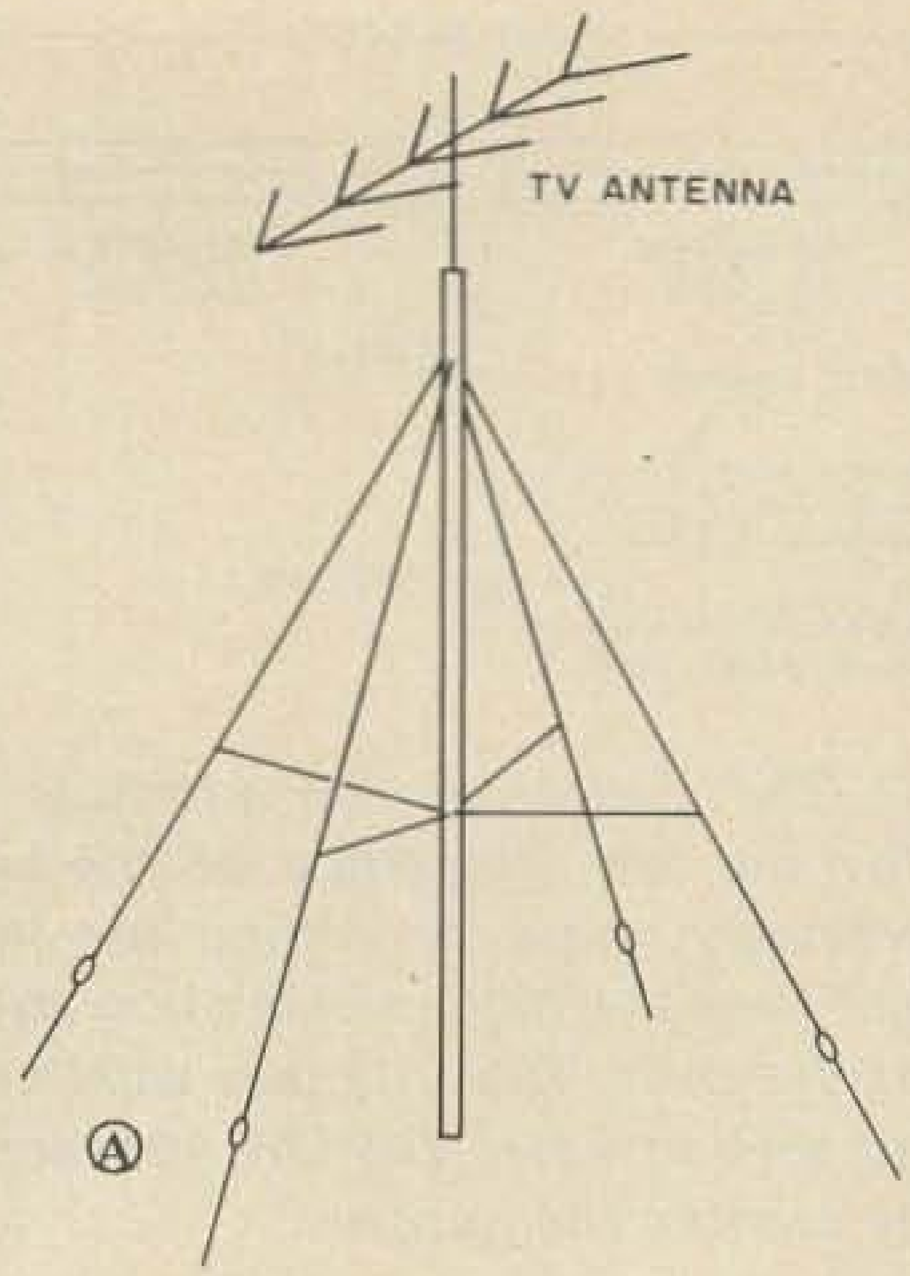
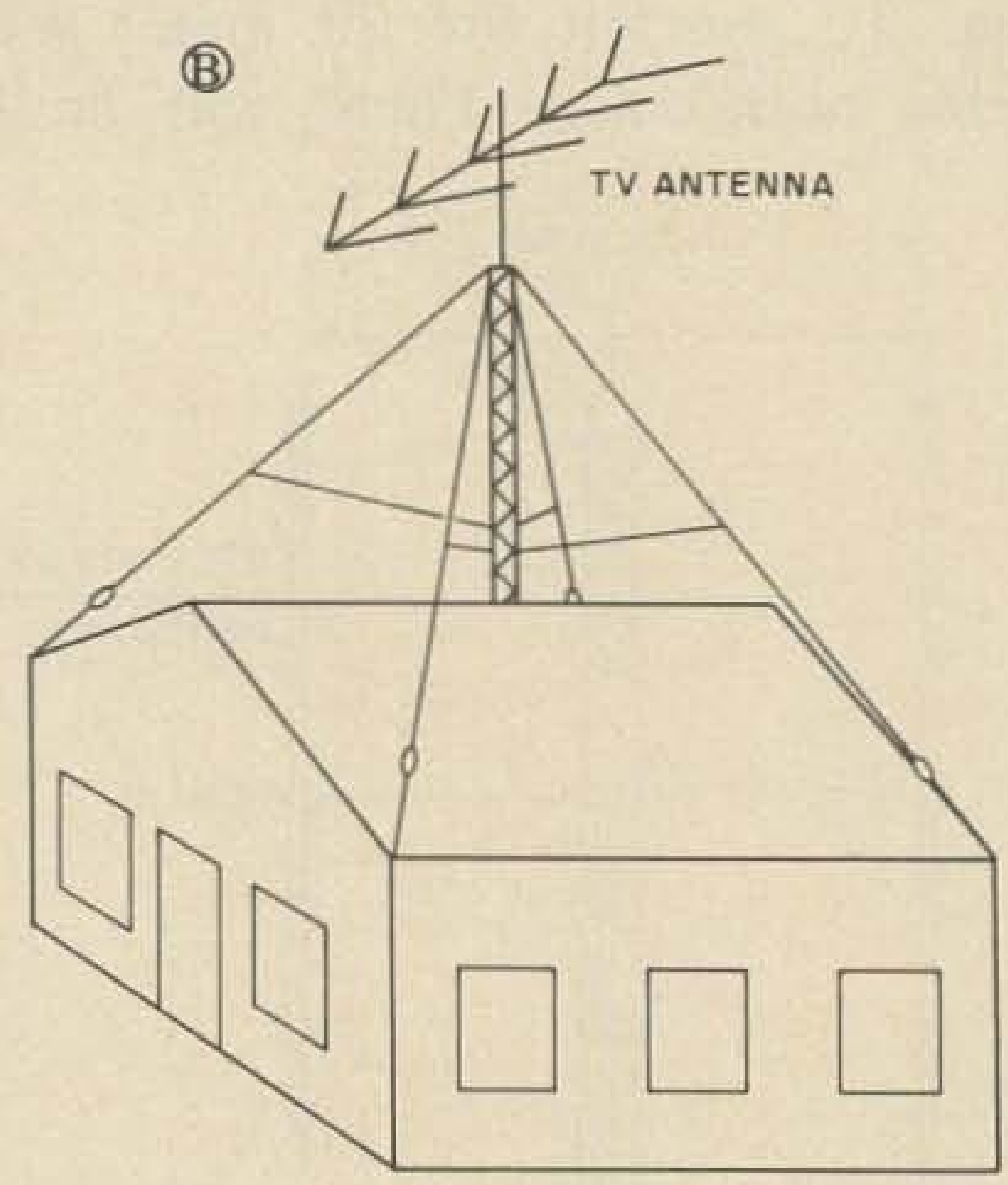


Fig. 4. (a) Rotating wire beam. You can either use four feedlines or use a relay. If you use a Dow Key relay, which grounds the unused lines, make the lead from the antenna one quarter wavelength to the relay. Then, when grounded, the antenna will be open in the center and detuned. If you use a coaxial switch, use half wavelengths from the antenna to the switch, and when the lead in is dropped from the switch the center of the antenna will be opened and thus detuned, by the rule that a half wave repeats the open impedance at the other end of the line. If you use a Dow Key relay with three positions, you can use just 3 antennas with nearly the same results. Naturally, you can also use the three antennas as guys for the tower. (b) Antenna mounted atop the TV tower.



will also detune the unused antennas. Naturally, you can also use the antennas to guy the tower.

Last but not least, how about a tower on top of the house with antennas to each corner of the house, for a NO SPACE antenna array?

...W8HXR

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The Oscar Zapper

Conclusion

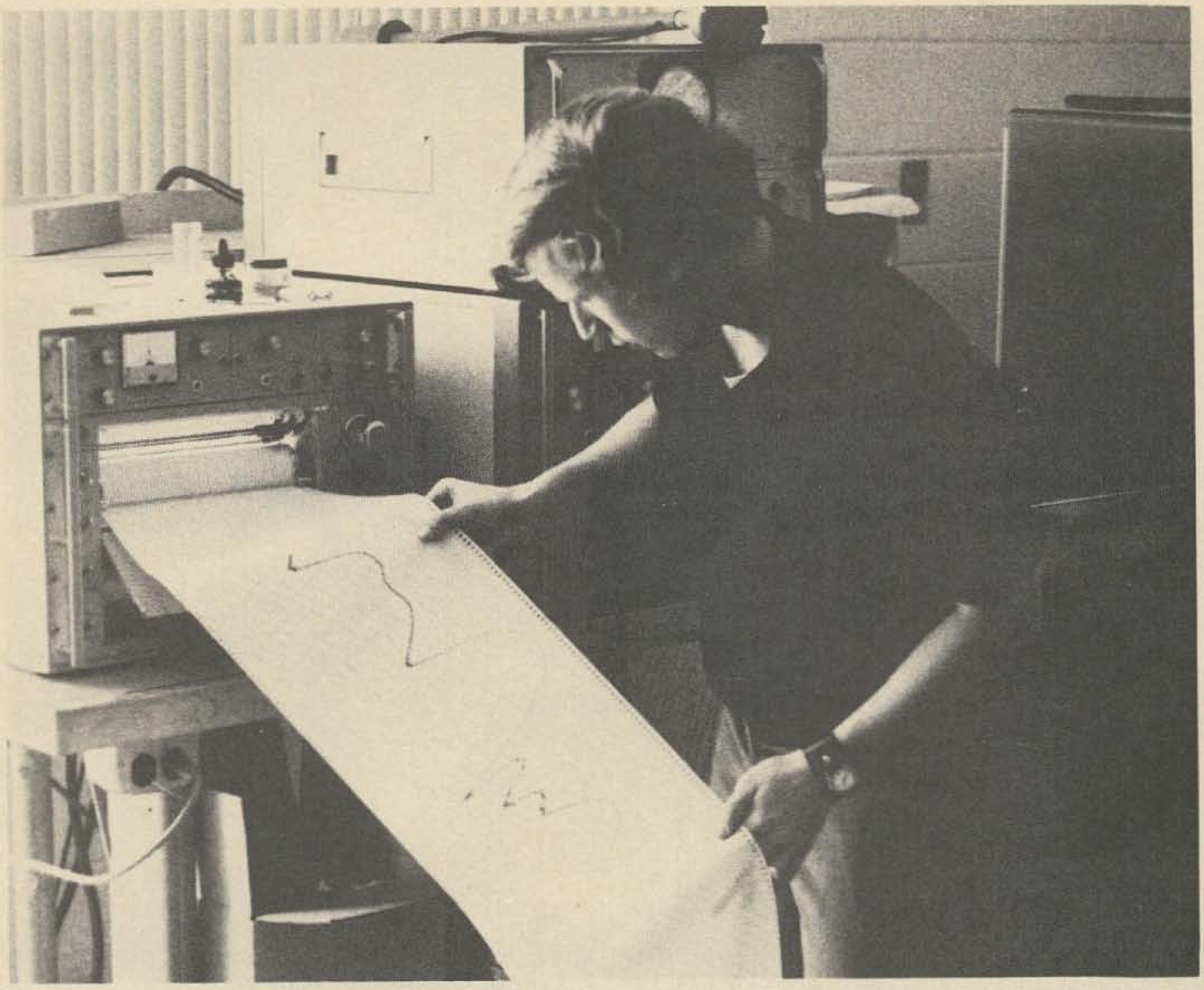
In beginning this project I felt that the helices would work very well and would yield a 12 to 15 dBi circular gain. I also thought that it was necessary to measure the gain as well as the antenna radiation pattern, so that the performance of the helices could be verified. Since I was a graduate student in physics at Georgia Tech, the antenna pattern was measured using the facilities that are available at the Georgia Tech Engineering Experiment Station and the Antenna Lab of the School of Electrical Engineering. I hoped to be able to perform the antenna measurements and actually see if the pattern (i.e. the beamwidth) and the gain of the antenna were comparable to the theoretical pattern and gain. Cliff Burdette WA8GRE, Research Scientist at the Georgia Tech Engineering Experiment Station, and I made the pattern measurements in April and May of 1974 (before the array was completed).

The 70 centimeter helix was measured on the outdoor antenna range located on the roof of the Electrical Engineering Building at Georgia Tech. Instrumentation consisted of a Scientific-Atlanta amplitude receiver, a series 1520 pattern recorder, a UHF oscillator, and an antenna positioner control and turntable. A block diagram of the measurements setup is shown in Fig. 5. Using this configuration, patterns of the principal planes of the antenna were measured for both linearly and circularly polarized transmitting antennas. The antenna range is, however, not free from reflections. Nearby objects such as building corners and a crane prevented us from obtaining "free space" conditions. However, the far-field pattern can be measured since the far-field distance for the two antennas was only ten feet, as given by:

$$\text{Far-field Distance} = \frac{2(D_1 + D_2)^2}{\lambda}$$

where D_1 and D_2 are the largest aperture dimensions of the transmitting and test antennas, respectively. At this distance, the reflections should be approximately 40 dB below the maximum signal of the test antenna.

The measurement of an antenna pattern (i.e. the far-field pattern) involves the test antenna, whose pattern is being measured, and another antenna located at a certain



Cliff Burdette WA8GRE observes one of the antenna patterns as it is generated by the recorder. Equipment used in the pattern measurements is located in the background.

distance away, that is, in the far-field region. The test helix is used as a receiving antenna and at the same time rotated about a vertical axis through the desired angles in measuring the pattern. The test antenna was operated in the axial mode with right circular polarization. Two different transmitting antennas were employed – a half-wave dipole and a 3 turn helix of the same polarization of the test antenna. Pattern cuts were taken using both transmitting antennas. The measured beamwidth of the test helix is approximately 39 degrees (and corresponds to the theoretical value). This represents an adequately directive antenna for amateur satellite communications. The pattern nulls are quite good and nearly symmetric. The patterns, shown in Figs. 7 and 8, do show a slight asymmetry or distortion. This might be due to the location of the feedpoint of the test antenna. The helix was fed approximately 2 inches to the left of the axial center. This effectively produces a "tilt" in the pattern of the antenna. The level of the first lobe is approximately 16 dB below the level of the main beam of the antenna. However, this tilt is more likely to be a result of the antenna range itself as the reflections from the building and the crane and other factors can very easily cause such a tilt. The level of the first lobe cannot be pinned down because the pattern is slightly nonsymmetric. One lobe is 9 dB down, while the other is 16 dB down, as shown on the 40 dB plot of the pattern (Fig. 7). A minimum level of about 10 dB below the level of the main beam is desirable.

The gain measurements were made by direct comparison with a dipole, and the resulting gain was approximately 16 dB over a half-wave dipole. Since the gain measurements were made at 445 MHz, the gain at 432 MHz (the design frequency) would be less; nevertheless, the pattern results that

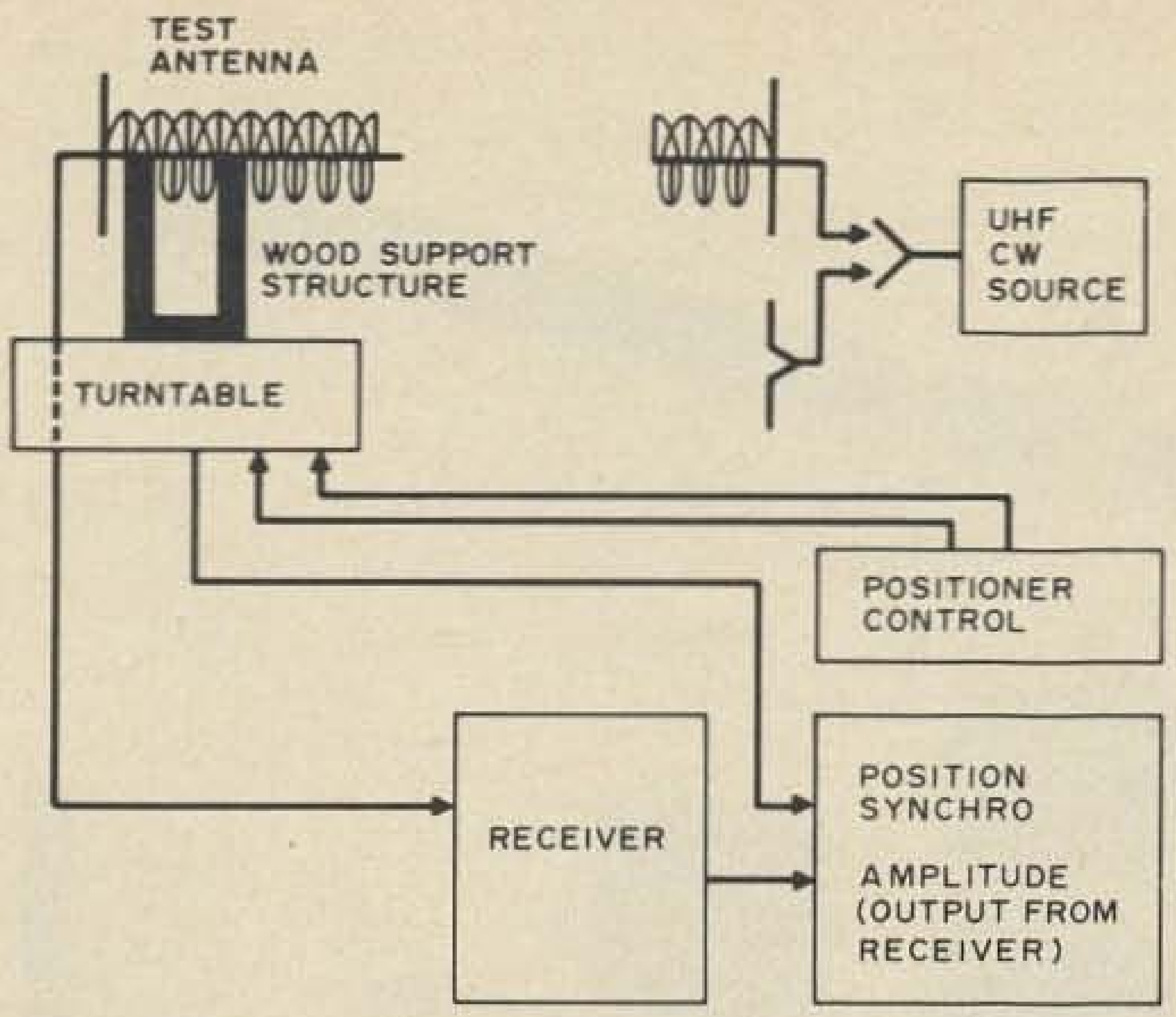


Fig. 5. Block diagram of antenna pattern measurements setup.

were obtained indicate that these antennas should be performing very well.

My results almost exactly correlate with Dr. Kraus's original graphs, i.e., the measured beamwidth and the theoretical beamwidth are practically the same. Since the center or design frequency is 432 MHz and since the gain depends on the circumference C, the number of turns n, and the spacing S, it can be easily seen that, as one goes to a higher frequency or frequencies above the design frequency, the gain will correspondingly increase [from Gain = $11.8 + 10 \text{ Log}_{10}(C^2 nS)$]. Likewise, at frequencies below the center frequency the gain will decrease. Here the measured gain at 445 MHz corresponds to the correct increase, so at 432 MHz the gain should be about 14.7 dBi circular.

Another very important measurement is the axial ratio or ellipticity, especially where circularly polarized antennas such as helices are concerned. Here the axial ratio is the ratio of the major axis to the minor axis of the polarization ellipse. For the axial mode helix the axial ratio is described approximately by AR = 2n + 1/2n, where n is the number of turns. For n greater than 3, the axial ratio will be nearly unity.

I tried two different ways of determining the polarization. The pattern method utilizes a linearly polarized directional antenna and also a circularly or elliptically polarized test antenna. A polarization pattern is traced out in this method. Basically, a circle is generated for circular polarization.

The other method is the circular component method. In this case, it is necessary to use two circularly polarized antennas of opposite sense. One must compare the relative signals of the two helices, E_{lcp} and E_{rcp}, to find the axial ratio:

$$AR = \frac{E_{rcp} + E_{lcp}}{E_{rcp} - E_{lcp}}$$

If the axial ratio is positive, then the wave is right circularly polarized. For these helices, AR will be very nearly unity. In my radiation pattern measurements I used two three turn helices of opposite sense plus the eight turn test helix for 432 MHz. Suffice it to say that the 8 turn helix was right circularly polarized (AR approximately 1.07, as compared to 1.0555 theoretical).

Conclusion

A lot can be said about helices and their good characteristics, and how they can be successfully used on the amateur bands. I

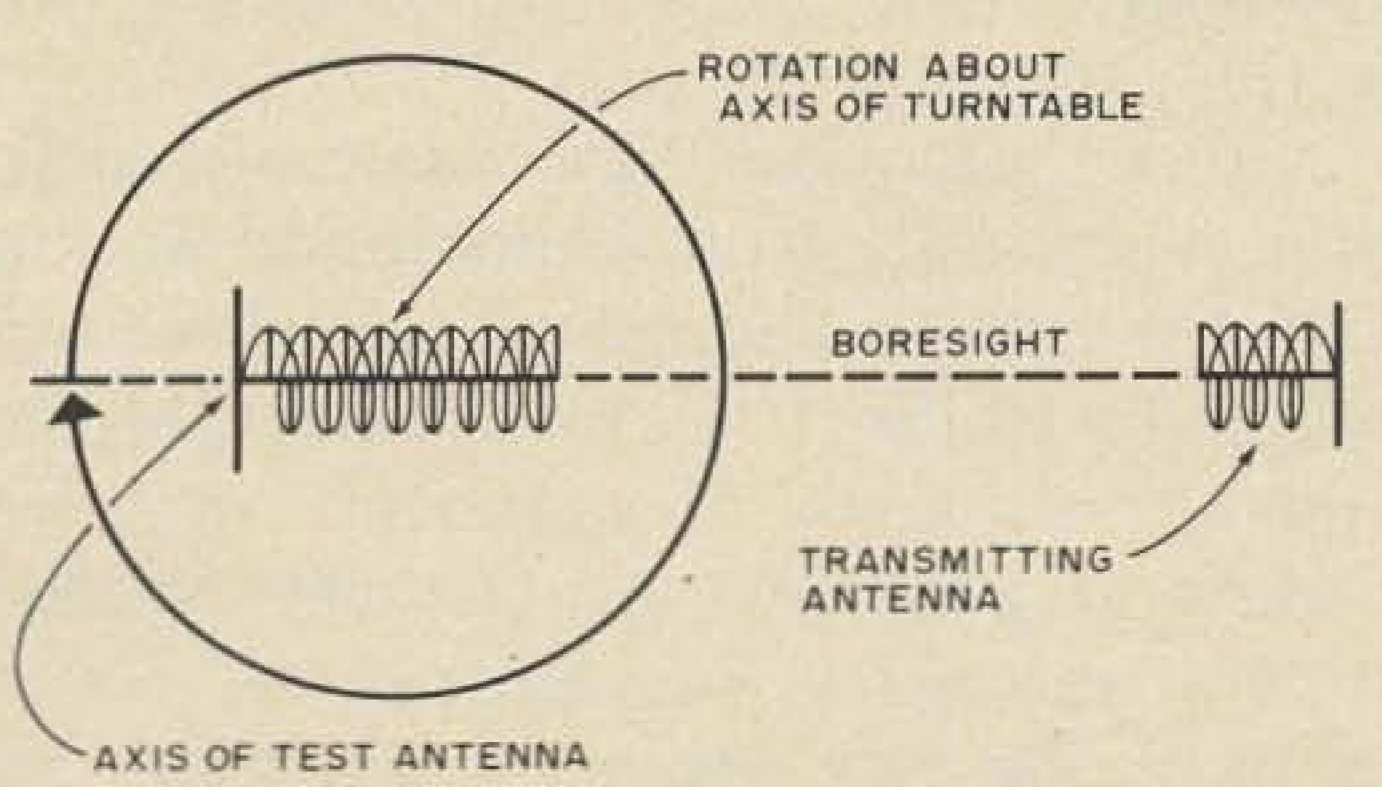


Fig. 6(a). Pattern measurement using test antenna for reception.

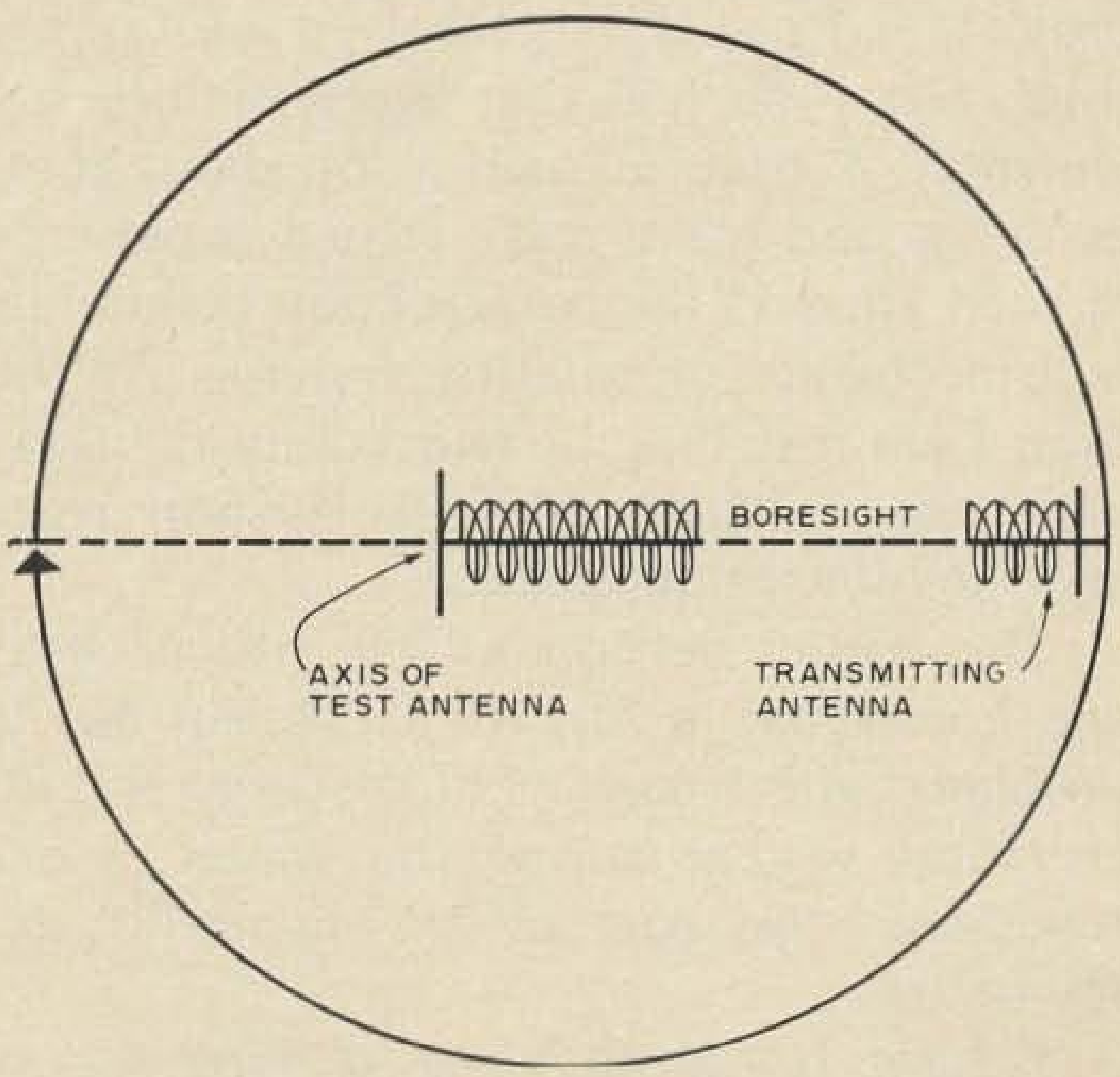
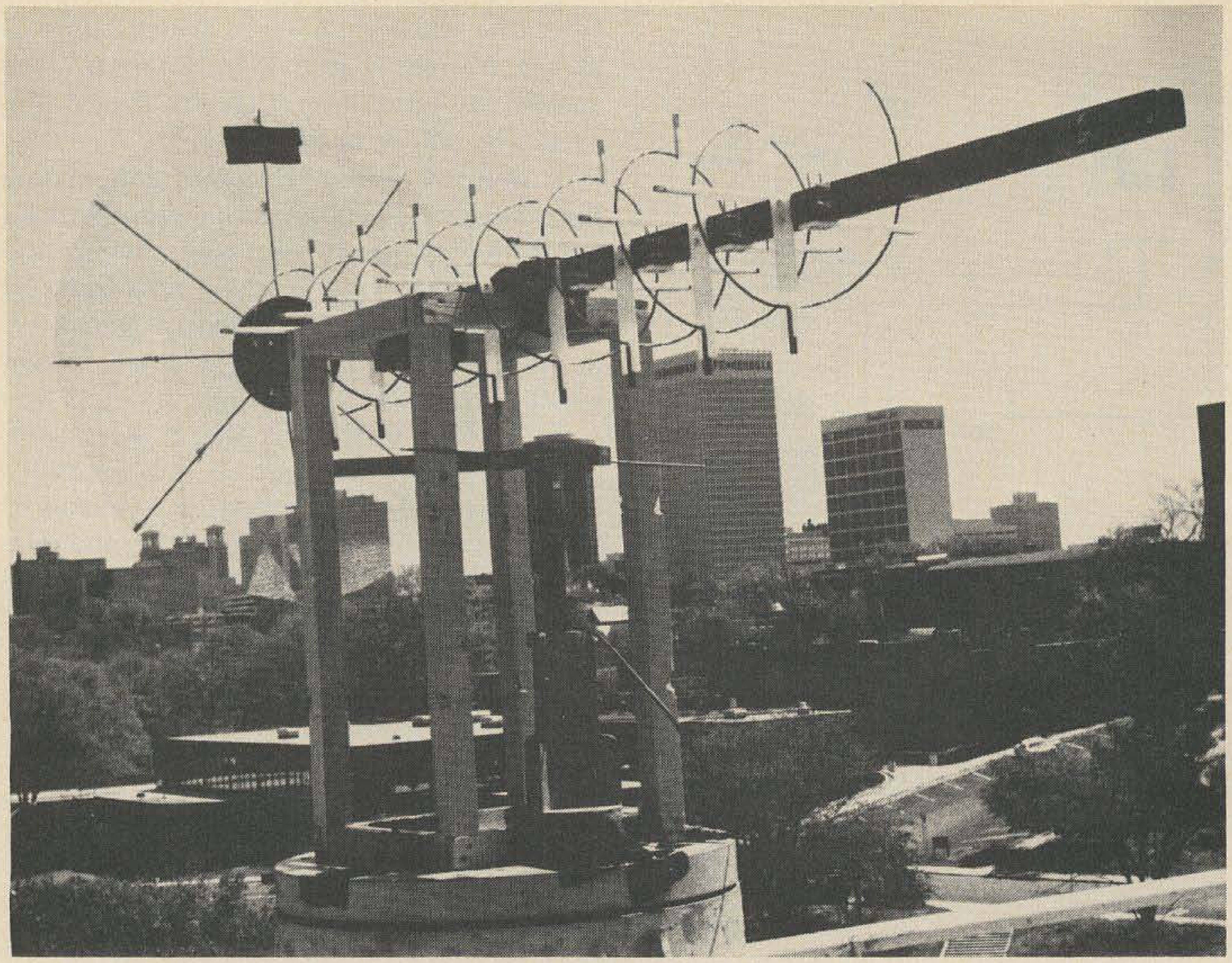


Fig. 6(b). Pattern measurement using test antenna for transmission.



The test antenna used during antenna pattern and gain measurements was the 8 turn 70 cm helix shown here. The helix was mounted on a wooden structure and placed on top of the turntable. The half-wave dipole used during gain measurements is located toward the front of the helix in the center of the picture.

feel that these antennas deserve more attention than they have gotten, even though I do not expect everyone to rush out and build an array like the one that I have. The project, as I call it, has involved a lot of my time, but I do feel that every minute was worth it. I have learned a lot about these antennas and have really gained experience in such areas as the construction techniques and mechanics of rotating systems. At this time I am installing or reinstalling the array with the updated azimuth-elevation rotor and the remounted helices.

The earlier version of the helical array was completed in August, 1974, but due to problems with balancing of the array and the elevation system during the winter, I had redesigned this part of it – hopefully, for the better.

I have found that, by making use of surplus materials in putting the array back together, I could come up with both a small investment and a mechanically sound antenna array. Also, in remounting the helices I decided that a counterbalance system should be installed, since I had found it very hard to balance the first array. Improper balance alone would cause rotor problems. By eliminating, in this updated version, the major stresses encountered with the elevation drive, the mechanical problems are solved, which means I can use the antennas more without having to keep working on the array.

Other "gleanings" have come out of the project, basically from building and working with the helices. I somehow found the time to build a 10 turn helix for 2 meters, which I entered in a home brew antenna measuring contest at a hamfest last October. Needless to say, this array was quite large, but its performance was what I expected and brought a first place in the "most gain" category of the contest. From this helix,

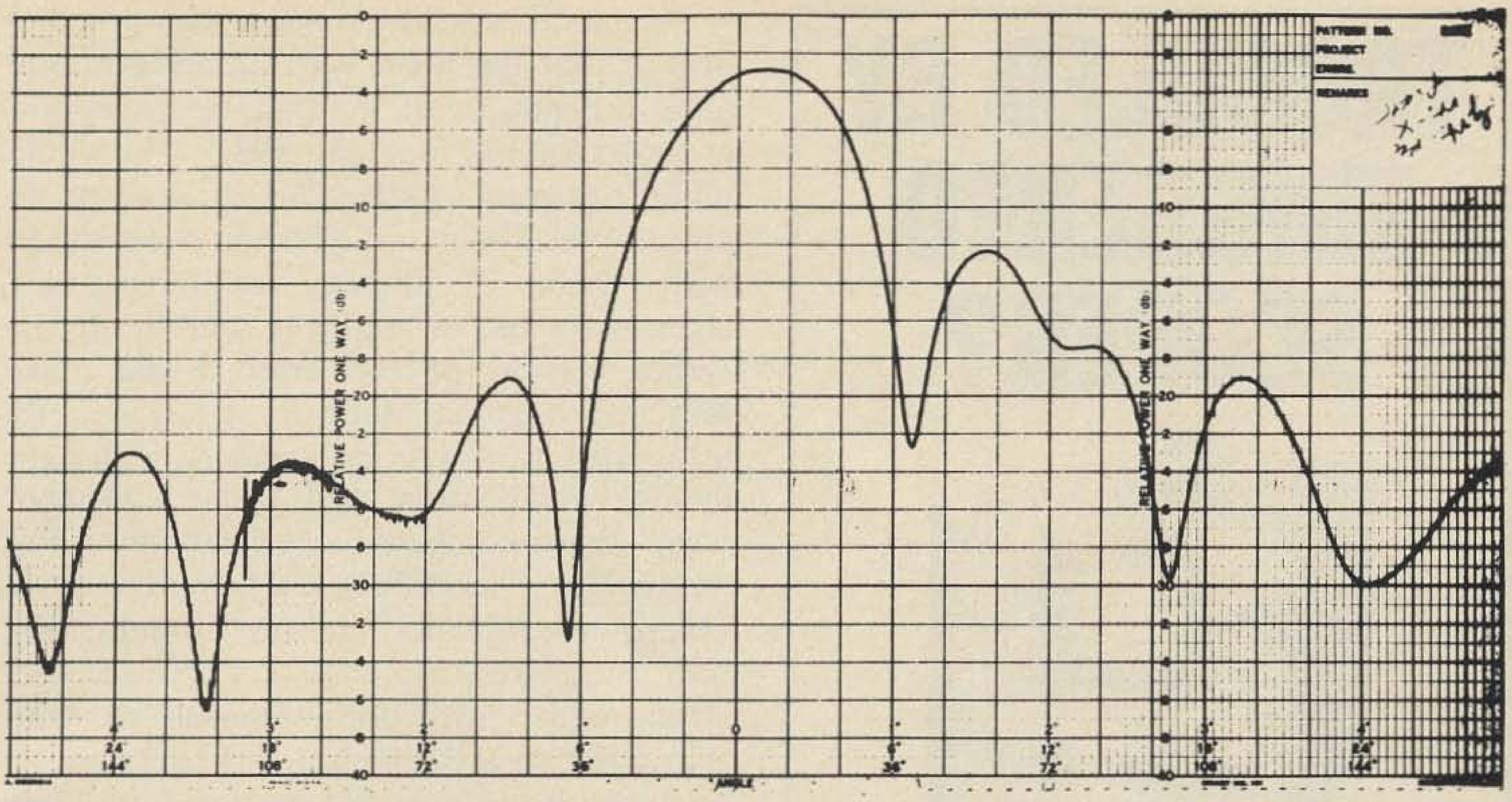


Fig. 7. Radiation pattern for 8 turn helix taken on a 40 dB rectangular recorder.

which was basically designed to be built and taken apart in less than an hour, I have found that a ground plane made of an aluminum plate with 8 radials will suffice. Here my original installation was too heavy and the ground plane for the 2 meter helix was the major factor. So in redoing the array I have tried to reduce the weight where possible without sacrificing any of the performance of the antenna.

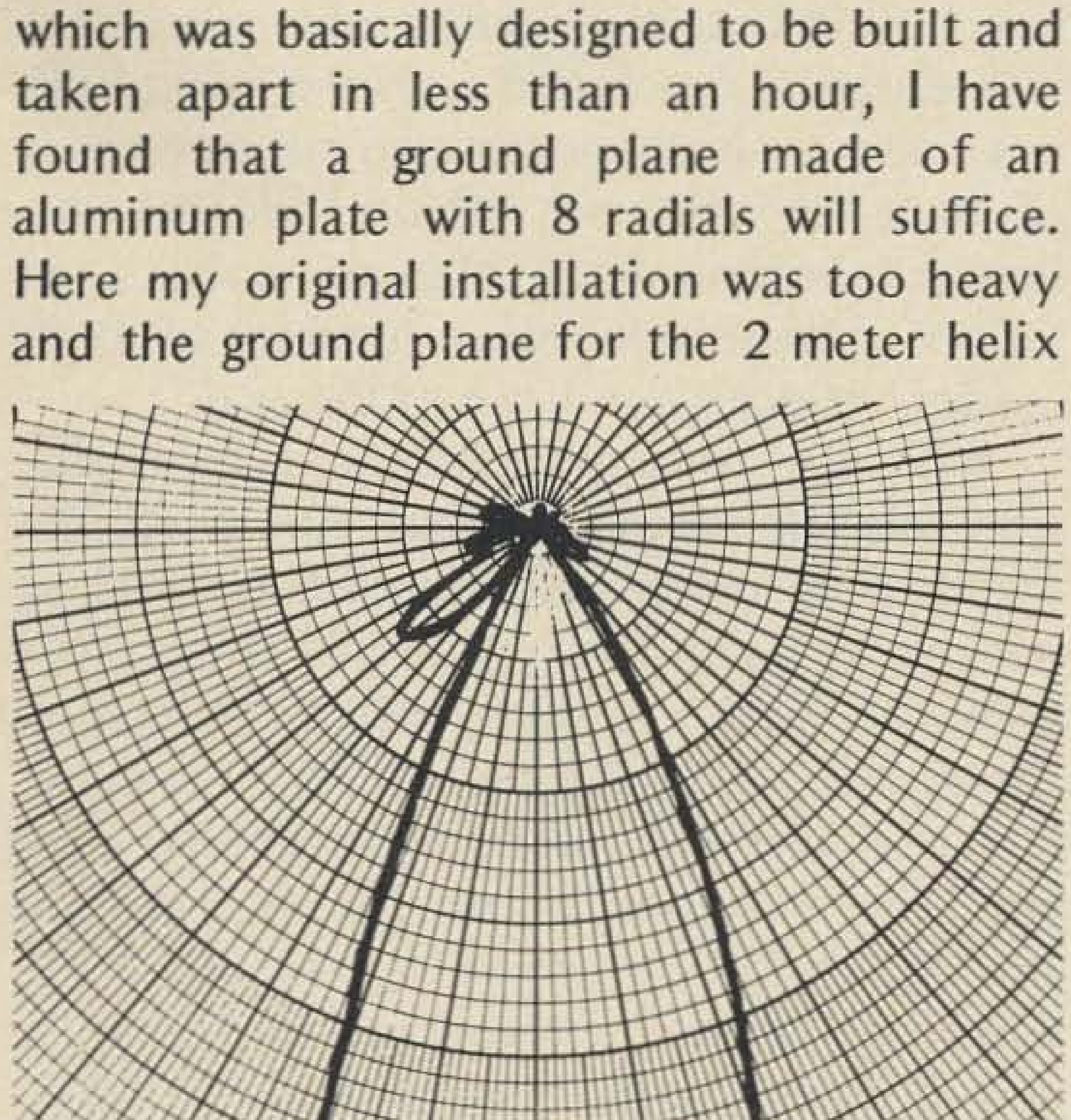


Fig. 8. Polar plot of radiation pattern of 8 turn helix.

Another factor in putting together these antennas was utilizing materials available at the lowest possible cost. The plexiglass supports, which can be used up to 1000 MHz, were spaced at 90 degree intervals along the turns of the helix, even though other spacing could have been used. Also, 120 degree spacing on a triangular crossed sectioned boom could be used, depending upon the band of operation and the type of wire used for the conductor of the helix.

Fiberglass or aluminum can be used for the boom. Aluminum does not degrade the wide band characteristics of the helix when it is used primarily as a narrow band antenna, although the helix conductor must be insulated from the aluminum boom.

Since the helix is pretty broadbanded, i.e., a design at 160 MHz will operate well at 137 MHz and 220 MHz, so construction techniques depend on its basic use or application (Ref. 1, 2 – see *73* #178, page 64). For instance, a high performance array of helices could be built for working moonbounce, possibly using 4 helices of about 20 turns to obtain about 24 dBi circular gain. (Or possibly more than four antennas could be stacked to get more gain, such as is done by W8JK's 96 helix array at Ohio State.)

As far as satellite work is concerned, I believe that the helix will out-perform any other antenna (with the possible exception of a parabolic dish at 432 MHz). The whole point in putting together this array was to be able to use antennas of different polarization with Oscar 7, thereby optimizing the chances for success with the satellite. In the earlier version of the array I did make receiving tests on Mode B of Oscar 7. By using the 6 turn helix on 2 meters, with right circular polarization, and also a 4 element yagi, I have compared signal fading on this mode. Here I used both a 2 meter converter (Microwave Modules) and my Gonset GSB-2 SSB transceiver on 2 meters. I received very strong signals with both antennas, but with the yagi I do get fading every 5 to 7 minutes or so. With the helix and the yagi both tilted at 30 degrees and only rotated in azimuth, I have found that the fading problem inherent in the yagi is not found with the helix. I did not really take any qualitative measurements or data on this, but when I do get this updated version I do plan to make some serious polarization measurements of both modes of Oscar 7 and also of Oscar 6.

With the rotor problems and re-installation of the array, I have not used the antennas as much as I should have. Making use of the tracking capability of the array, I plan to make some more polarization measurements, switching from right circular, left circular, and linear polarizations. Here also, the array will be diverse, as I can use the rcp helix for Mode B, the lcp helix for Mode A on 2 meters, and the lcp helix at 432 MHz for the beacon at 435, 1 MHz. By choosing the number of turns that correspond with just enough gain to work Oscar, and with the appropriate polarizations, this array will truly be capable of performing well in all respects.

Acknowledgments

I wish to thank WA8GRE, Cliff Burdette, Georgia Tech Engineering Experiment Station, who assisted me in making the antenna pattern measurements and collaborated in writing the section of the article concerning that subject. I also wish to thank WB4KUX for his help and suggestions.

. . . WB4VXP

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Mt. Kisco NY 10549

Digital SWR Computer

Conclusion

Once the swr computer is built, you should check its proper operation before connecting it to an swr directional coupler. At this time some minor adjustments may be necessary.

Whether or not adjustment is needed depends on the quality of the 741 operational amplifier ICs. Ideally, if an op amp receives an input of 0 volts (that is, its two inputs are shorted together), its output should also be 0 volts, In practice, however, this does not happen. Instead, in order to obtain a 0 volts output, a slight input voltage (either positive or negative) has to be applied between the two inputs; this is called the input offset. For good quality op amps, this input offset is very small, on the order of millivolts. However, many of the 741 op amps available to the amateur at low prices are of dubious origin – such as factory rejects. One common reason for being rejected is that a unit may have a high offset voltage requirement. Although such an amplifier may still be perfectly usable for ac amplification, the offset voltage introduces a slight error in dc amplification applications. For this reason, we will check the operation of the 741 op amp ICs in this circuit, and if necessary introduce a slight amount of "offset compensation," which will compensate for the high offset and produce normal operation.

As an initial check, connect the V_F input to a 1.5 volt dry cell as shown in Fig. 7; this puts about .26 volts dc on the V_F input. Turn both R1 and R2 to minimum, and turn on the ac power to the power transformer. At this time the decimal point on the center LED should light, and the display may or may not be on. If the center decimal point is not on, turn off power and check the power supply.

Now slowly turn R1 toward its maximum setting. As you begin, the display should start to flash on-off-on-off . . . , and the flashing speed should get faster and faster as you continue to turn the pot until eventually it looks as though the display is on continuously (it is still flashing on and off, but so fast that you cannot see it). If this does not happen, refer to the troubleshooting section later in these instructions, and come back here after you find the problem.

Offset Compensation of IC2 and IC3. Now carefully turn R1 back toward its minimum setting. As you approach the minimum, the display should start to flash on-off . . . at a slower and slower rate, as slow as once every second or two, and should just *stop* flashing as you reach the minimum setting of R1. (As it stops flashing, it will either stay permanently on or stay off.) The important factor is that the flashing should stop just as R1 reaches its minimum setting, or else that the flashing should be *very* slow – not more than once a second or two. If this is so, IC2 and IC3 are OK; skip down to Offset Compensation of IC1, below. If not, simply interchanging the three 741 op amps (assuming that you used IC sockets or Molex pins) may produce good results.

On the other hand, if either the flashing stops *before* R1 reaches it minimum setting, or else the display still flashes fast although R1 is already at minimum, then compensate IC2 and IC3 as follows:

Obtain a 100k potentiometer, and temporarily connect it between pin 4 of IC3 (this is the -9 volt line) and *either* pin 1 of IC3 (if the display still flashes when R1 is at the minimum setting and you want to slow it down), *or* pin 5 of IC3 (if the display stops flashing before you get to the minimum setting of R1).

Adjust the 100k pot so that, with R1 at its minimum setting, the display is just on the verge of flashing at a very slow rate. When this is done, remove the 100k pot, carefully measure its resistance, and substitute an equivalent fixed resistor (½ to ¼ Watt) in its place.

Offset Compensation of IC1. After IC2 and IC3 are compensated, if needed, adjust R1 so that the display flashes fast enough to look as though it is permanently on. Now adjust R3 so that the display reads 01.0; as with any digital device, there may be a slight amount of flicker in the least significant digit, so adjust R3 until this flicker is at a minimum.

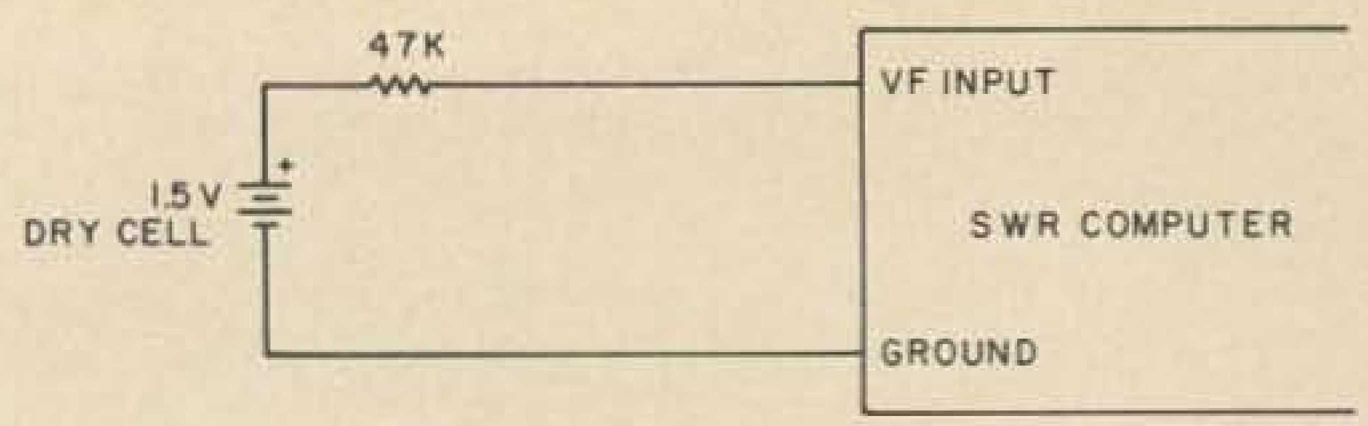


Fig. 7. Input test circuit.

Now turn R1 back toward its minimum setting. The display reading should stay between 00.9 and 01.1, and preferably at 01.0, as the display starts to flash more and more slowly. If it does, IC1 does not need compensation.

If compensation is needed, connect a 100k pot temporarily between pin 4 of IC1 and *either* pin 1 of IC1 (if the reading goes below 1 as R1 is turned lower), *or* pin 5 of IC1 (if the reading goes above 1 as R1 is turned lower).

Adjust the 100k pot so that the reading stays at 01.0 ± 0.1 as R1 is turned through its range. When finished, replace the pot by a fixed resistor of the same value. The offset compensation should be good for the life of your instrument.

Connection To Directional Coupler

A certain amount of discretion is needed in choosing an appropriate directional coupler (swr bridge) to use as the rf sensor. Though a coupler can easily be constructed using any of the variety of circuits given in ARRL publications and the ham magazines, the simplest and fastest solution is to connect into a commercially made swr bridge. The following description takes the latter approach, and describes the connection into a simple "Swr and Field Strength Meter" available from Lafayette Radio as their model 99-25371. To aid you in identifying this model, which is also available from other sources, a simple drawing is shown in Fig. 8. However, almost any swr bridge can be used as the sensing unit.

The internal circuit of the swr bridge is shown in Fig. 8.

In the particular sample of this swr bridge which we examined, forward voltage outputs for typical amateur powers were between about 0.2 and almost 10 volts, well within the range of the digital swr computer. (Incidentally, though this particular unit is

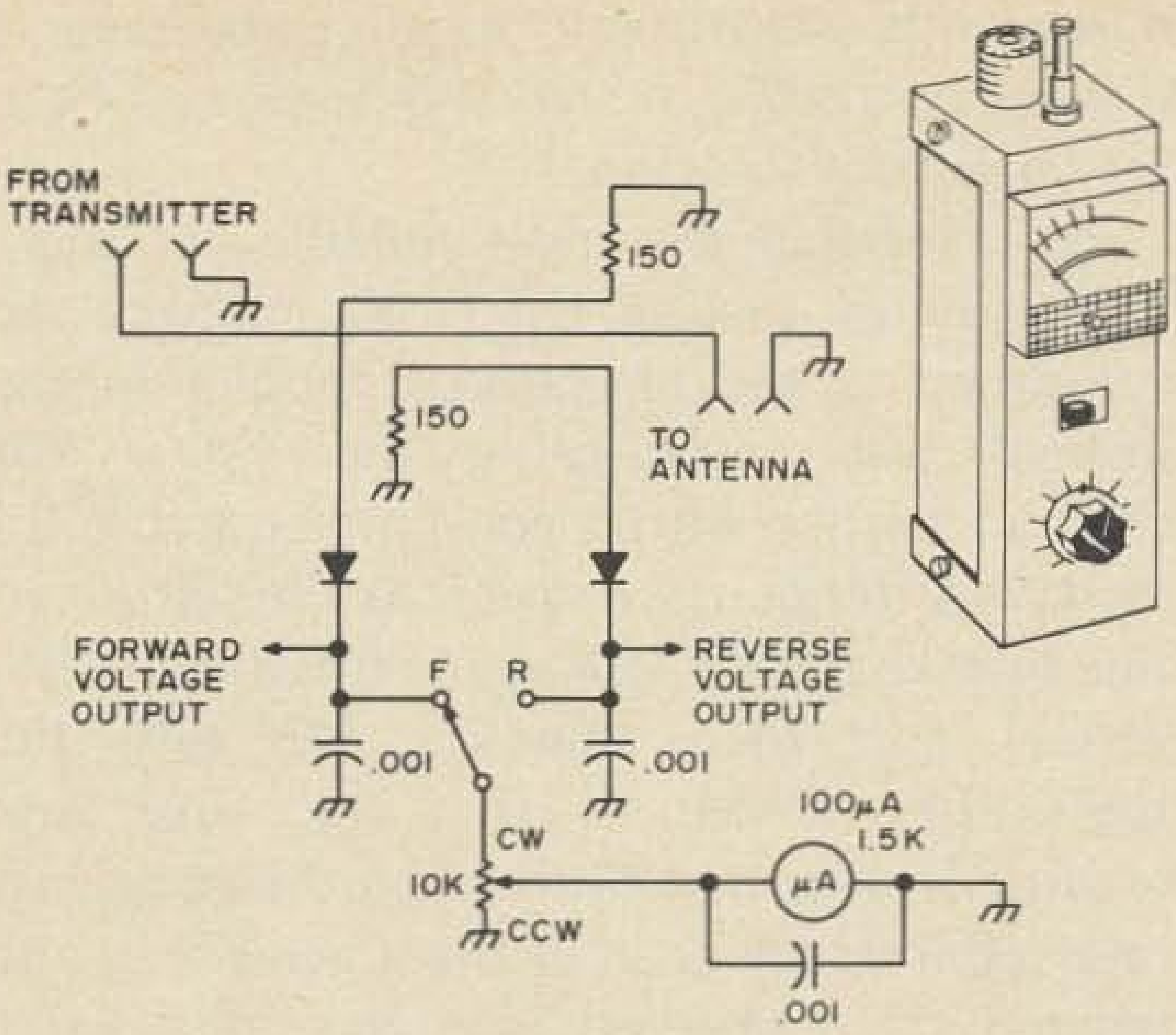


Fig. 8. Typical commercial swr bridge.

rated for use up to 30 MHz, we have in the past found it reasonably accurate even for use at 147 MHz, where a transmitter power of 10 Watts produced a forward voltage of about 4 volts.) In general, the higher the transmitter power or the higher the operating frequency, the higher the output voltage.

The connection to the swr computer consists simply of bringing out the forward and reverse voltage outputs as shown in Fig. 8.

Since the input resistance of the two swr computer inputs is approximately 10k, connection of the computer to the standard bridge does not upset the circuit operation; the swr bridge can still be used in its normal mode. This is of some use in checking the calibration of the computer.

On the other hand, the fact that the swr meter is connected to only one bridge output at a time can cause erroneous readings from the computer. For foolproof operation, the 10k pot in the bridge should ideally be disconnected from the switch. Actually, this is not necessary, as the computer can be calibrated to compensate for the 10k pot's existence, as long as the pot is in the fully counterclockwise position (to take the meter resistance out of the picture) and care is taken to leave the Forward-Reflected switch in the same position at all times.

If a different bridge or directional coupler is used, make sure that the two diodes are oriented as shown so that the bridge output voltage is positive, not negative.

Calibration

The voltage-to-frequency converters are quite linear over a range of more than 40 dB, that is, over a voltage range of 100 to 1, or a power range of 10,000 to 1. Hence adjustment of input levels is not too critical, with the only requirement being that the input level controls be adjusted so that, with the typical range of transmitter powers to be used, the circuitry operates within the linear range of operation.

At the upper limit of the usable range, operation of the circuit is quite linear up to the point where the voltage-to-frequency converter suddenly stops operating. This condition is quite obvious to the user. At the lower end of the range the accuracy drops before the voltage-to-frequency converter fails to function completely; however, a built-in safety device exists in that the display starts to flicker on and off at a noticeable rate when in the doubtful range, as a visual warning.

Calibration is done as follows:

1) *Adjustment of R1.* Connect a voltmeter across the 10k resistor labeled R4 (positive lead to ground). Connect the V_F input of the computer to your bridge, but temporarily leave the V_R input grounded. Now key your transmitter at your normal power and adjust R1 so that the voltmeter indicates about 1 volt. Then disconnect the meter.

Explanation: The voltmeter is measuring the applied voltage going to the voltage-to-frequency converter handling the $V_F + V_R$ signal; the range of fairly linear operation is from about 0.02 to about 2.5 volts. Our object here is to adjust the forward voltage input level to operate the converter in the linear portion of its range. With the normal V_F applying slightly less than one half of the full-range input allowed, we have enough headroom so that even with a very high swr (so that V_R is about the same as V_F, and their sum is twice as large as V_F) we are still in the linear range of operation. If you want to keep the calibration such that the swr computer will operate accurately, even though you vary your output power over a large range, the above information should prove sufficient for you to make your own adjustment. Keep also in mind that the swr coupler is more sensitive at higher frequencies, and thus a 10 Watt 2 meter signal may provide a higher voltage output than a 500 Watt 80 meter signal.

2) *Adjustment of R3.* Still keeping the V_R input grounded, adjust R3 so that the LED readout reads 01.0 with the transmitter keyed.

Explanation: With V_R equal to zero, the swr is 1. This adjustment matches the two voltage-to-frequency converters so that, with the same input, they provide the same output frequency, which is indicated as an swr of 1 on the display.

3) *Adjustment of R2.* This can be done in several ways, depending on the accuracy desired. The more accurate methods are more tedious, so we will give several ways, starting with the least accurate.

(a) Connect both the V_F and the V_R inputs to the forward voltage output of your directional coupler or swr bridge. Starting with R2 at the grounded end, key the transmitter and slowly adjust R2 while observing the displayed swr get larger and larger. Eventually the display will start to flicker at a slower rate, and at some point will blank out altogether. Adjust R2 just at the point where the display disappears.

Explanation: With the forward and reverse voltages the same, the theoretical swr is infinite since the difference V_F - V_R is zero. This adjustment sets R2 to the point where the difference voltage-to-frequency converter just stops working because it's getting zero input. This method of alignment does a good job at aligning the computer, but it ignores possible differences in coupler (bridge) sensitivity in the two directions. This might be a problem if the swr bridge's meter and 10k pot are left connected, as this loads down one output more than the other. This can be overcome by loading down the other side with an equivalent resistance (in this case 10k).

(b) An alternative method of setting R2 is to use another swr bridge to measure the swr in the line, and then adjust R2 so that the digital swr computer indicates the same value.

Explanation: No explanation for this is needed, but note that a high swr is needed during this adjustment so that the reverse voltage is sizable; hence this may not be a very practical solution.

(c) Probably the most reliable yet practical way of setting R2 is to connect the computer to the directional coupler in the normal way, monitoring the V_F + V_R channel (either with a good meter across R4 or with a frequency counter at the output of the sum channel's voltage-to-frequency converter) and then adjusting R2 with the transmitter keyed so that the same sum reading is obtained both when the coupler is inserted into the coax in the normal way and when it is connected into the coax backward.

Explanation: If the directional coupler is connected into the coax backward, the forward and reflected powers should be the same; hence the two output voltages out of the coupler should be the same except for the fact that they appear on the opposite lead. But their sum should be the same. If one of the two channels in the coupler has slightly lower sensitivity than the other, the adjustment of R2 will compensate for this fact. But the overall accuracy you should strive for in this adjustment depends on how well the two 27k resistors connected to IC1 (labeled "1" in Fig. 2) are matched, since they determine how well the sum signal V_F + V_R is obtained.

4) *Overall calibration accuracy.* One popular commercial swr bridge rates its accuracy as ±5dB, whatever that means. Even if your swr computer is only matched to within 10%, or even worse, you can still see that this would be a tremendous improvement over the accuracy you can normally obtain with a commercial bridge.

Of much greater importance than the *absolute* accuracy, however, is the *incremental* accuracy. That is, we normally do not care whether the swr on a given line is 2.1 to 1, or 2.3 to 1. No reasonably priced method of measurement is going to guarantee the absolute accuracy of that number. But of prime importance is the change — or increment — in the swr as we make a small adjustment in the antenna or operating frequency. This is where the digital swr computer really outperforms the commercial bridge, since even a change in swr of .1 unit is easily seen, and changes even of 0.05 unit or less can sometimes be observed, though not actually measured. The gist of this is that you should strive to match the 27k resistors and do the adjustment of R1, R2 and R3 as well as you can, but all is not lost even if you cannot do so because of lack of a good meter or other equipment. Even if the digital swr computer is only aligned to within 10% or worse, it is still a tremendous improvement over the conventional swr bridge.

Troubleshooting

Because the swr computer is built on a printed circuit board, construction is fairly foolproof. Most problems arise due to either bad solder joints or accidental shorts, or defective components.

After mounting all the components, check all your connections for solder bridges between adjacent pins for cold solder joints. Good wiring of printed circuit boards requires good thin solder (60% tin, 40% lead) with a rosin core, a small pencil iron of 25-40 Watt capacity with a very small tip, and great care.

Use the following procedure as a general guide for troubleshooting:

1. With no inputs except power, the decimal point on the center LED should light. If not, check the power supply. Check the +9 and -9 volt supplies, and check that the +5 volt supply is really very close to +5 volts.
2. Connect the V_F and V_R inputs to +1.5 volts from a dry cell. Starting with R1 and R2 both at the grounded side, pin 6 of IC3 should be near 0 volts, while pin 6 of IC1 and IC2 should be near -0.6 volts.
3. Turn R2; pin 6 of IC3 should go negative, and reach -1.5 volts when fully on. Turn it back to the grounded end.
4. Turn R1; pins 6 of IC1 and IC2 should both go more negative, down to at least -3 volts or more.
5. As you are doing step 4, the two voltage-to-frequency converters should be generating outputs whose frequency goes up as R1 is turned further away from ground. With a frequency counter, if you have one, you can monitor the frequency on either side of the 0.002 uF capacitors. Most scopes won't display the very short pulses here, but should show a nice triangular wave on the emitter of the appropriate unijunction transistor. Chances are that at least one of the two circuits will work properly, so you can then use it to tell you what should happen in the other one.
6. The output of IC4, pin 11, should be one-tenth the frequency of the input, pin 14.
7. The output of IC5b, pin 12, should be one-half of the frequency of the input, pin 1.
8. With IC7, IC9 and IC11 unplugged, the LEDs should display the number 888.
9. With IC5 unplugged and a temporary jumper between pins 5 and 9 in its place, and R1 near its ground end, the LEDs should count up, counting the output of the voltage-to-frequency converter.
10. IC5 pin 6 should be near +2.5 volts with barely visible pulses on it; IC6 pin 3 should be near ground, with barely visible positive pulses on it; IC7 pin 4 should be near ground when the LEDs are dark, and should be near +3 volts when the LEDs are lit.

The above operational checks will help you narrow down the cause of any problem, if necessary. Since the unit has four 7490 and three 7448 ICs, as well as three identical LEDs, interchange of these units should help to spot defective ones. A good reason for using IC sockets or Molex pins!

Modification

Exists there a ham who ever builds a project exactly as described? Here are a few possible parts substitutions and modifications which may occur to you.

1) T0-5 style 741 op amps can be used instead of the 8-pin DIP style for which the board is designed. The pin numbers on the T0-5 are the same as for the DIP package. 741 op amps are also available in a 14-pin DIP package, which has different pin numbers and would therefore require some changes. Dual 741 amps are available under the numbers 747 or 5558; however, again they do not fit the board layout and so some changes would be necessary.

2) The PNP and NPN transistor types specified can be easily substituted for. Instead of the 2N706 NPN transistor, you

may use any NPN silicon switching transistor, and others as well. This transistor is not at all critical, and even a 2N5172, which costs only some 15¢ or so (*list*) will do. For the 2N3638 you may substitute any PNP silicon low power transistor, but make sure that it has a good beta and low leakage, as a good quality unit is needed here – I used the 2N3638 only because it is cheap and I had some. But use the same type number in both voltage-to-frequency converters – matching is important here.

3) Other unijunction transistors can be used instead of the 2N4891 specified. I chose this one because it is a standard Radio Shack item and therefore easy to get. But again, make sure to use identical transistors in both circuits.

4) Common-cathode LEDs were used because their price is often slightly lower than common-anode LEDs. However, other LEDs can be substituted. Other common-cathode LEDs may require slightly larger resistors – check their spec sheets. Common-anode LEDs require the 7447 driver rather than the 7448, and a different connection. Other types of readouts, such as Numitron, fluorescent, or several others, can also be used. Alternatively, a separate printed circuit board, originally designed for the K2OAW counter, may be used if you wish to use MAN-1 type common-anode LEDs (see the K2OAW counter articles in the May, July, September 1972 and November 1974 issues of 73 Magazine for circuitry). Obviously, using common-cathode LEDs is a cheaper and easier solution than trying to adapt the layout to common-anode LEDs.

5) If you already have the K2OAW counter, or are planning to build it, you can use the counter as the digital readout for the swr computer. This will significantly reduce the computer's cost.

If the counter is used, you may omit IC4 in Fig. 2, *all* of Fig. 3, and all except the two diodes and two capacitors used to produce -9 volts in Fig. 4.

The K2OAW counter power supply can provide +9 and +5 volts to the swr computer. Adding the four parts specified above to the counter power supply will produce -9 volts.

The *sum* output from Fig. 2 is fed into the counter input, that is, into the low frequency input, in the same way as an unknown signal.

The *difference* signal from Fig. 2, which would normally go to pin 14 of IC4 for division by 10, now goes to pin 14 of IC29 of the counter instead. A switch will have to be put into the counter to select whether the input to IC29 comes from IC28 or from the swr computer. In operation, this switch would be placed in the swr computer position, and the Hz-kHz switch would be placed in the Hz position.

6) For some applications, you may not need readouts as high as 99; let's face it, most commercial swr bridges are not calibrated for swr's above 8 or 10. If a maximum swr readout of 9.9 is quite satisfactory for your use, you may remove the most significant LED as well as IC10, IC11 and the seven 390 Ohm resistors associated with this digit, and place a jumper between pins 14 and 11 of the IC10 socket to connect the overrange circuit directly to IC8. This simplification can save you about $5-6.

. . . K2OAW

Paul Rudolph WB6OMT
P.O. Box 176
Bangor CA 95914

Full Break-in at 60 wpm?

With this device you can, with every tap of the key, mute your receiver, key a transmitter, and activate a sidetone oscillator for monitoring your CW, to achieve true, quiet, full break-in CW to 60 wpm, without using a TR switch. The gadget will work well with any station using a separate transmitter and receiver, and separate antennas; it goes together easily in under an hour. The cost? Under $1.50.

Parts needed for the device are: One cold chisel, about 30 feet of enameled magnet wire, and a $1.29 package of four magnetic reed switches from the local Radio Shack store. (Catalog number 275-026, or whatever you can find there with ratings sufficient to handle the key circuit on your rig.)

Close-wind the magnet wire in one direction, one layer, the full length of the chisel (or other bar of steel or iron), leaving about six inches of lead wire on each end. Tape the coil ends to keep them from unwinding, then lay the coil on a piece of wood or cardboard and tape it in place.

Open the package of reed switches carefully, being sure not to ruin the plastic "bubble" on the package, as it is one of the components of the device. Cut out the ends of that bubble, place it over the coil, and tape it in place. See the photograph.

The schematic indicates the wiring of the coil, from a source of dc (6-20 V), through the station key. A simple rectifier-filter circuit is shown in the event you cannot tap

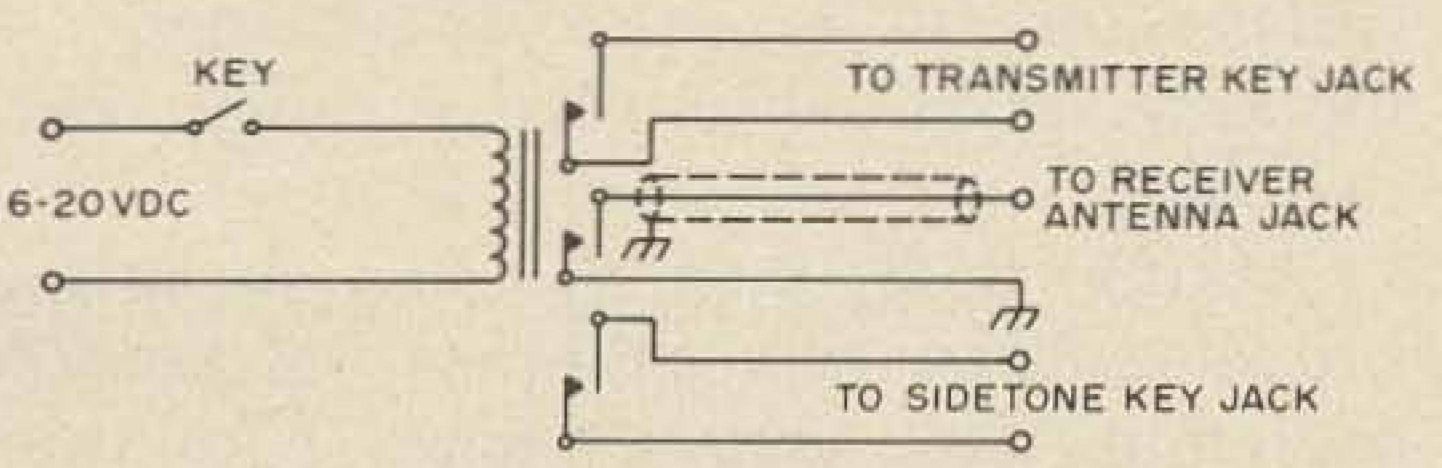


Fig. 1. Schematic.

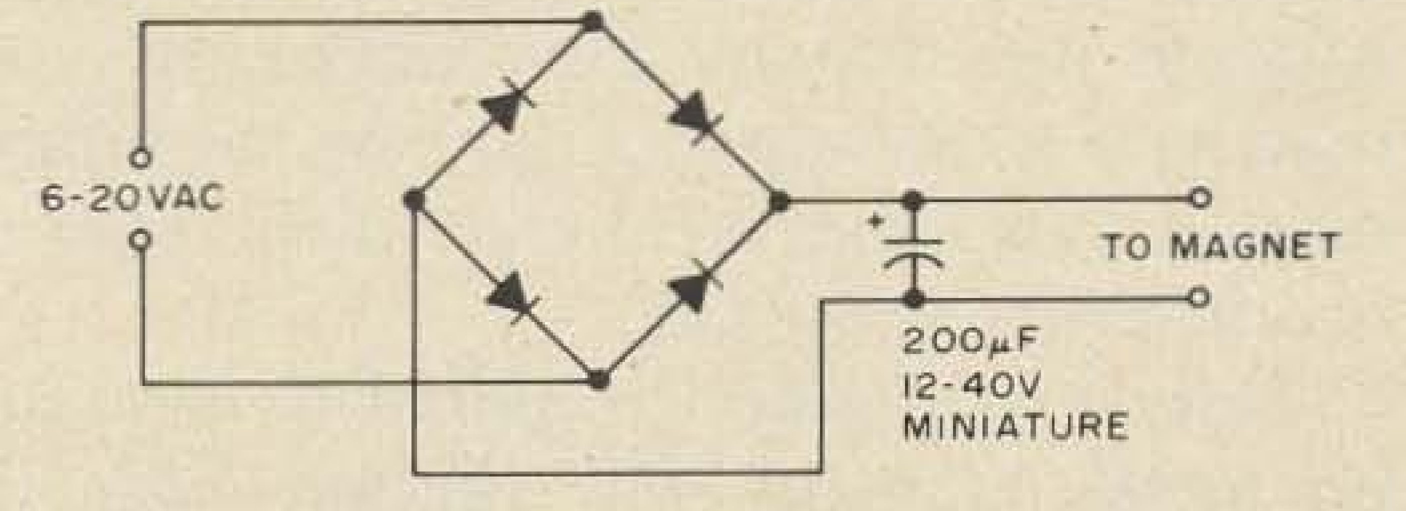
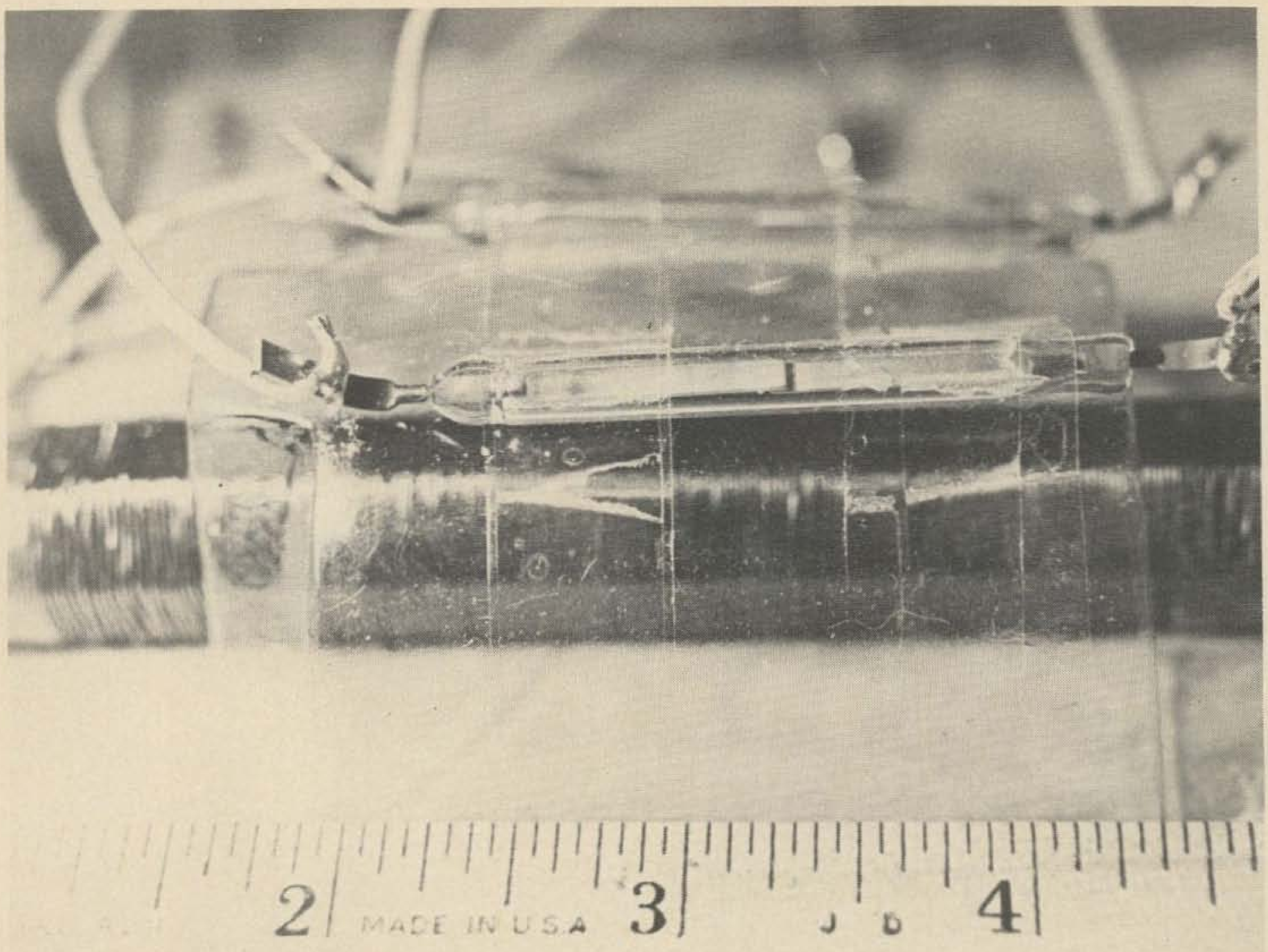


Fig. 2. Rectifier/filter for filament/panel lamp circuit use.



any dc, and must tap a filament or panel lamp circuit. Dc is a must. Granted, ac will produce a field around the coil, but reed switches will chatter in the vicinity of a rapidly changing field. A battery was tried, and worked well, but lasted only an hour. Portable operation with the device could be possible by keying the car battery to the magnet, through a resistor to eliminate the huge blue flash at the key that would occur without the resistor.

Once the magnet is wired, the bubble is in place over the coil, and a roll of cellophane tape is at hand, place the switches on the bubble one at a time while keying the coil. Find a spot where each switch pulls in every time you depress the key, and tape it on the bubble in that place. (Every switch in the package will respond a bit differently, and may have to be moved around on the bubble quite a few times before positive action is had from each switch.)

Note that the device cannot be mounted on metal, as metal will interfere with the magnetic field. Mount the device on a small board, on a wall, on a floor under the table, or wherever you can get at least six inches clearance from metal.

All that is left is to connect the circuits you wish to activate, or ground, to the switch prongs. One can key the transmitter (mount a key jack on the leads from the switch, and plug it into the key jack on the rig); another switch can short the speaker leads; another can short the receiving antenna to chassis ground; and another switch can be used to key a simple code practice oscillator for monitoring your sending. The number of circuits you can activate by keying the gadget is limited only by the number of reed switches you can crowd around the coil. You could conceivably mount the coil in the cardboard tube accompanying bathroom stationery, and mount switches around the whole circumference of the tube, if you had need for that much switching.

At this QTH, three switches are in use, and have been giving flawless full break-in operation for seven months, following keying faster than you can say -... ...-.

. . .WB6OMT

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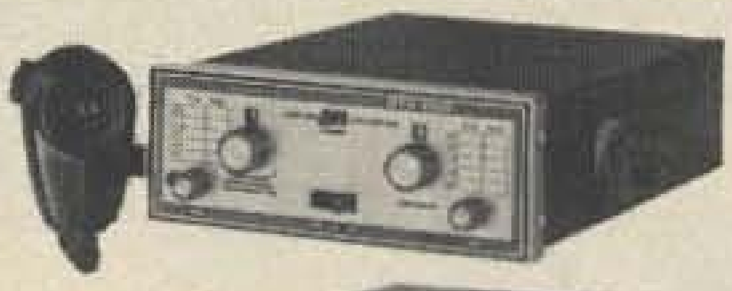
☐ 

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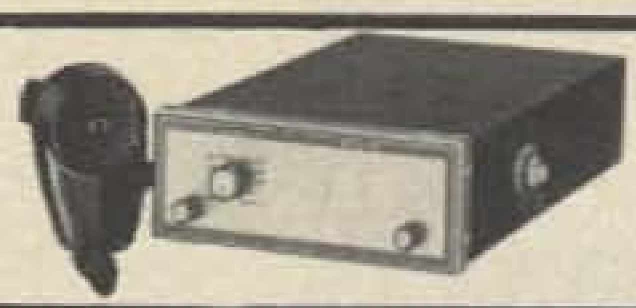
☐ 

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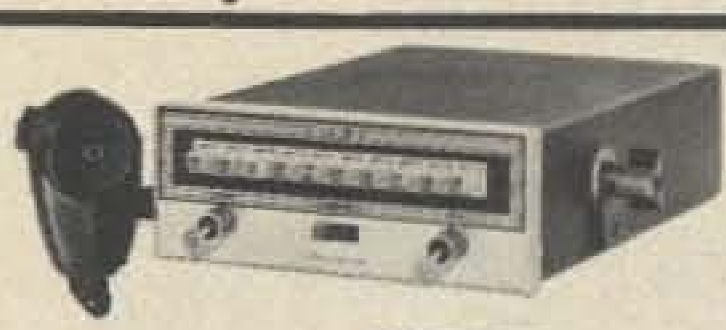
☐ 

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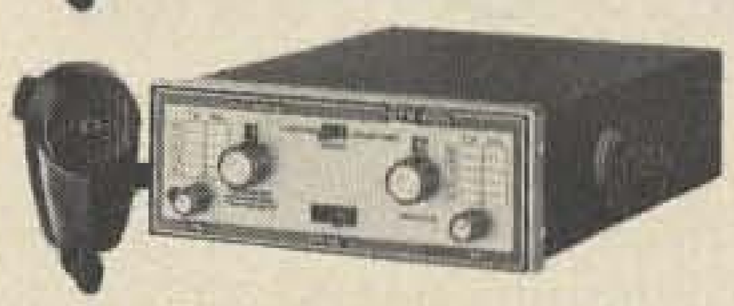
☐ 

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Byron H. Kretzman W2JTP
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Huntington NY 11743

Odd Problems With an Old Antenna

You see, I have this summer place in the country, up-river, where I can escape from the rat race in the city. Actually, it is a year-round place, and I go up there just about every weekend, summer and winter. Built on the side of a hill, a big picture window in the den (ham shack, to you) looks out over the hill, sort of a plateau, covered with tall grass. After a week of the hustle and bustle of the city I can come up here, unwind, and really enjoy ham radio, in particular the chase of DX which has never paled for me.

Alongside the house a 75 foot telephone pole supports a full size five element rotary beam, a Yagi, for 20 meters. The receiver is highly sophisticated, and a chrome-plated linear amplifier permits the full gallon input on CW and 2 kW pep on sideband. It's CW that I enjoy the most, although I have more than 200 countries on phone. But, Asiatics have never come easy, phone or CW. Which brings me to this story.

One nice day, near the end of summer, I'm sitting at a table out on the patio making out QSL cards when one of the local fellows, a farmer, drives up to tell me about a county hamfest he and some other locals are planning. I invited him to have a nice cool tall one and to sit down and chew the rag; about DX, of course. I was bemoaning the difficulty in working the Asian stations, in spite of my beam and chrome plate linear. He sort of smiled (I never did find out how many countries he had) and looked out over the hill in back. "You know, son," he says, "If I had that much unplanted acreage and if I wanted to work Asians that bad, I would put up a rhombic!"

All next week I thought about that suggestion. A rhombic antenna. What ham used a rhombic these days? There wasn't much about this kind of antenna in the Handbook. No constructional info, but this statement, "Antenna gains of the order of 10 to 15 dB can be obtained. . ." So I did a little research on rhombics. An old World War II Signal Corps technical manual gave me the information I needed. Well, I spent the balance of the summer and most of fall building a pair of stacked three-wire rhombics, one behind the other, and pointed in the direction of central Asia. Seven telephone poles, each about fifty feet high, supported these monsters, 7½ wavelengths long on each side. A weather-proof box on the rear pole housed a bank of high power terminating resistors. A two-wire transmission line, with a tapered transformer section to bring the 800 Ohm impedance of the antenna down to the 600 Ohm line impedance, led into the shack through two large bowl-type feed-through insulators in the middle of a glass window pane, which had been carefully drilled. A large ferrite balun transformed the 600 Ohm line to the 52 Ohm coax to the antenna relay in the linear.

At long last I was ready to try out this creation. An extra set of coax relays were connected to allow me to make an instant comparison with the five element Yagi. First I carefully tuned the low end of 20 with the Yagi, pointed towards Japan, switched in. The band was reasonably good. A fair complement of J's, KL7's and DU's were coming in S-4 to S-5. Then I switched to the rhombics. Looking at the panadapter, it appeared as if the ambient noise level had risen, but interestingly, the Asians heard just a few seconds ago on the Yagi had dropped down into the noise. Nothing from them could be heard. I continued to tune the band until I spotted a weak CW signal, barely above the noise. It was chirpy and it drifted quite a bit, but with the noise blanker switched on I copied him. He signed, "HS1RJ." I rapidly zeroed in the VFO and gave him a call. Nothing doing. He came back to a W6, giving his QTH as Siam. *Siam?* Then I lost him in the noise. I continued to tune. With the aid of the panadapter I found another weak signal, just above the noise, calling CQ. It signed MX3A. I gave him a short call but he came back to W8CRA and gave his QTH as Manchukuo. *Manchukuo?* Where the heck is that? Before the night was over I copied, and called, ZM1AA, PK1TT, XU6ST, KA8ZK and VS2AL. Not one came back to me! Dawn was breaking as I crawled wearily, frustrated into bed. Right after my head hit the pillow, I sat bolt upright as a thought banged into my head: There were no pile-ups around any of these stations! I collapsed and fell asleep without further consideration of that one.

Next weekend I went at it again. This time I concentrated on the high end of 20. Underneath the quacking SSB phone level I dug out such goodies as VU2EU, XU4XA and VS7RF. Out of the band, above 14,350, I found UK8IA and J8CG. I hugged the band edge and called them. Neither one came back.

Since there was little agreement between the Call Book prefix QTH's and QTH's given by the DX, I decided to write the DXperts in Newington to see if they could explain this. Also, since none of the stations came back to me, I figured maybe I needed a little bit more power. That's when I remembered Big Bertha. Big Bertha was built about 10 years ago, when I was living with my folks in the city. It is very efficient, much more so than any linear, because it runs Class C. A pair of 4-1000A tubes in push-pull are in the final. (I moth-balled it because the ac power lines in the city were just not stiff enough. Lights dimmed for blocks every time I pressed the key.) At that point I decided to take a week's "vacation" and get Big Bertha up to the summer place where the ac came from a nice, stiff, REA line.

I won't go into the details of getting Big Bertha trucked up and moved into the shack. It wasn't easy. Neither was its installation, which took the rest of the week. But, there it was, on the other side of the room, across from the operating desk. Ducting and a ventilating fan was put in directly above the big cabinet to take the heat out through the roof. Input to the king-size plate transformer primary was controlled by a variac on the front of the rig, its knob as big as a steering wheel. The two-wire spaced feeders were now brought directly into the cabinet through a pair of big bowl insulators to a huge 2-pole antenna relay. Its transmit contacts went to the swinging link of the tank coil and the receive contacts were connected to the ferrite balun for the coax to the receiver, via the switching relays mentioned before.

It was late Sunday night before Big

Bertha was ready to go. A storm was brewing in the west. Lightning was flickering on the horizon but when I turned on the receiver the QRN had not as yet built up. Nothing but noise was coming through on the rhombics. I tuned around for a long time. The storm was getting closer. The thunder, and the QRN, was building up. Then I heard it, weak but above the noise, calling CQ. AC4YN. Quickly I had the vfo on him, switched it into Big Bertha, and gave him a short call. The plate voltage meter read 3,300 volts. Nothing doing. Another short call, this time with 5,000 volts. Nothing doing. The storm was right overhead now. The thunder had become crashes. Another short call, this time with 6,500 volts. Then, *Whaap!* A ball of lightning came in on the feeders with the roar of a freight train, smashing into Big Bertha like a mortar round. Steel flew around the room like shrapnel, for the most part missing me because I was momentarily unconscious behind the desk. When I came to, the rig was a molten mass of glowing metal. Every light in the house was out. Through the picture window I saw that the center pole with its yardarm was a flaming cross etched against the black stormy sky. Flames were also licking at the ceiling where the fan had been so I struggled to my feet, grabbed the CO2 extinguisher and cooled things down as quickly as I could. Then the rains came. With the aid of a flashlight I reset the house lighting breakers, all of which had been tripped.

The rain stopped as quickly as it started. I spent the balance of the night patching the roof and putting in a plywood panel where the feeders had come in through the window. And, occasionally squirting the fire extinguisher at the still hot pile of debris. The smell of burnt bakelite permeated the whole house.

In the morning I shoveled the mess that had been Big Bertha into a wheelbarrow and gave her a decent burial in the back 40. Walking out on the hill afterwards I found that not a scrap of wire was left, just broken and blackened insulators. The terminating resistor bank, and its dog house, were completely gone. The blackened center pole was still smouldering, in spite of the rain. A very disheartening sight. As I turned to go back down the hill I noticed the mail man's truck coming up the road.

There was just one letter that day. From Newington. Scrawled with a felt pen across my letter to them were these words, *"Who are you kidding? These stations haven't been active in 35 years! Most of the ops are Silent Keys!"* That did it. I cleaned up what was left of the mess, closed up the house and headed back to the city.

Epilogue

It wasn't until next Spring that I had the heart to go back up the river to the summer place. But, a ham is a ham is a ham. Over the summer I rebuilt the rhombics, this time with a big outside grounding switch and with underground coax feeder. The chrome plated linear was back on the desk. However exotic DX calls out of the past were never heard again. Those Keys were really silent now. What little Asiatic DX I did hear now and then was only one or two S-units better on the rhombics than on the Yagi; and, I *did* manage to work a few. ... W2JTP

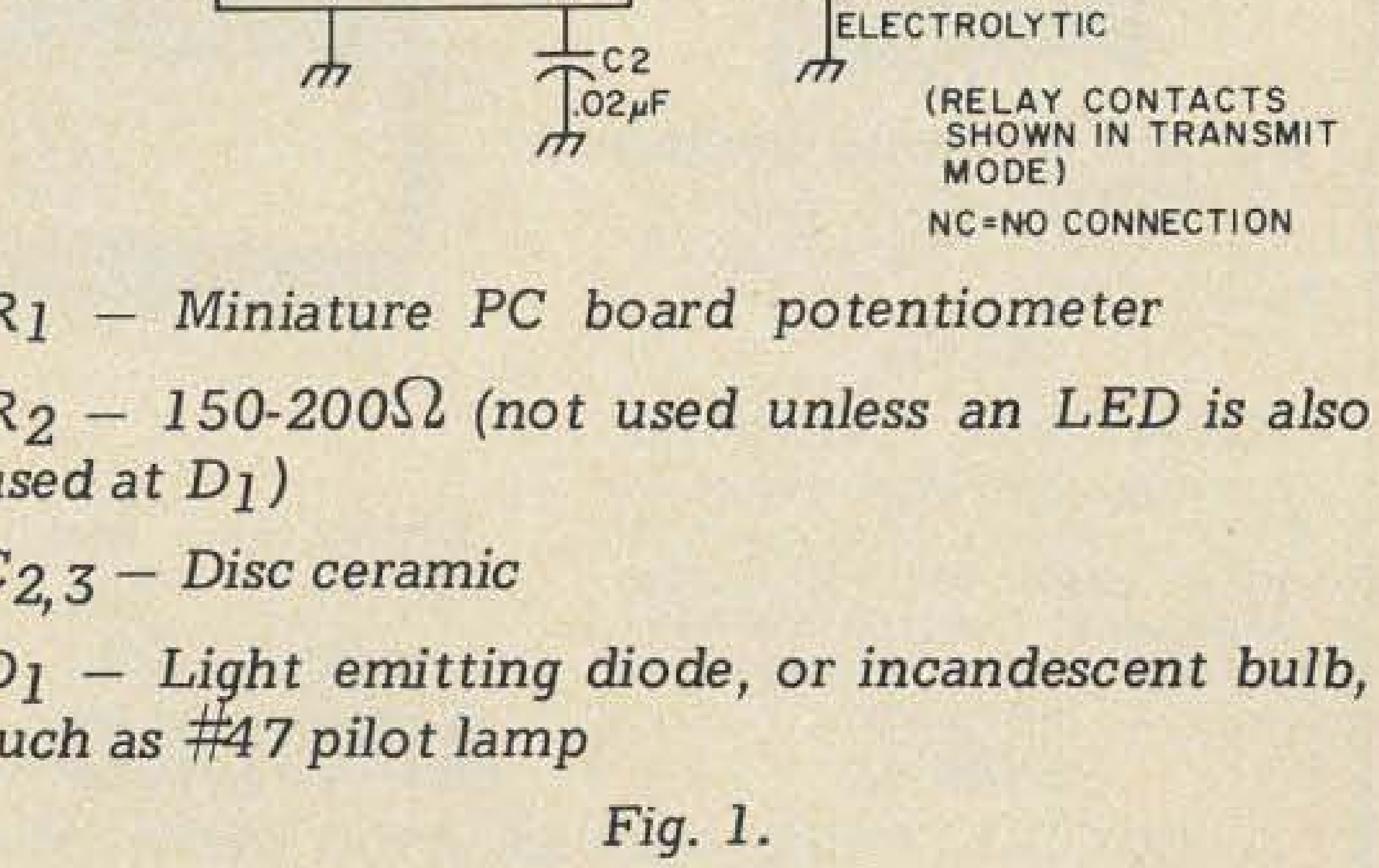
Mike Brame WB8EQQ
#41, 7519 Dorr Street
Toledo OH 43617

The Alligator Squelcher

This is a simple project which can be built in an hour or so and requires no exotic parts or bottomless junk box. If you buy every part new, the cost is less than $6.00 at any electronics hobby store, such as Radio Shack, Lafayette, etc. The heart of the time-out timer is an NE555 timer, wired to turn on after the pre-set interval. After the transmitter has been keyed for the preset time, the indicator light (or bell, or cannon) will come on and let you know that your time is up, and you should now (1) let the repeater drop; (2) ID; (3) replace your sweep tube finals which have just gone west; or (4) all of the above. None of the component values are particularly critical, so you can substitute freely.

The purpose of the relay is two-fold: One set of contacts resets the timer at the end of each transmission; the other contacts apply voltage to the timer during a transmission, so the circuit will be completely off during receiving. C3 keeps transients from re-triggering the timer. C1 and R1 together determine the time interval. I used 10 microfarads and 5.6 megohms for a delay of about a minute and forty seconds. Most electrolytics are *not* the exact capacitance they are supposed to be. In fact, they may vary as much as minus 50% to plus 100% in an actual circuit. If you want this to be a ten-minute timer, then in theory a combination of 100 microfarads and 6 megohms would give a 600 second delay, but in practice you will have to fudge a bit. In any event, when you try it for the first time, just push down the plate of the relay rather than key the rig. It saves wear and tear on the finals, and you won't be QRMing anyone while you're finding the correct setting of R1 for the time interval you want.

If you use a light emitting diode for the indicator, you will need a current-limiting resistor, R2, and a value of about 150-200 Ohms is OK for a 12 volt supply voltage. An incandescent bulb that draws up to about 100 milliamps will work also, and you won't need the limiting resistor R2. If you would rather have an audible alarm, most hobby stores stock a small code oscillator module manufactured by Carl Cardover for 98 cents.



R_1 – Miniature PC board potentiometer

R_2 – 150-200Ω (not used unless an LED is also used at D_1)

$C_{2,3}$ – Disc ceramic

D_1 – Light emitting diode, or incandescent bulb, such as #47 pilot lamp

Fig. 1.

In place of a light, wire the module so the positive terminal goes to pin 8 of the 555 and the negative terminal goes to pin 3. As a last resort, if you're the type that ignores everything while you're talking, you could hook up another relay to pins 3 and 8 that would cut off power to the rig at the end of the time interval.

Layout of parts is not critical, so long as you keep the project down to a reasonable size. Just remember, having very long leads in a circuit near an operating transmitter is asking for rf pickup. I used a 14 pin integrated circuit socket as both a terminal strip and IC holder. The extra pins can be cut off, or used to attach the circuit to the rig.

Before trying my circuit out in the transmitter, I hooked everything together with clip leads, and cut and tried until I found the right value of resistance of R1. This done, the completed circuit worked right the first time when put in the rig, something I only dream of for most of my projects.

. . .WB8EQQ

Herb Schoenbach W9DJZ
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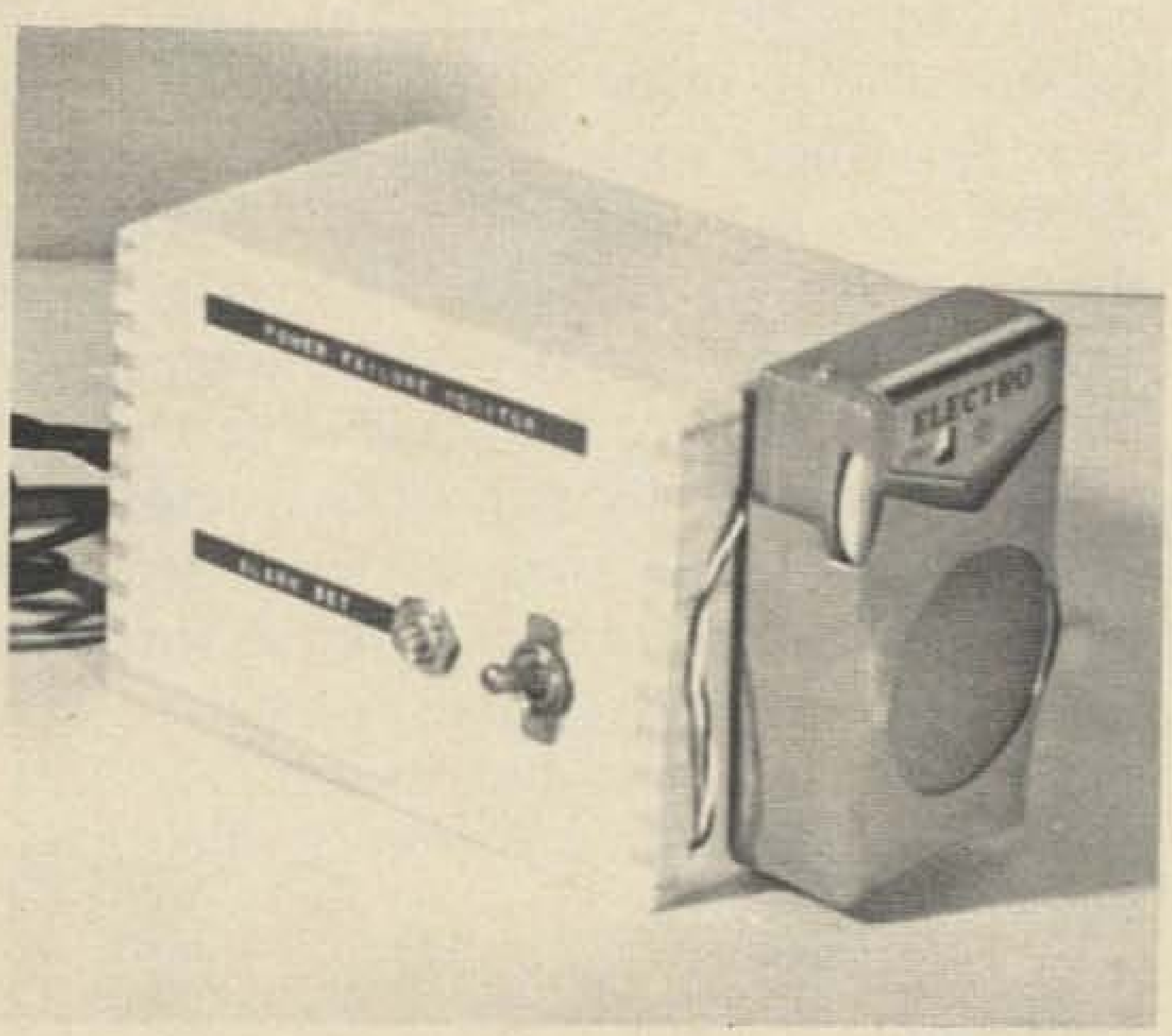
Downers Grove IL 60515

You Don't Have a Power Failure Alarm?

You probably need a power failure alarm. Why don't you have one? You haven't seen one for sale? Then why don't you build one? You just don't think it's worth the trouble for one or two power failures each year. And after the lights come back on you just know it won't happen again for a long time.



Front view, PFA. A larger box would allow radio to be placed inside.

Well, that is exactly how I felt about PFAs (power failure alarms), until about six years ago when I found just the right assortment of parts to make one. This little warning device has done such a good job for me that I have not even "improved" it, and that is unusual at my shack.

What It Will Do

The device I built is somewhat different from others I have seen. Here's what it will do for you:

(1) If power fails while you are asleep it will gently awaken you with an audible signal so familiar sounding that it will not scare you out of your PJ's at 3 a.m. some morning. . . no bells, sirens, buzzers or whistles.

You can then set your trusty wind-up alarm clock or sit up and read some back issues of this magazine.

(2) If power fails during daylight it will warn your MYL (in case she was scrubbing floors instead of watching TV, which would have also warned her).

(3) If power fails while you are all away from home, you will know about it as soon as you return. The GENTLE alarm will be on, even though power has been restored in the meantime. Without the PFA you might have gone to bed and not noticed the electric alarm clock was 45 minutes slow.

(4) If your electric service never fails (you dreamer!) this project is still not a total loss because you can use this PFA as a spare radio. . .just flip the switch.

Here's what it will not do: (1) It will not sound an alarm every time the lights flicker in a storm. There is a three second delay before the alarm trips. (2) It will not recharge or replace its own battery. . .you have to do that about once a year.

Construction Notes

Now let's get on to some of the details of this PFA. The assortment of parts I mentioned before includes a wooden file box, a retired transistor radio that still works, a fresh 9 volt battery, a sensitive relay, a momentary contact push-button, and parts to make a small power supply. Throw them together as shown in Fig. 1. Construction can be plain or fancy according to your taste. A small purchased power supply will save you some labor but will raise the cost.

The radio used should be a 9 volt type; otherwise, you may have to modify the circuit. Prepare the radio by removing its battery and bringing out the power leads. The file box should be made of wood or plastic so the radio's antenna will not be detuned, and so the radio can be placed inside, if desired.

A cigar box might also be a suitable cabinet. I attached the radio to the outside of the file box as shown in the photo. The relay should be the small, sensitive type rated at 9 volts or less and drawing less than 20mA. This will keep power consumption to 200mW plus transformer losses. If the relay coil is rated lower than 6 volts, use an appropriate dropping resistor in series with it.

The power supply, if not a ready made item, should be enclosed in a metal case for safety. Use a ½ A fuse in the line and a UL

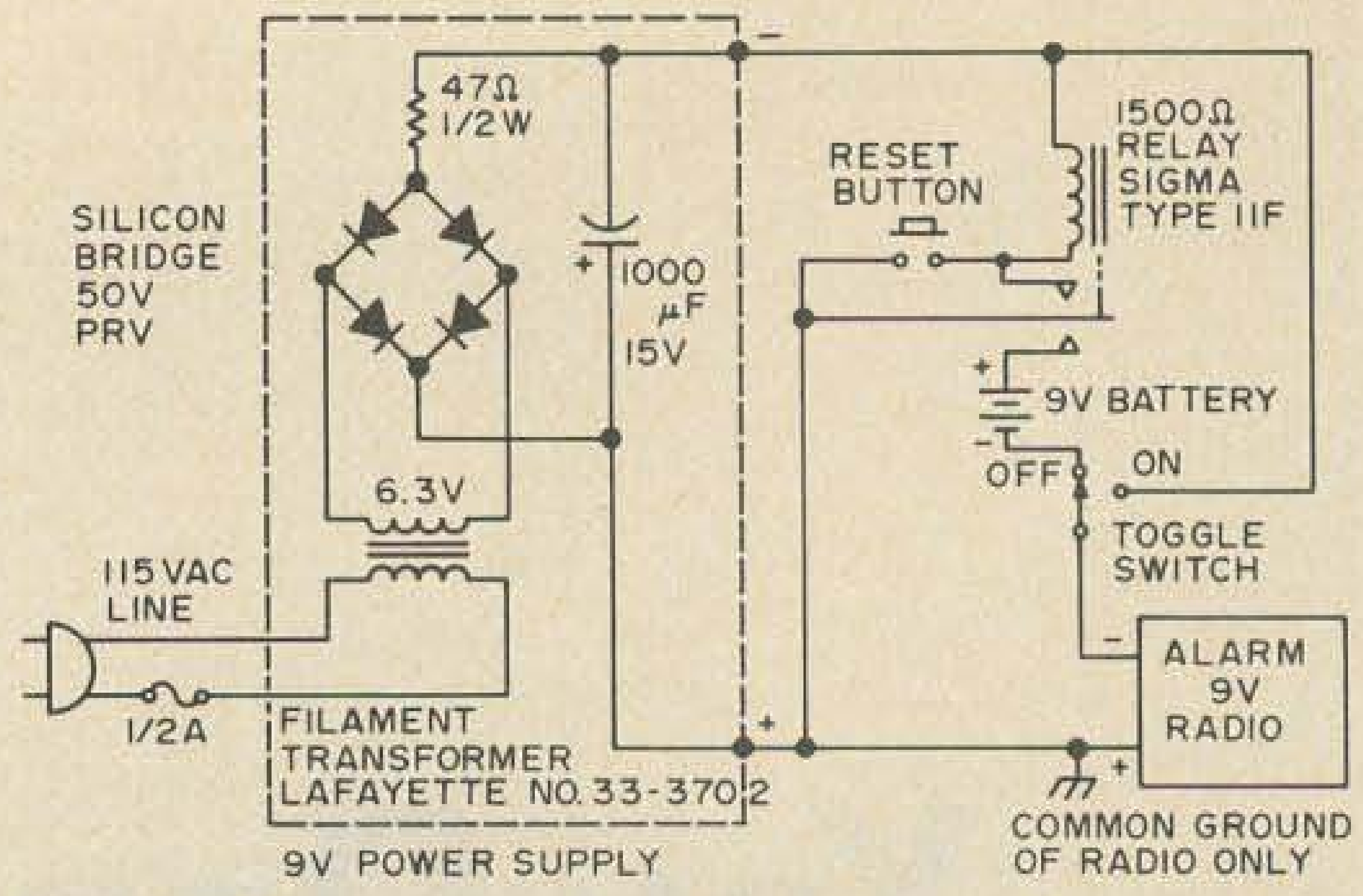


Fig. 1. Schematic of simple power failure alarm. The 1000μF electrolytic capacitor should be increased in value if a longer delay time is desired.

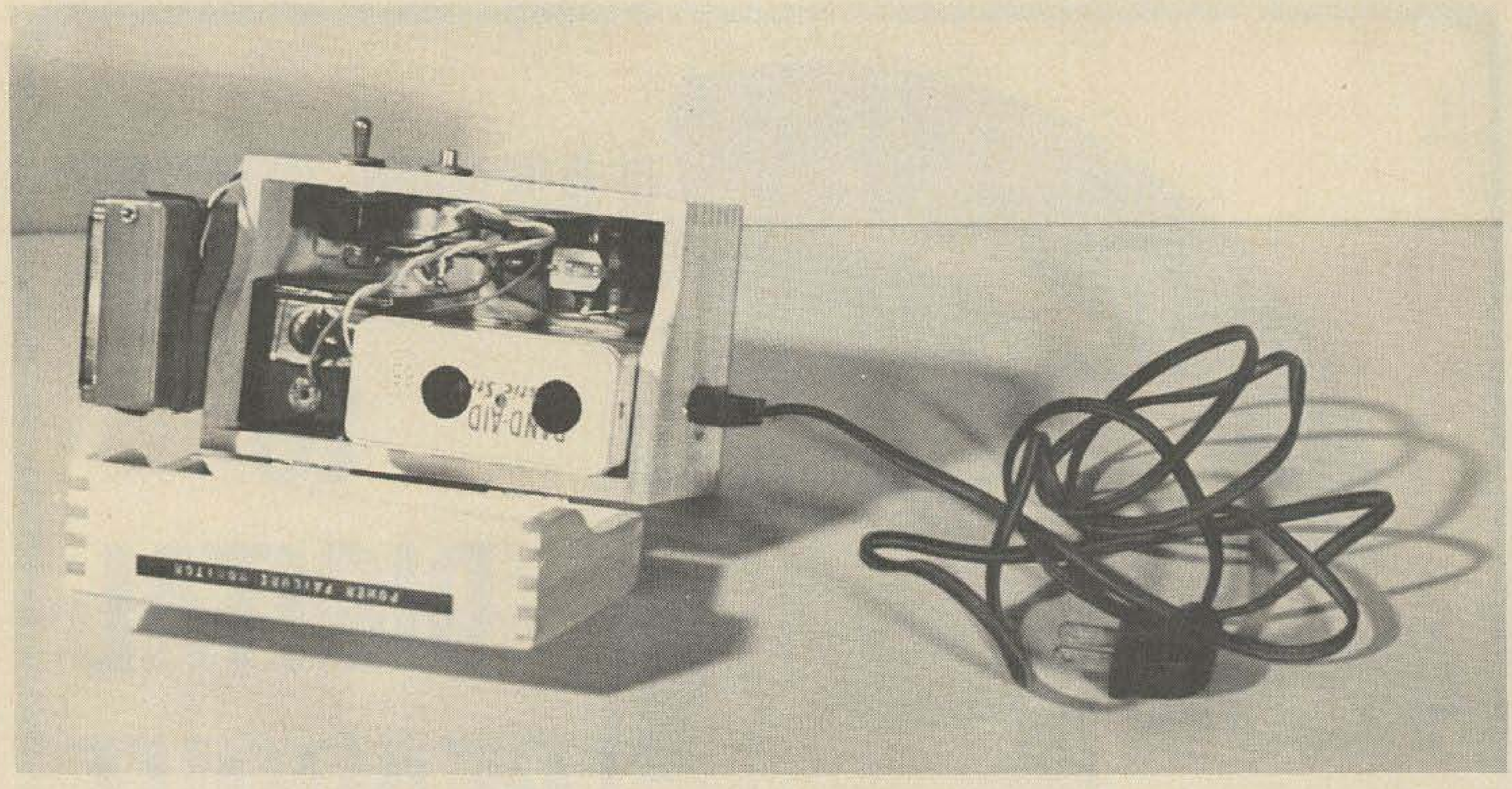
approved cord. Make certain your 115 volt wiring is well insulated! Remember, you are constructing a piece of equipment which will be connected to the power line 24 hours a day. It can be safer than a table lamp if it is built well.

By now you have probably figured out how it works. The relay is normally held energized by the 9 volt power supply. When 115 volt power is cut off, the filter capacitor will hold the relay energized for about three seconds. After this delay period the relay drops out, or de-energizes, and connects the 9 volt battery to the radio which has been carefully preset to your favorite 24-hour-a-day radio station at a GENTLE volume. In case you live where there is no dependable 24-hour-a-day station, set it to a station that comes on early enough to get you to work on time.

The battery problem is one of the drawbacks of this PFA. You can either buy a new battery for it once a year, or else keep rotating. When some other radio needs a battery, use the one from the PFA and put the new battery in the PFA. The PFA battery will usually not wear out unless you take long vacations. I used a large D6 size battery and actually the 2U6 would have done the job. The large batteries seem to deteriorate with age about as fast as the little ones. If you do insist on having a battery-less alarm, a clever one is described by Frank H. Tooker in *Popular Electronics*, February, 1968.

Operation

Operation of the PFA is simple but confusing to write about. PFA unplugged



Inside of PFA. Power supply is in BAND-AID® can.

and switch "off" causes the radio to play from battery, which is the alarm condition. If you now plug PFA into a live 115 volt ac line, the radio should continue to play from the battery. Push the reset button. The relay should latch causing the radio to go off. This is the normal condition: power is on, switch is "off", and radio is off; the alarm is set.

Now test the PFA. Unplug the cord for two seconds and reconnect. . .nothing should happen. Unplug the cord again and in 2 to 5 seconds the radio should start to play. When you have the PFA working right, it is a good idea to tape the radio's volume control and tuning dial to prevent accidental misadjustment.

Let's take some actual situations. Electric service is interrupted for ten minutes while you are away. When you return the lights are working, the refrigerator is running and everything seems normal, except the PFA radio is playing.

Simply reset with the push-button, set all your electric clocks and wait for the next power failure. Let's say you are at home when that happens. It is daylight and you might not know that power is off. But the PFA warns you immediately.

If you want to be alerted when power is restored, flip the switch to "on." This now turns PFA radio off. When power returns you will hear the radio again. Now turn the switch "off" and push the reset button. Should you want to catch a news or weather report while power is normal, just turn switch to "on" and now, believe it or not, the radio will play. But if you have a power failure now the radio will stop playing. See what I mean about confusing? It is really much simpler than it sounds. After all, with only two controls, it doesn't take long to try all the combinations.

After you install this PFA in some remote nook or cranny of your house, you should forget about it, and you will forget, just as my wife did. Her first experience with the PFA was about six months after I had placed it on a high shelf behind some pictures. One afternoon she was completely perplexed by mysterious music in the house. Cautiously tracing the sound to its origin brought her face to face with the PFA, clearly labeled: POWER FAILURE MONITOR. She then realized the electricity was off. But alas! She didn't shut off the PFA by turning the switch to "on." No, she very sensibly and simply turned the radio itself off. Now you know why I said to tape up the radio's volume control.

In six years of operation my PFA has never failed to signal a power failure. The situations mentioned before have all occurred in our household.

. . . W9DJZ

Alan Smith W8CHK
3213 Barth Street
Flint MI 48504

Portable QRP Power Unit

One of the very attractive advantages of QRP operation is its built-in potential for ultra-portability. The easy way a 3 or 4 band CW transceiver fits into an underseat flight bag speaks volumes for the tote-ability of these little gems.

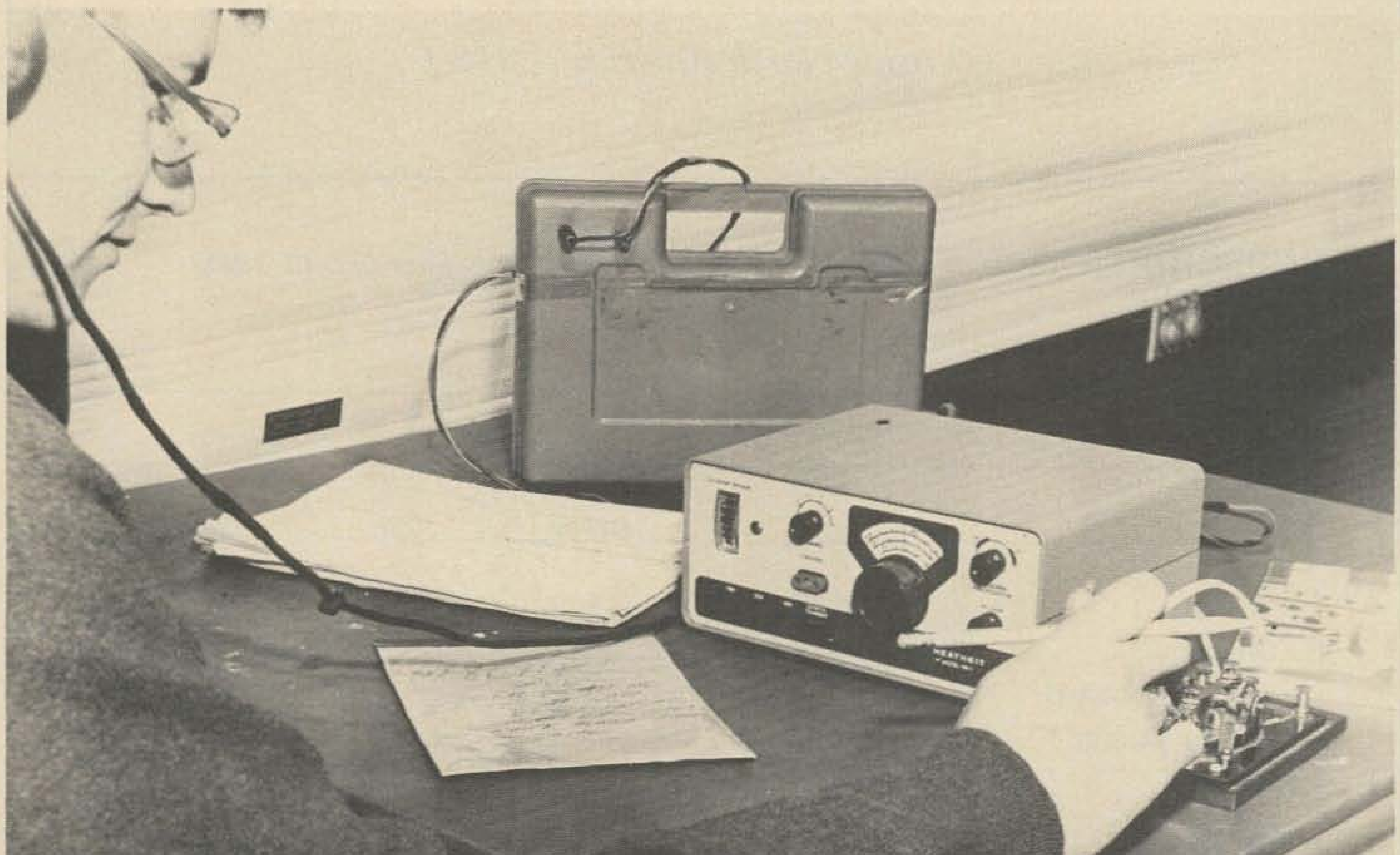
In truth, these rigs can be taken anywhere as handily as a lunch bucket or a briefcase. And with a little imaginative antenna work, you can be on the air as fast as you can say Wayne Green 73 times.

Maybe even faster.

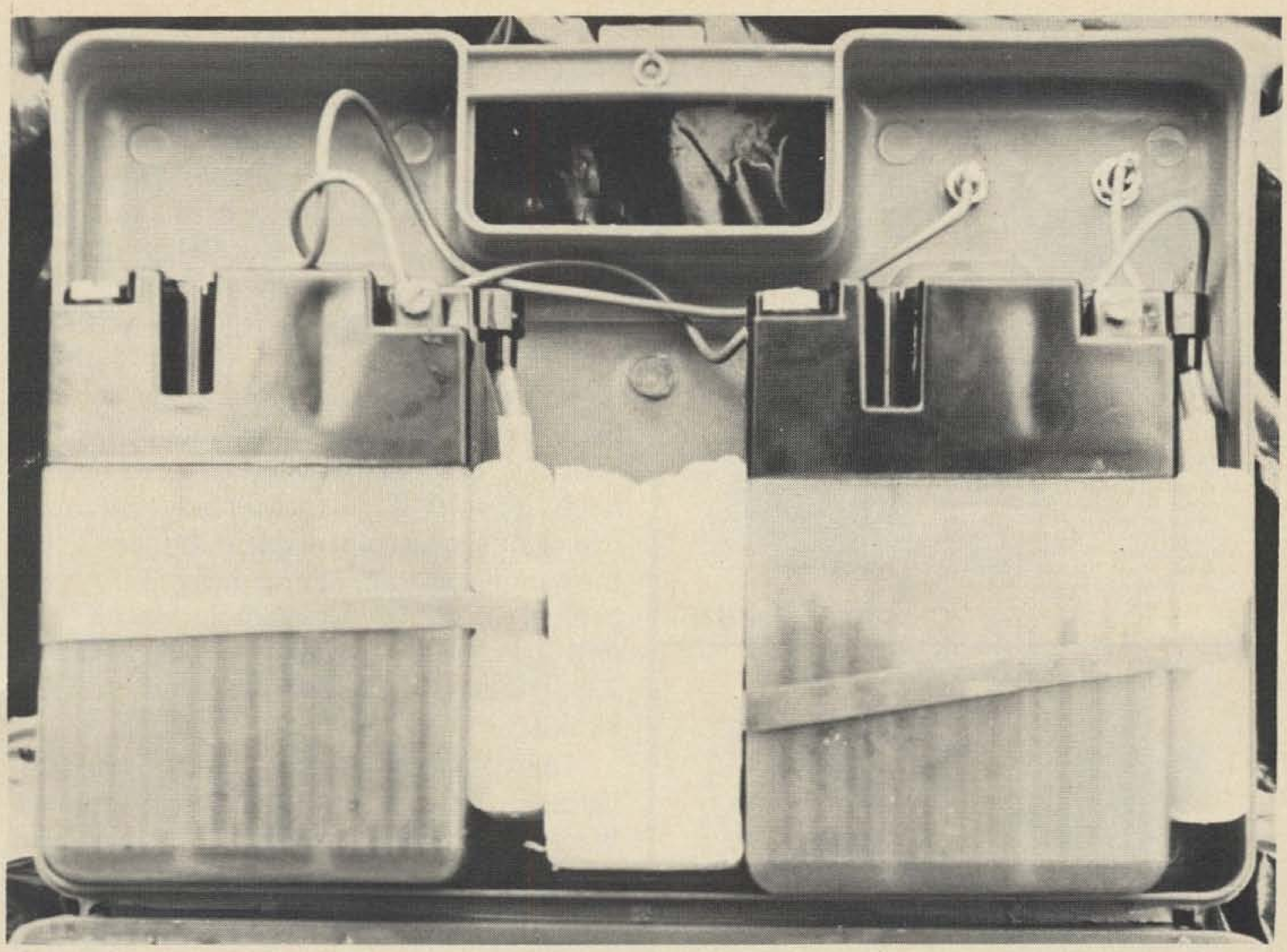
Now these QRP transceivers don't require much in the way of fan cooling, but they still need a little punch from a friendly power source.

Most often, power is supplied at 12 volts dc. This is easy when 120 V ac is at hand, but the implication of QRP is that it may be used at a QTH many furlongs from a high line.

Of course, 12 volts is also available wherever you can take a car, but when you are really out there, up there or down there, the choices all add up to batteries. And there



Mark Smith WB8KKZ and battery pack get it all together.



12 volt battery pack.

are batteries and batteries. Some are cheap, some expensive. The rechargeable variety is usually the most costly, although the recharging angle brings the cost per hour down.

Dry cells are, as everyone knows, an easy answer to the portability question. But the right dry cells are not available just anywhere and when they are dead, you throw them away. There is, however, another way to go. What is needed is a compact, heavy duty rechargeable 12 volt supply obtainable without giving up your last Picasso in the process. It is really quite simple. All you have to do is assemble a small lead-acid storage battery pack from easily available parts.

First on the bill of material is a brace of the 6 volt miniature lead-acid batteries now being marketed at many electronic parts outlets. Olson sells one for a very reasonable price. The Olson battery measures 5½ x 4½ x 2½ inches and is rated at 6 Ampere hours. Hook up two of these in series. Fit them into a cast-off plastic carrying case such as is used to package certain brands of soldering guns (Weller and Montgomery Ward) and you are ready to go.

The Weller and Montgomery Ward cases are sized exactly right to house two Olson batteries plus a styrofoam spacer to keep everything snug. A couple of *color coded* pin jacks installed in one corner of the case provides easy access to the 12 volt output.

The battery pack pictured here is housed in a Wards soldering gun case. Starting with a full charge, it was used to power a Heath HW-7, also shown, during a 2 week Michigan camping trip. The rig was used off and on each day by two operators. At the end of the 2 weeks, good signal reports were still coming in although the batteries had not been recharged.

Electrolyte leakage, the curse of lead acid batteries, is well controlled in the Olson battery. During the 2 week camping trip the batteries remained perfectly dry on the exterior. And considering the generally rough treatment handed out, this is quite a feat.

Nickel-cadmium batteries of the same capacity are much more expensive. Although they have the advantage of not having free electrolyte to worry about spilling, they have their own private curse. This is the polarity reversal gremlin that almost always appears when a ni-cad is depleted until the voltage drops. This is an expensive curse because polarity reversal ruins the affected cell.

A new plastic carrying case for the batteries can of course be obtained, along with a soldering gun, wherever such battery items are sold. If you are already the proud owner of such a soldering gun, but can't find the case it came in, Montgomery Ward is the best place to try for a replacement. You might also try "The Cooper Group," PO Box 728, Apex NC 27502 (cat. no. PUC20, $3.00).

This pack will quickly suggest other uses: lighting, rocketry, test bench and so forth. We even use ours to check out the trailer brakes before hitching up to the car.

Your list might be even more interesting.

. . . W8CHK

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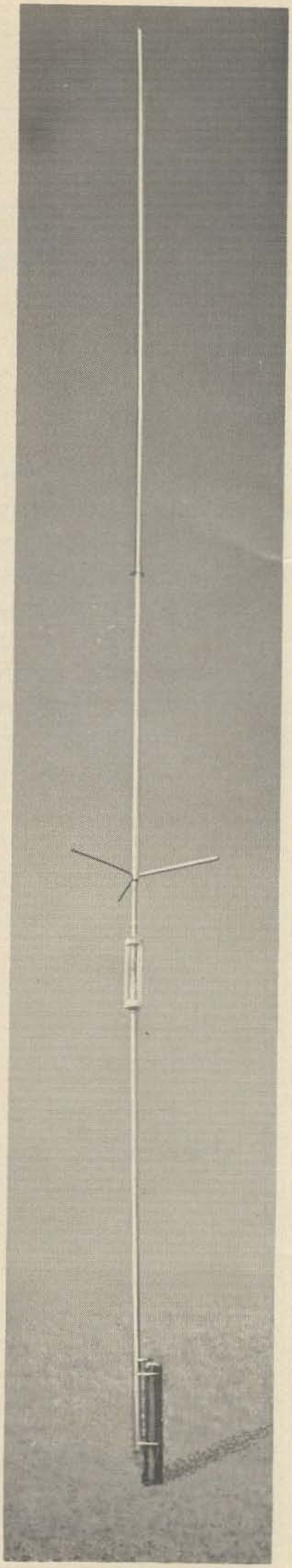

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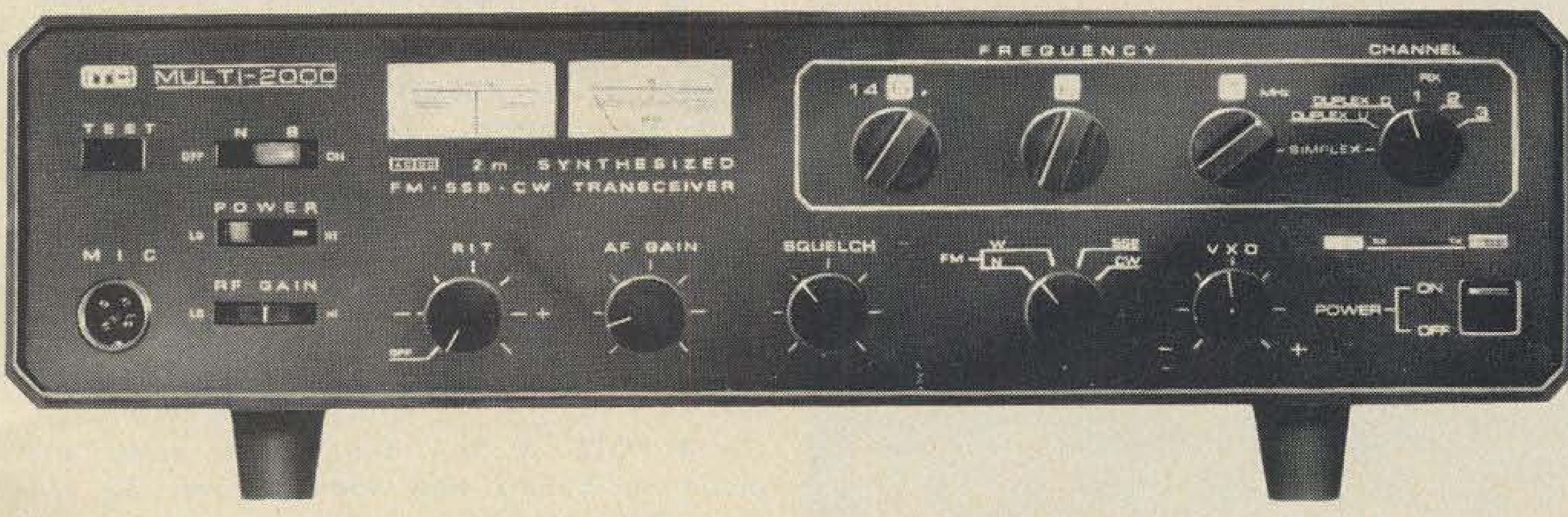

Whether your interest is simplex, repeater, DX or OSCAR the new ITC MULTI-2000 lets you get into all the action on all of the band. Fully solid-state and employing modular construction, the MULTI-2000 enjoys features found in no other 2m transceiver.

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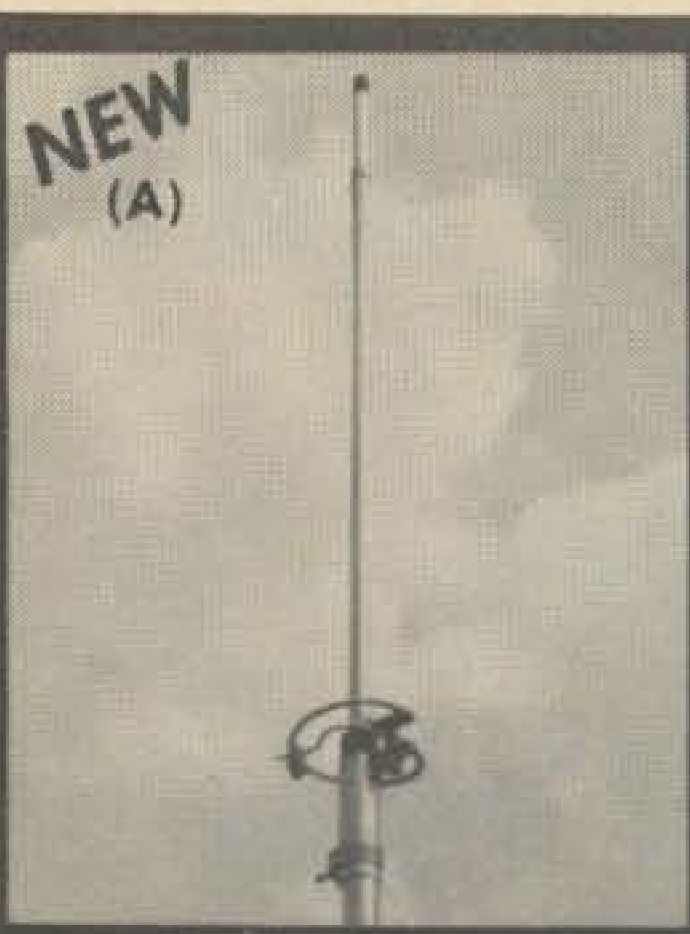

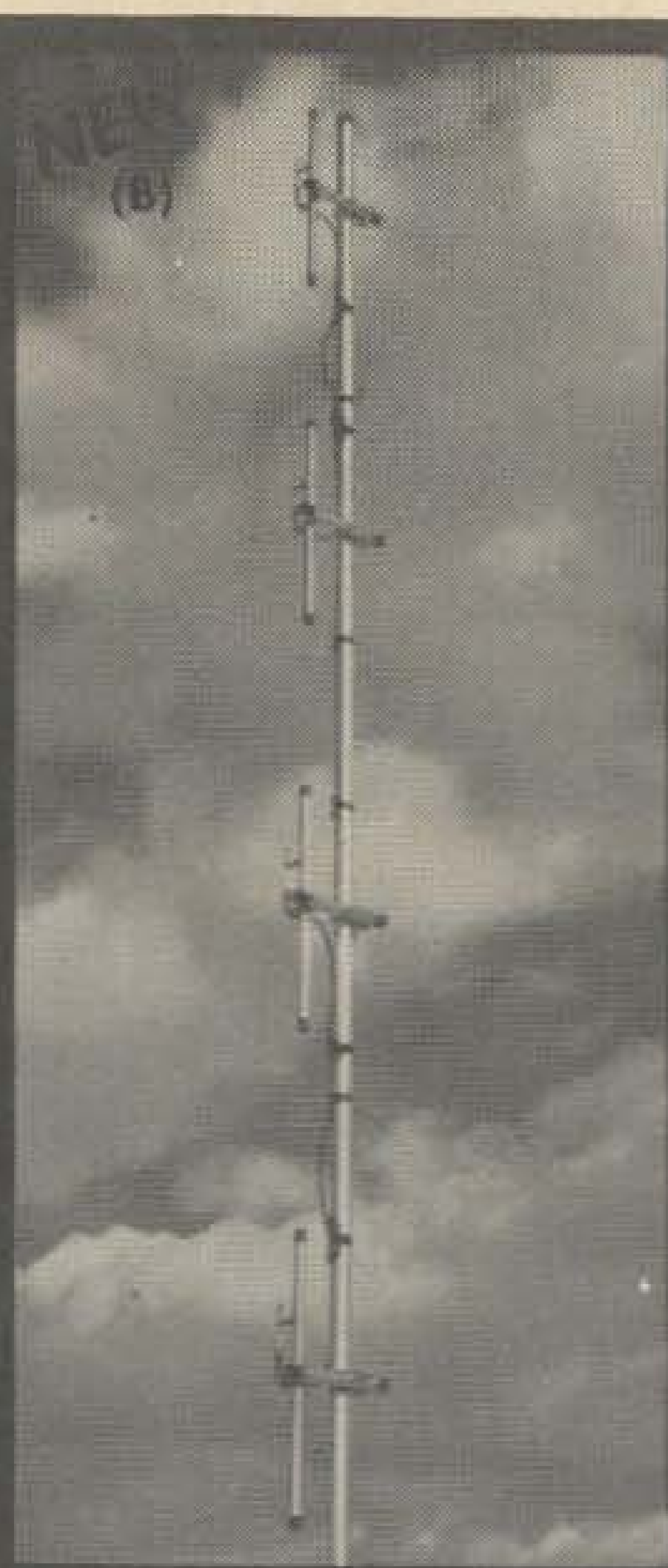

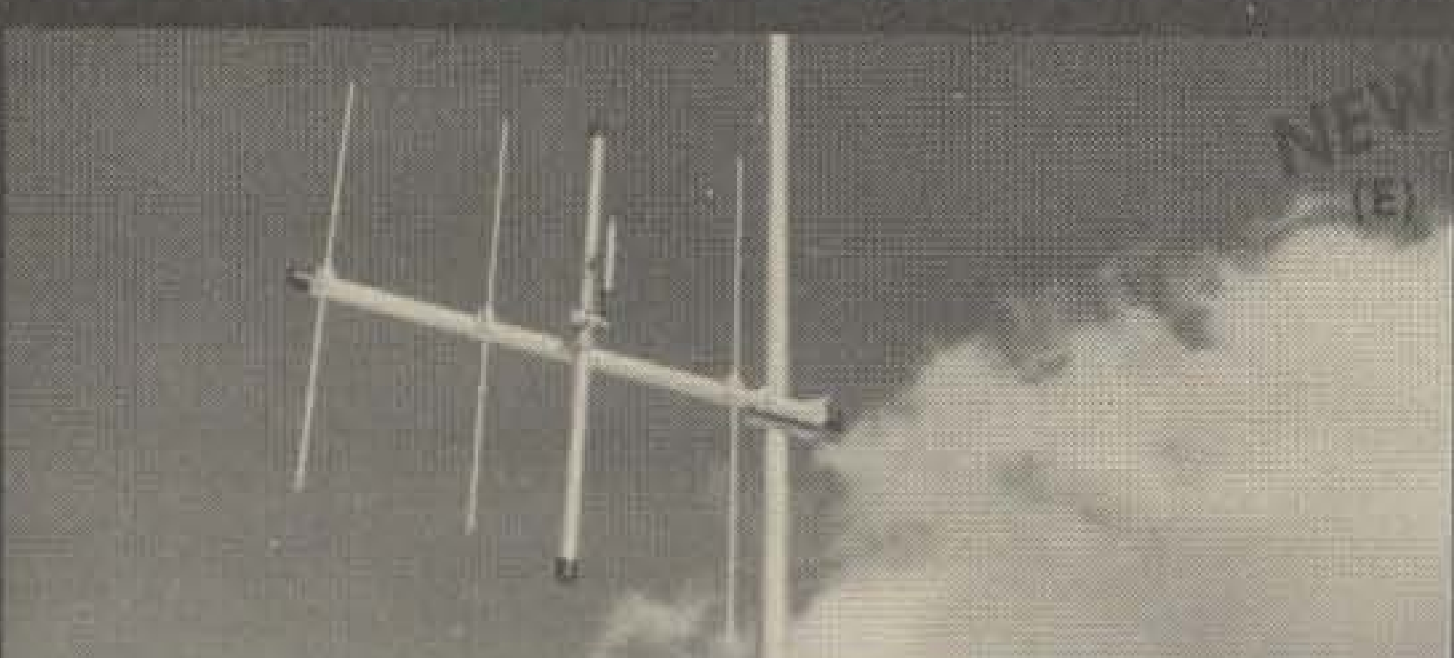

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Eugene Fleming WØHMK
1327 Prairie Road
Colorado Springs CO 80909

You CAN Fix It!

The rest of the family is in bed. You sit at the kitchen table soldering the last connections in place. You sigh, a little in relief at completing the project. But it is more in anticipation of seeing results from all the time last weekend and a couple of evenings this week, plus the wad of cash you put into that gadget in front of you.

You check the controls. The power switch is off. You connect the battery and reach for the switch. The moment of truth has arrived. It's time for those assorted parts so carefully assembled to spring to life. SNAP! goes the switch. Then nothing. No gurgles. No blurps. None of the squeals and howls for which hams are so well known. Thank goodness it didn't smoke.

You unplug the battery after turning off the power switch. A quick visual scan for loose wires or a bad solder joint gives no clues. Poking the wiring is just as fruitless. Sigh again. This time it is in disappointment bordering on disgust.

Every builder knows this scene. And engineering technicians report that hobbyists and experimenters do not have a monopoly on it. The simple fact is that few pieces of electronic equipment that have more than six or seven interconnecting parts operate properly the first time they are turned on. This applies whether they are one-of-a-kind home built gadgets or assembly line produced consumer products. Texas Instruments has a large, well-equipped lab designed for fault detection and analysis in items ranging from single components and circuit boards to finished products. Other manufacturers surely have similar facilities.

If the pros have this problem too, the weekend homebrewer need not berate himself for his stupidity when he throws the power switch and nothing happens. But where does he go from there?

In order to answer that, let's back-track just a little. The builder assumed that he used parts that are in operating condition. As nutty as a bunch of us hams are, it is hard to imagine one intentionally installing defective parts in his own project. If he checked each part on a suitable instrument, his problems are a little different than if he did not test them.

A personal example will illustrate this principle. During the time since the original draft of this paper was written, the writer was asked to check out a transceiver for a friend. When one of the 6146s was found to be shorted, the owner decided it was a good

time to replace them both. New ones were purchased and installed, without being tested. Yep, you guessed it. The rig wouldn't work properly. Before tearing deeper to see if the original defective tube had caused other circuit damage, it was decided to put the tubes on a tester. Sure enough, one of them showed a heater to cathode short. The rig worked fine when two tubes that gave a proper indication on the tester were installed.

It will have to be assumed that each part has been checked before installation.

Step One: Carefully look over the wiring to spot poor connections. If there are none, trace the wiring carefully to be sure it matches that in the schematic of the project. However, if the project is a multi-stage affair, circuit tracing may be deferred until the faulty stage is localized as described below. In any case, circuit tracing is best delayed for at least 24 hours after wiring is completed. This gives the builder a chance to forget some of the details and approach his work with a mind not quite so cluttered with details he is sure are correct.

Step Two: Reread the discussion of "how it works" in the article from which the project was built. A knowledge of the theory behind the hardware will save much fruitless poking and prodding. It will give meaning to voltage and resistance measurements to be made later. If your project was built from a scrawled schematic supplied by a friend, try to locate something similar in a handbook or the annual index published by most electronics magazines. Time spent in this way not only can save time in the repair, it might also help you answer some of the questions next time you visit Fox Charlie Charlie.

Step Three: Bring out the test equipment. Exactly which instruments are needed depends on the nature of the project.

The homebrewer should have access to the best multimeter he (or his friends) can afford. He will probably choose to own it if he hopes to do a great deal of building his own or servicing of commercial equipment. "The best he can afford" does not necessarily mean buying the most expensive model in the catalog. A friend or ham club may have equipment he can rent or borrow. Digital instruments are nice, but a used volt-ohmmeter picked up at a flea market can often do the same job. It has the added advantage that there are fewer parts inside it that might need fixing before checking out the latest project.

The following suggestions can serve as a general guide to troubleshooting and give a general feel for the procedure. In this type of presentation, it is not possible to give details required for a specific project.

One of the few things common to all electronic equipment is a power source. Check it to learn if it is producing the needed voltages at its output. To do this, set the range switch of the multimeter to the highest voltage expected. This might be the 10 or 15 volt dc range if a 9 volt battery is used as the power source. It would be the 150 volt dc range or next higher if rectified line voltage is used to supply the power. Connect the negative (-) probe, which is usually a black lead to the negative side of the power supply and the positive (+) to the positive output of the power source. A beginner should do this before turning on the power switch to avoid the shock hazard.

If there is no output voltage or it is quite low, the supply may be faulty or there may be a short in the load causing excessive current drain. To determine which it is, disconnect the load (with power off, of course) and measure the output voltage in the same manner. A normal voltage will indicate a properly functioning power supply.

An important exception to the last statement is that a stale battery can show full voltage at no load, but drop to practically zero when put under even light loads. Most batteries can be checked by connecting only a thousand Ohm resistor across the terminals and measuring the voltage across it. If that voltage is more than half a volt below the rated voltage of the battery, it is best to replace it. Keep in mind that a short in the load could have caused the demise of the battery, so check before installing a replacement.

In the case of an ac supply with rectifiers, check the line input voltage. To do this set the multimeter on the 150 volt ac range and connect either probe to one side of the transformer primary and the other probe to the remaining primary lead. Then turn on the power. The meter should show a reading between 110 and 120 volts. This procedure can be skipped if there is a pilot light in the circuit which lights as it should. No voltage indication means there is an open circuit which can be found by resistance checks of the line cord, power switch or solder connections. The most common point where a line cord develops breaks is at the junction of the plug structure and the wire cord. This is particularly true of molded plugs. More than one old-timer has asked this writer to repair equipment with nothing more seriously wrong with it and then asked him not to tell others of the incident.

At the risk of being tedious to those with some experience, a brief explanation of how to make a resistance check seems in order. Set the range switch to low Ohms scale for checking wire continuity. Disconnect all power. Connect either probe to either end of circuit to be tested and the other probe to the other end. The power cord will show a fraction of an Ohm even for many feet of wire. A switch should show zero Ohms, if good, and the primary windings of most power transformers have resistance running as high as 500 Ohms or so. An eight Ohm speaker coil seldom shows more than a fraction of an Ohm at dc. Low voltage secondary of a transformer, both power and audio output, will show very low readings, usually less than a couple of Ohms. High voltage secondaries usually show several hundred Ohms of resistance. An extremely high Ohms reading in any of these circuits will indicate an open circuit. Transformer windings sometimes open at the point where wire from the outside connects to the smaller internal wire. At today's prices for transformers, it is worthwhile to carefully remove the outer insulation paper to check this point when an open winding is located.

To summarize on resistance measurements, the most important part is to know how to interpret the readings you obtain. This comes only with experience. Therefore, make measurements in operational equipment to gain a knowledge of what you should expect when you are working on malfunctioning equipment. Resistors are easy to measure, because the values are marked on them. On other components, it is worthwhile to make notes on values so they will be available for comparison at a later time.

Continued

Now back to power supply measurements. When a proper ac voltage is obtained at the primary input, the next step is to go to the various secondary outputs. Set up the meter for a full scale range slightly higher than you expect to read, connect the probes to the pair of wires coming from the winding, apply power, and note the reading on the meter. If there is none, check for open circuits. If it is too low, disconnect the load and check the voltage again. Check all secondary windings in this way. Lighted tube heaters or pilot light on a particular secondary show it is working, so don't bother measuring it.

Once you are sure the proper voltage is being produced by the power source, other parts of the circuit can be checked. However, if the output voltage is too low, it may be caused by a part of the load drawing too much current. Since most projects have several branches of the dc line, a logical procedure is to disconnect them one at a time, apply power with meter connected to read dc voltage at output of power source, and note if the voltage rises to normal. When it does with one branch disconnected, that branch should be checked for wiring errors or defective parts. This approach will save much time in comparison to tracing the wiring in the entire project.

Although the foregoing explanations are somewhat cumbersome, the tests, with exception of the previous paragraph, can be performed in less time than it takes to read about them. Experience has shown that these simple measures can put about 75 percent of home built projects into operation when no defective components have been installed. Another 20 percent require signal tracing or injection which will be discussed in a future article. Most of the remainder have a component damaged when power is switched on because of a wiring error.

In conclusion, do not be afraid to tackle the chore of finding where the problem lies in that newly built project. If you had knowledge enough to put it together, there is a good chance you can make it operate, even if it failed the smoke test.

. . . WØHMK

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Precision +10.000 V dc Voltage Reference Standard

This article describes a simple, easy to build dc voltage reference standard whose temperature coefficient (tempco) can be tailored to the ham's individual requirements. It can be used by itself or as an individual circuit element.

Design Considerations (see Fig. 1)

The circuit described uses an operational amplifier in a non-inverting circuit utilizing a single positive supply. The output of the reference standard supplies the zener reference diode current, providing a stable supply voltage for the zener and de-coupling from the positive supply voltage. The positive supply voltage should be regulated by either a three-terminal regulator or zener diode and should be from +15 to +18 volts.

Temperature stability is expressed in %/°C or ppm (parts per million)/°C. (.0001%/°C is equivalent to 1 ppm/°C.) A 1 ppm/°C change referred to an output of 10.000 volts is 10 uV/°C. Both terms, %/°C and ppm/°C, will be referred to in this article.

The zener reference diode, CR1, should not be confused with the more common zener regulator diode. The zener reference diode is intended for use in applications where it is important to maintain stable dc voltages under severe combinations of temperature, shock and vibration. The temperature stability of the zener reference diode is due in part to the combination use of reverse-biased and forward-biased silicon p-n junctions, taking advantage of their opposing tempco characteristics. Application notes and design data sheets are available from the larger suppliers of zener reference diodes (e.g. Motorola, Dickson, Centralab) and are invaluable as reference material.

The 1N821 through 1N829 family of zener reference diodes is used for CR1. The diodes in this family exhibit tempcos from .01%/°C (1N821) to .0005%/°C (1N829) at a nominal zener current of 7.5 mA. The nominal zener voltage is 6.2 V ±5%. R1, which sets the nominal zener current (7.5 mA in this case), should be a 100 ppm/°C metal film resistor. Other families of zener reference diodes can be used, such as the 1N4565 through 1N4584, with a corresponding change in nominal voltage and current.

As a general rule, the gain resistors used in the reference standard should have tempcos similar to the zener reference diode selected. For example, if the 1N821 is selected, gain resistors R2 and R3 should have tempcos of .01%/°C (100 ppm/°C).

The overall tempco of the reference standard is dependent upon the tempcos of the reference zener CR1, gain resistors R2 and R3, and to some extent, the zener current resistor R1 (providing it has a 100 ppm/°C tempco) and A1.

The gain required of the circuit is dependent upon the zener voltage. The nominal voltage of the 1N821 is 6.2 V, necessitating a gain of 1.613 for an output of +10.000

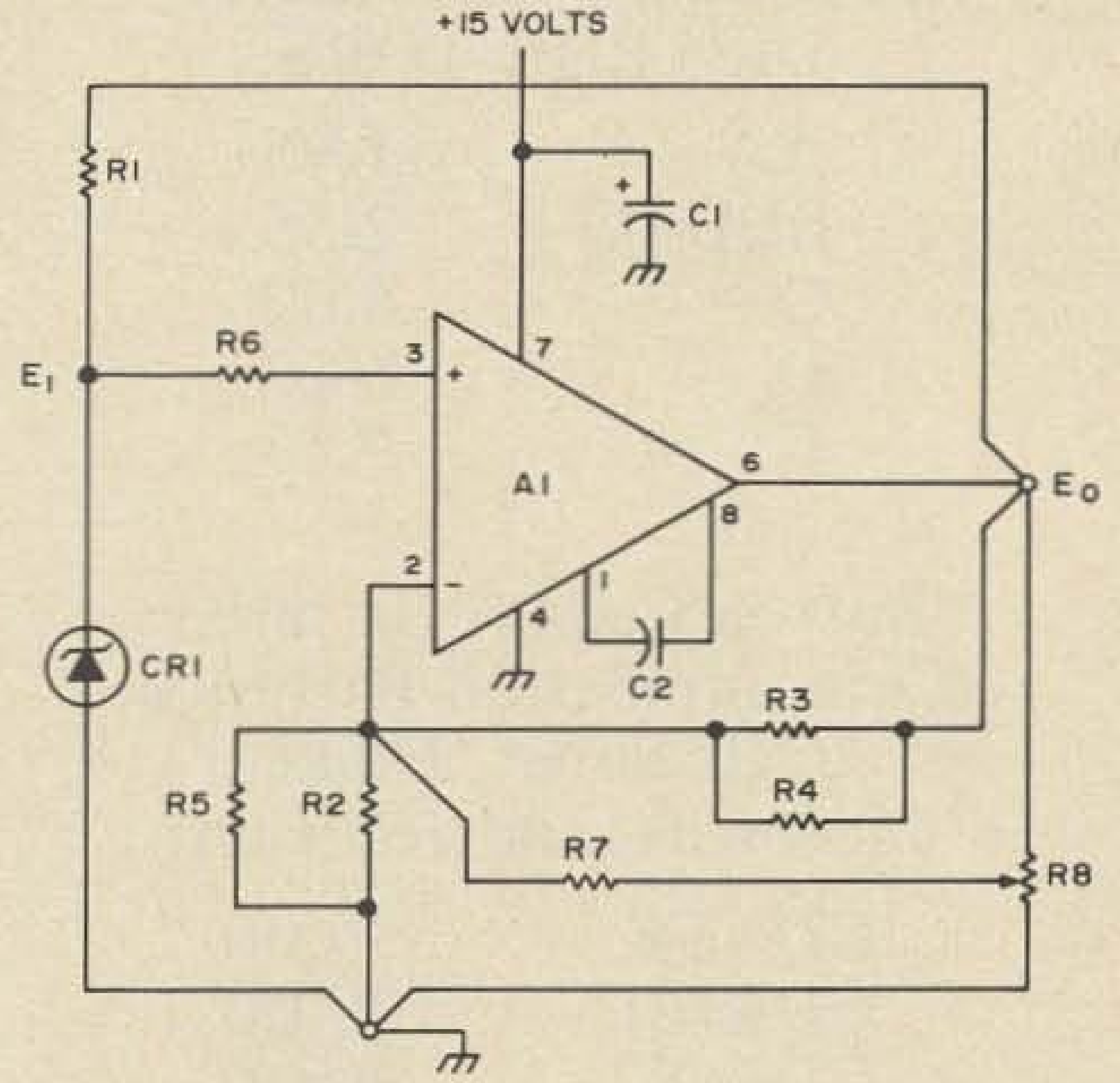
volts. The total resistance of R2 and R3 should be 5k to 10k, limiting the current through the gain resistors to from 1 mA to 2 mA.

If R1 is a 100 ppm/°C as suggested, here is an easy way to estimate the overall tempco of the completed reference standard: 1) Write down the tempcos of CR1, R2 and R3 in ppm/°C; 2) Square each one that you have written down; 3) Add the squares of R2 and R3 together, dividing the answer by seven; 4) Add the square of CR1 and the answer of step 3; and 5) Find the square root of the answer in step 4. Step 5 will be the approximate overall tempco of the reference standard in ppm/°C. This will give you a good idea if the components you have selected fit your tempco requirements. If CR1, R2, and R3 have the same tempco, just multiply the tempco of *one* of them by 1.1 to determine the overall tempco of the reference standard. The reason for the division by seven in step 3 is that the tempco of R2 and R3 is reduced a factor of approximately 2.7 (depending on the gain) by the low gain of the amplifier.

The output of the reference standard can be trimmed to +10.000 volts by paralleling a resistor across R2 and/or R3 as required. Tempco of the gain trim resistors, R4 and R5, is critical, and should not alter the tempco of the gain resistors. For example, if R2 was a 6.04k 25 ppm/°C resistor and a 62k ½ Watt carbon resistor was paralleled across it having a 1000 ppm/°C tempco (typical tempco of carbon resistors), the result would be the same as using a 5.5k 100 ppm/°C resistor. The effective tempco of the trim resistor in this case would be 1/10 its real tempco. A 620k ½ Watt carbon, in the same example, would have an effective tempco of 1/100 or 10 ppm/°C, and a 6.2 megohm would have an effective tempco of 1/1000 or 1 ppm/°C. Some discretion must be used when selecting the value and tempco of the trim resistors.

Practical Design

The next step is to build a working reference standard. The following components were selected for a reference standard having a calculated tempco of 22 ppm/°C and a measured tempco of 17 ppm/°C after assembly. An LM301A operational amplifier was selected for A1. The LM301A will supply approximately 20 mA and has a typical tempco of 1 ppm/°C. A 1N825 reference zener was selected for CR1 which has a 20 ppm/°C tempco and a nominal voltage of 6.2 volts at 7.5 mA. An RN55 100 ppm/°C 511 Ohm metal film resistor was selected for R1. The actual reference zener voltage at 7.5 mA measured 6.286 volts, necessitating a gain of 1.591 for +10.000 volts output. For a gain of 1.591, an RN55E 25 ppm/°C 6.04k metal film resistor was selected for R2 and an RN55E 25 ppm/°C 3.57k metal film selected for R3. A ½ Watt 2.2k 5% carbon resistor was



$$Gain = \frac{R2 + R3}{R2}$$

$$E_O = E_I \frac{R2+R3}{R2}$$

A1 – LM301A Operational Amplifier
C1 – 1 mF electrolytic capacitor, 25 W V dc
C2 – 30 pF ceramic disc capacitor
CR1 – Reference zener diode, 1N821 family
R1 – 100 ppm/°C metal film resistor (Select value for the nominal current of CR1.)
R2,R3 – Gain resistors (Select for desired tempco.)
R4,R5 – Gain trim resistors
R6 – ½ Watt resistor (Value should be the parallel equivalent of R2 and R3.)
R7* – Optional +10.000 volt trim resistor for use with R8 (Value can be 100k to 1 megohm, 5-10 ppm/°C.)
R8* – 10k 89PR cermet pot or equivalent optional +10.000 adjust.

*with a 100k resistor at R7, the output can be adjusted about 10% if the sum of R2 and R3 is 10k. 1 megohm will provide about 1%.

Fig. 1. Voltage reference standard schematic.

selected for R6. After assembly, R3 had to be trimmed for an output of +10.000 volts.

The most difficult task after assembly for the average ham will be finding access to a 4 or 5 digit digital voltmeter so that the reference standard output can be trimmed to +10.000 volts. No special equipment is required up to the trimming operation. The accuracy of the reference standard will be as good as the equipment used to trim it.

Conclusion

It has been demonstrated that a precision reference standard can be constructed by utilizing available reference zener diodes and suitable gain resistors. This article was written primarily as a tool to enable some of those interested in acquiring a stable dc source to design their own. Different output voltages can be obtained by either changing the gain of the amplifier or adding a voltage divider across the output of the reference standard (current cannot be supplied in this mode). Layout is not critical, cost is minimal, and performance can be determined to some extent before assembly.

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Building a 135 kHz i-f Strip

This article describes the use of the second surface of a baseboard for a 135 kHz i-f strip. I used the first side for the converter, 1.65 MHz to 135 kHz mixer, and the 1.785 MHz oscillator, which left the other side bare and ready for mounting the 135 kHz strip.

The first thing to do is the construction of the two terminal strips with their .021 diameter pins to hold the various components in place, such as the resistor tie points, capacitors, three pins for each transistor, interstage coupling capacitors, 12V bus, etc.

Fig. 1 shows placement details of these pins on the 3¾ x ¼ in. fiberglass strips which are .035 thick. As in my converter strip, 1/8W or 1/10W was used for resistors throughout, and small 10 mF electrolytics are also a must. There are two components which are still fairly large, the 135 kHz inductors and the mica compression trimmers, but even when these are mounted there is still lots of space available, as you can see in Figs. 5 and 6.

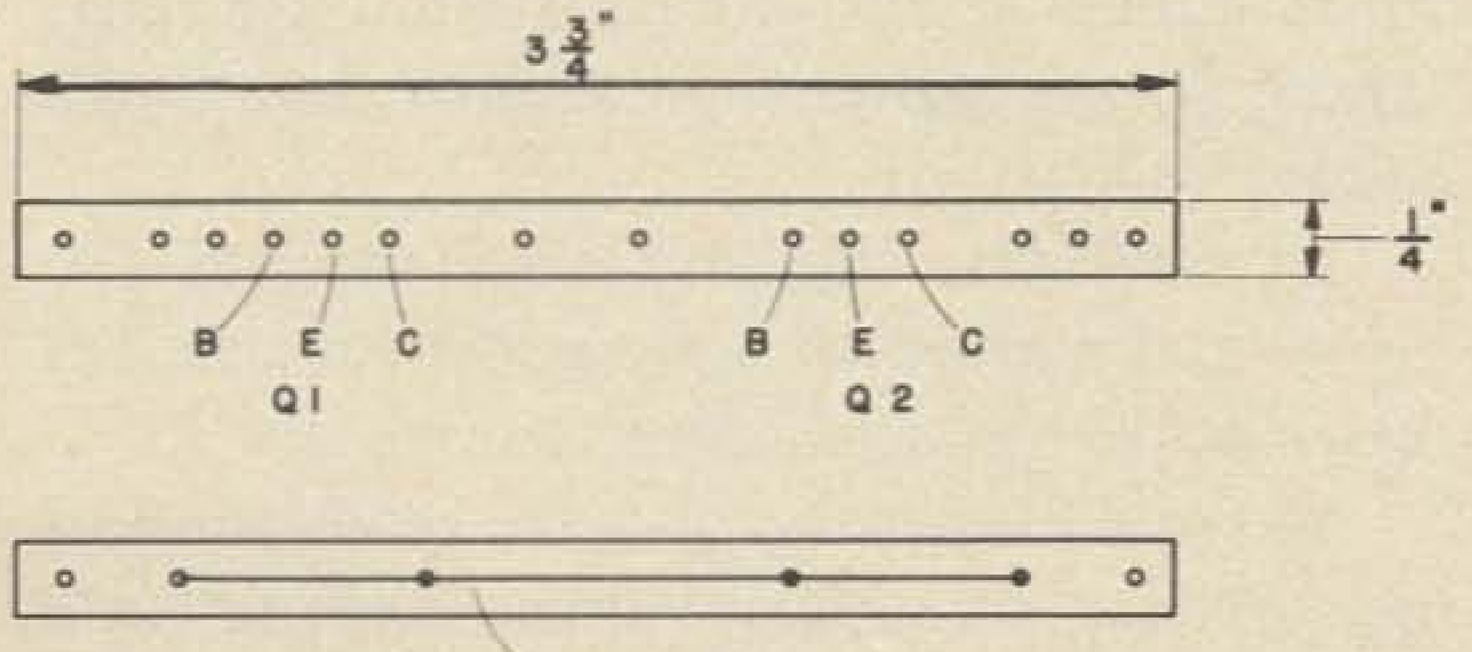

Fig. 1. Terminal pin layout.

Be sure to use the narrow type trimmers which are only 3/8 in. wide but still have 700 pF maximum capacity, which are the kind of values you need down at 135 kHz. As you can see, the 12V bus is interrupted at one end for the avc line, and on the other end has a 100Ω resistor for dc battery supply purposes.

The top line of terminals works out nicely with, from left to right, "S" meter connection, input to the base capacitor, base, emitter and connector pins, collector bus, interstage capacitor, second stage B, E; and C pins, diode one, and the output capacitor. Three more pins were needed for the avc diode and its associated avc components.

The HEP 55 Transistor

Practically in the middle of building and

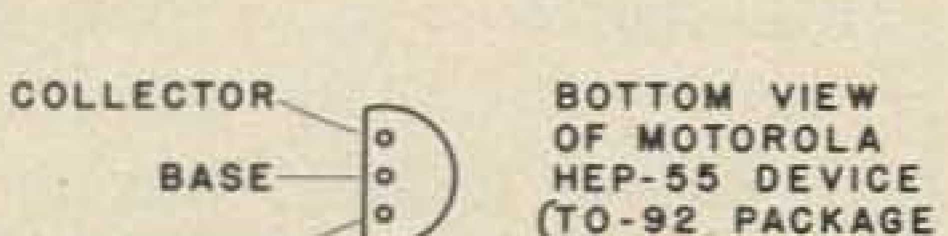

Fig. 2. HEP 55 pin connections.

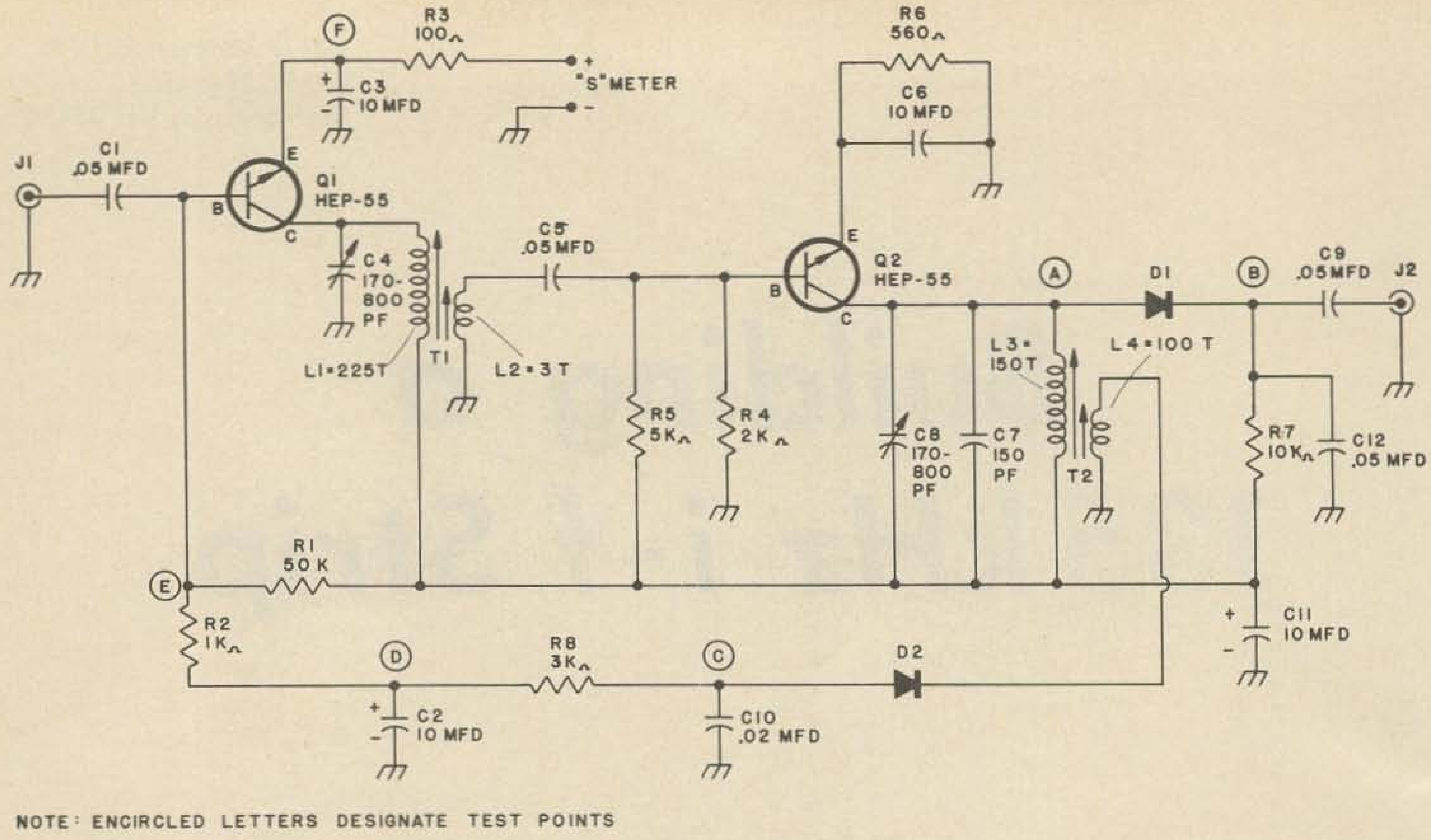

Fig. 3. 135 kHz i-f circuit.

testing this unit I received a shipment of goodies from Motorola. There were a bunch of HEP 55s in the box, and these look like the answer for use in all the stages between (and including) 135 kHz up to two meters.

I tried one (HEP 55) right away in the 135 kHz strip against a 918 and the increased gain showed up quickly.

Tubes used to have a fairly simple parameter called "Gm," or transconductance, which gave a pretty good idea of what the tube would do, at least on lower frequencies, with other things being equal. There are, to start with, some 100 symbols in fairly current usage for transistor parameters, but fortunately there is one that helps a lot as a preliminary indication, again on the lower frequencies. It is known as *beta,* using the common emitter circuit, and is simply the ratio of the change in output current to the change in input current that caused it. In an HEP 55 for example, a one microampere change in the input can become a 350 uA change in the output. This therefore is a hot device! Testing a number of them against 918s, 3600s, and various others, the HEP 55 simply amplifies more at 135 kHz. Don't get me wrong about the 918s, though: They are of course made for UHF work and the HEP 55 is listed for use up into VHF only.

The HEP 55 is good for 200 MHz, which is listed as Ft, the cutoff frequency, and so is good for nine stages in the 432er. These are the two at 135 kHz, mixer, oscillator, two i-f stages at 1.65 MHz, and the rf, mixer and oscillator of the tunable i-f at 28 to 30 MHz, otherwise known as the ten-meter-receiver section.

The terminal arrangement is not exactly ideal, but is satisfactory when mounted as in Fig. 2. It does have some good features for sure. For example, the base-emitter voltage is listed as five, which is better than the 918s which only can take three volts. Don't forget, almost any transistor can burn out a following one of the same type, so step down that impedance!

The dissipation of the 55 is 310 mW, which is alright in the receiver. The maximum collector current is listed at 200 mA, which seems higher than needed, but that's Motorola's affair.

At 200 MHz the beta is still around 250 or so and should thus be good for receiver work up to and including two meters.

As you know, if you have read many of my articles, I've always been looking for a universal transistor, out of the many thousands available, that can be used in almost every receiver stage up to two meters. This

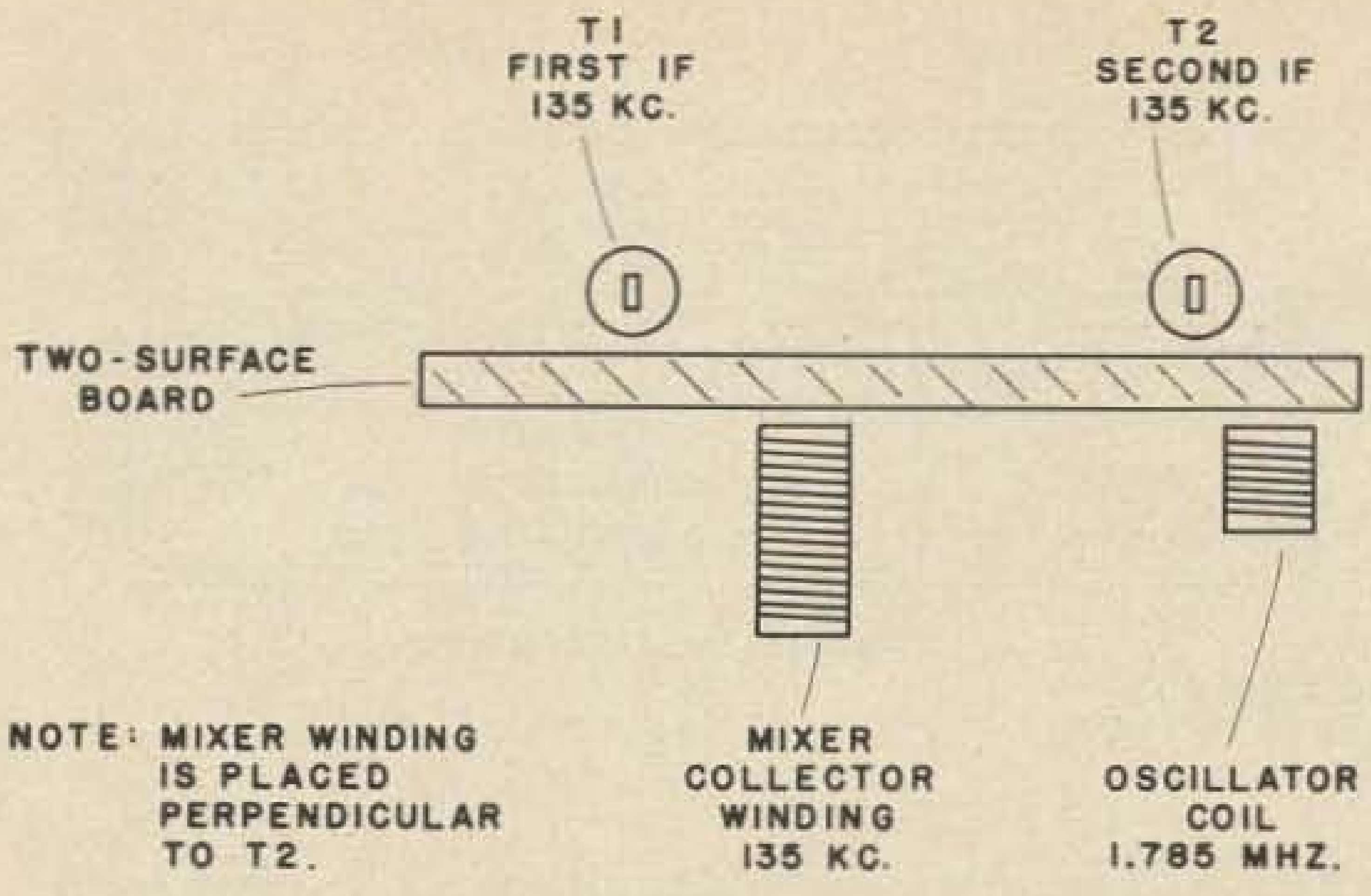

Fig. 4. Magnetic feedback prevention details.

does not include the low-noise rf stage or stages, for which you will have to pay a little more at present.

If further tests hold up, the HEP 55 may just be this universal device.

If you're going to de-breadboard a circuit and minibox it, go ahead, but *copy*, don't *change*! I did (change) and it cost me two extra days of hard work. I don't mind the time if you can profit by it, so here goes.

The final circuit is shown in Fig. 3, which looks almost like the one in my breadboard unit. It was supposed to be the same, but as soon as I turned it on – zilch! Insufficient avc action with af diode blocking on any signal over an S5. After hours of checking for proper avc voltage, milliamps of current with the signal generator on and off, I dismounted the original breadboard 135 kHz i-f and checked it for overloading. None – it was perfect. Alright, just what had I done, or changed?

After checking capacitors and resistors, diodes 1 and 2 were replaced. Still nothing. What remained? I had put in two of the higher gain HEP 55 devices for Q1 and Q2, so they were replaced with the original 918s. Still nothing. There remained only the "new" winding of 225 turns instead of the original 150. And that was it! As soon as I wound up another T2 using the original 150 turns, with 100 turns in the avc diode secondary for good measure instead of 80, bang, good avc again. Current in Q1, the avc controlled device, dropped to 10 uA with a good signal at the input.

So, once again, *don't* make changes when reducing the size, unless you're ready to do more experimentation, maybe several days of it, because the smaller you get the harder it is to change components.

More Avc Details

"Out of evil comes good," it says in the Good Book, so sure enough, while on the blocked avc trouble I was able to improve the avc circuit. Checking the circuit in Fig. 3, you will see R8 feeding the avc line. When only one diode is used for both af and avc, this resistor cannot be very small, but when a separate diode D2 is used, R8 can be of any value you want because it now serves just as a filter in the line and does not have to isolate the line from the af channel. The smaller you make it the more avc action you will have. You can see the balance needed between R8 and R1, the 50k resistor feeding plus voltage to the base of Q1. If you want more, or less, avc action with this circuit, you can juggle the values of these two resistors, R8 and R1.

The lower impedance of L1 with 150 turns instead of 225 also gives a better match for Q2 making it more of a current driver into D2.

Table 1 shows representative voltage readings at significant test points for avc action. Readings at these points will vary somewhat depending on your voltmeter, transistors, etc. I used a small VOM but of course a VTVM would be better.

The Final Circuit

Every value given in Fig. 7 is exactly as in the working model which is completely

		Volts	
Point	To Point	Sig. Off	Sig. On
A	B	0	about 1V
C	GND	+.2	−.5
D	GND	+.9	+.3
E	GND	+ 1V	+.5
F	GND	+.5	close to zero volts.

Table 1. Avc voltage test points. Note: Signal "On" was the "Low" output from a Lafayette signal generator, output control full "On," through a 100:1 resistor attenuator, home brewed, frequency 1.65 MHz. No tuned circuit was used at 1.65 MHz – just a direct cable connection to C1.

enclosed in the 4 x 2 minibox and working well.

An output link on the 1.65 MHz to 135 kHz mixer comes through C1 to the base of Q1, an HEP 55 Motorola NPN. Base bias is obtained as detailed in the avc section above, with emitter current going out to the "S" meter on a pair of red and black flexible wires.

The secondary of T1 was changed to 3 turns to drop the gain a little and provide more selectivity.

The circuit of Q2 is almost identical to the breadboard one, with another HEP 55 being used. The avc secondary of T2 is now 100 turns instead of 80, to provide more avc action, and R7 is lower for the same reason. The idling current of Q1 is about 5 mils, dropping to as low as 10 uA on almost any good signal. Needless to say, there is plenty of af out of J2.

Figure 4 shows the final placement of the mixer collector winding in relation to the collector winding of the first stage i-f, T1. Note that Q1 has its collector in T1 and its base in the mixer winding. If any coupling is present between these two it could provide a feedback path and oscillate. It did!

The magnetic field went right through the copper baseboard (naturally enough) just as though it weren't there, and Q1 made like an oscillator. Adding four small pieces of flexible wire (you can do this at 135 kHz but *not* at VHF) to allow moving the coil around, it was rotated in several planes. Sure enough, when parallel to L1 it produced nice, clean (but unwanted) oscillation. When mounted perpendicular to L1 as in Fig. 4, no feedback and no oscillation.

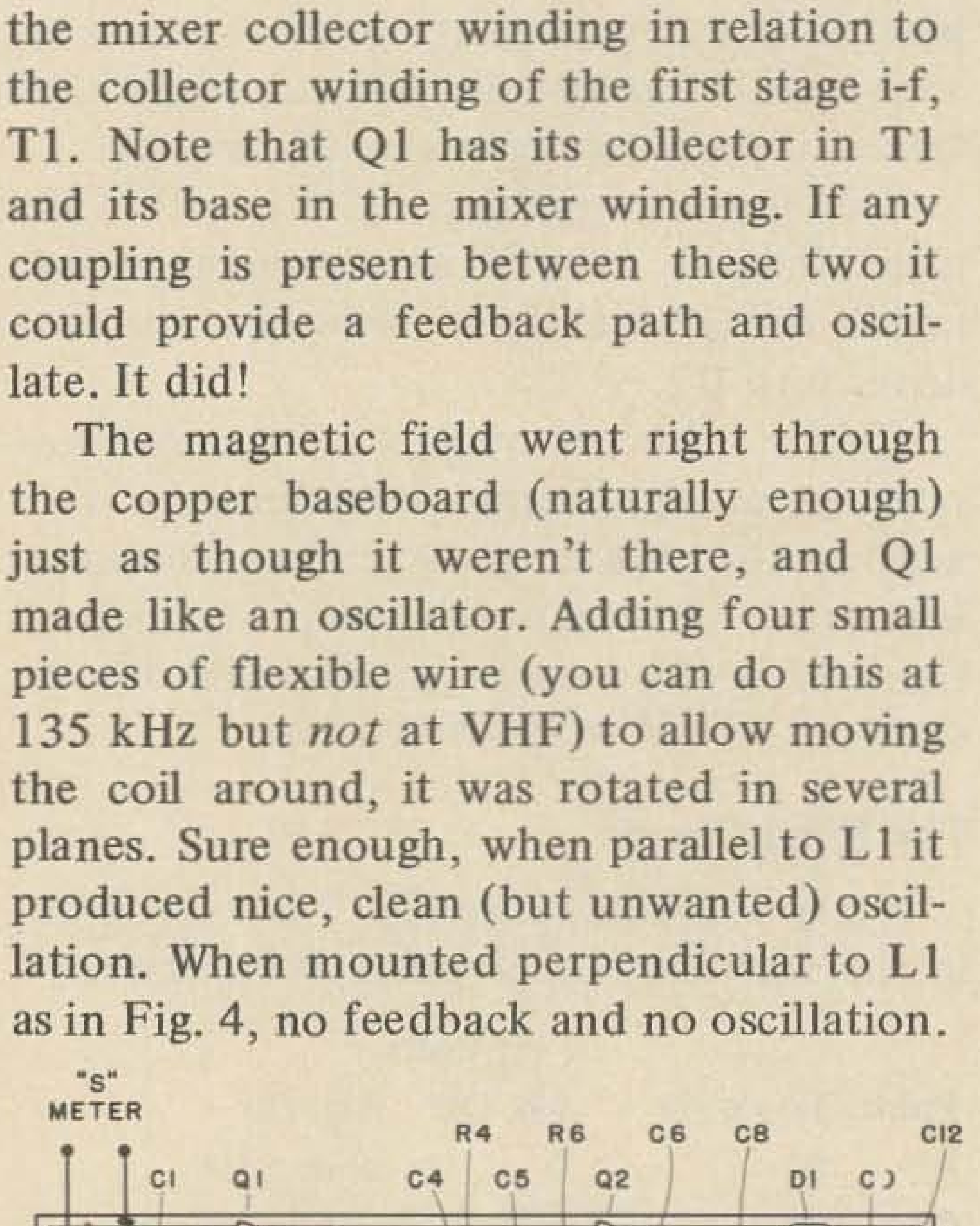

Fig. 5. Layout of the 135 kHz i-f strip.

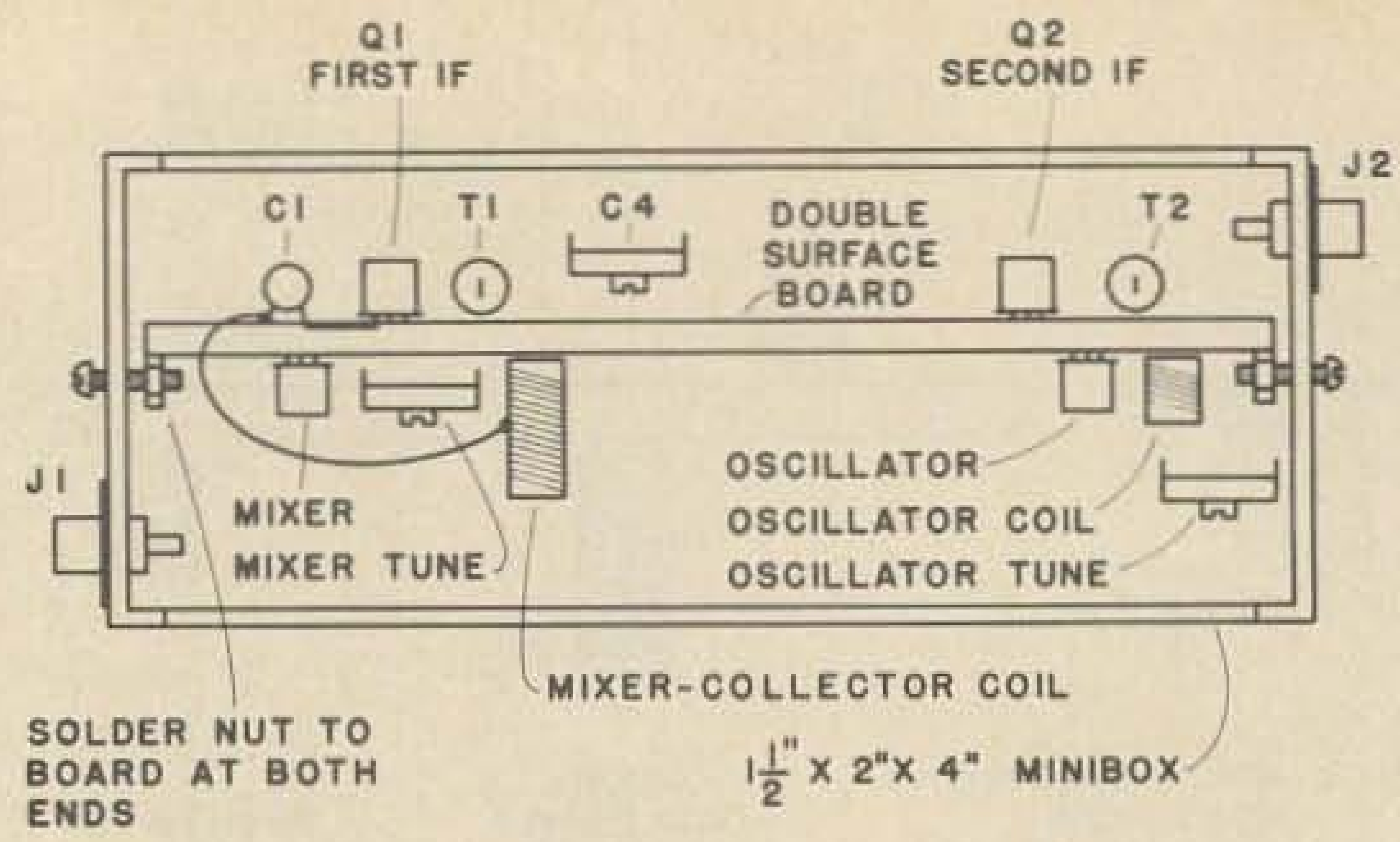

Fig. 6. Installation in a minibox, top view with cover off.

The Layout

Figure 5 shows the various components and how they are fitted onto the 3¾ x 1½ in. second surface of the baseboard. I clamped the board bare side up in a drill vise and proceeded with the entire assembly and tuneup on 135 kHz. I then brought just one wire over from the mixer transformer to Q1, and the 12V to the bus, and the two sides were in action together.

Looking onto this 135 kHz strip, you can see in Fig. 4 that there is still plenty of room left and so far nothing is covered up, with all the components in plain view. As mentioned, the transformers and trimmer capacitors loom rather large among the 1/10th watters and transistors, but I still can't believe the amount of empty space in that little box, even when I'm looking right at it.

Tuning Up

Referring to Fig. 3, the final circuit, the interstage transformer T1 tuned quite well over the range of 130 to 150 kHz with the mica trimmer C4, 170 to 600 pF. This inductor plus the mixer collector coil determines the 135 kHz center of the narrowband i-f. T2 is fairly broad with its close coupling to the af diode and also to the avc diode now with the 100 turn secondary. Both af demodulation and avc action are aided by this close coupling, so the sharp selectivity is left to the first two transformers.

With quite a bit more work and winding time you could add more tuned circuits, but this whole triple conversion receiver is enough of a project for now.

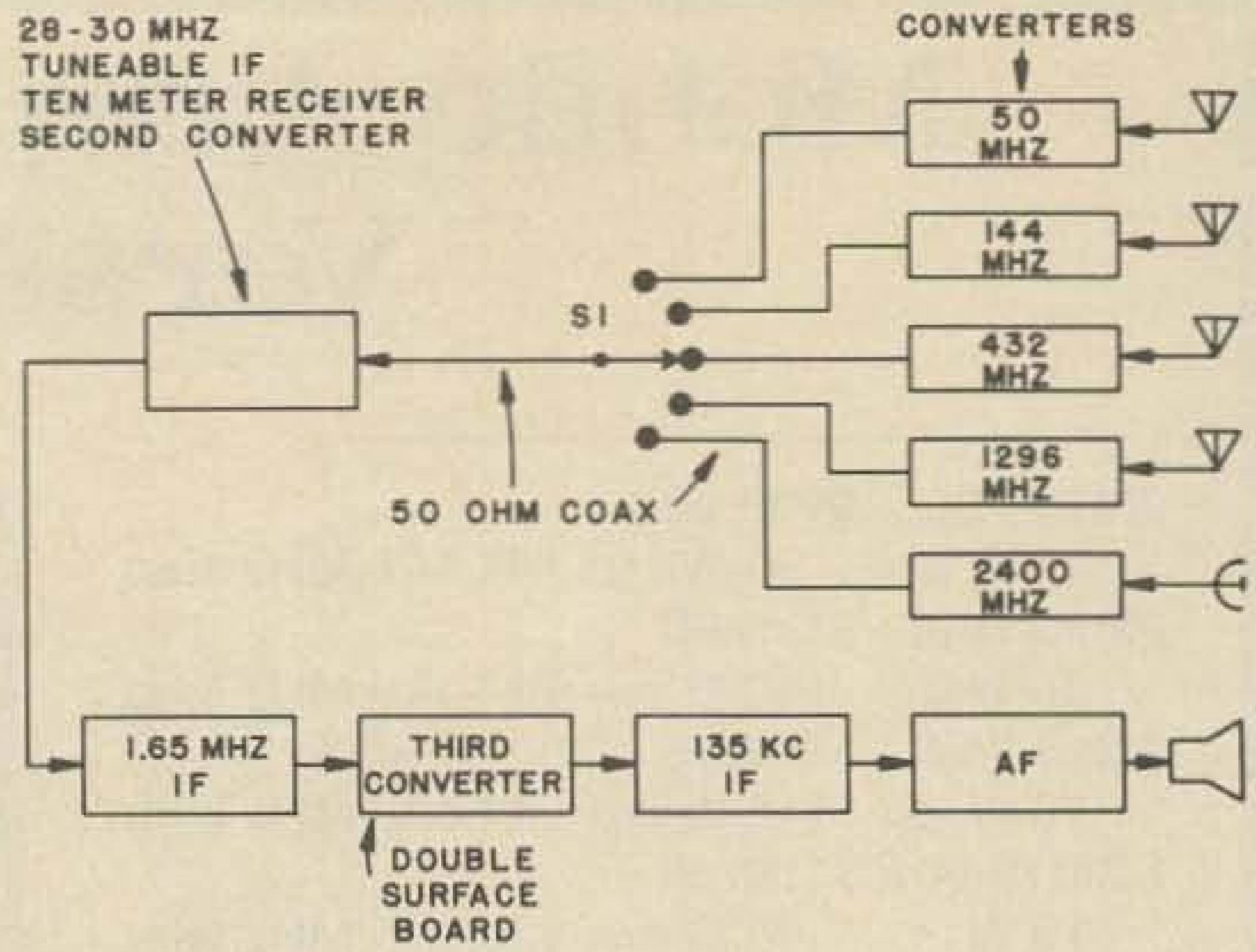

Fig. 7. Block diagram of an all-band VHF-UHF-S-Band receiving system.

The modular concept is still very evident. In fact, it's even more so now with each module consisting of an enclosed minibox instead of a breadboard. I'm getting quite curious to see just how small the whole receiver can be. Putting the entire rf section into closed boxes looms as the toughest size problem.

Installation in the Box

Fig. 6 shows a view looking down into the minibox with the cover off. You can see that with both sides of the box open, almost all the components are available for service if needed.

To remove the board from the box only two wires have to be unsoldered, one to J1 and one to J2. The layout of Fig. 5 shows all the detail needed for the 135 kHz side.

Now you have the narrowband i-f in a small minibox, so next in line, going backwards toward the antenna, are two 1.65 MHz stages which should go into an even smaller box, as long as there is room for a ½ in. control to set the i-f gain to your fancy. Using the two low noise rf stages and the battery-operated "ten-meter-receiver" section in front of the two i-f strips, you certainly don't need much i-f gain.

Note that these units, beginning with a 28 to 30 MHz tunable i-f, can be used on Six, Two, 432, 1296, and 2400 MHz to make up an all-VHF-UHF-S-Band receiving setup, as in Fig. 7, and that they can all operate from one battery.

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A True Tale of the Faked Fist

A ham or commercial radio operator's signature is his "fist." More than a dozen years ago when I was a Novice I worked a fellow named Ashley WA4AGT, in Valdosta GA on CW almost every afternoon. Ashley had a good fist, not perfect, but better than average. When I tuned across the 40m Novice band in search of a contact I would recognize Ashley's signal even before he finished a word or gave his call. Soon I recognized others by their fist alone, the staccato, machine-gun like Frank K4RAD, and John WA4BMG, with his dots almost as long as his dashes; and the perfectly spaced characters of Owen K4YXN. The "fist" is as much a part of an operator's being as his voice.

During World War II a trio of FBI agents used the characteristics of a man's keying hand to fool the Germans. A Dutchman named Albert Van Loop was sent to the United States to spy for the Germans and to set up a transmitter to send information back to Germany. But Van Loop, a 50 year old engineer and jeweler, defected to the United States. The FBI, however, thought it would be interesting if they kept the defection secret and set up the transmitter and sent back false information to Germany.

Van Loop, who told U.S. intelligence agents that he signed up for German spy school because he wanted to get out of Europe, showed up at the American consulate in Madrid in April 1942. He told an assistant ambassador that he had been sent by Germany to spy on U.S. troops and that he had been instructed to set up a transmitter in the U.S. and send the information back to a station in Hamburg. He had microfilm of a radio transmitter schematic, parts list, assembly instructions, a secret code plus more than $16,000 in cash. He was to buy an off the shelf receiver. The U.S. intelligence establishment, including the FBI, decided to play along.

Van Loop and his wife arrived on a Portuguese ship in New York and were immediately submitted to grueling questioning by the FBI.

From the questioning and research the FBI found that Van Loop had been a spy for the Germans during World War I and he had been convicted and spent time in jail for stealing $7,000 in Holland.

The FBI agents didn't fully trust the little Dutchman, so they allowed him to rent an apartment in New York, but under the FBI's close watch. He got a job in a jeweler's shop. The FBI set up the transmitter on Long Island and made the first contact with Hamburg on February 7, 1943.

Van Loop did not operate the transmitter; instead, it was manned by FBI men who knew German and could send and receive CW, taking the place of the Dutch counterspy.

Since this was before widespread use of magnetic tape, Van Loop recorded phonograph records of his fist and the agents played them back over and over trying to sound exactly like the counterspy. Actually it wasn't easy, for Van Loop had a very sloppy fist and his dots were far too long, but it would have been a mistake to try and correct the faults in his sending.

A German named Vizetun could identify anyone he had ever worked on CW and American agents knew that Vizetun had listened to Van Loop sending before the Dutchman left Germany just in case someone tried to call Hamburg saying they were the real German spy when they were not.

Also, the agents had to memorize the slang or oddities of a German speaking Hollander and use them in their reports back to Germany.

Most of the information sent back was of little importance, usually true material but just trivia. One day in May 1944 word came from Washington to the agents to transmit data about troops shipping out from New York to Iceland. The agents made up stories of a drunk sailor and drunk army officer making a remark about going to Iceland. Other false leaks about Iceland were transmitted. Within 78 hours the Germans sent a photo plane over Iceland and observed dozens of tents and barracks that had recently been put up.

Actually the barracks and tents were decoys so the Germans would think the D-Day invasion would take place in Norway instead of France. The fake barracks caused the Germans to believe the Iceland base was a staging area.

Because the Germans couldn't be sure where the invasion was coming from until a few days before the battle, many troops and much equipment was held in Northern Europe and not on the beaches of Normandy.

The agents continued sending in the sloppy fist of Van Loop until April 27, 1945, when the station in Hamburg was destroyed.

Van Loop opened a jewelry store in a large Eastern city after the war and became a citizen of the United States. If you have ever worked an old Dutchman with dots twice as long as they should be, he might have been the hero of Normandy who spent the day of battle in his New York apartment while special agents sent false information to the enemy using Van Loop's fist.

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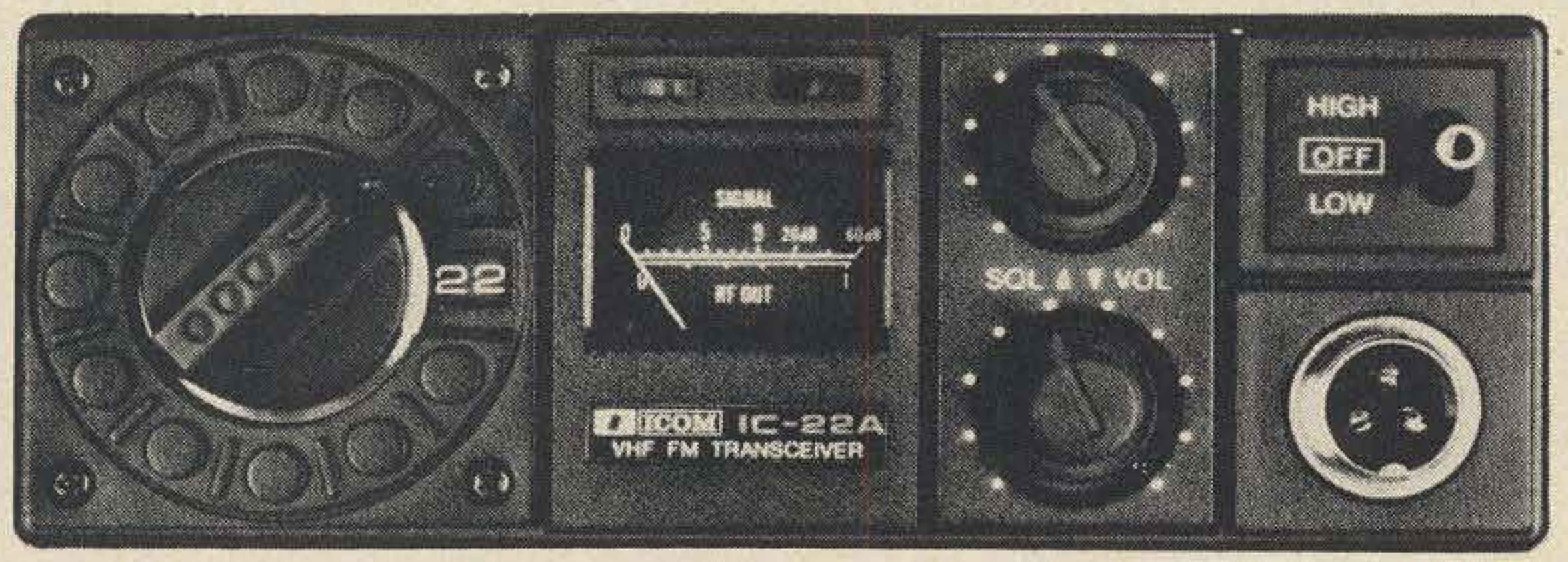

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Adapting Telephone Handsets to FM Transceivers

Many hams are enjoying the benefits of using a telephone type handset in conjunction with their two meter FM equipment. There are several advantages to this type of microphone arrangement. The shape of the handset almost assures proper microphone technique; the earpiece frequently improves the readability of incoming signals by reducing the apparent amount of road noise; and the listener gains a bit of privacy, if desired, by not using the speaker in the set simultaneously.

At the top end of the spectrum are commercial handset assemblies such as the Shure model TH-100. It includes switching to mute the speaker in the set when the handset is in use, and is designed principally to be wired directly into the set, rather than to adapt to an existing microphone connector. At a lower cost, the ham can convert a handset designed for another purpose for use on an FM transceiver. Frequently surplus outlets offer handsets, usually manufactured by Stromberg-Carlson, which include a carbon microphone, a high impedance earphone, and a quality push-to-talk switch. Alternately, a small pushbutton can be installed near the earpiece end of a conventional handset from a telephone set in order to provide for PTT operation.

In order to adapt a handset using a carbon microphone to most modern two meter FM transceivers it is necessary to change the microphone element and the coil cord. If your transceiver uses a low impedance microphone such as a Drake TR-22, the replacement cartridge for a Shure type 514B hand microphone is an excellent choice. While not the least expensive element, it delivers high output with superb audio quality, and readily fits in place of the original carbon type by simply wedging it from behind with a small pad of foam rubber. For sets like the Clegg or Regency which use a high impedance microphone, the replacement cartridge for a Turner model 360 hand microphone provides good audio quality and also is a snug fit in most handsets. The coil cord may be replaced with a Belden No. 8497 coil cord. This is necessary because the original cord does not have a shielded conductor which is required because of the low level of non-carbon microphones.

Most two meter transceivers employ a three circuit microphone connector. Since a ground, a switching lead, and a microphone audio lead are required for a conventional

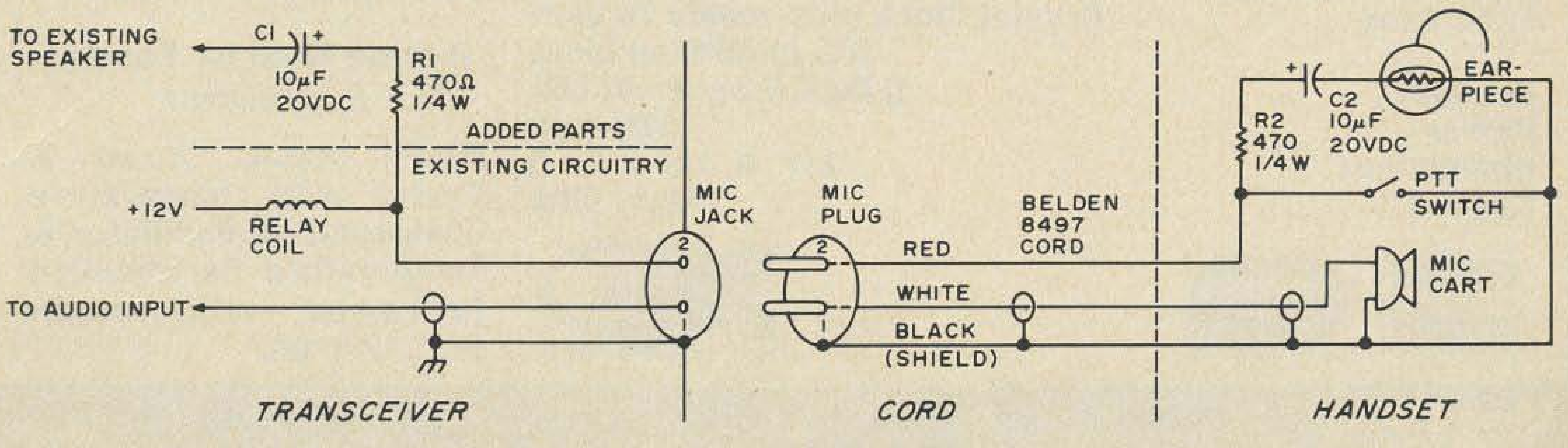


Fig. 1. Handset connection.

microphone, there is no conductor left to bring the receiver audio up to the earpiece. To avoid defacing a truly fine radio such as a Clegg FM-27B (mine in this case), an alternate solution to changing the type of microphone fitting was needed.

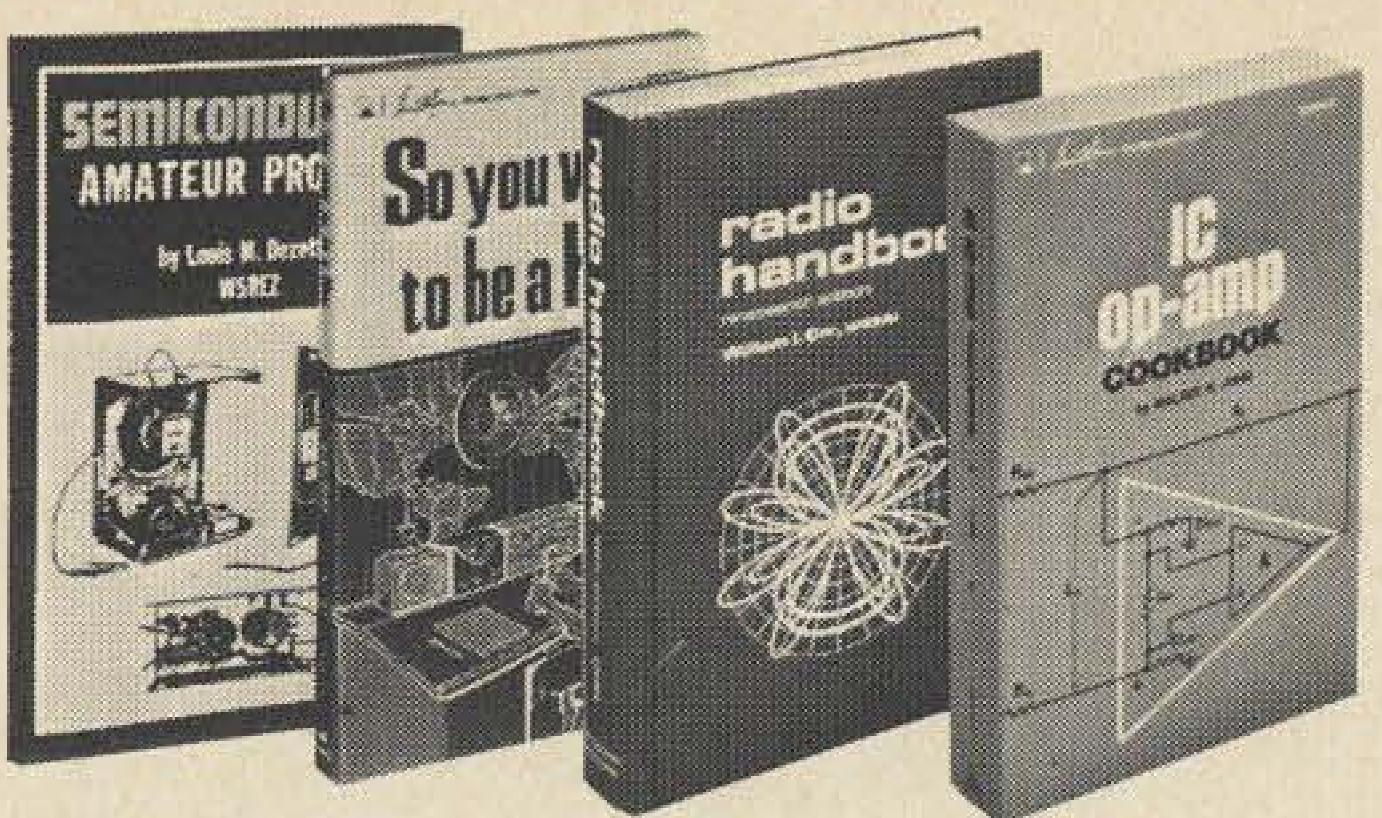
A little thought yielded an easy solution to the problem; simply superimpose the receiver audio on the push-to-talk conductor in the coil cord. This is a workable solution since the relay coil looks like a fairly large inductor at audio frequencies, and therefore will not short out the receiver audio. Conveniently, the PTT switch will short out the line to the earpiece, fully muting the receiver audio in the transmit mode. This is a nice plus, as some transceivers do not fully deactivate the receive audio in the transmit mode, resulting in a faint but annoying sound in the earpiece while transmitting.

A glance at Fig. 1 will show how it all goes together. The values of R1 and R2 were used successfully with both a Clegg FM-27B and a Regency HR-2A; however, they may be reduced to provide more audio to the earpiece, or increased to provide less should a different balance between speaker and earpiece volume be desired. Most handset earpieces have a small beadlike device across the terminals. This is a varistor whose function is to level out variations in signal input. It is recommended that this be left in the circuit as it really does help.

A note of caution to anyone planning to disconnect the internal speaker in the set is in order. If you do remove the speaker, or install a switch to defeat it at will, be certain to substitute a resistor such as 10 Ohms at one or two Watts in place of it. This is important because failure to do this may result in reverse polarity appearing across C1 with certain types of transceivers. This is not good for electrolytics.

Several of the local hams have added the convenience of handset operation to their sets using the methods outlined here. All are reporting fine results. Naturally, the original microphone may be carried as a spare; its operation is of course not affected by the addition of the circuitry for the handset audio. See you on 88 or 61 or 94 or. . .

. . .WA8LEM



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Atlanta 1975

The Atlanta Hamfest was a perfect way for the family to spend the Fourth of July holiday weekend, and the Atlanta Radio Club did a fine job of planning.

For the ham, there were many manufacturer and dealer exhibits, as well as a sheltered flea market. Fifteen forums and meetings were well attended, especially the ARRL and FCC ones. XYLs and YLs had a special hospitality suite – not to mention bus tours of Atlanta and vicinity. There was even a well equipped nursery for young harmonics.

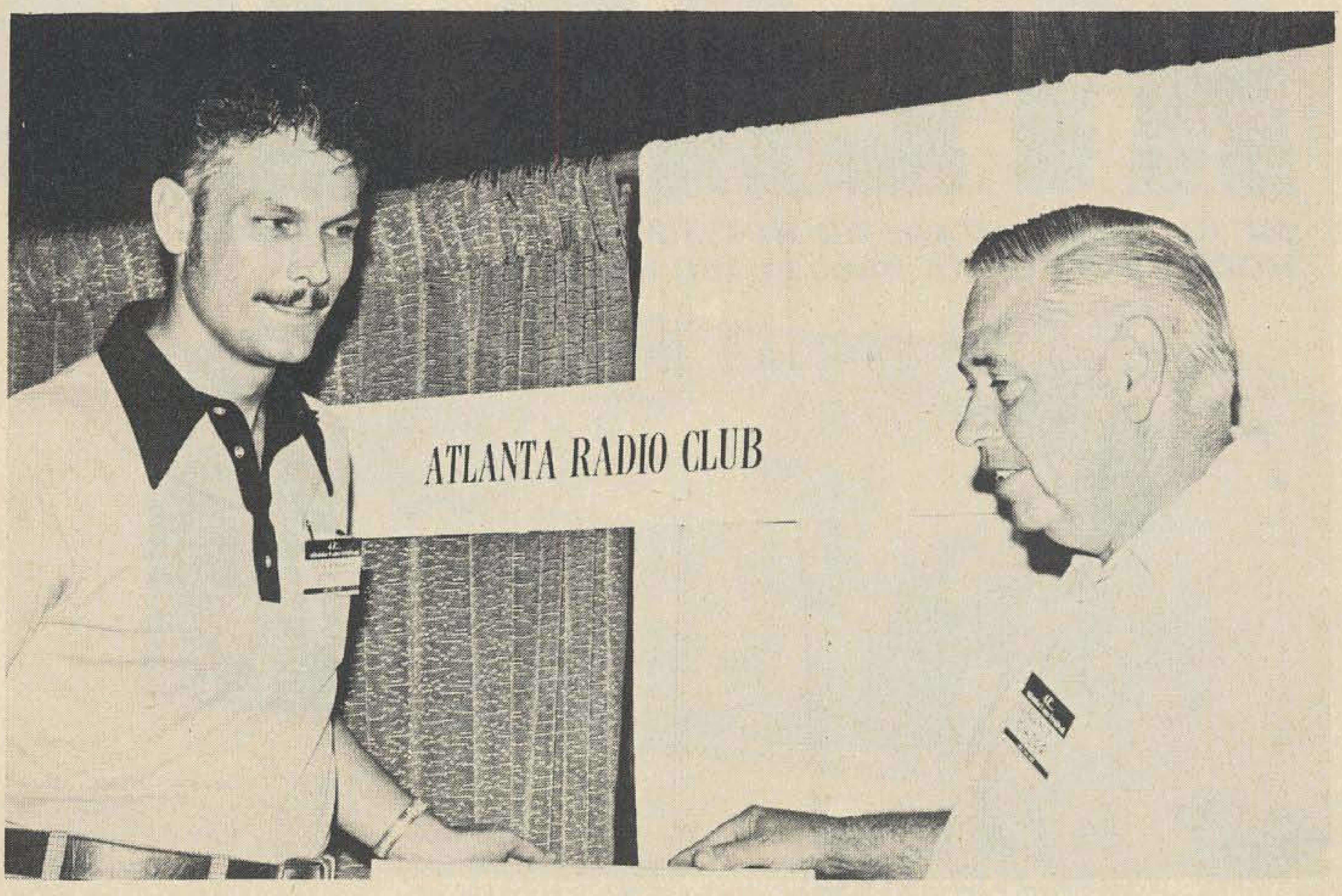
Eighty persons took advantage of the special opportunity offered by the FCC to take a license exam on Saturday morning. Mr. Ditty, Atlanta District Engineer-in-Charge, and several other employees gave up their day off just to administer the exams! Who said the FCC has no heart?

Saturday night, Prose Walker was the featured speaker at the banquet, where he spoke to a "full house" of 300 persons on Docket 20282. Among his comments at the banquet and at the FCC forum the next day, Walker stated that restructuring is necessary to increase the number of licensed amateurs in the United States. Less than 275,000 amateurs occupy 13% of the spectrum between 3 and 30 MHz, and this number is decreasing monthly. "The future of amateur radio demands that our ranks be increased," he asserted. "The average age of an amateur today is 43 years old."

The "Communicator" or "Basic Amateur" license class is inevitable. The unanswered question is, "How do we accelerate him into the mainstream of Amateur Radio?" Walker said that this must be done by education and training, in ham clubs and on the air. The FCC has no magic formula for best restructuring ham radio. They are reading the 2000 comments filed to date, trying to find the right direction, and claim the results of the ARRL membership poll should be of assistance.

The only thing I did not quite follow was the comparison of hams and CBers: Amateur radio is clearly defined in Part 97, while the purpose of CB radio is defined in Part 95. A ham is permitted to radiate a signal with 2000 Watts PEP with the intent of being

Display booth bedlam.



Dick Ehrhorne presents Alpha 374 2 kW linear to K4IOQ.

heard anywhere in the world. A CBer, in contrast, transmits a 5 Watt (12 Watt PEP) signal for the purpose of short range (less than 150 mile) communications. How can these two very different services be compared only in terms of number of licenses of transmitters?

Prose Walker at the podium.

Another area covered was plans for the upcoming WARC '79; Walker received a standing ovation for his speech.

It is interesting that the only equipment reported stolen at the Hamfest was a walkie-talkie from a booth. No automobile or room burglaries were reported. Could it be that people in the southeast practice the golden rule?

Eight thousand dollars worth of prizes were given away, with K4IOQ the proud winner of the first prize, an Alpha 374 2 kW linear amplifier.

Sales were generally slow. Most exhibitors felt they had excellent exposure and most recovered their costs. Could be that southeastern hams are saving up for a rainy day.

Everyone did agree that the 1975 Atlanta Hamfest was well planned and coordinated, and we're looking forward to next year.

. . . W6LJU

John G. Oehlenschlager KØMOC/WA4EMO
3900 DeSoto Court
Woodbridge VA 22191

ATV on 450 with a T44

TV is presently enjoying a never before realized popularity. Much of the rf equipment now utilized for ATV has been 450 UHF commercial FM equipment with video modulators added.

The most popular of the present modified mobile equipment are the Motorola T44, the GE Prog line and the RCA Carphone. Each of these rigs possesses certain advantages and disadvantages. All of them do have the significant disadvantage of requiring relatively heavy, complex power supplies and consuming relatively large quantities of power.

In an effort to reduce the cast iron content of my shack along with a reduction in power consumption, I decided to utilize already existent solid state equipment to simplify my TV system.

The first ingredient in the project was a newly purchased SB-450 transceiver. The second item was the dead T44 transmitter strip from the junk box. Last, a WØMZL video modulator was added to the stack. A liberal application of miscellaneous parts from the hidden recesses of the work shop yielded one hybrid (1 tube) television transmitter.

The total power drain was 90 W for a 30 W rf output! (Contrasted with more than 250 Watts for a T44 under similar conditions.)

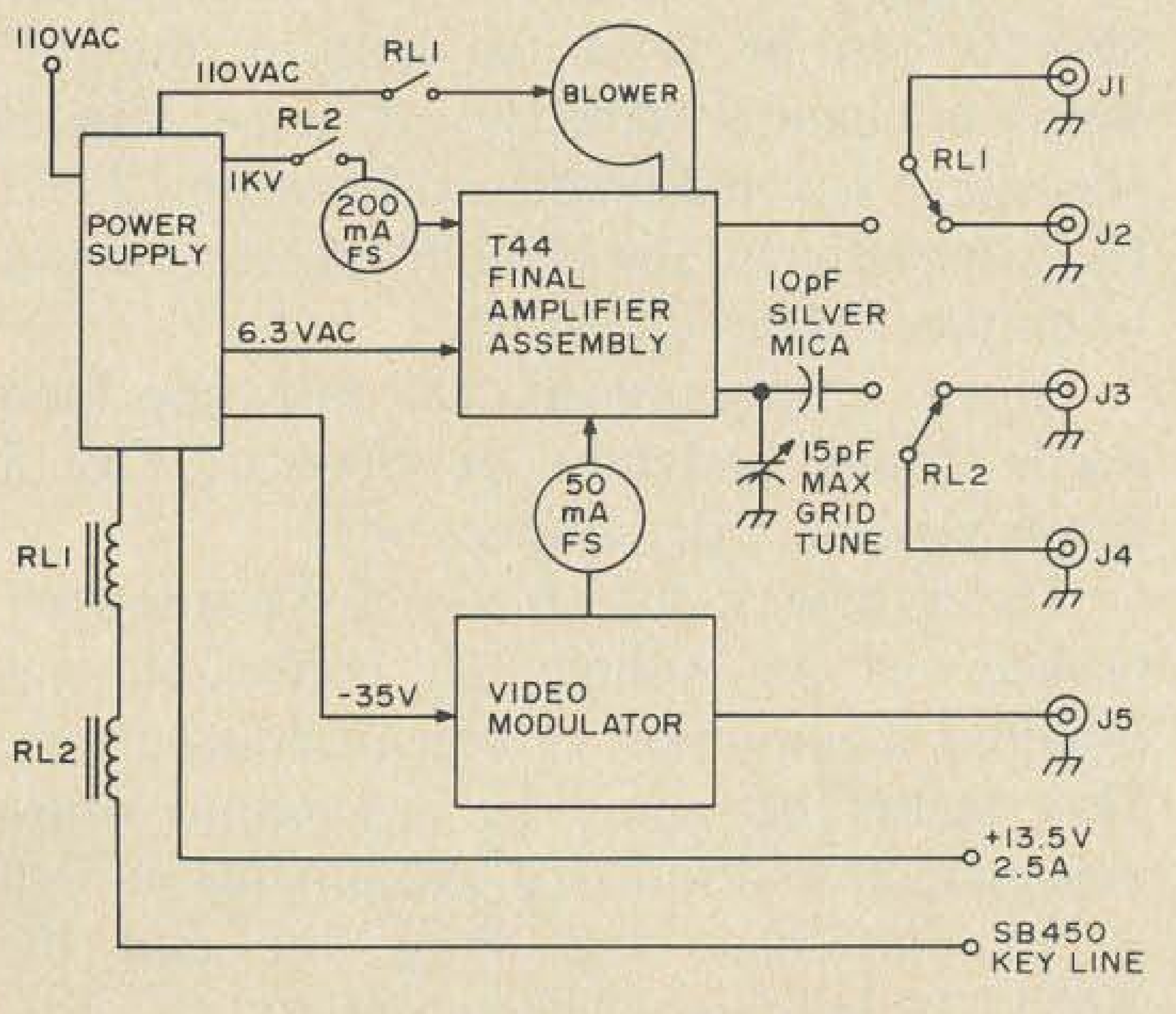


Fig. 1. System block diagram.

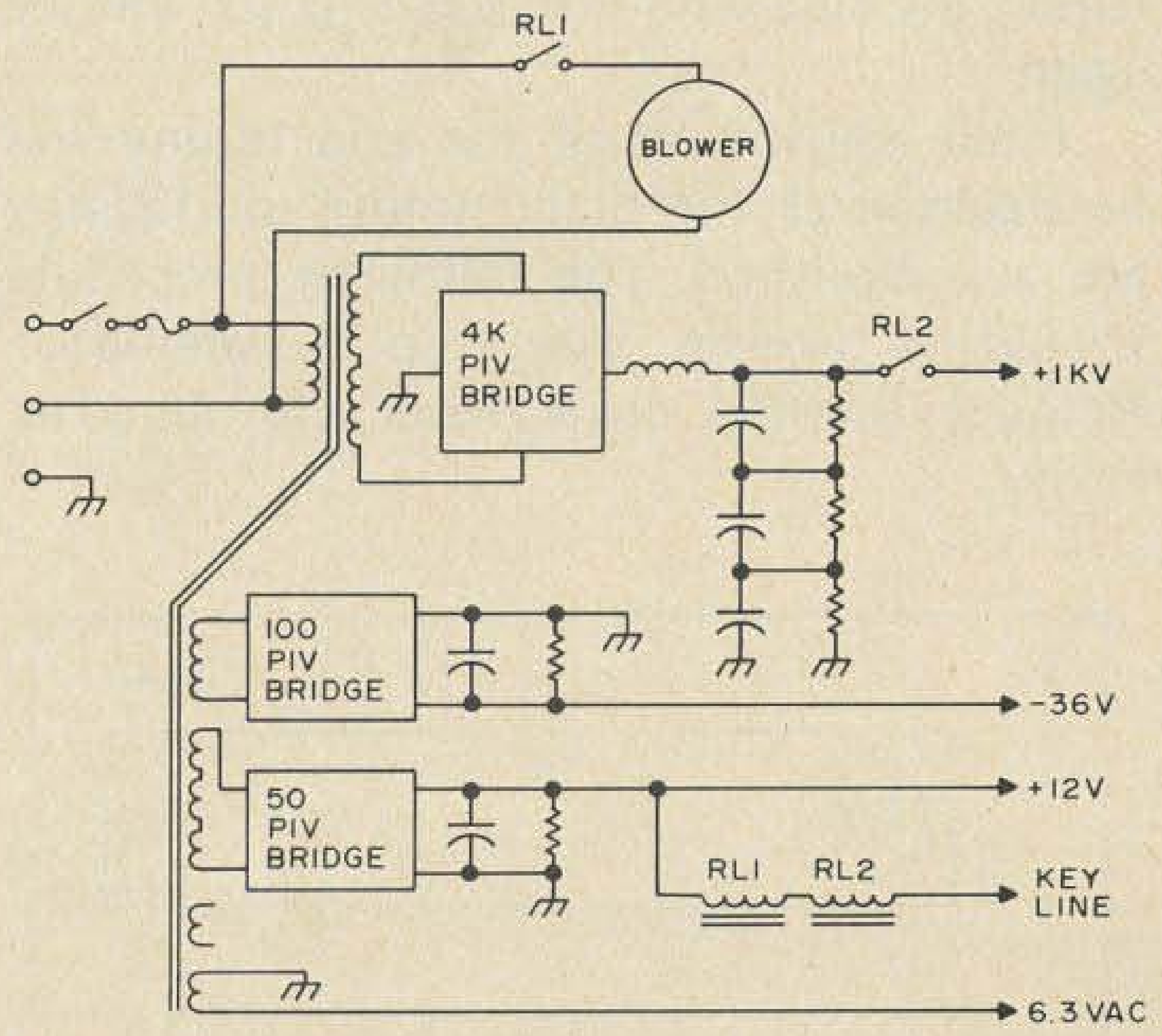


Fig. 2. Typical power supply.

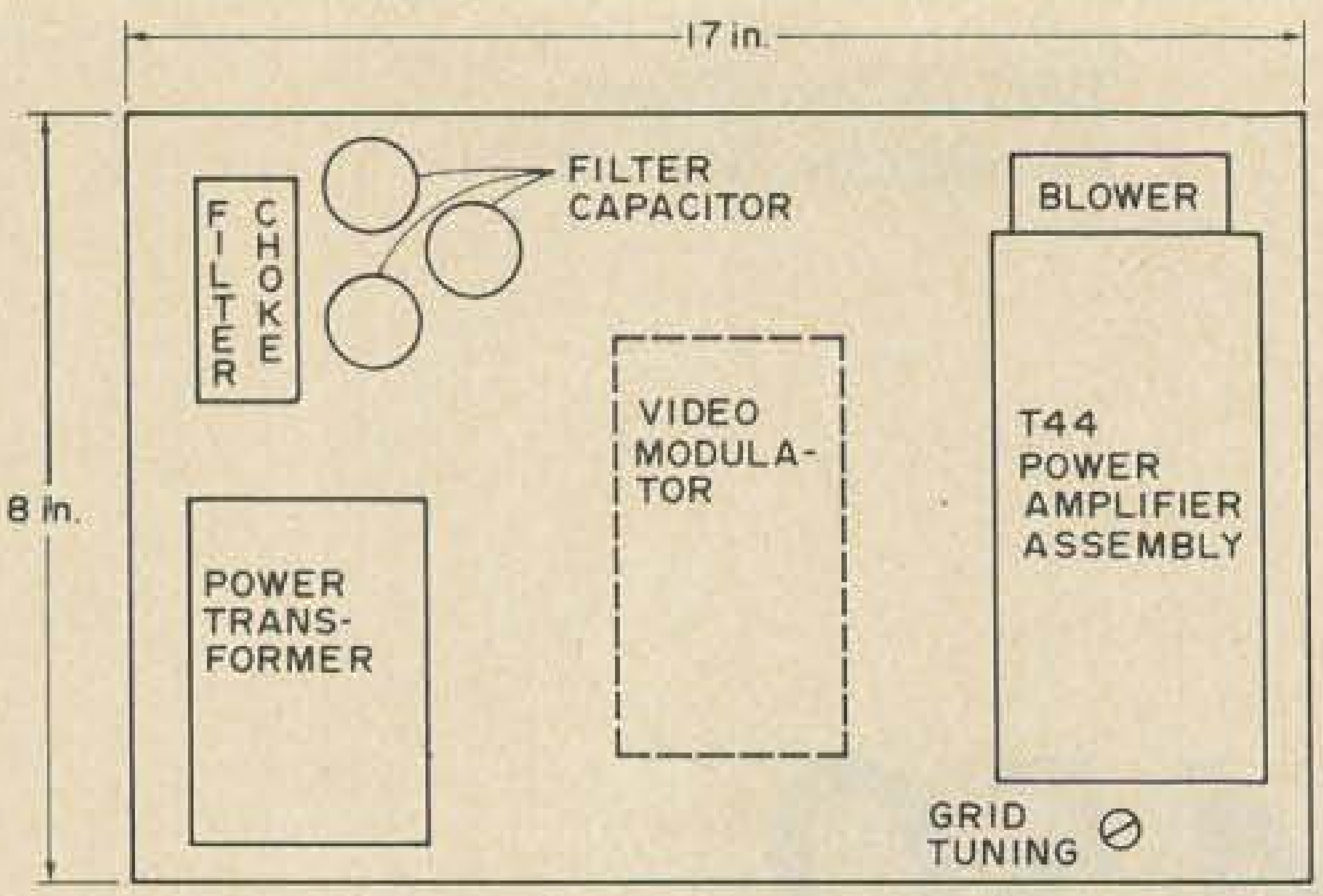


Fig. 3. Chassis layout.

Fig. 1 shows the block diagram of the hybrid transmitter. The power supply is left to your own devices. Fig. 2 shows the one that I used. A minimum of 800 V dc at 150 mA (max of 1 kV) is recommended for the high voltage. Relays RL1 and RL2 were salvaged from Motorola T44s also.

The layout of Fig. 3 is one of many possible arrangements. This particular arrangement divides the chassis into three nearly equal sections – power supply, video and rf – and is convenient.

Tune up of the amplifier is simple with only one possible hitch. The SB-450 possesses an swr protection circuit which turns off the transmitter. In order to reset the protection circuit, the SB-450 power switch must be turned off and then returned to the on position.

With this in mind it is important to preset the grid tuning capacitor to approximately ½ mesh. If the transceiver trips, reset and rotate the capacitor one way slightly and try again.

Final adjustment of the grid tuning will be made after the plate tuning and loading are accomplished. The following procedure should be used in setting up the amplifier. Remove the top cover from the amplifier cavity.

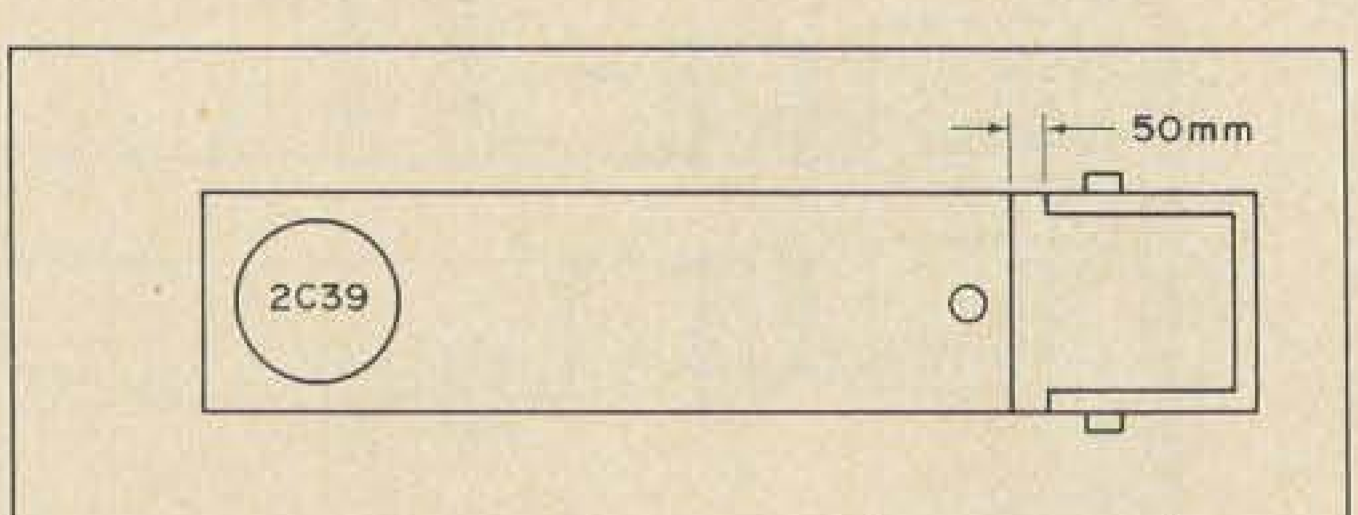


Fig. 4. Cavity amplifier – Interior.

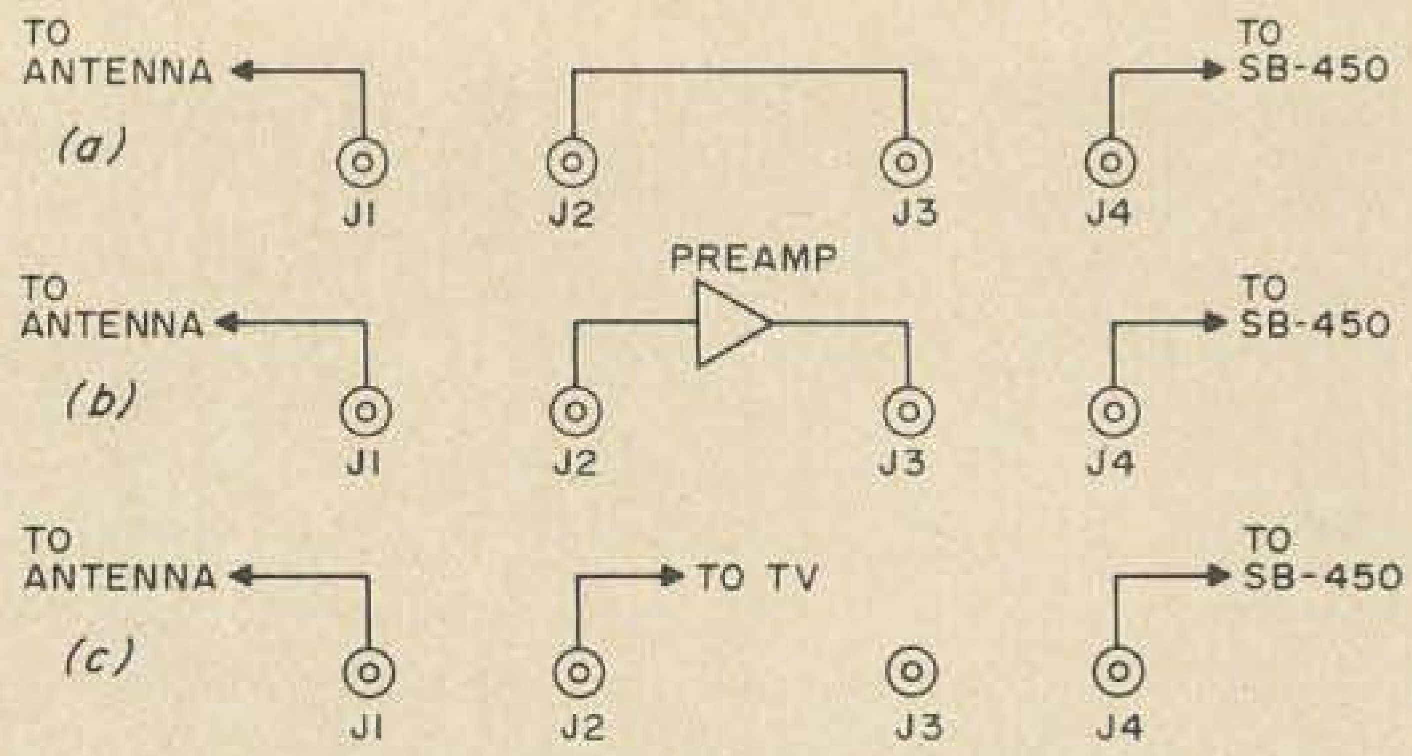


Fig. 5. Possible interconnection diagram.

The physical layout of the interior is shown in Fig. 4. Set the length of the line plate to the dimension shown. (50mm for 440 MHz.)

Apply drive to amplifier, and adjust plate tuning for a dip. The plate tuning control is the large screw-driven adjustment on top of the cavity. Then adjust the loading control using a non-metallic screwdriver for maximum power output, taking care not to exceed 100 mA average plate current. Grid bias should be about -25 V and power output should be about 35 W. Detailed tune-up procedure for video operation can be found in the December 1972 issue of QST.

The amplifier can be used for TV, FM and AM if desired. If desired for use only as an FM amplifier, the video modulator may be eliminated. For AM operation an external modulator may be used or the video modulator may be used simply by providing 1 V peak to peak audio to the input of the video modulator.

Several options are available for receiving. By placing a jumper between J2 and J3, the SB-450 can be used to monitor the TV simplex channel directly. If a preamp is necessary, it could be placed between J2 and J3. Alternatively, the Ham TV receiver could be connected directly to J2.

Other combinations to suit specified needs could certainly be devised. Fig. 5 shows possible interconnections.

The hybrid approach to a TV transmitter proved to be simple to construct and required a minimum of construction effort. This technique could be applied to other commercial and military equipments as well – in particular, GE Prog line and the AM-1178 military UHF amplifiers.

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0-60 MHz Synthesizer

Part One

The design of a stable yet versatile frequency source has long been a central problem of amateur radio. And while great progress has been made over the years, VFOs still drift, and crystals still cost upwards of $5. Operation in VHF and UHF is still largely crystal controlled.

The ideal solution to the problem is the frequency synthesizer, which combines the versatility of the VFO with the stability of a crystal. Suitable synthesizers, such as the Hewlett-Packard HP-5100B, have been around for a long time, but a price tag of around $10,000 put them far beyond reach of the amateur.

However, the introduction over the past 2 years of a whole line of ICs specifically designed for phase locked loop (PLL) fre-

Front view.

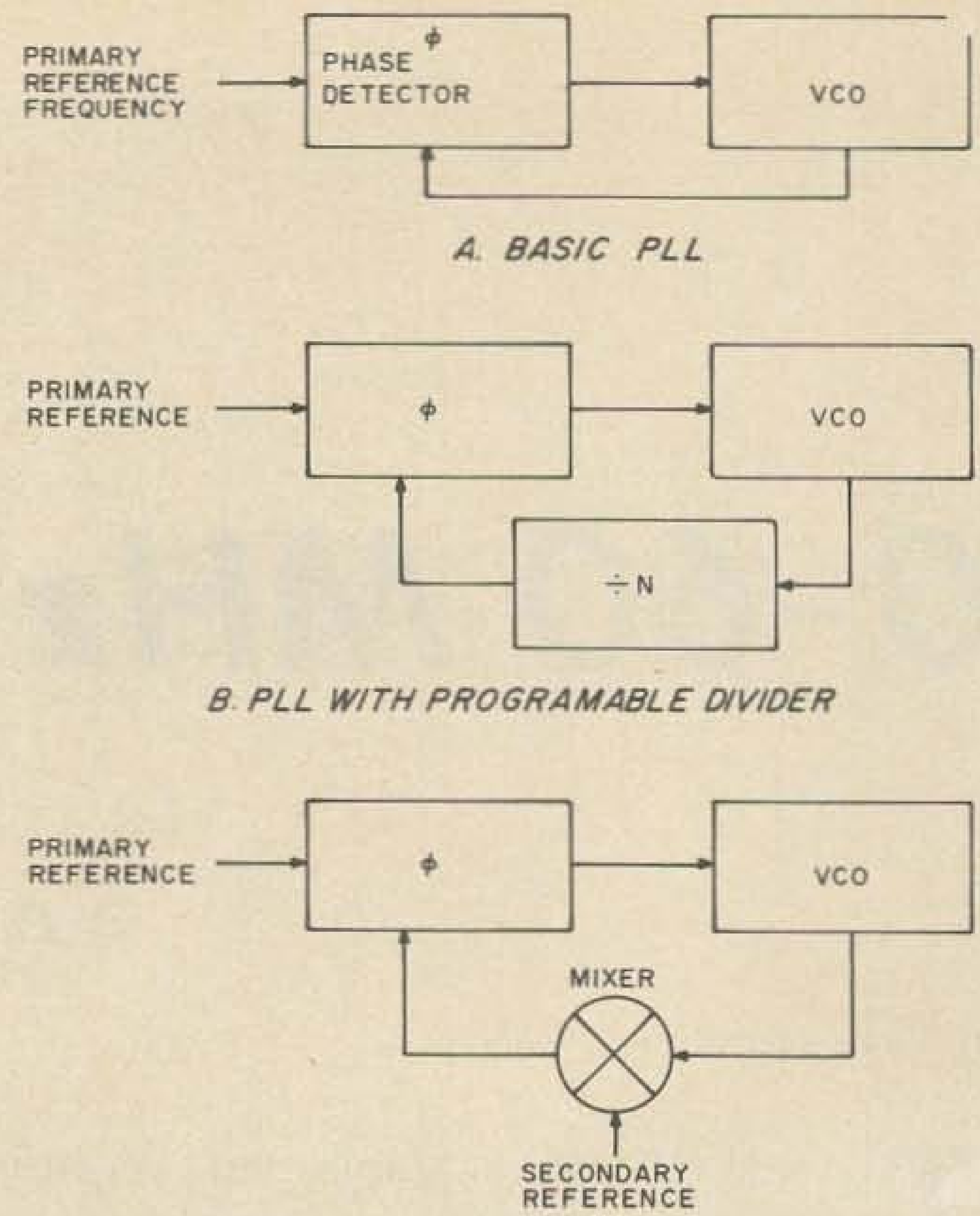

Fig. 1.

quency synthesizers has completely changed the picture. By using these ICs and the circuitry described in this article it is now possible for the amateur to build a frequency synthesizer offering 1 kHz (0.1 Hz optional) resolution to 60 MHz, along with excellent spectral purity, for around $300.

A Word About Synthesizers in General

The frequency synthesizer described in this article works on the phase locked loop principle recently made famous by such ICs as the Signetics 565. There are, however, several other types of frequency synthesizers, and before going on I would like to briefly mention two of them.

The oldest principle, and the one on which the venerable HP-5100B is based, generates the desired frequency by performing arithmetic operations (addition, subtraction, multiplication, division) on a set of crystal-controlled primary standard frequencies. This method requires a large number of primary standards (20 or more), a highly complex system of mixers, multipliers, dividers, and filters – plus a sophisticated control section. It works very well, and can switch between channels extremely fast, but it is too involved and expensive to be worthwhile to the amateur.

Another principle in use today is that of direct digital synthesis. In this method some sort of digital counter is used to drive a ROM (Read-Only-Memory) which in turn drives a DAC (Digital-to-Analog Converter), which generates a sine wave (or other desired signal). This method is capable of high resolution and fast switching time, but the maximum frequency obtainable is limited by the ROM to 1 MHz.

This leaves the phase locked loop. In this method, Fig. 1(a), the output of a voltage-controlled oscillator (VCO) is compared to a reference frequency, and a correction voltage applied to the VCO to keep it precisely in phase with the reference frequency. The loop may be opened, as shown in Fig. 1(b), and a divider inserted, so that the VCO is locked to the n_{th} harmonic of the reference; or, as in Fig. 1(c), a mixer can be inserted, so that the VCO is locked to the secondary reference frequency plus or minus the primary reference.

When used with a programmable divider the resolution (minimum frequency difference between adjacent channels) of the PLL is the same as the reference frequency. When a mixer is used the VCO frequency is entirely determined by the two reference frequencies and the question of resolution doesn't arise.

Now we come to the basic disadvantage of the PLL. Because the signals involved are almost invariably digital, correction voltages can be generated no faster than once each cycle of the reference frequency. As a result, the loop can respond to changes, either external programming changes or internally generated noise, no faster than about one tenth the reference frequency. Here then is the problem; in order to achieve high resolution a low reference frequency must be used, while in order to achieve fast response time and a clean signal a high reference frequency must be used. Therefore high resolution and low noise are mutually exclusive goals for a single PLL, and we reach an impasse.

The way around it is to use several PLLs together.

A Practical Multi-PLL Design

The block diagram of the synthesizer is

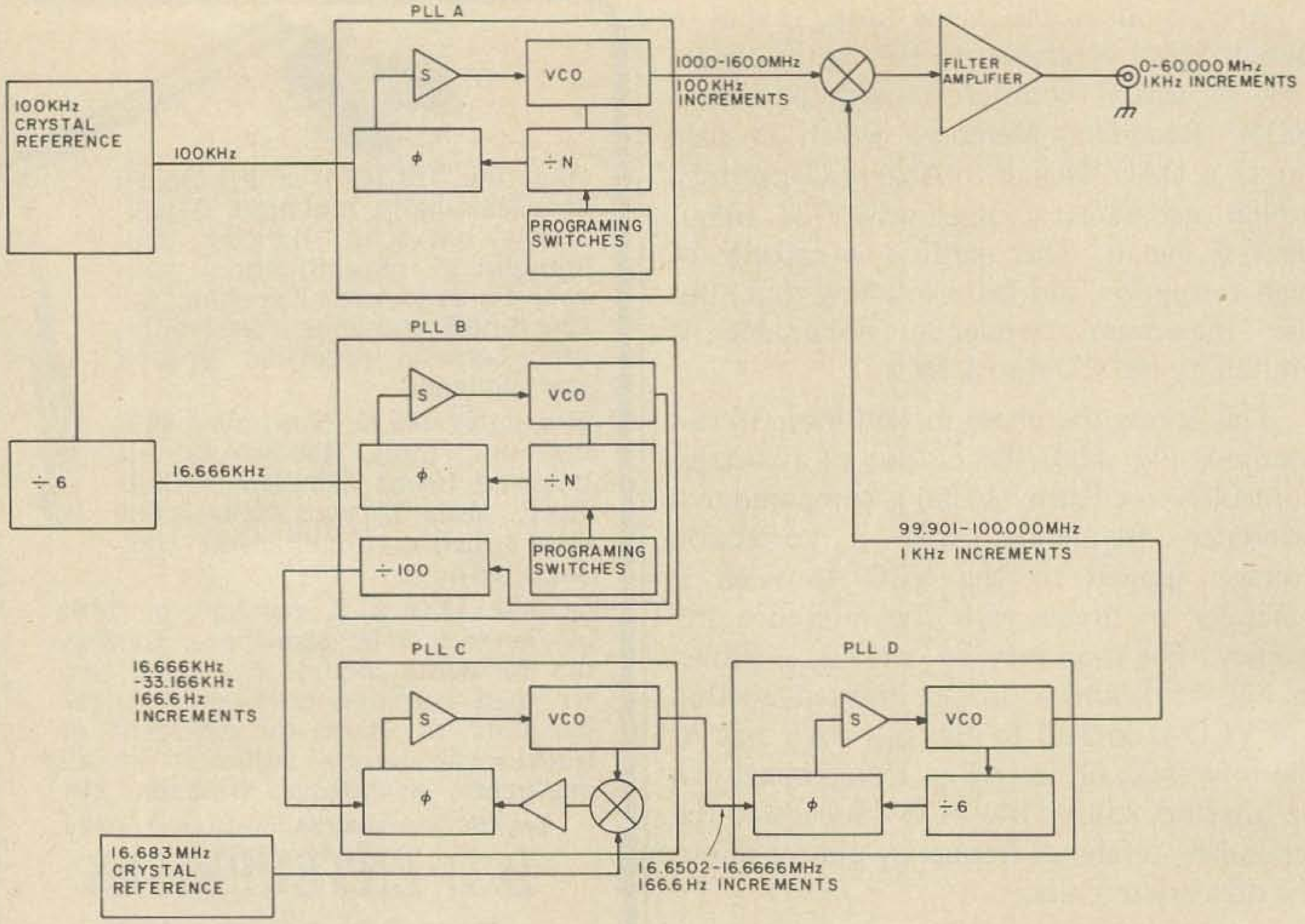

Fig. 2. Frequency Synthesizer.

shown in Fig. 2. It consists of four PLLs connected together.

The operation of PLLs A & B is straightforward. PLL A is programmed by the front panel programming switches to produce any multiple of the 100 kHz crystal reference between 100.0 MHz and 160.0 MHz. PLL B, also programmed by the front panel programming switches, produces any multiple of 16 2/3 kHz between 1666 2/3 kHz and 3316 2/3 kHz.

The output of PLL B is then divided by 100 to produce 16.666-33.166 kHz in 166.6 Hz increments. This is fed into the primary reference input of mixing PLL C.

Instead of dividing the output of its VCO with a programmable divider, PLL C mixes the VCO output with a secondary crystal reference frequency and obtains the difference frequency. The difference frequency is then compared to the output of PLL B and a correction voltage generated to keep them in phase. The net result of this process is to subtract the output of PLL B from the 16.683 MHz secondary reference, giving 16.6502-16.6666 MHz in 166.6 Hz increments.

The output of PLL C is fed into PLL D, which simply multiplies it by six, thus producing 99.901-100.000 MHz in 1 kHz increments.

The output of PLL B is then subtracted from the output of PLL A, giving a final output of 0-60 MHz in 1 kHz increments.

The synthesizer is much more complex than a single PLL, but this is justified by major improvements in performance in three key areas.

The response time of a single PLL with 1 kHz resolution would be around 100 ms; the response time of the synthesizer is around 2 ms.

Noise, both sideband and white, in a PLL with 1 kHz resolution would be totally unacceptable. Noise in the synthesizer originates primarily in PLL A and PLL C. However, PLL A operates at a reference frequency of 100 kHz, which is high enough to get rid of all audible noise, and PLL C uses a special crystal controlled VCO which generates virtually no noise to begin with. The result is that noise is kept 80 dB down.

Finally, the resolution of the synthesizer can be extended to 10 Hz, or even 0.1 Hz, with no increase in response time or noise. This is done by adding some more PLLs between PLL B and PLL C, as shown in Fig. 3.

The thing which more than anything else made the construction of the synthesizer possible was the introduction by Motorola of the PLL building blocks, especially the 4016 programmable divider, the 12012 prescaler, and the 4044 phase detector. These ICs compressed whole circuit boards into a few DIPs so easy to use that the actual circuit looks like a block diagram. This external simplicity combined with internal complexity can make their operation seem mysterious, so before going on I will give a very brief description of them. Complete descriptions are given in the Motorola data sheets listed at the end of Part Two.

Programmable Dividers

The Motorola set of programmable dividers consists of the 4016 presettable down counter, the 12012 variable modulus prescaler, and the 12014 control logic.

The 4016 counters are down counters with internal zero detection and a program enable input. In operation they count downward from whatever they are preset to until they reach zero, when they reset themselves

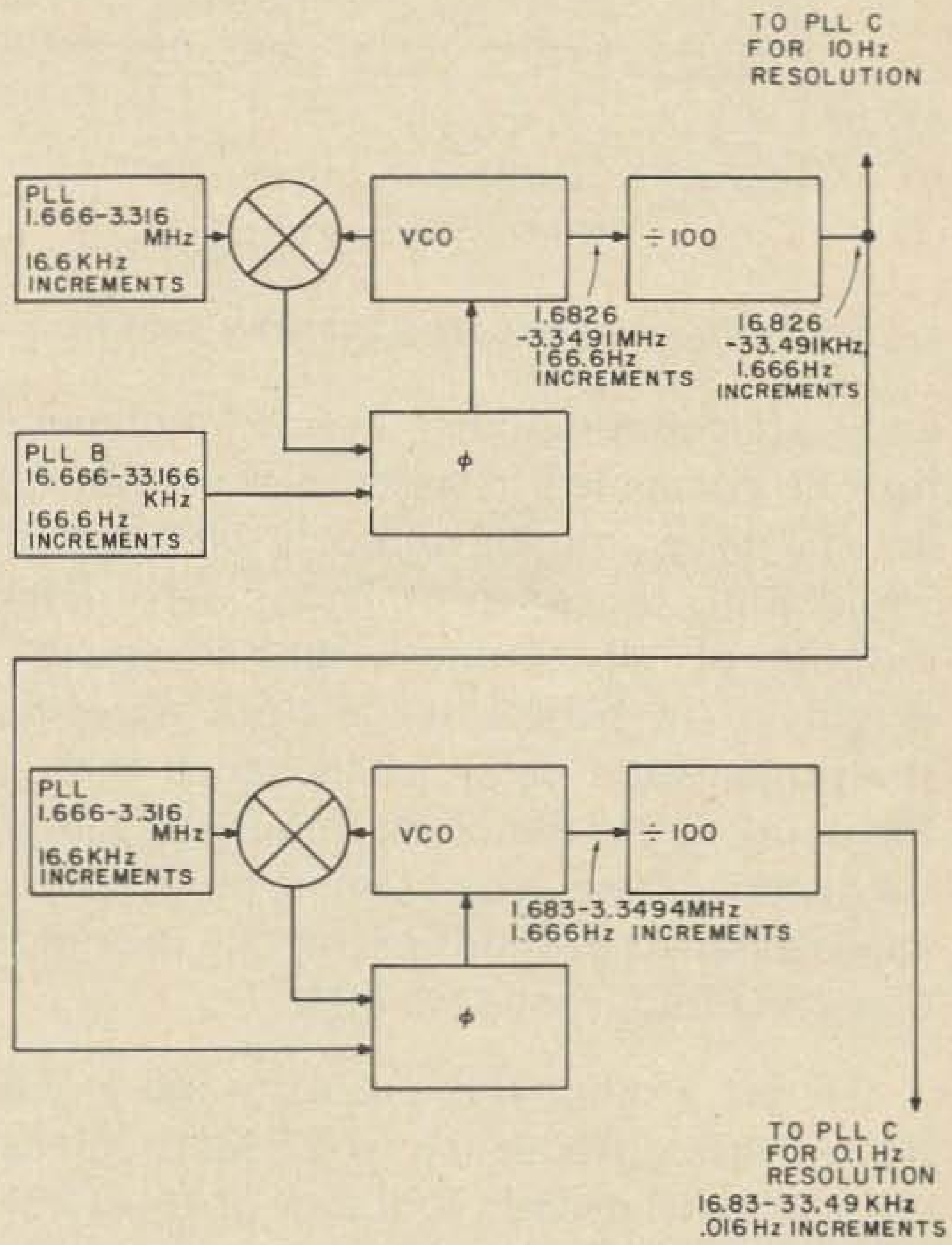

Fig. 3. Extending resolution of synthesizer.

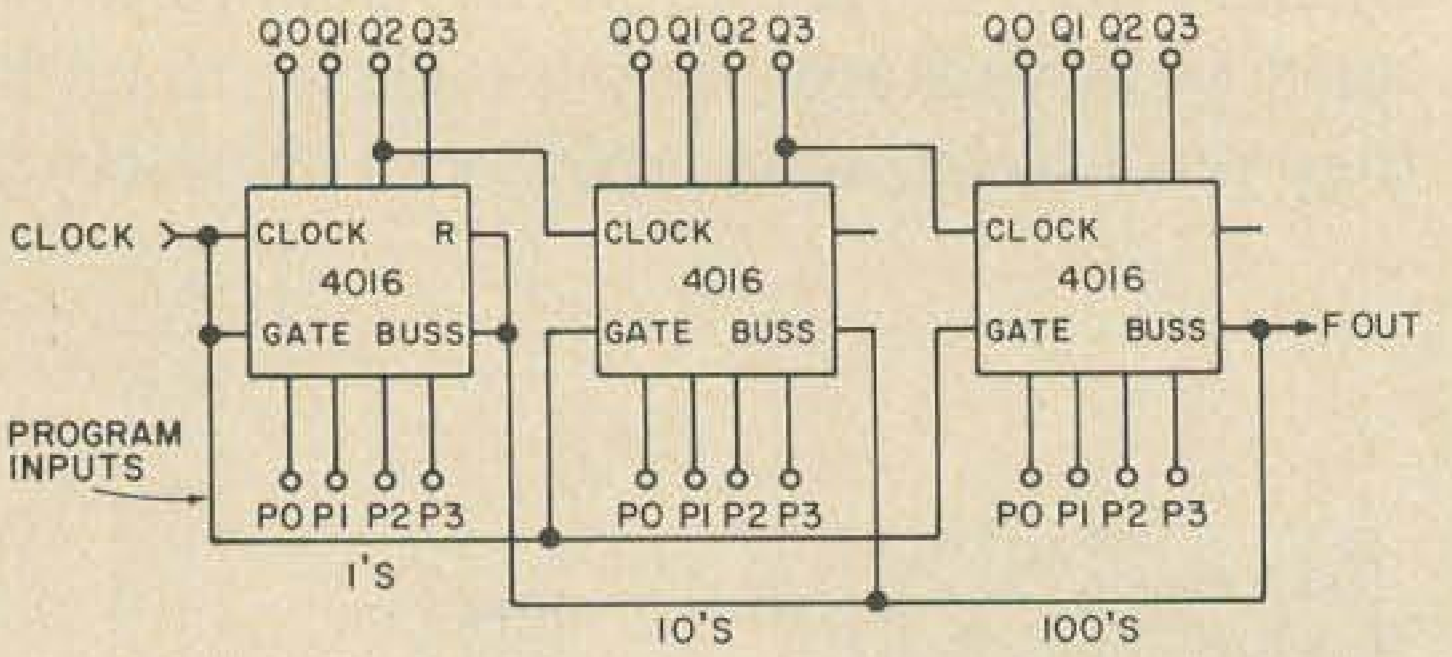

Fig. 4. Three decade programmable counter.

and start counting down again. Any number may be connected in series as shown in Fig. 4. The programming pulse is obtained by wired-oring the open collector zero detect outputs of all counters, and is equal in length to the period of the clock signal less the propagation delay of the clock through the counter. As the clock frequency goes up the length of the programming pulse quickly approaches zero, thus limiting the maximum operating frequency to 8 MHz.

To get around this problem and extend the operating frequency to 25 MHz you can use the early decode function of the 12014 control logic IC. This function detects when the 4016 counters reach the count . . .02, and then programs them with a pulse one whole clock period wide, counting the remaining 2 counts itself and then enabling the counters again.

However, 25 MHz is still far below the 160 MHz required by the synthesizer. It is possible to simply divide the output of the VCO by 10, and then use the 4016s, but in order to maintain resolution the reference must also be scaled down by 10, thus greatly increasing noise and response time.

The solution is to use a method called variable modulus prescaling. This method employs a high frequency prescaler capable of being programmed to divide by 2 numbers, usually 10 and 11. The number by which you wish to divide the clock frequency, call it X, is then separated into two components: the least significant digit, L, and the rest of the number, M. Thus, X = 10(M-L)+11(L). For example, if X=387, then L=7 and M=38.

The prescaler is then set up so that it divides the clock by 11 L times, and by 10 (M-L) times before starting over. Take 387 again; L=7, M=38. The prescaler counts to 11 and resets (in other words, divides by 11)

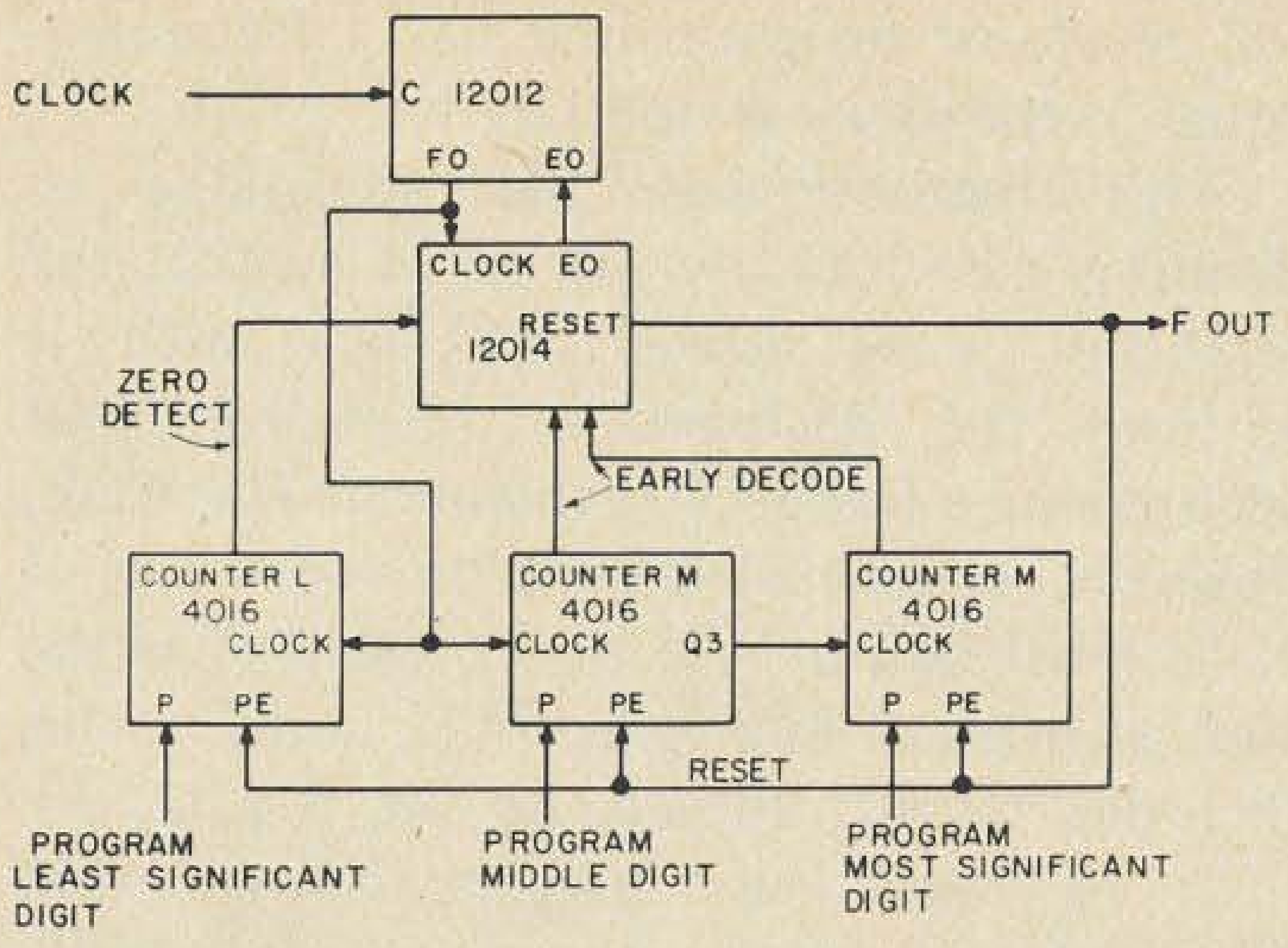

Fig. 5. Block diagram of variable modulus programmable counter.

7 times, a total of 77 counts. It then is reprogrammed to divide by 10, and counts 10 clock cycles M-L, or 38-7= 31 times, for a total of 310 counts. It now reprograms to divide by 11 and starts over, having counted exactly 387 counts, which is another way of saying that it has divided the clock frequency by 387.

This is precisely the way the Motorola 12012 high frequency variable modulus prescaler works. Programming is accomplished by holding the EO input low for divide by 11 and high for divide by 10. In combination with the 12014 control logic and some 4016 counters it forms a complete high frequency programmable counter capable of operating up to 200 MHz. A block diagram of a typical circuit is shown in Fig. 5.

The least significant digit of X is programmed into Counter L, while the remaining digits, M, are programmed into counter M. Let's take 387 again. Counter L is programmed to 7 and counter M to 38. The counter control logic senses that Counter L is not at zero, and programs the prescaler to divide by 11. Every time it counts 11 clock pulses it produces a single pulse which counts both the L and M counters down by one. When the L counter reaches zero, the control logic reprograms the prescaler to divide by 10. The prescaler now produces a single pulse for every 10 clock pulses, and the M counter, now down to M-L, or 31, continues to count down. When it reaches . . .02 the control logic as described earlier resets both counters, and the process begins again. The counters are reset once every 11L+10 (M-L), or X pulses, and thus the reset, or program line has a frequency equal to the clock divided by X.

This method has the advantage of dividing the clock by 10 or 11 so that the relatively slow 4016s can deal with it without the decrease in resolution that accompanies fixed ÷10 prescaling. There are, however, some restrictions on the value of X. It must be possible to represent it as the sum of integral multiples of 10 and 11. This includes 10, 11, 20, 21, 22, 30, 31, 32, 33, ...99, and all integers above 100. Obviously this method is restricted to applications where X is larger than 100. In the synthesizer described here the minimum X is 1000, so this is no problem.

The 12012 prescaler is an ECL device, as indeed it has to be to operate at 200 MHz. However, in order to make it easier to use it contains on chip ECL–TTL and TTL–ECL translators on the FO output and EO input, which explains the apparent abandon with which it is connected to the TTL control logic. The clock input remains standard ECL 10k, and is best driven from an ECL line receiver such as the 10216.

Phase Detector

The 4044 phase detector consists of a digital phase detector and a charge pump. When used with an integrator it forms a near ideal PLL building block. The logic of the phase detector is quite complex, and, as a full description is given in the data sheet, I will give only a brief functional description here.

The phase detector has two inputs and two outputs. It accepts the reference fre-

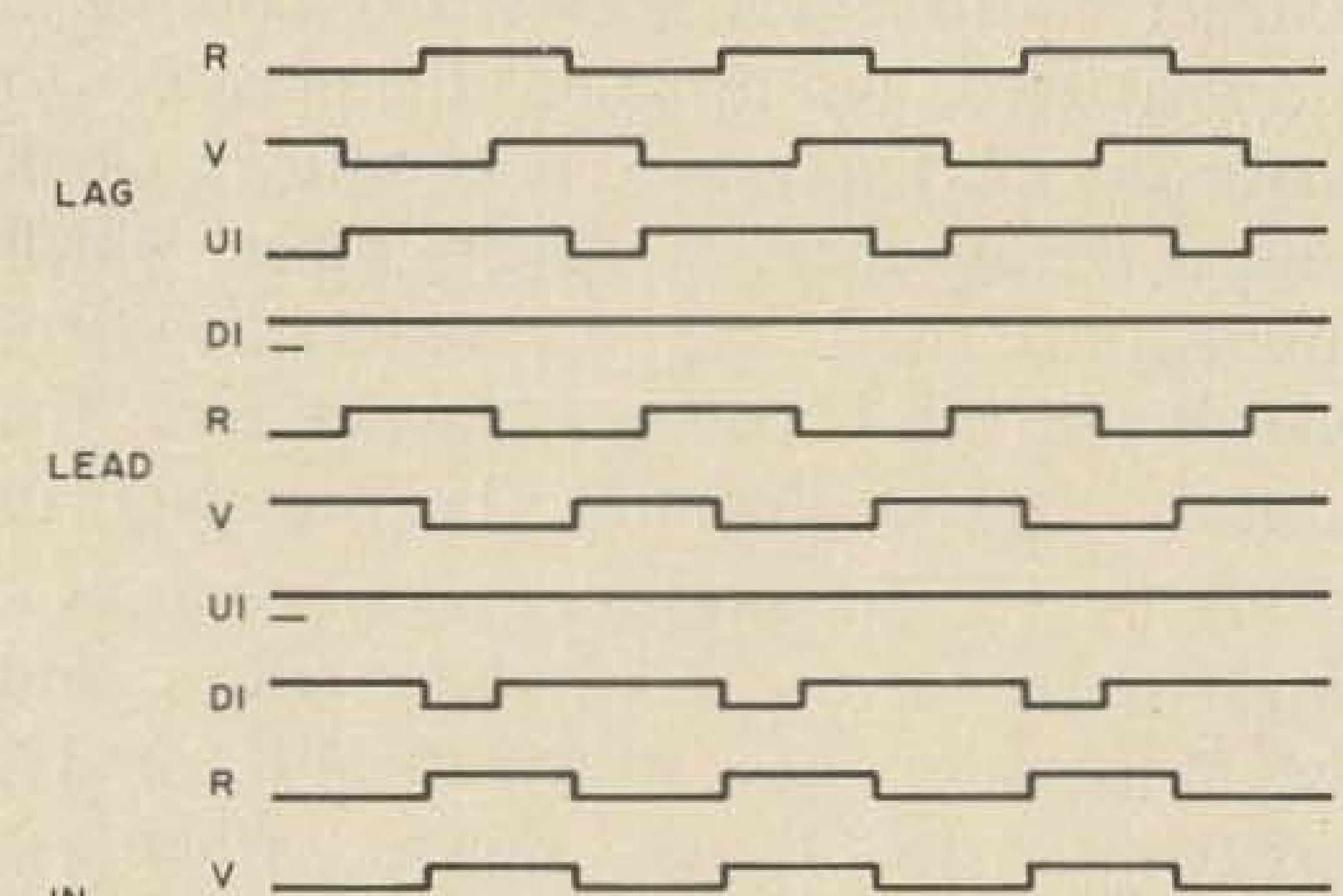

Fig. 6. Waveforms of 4044 phase detector.

quency at one input, and the output of the programmable divider, mixer, or VCO at the other input. It is sensitive only to the downward transitions of the inputs, so duty cycle is unimportant.

If the downward transitions of both inputs occur together, that is, if they are in phase, both outputs remain high. If one input lags behind the other, a pulse appears at the appropriate output, as shown in Fig. 6. The phase detector also prevents harmonic lockup. The outputs of the phase detector are fed into the charge pump, which consists of an inverter and a couple of diodes. The charge pump is connected to an integrator, and the output of the integrator is connected to the VCO, thus closing the loop. See Fig. 7.

Operation is as follows. If the VCO and reference are in phase, no pulses appear at the output of the phase detector, the charge pump neither pushes nor pulls current out of the integrator, and consequently there is no change in the output of the integrator or in VCO frequency. If the two are not in phase one of the outputs of the phase detector pulses, the charge pump pulls or pushes current out of or into the integrator, and the control voltage moves up or down to correct the error.

This system has the advantage that when in lock the only ripple appearing in the control voltage — which causes FM of the VCO, or sidebands — is the result of leakage in the integrator and charge pump, and these can be made very small.

The response characteristics of the loop are determined by the components used in the integrator. The values of these components are a compromise between low sideband-causing ripple and fast response time, and are rather critical. A full explanation of the equations used is given in the 4044 data sheet, so I will give only a highly

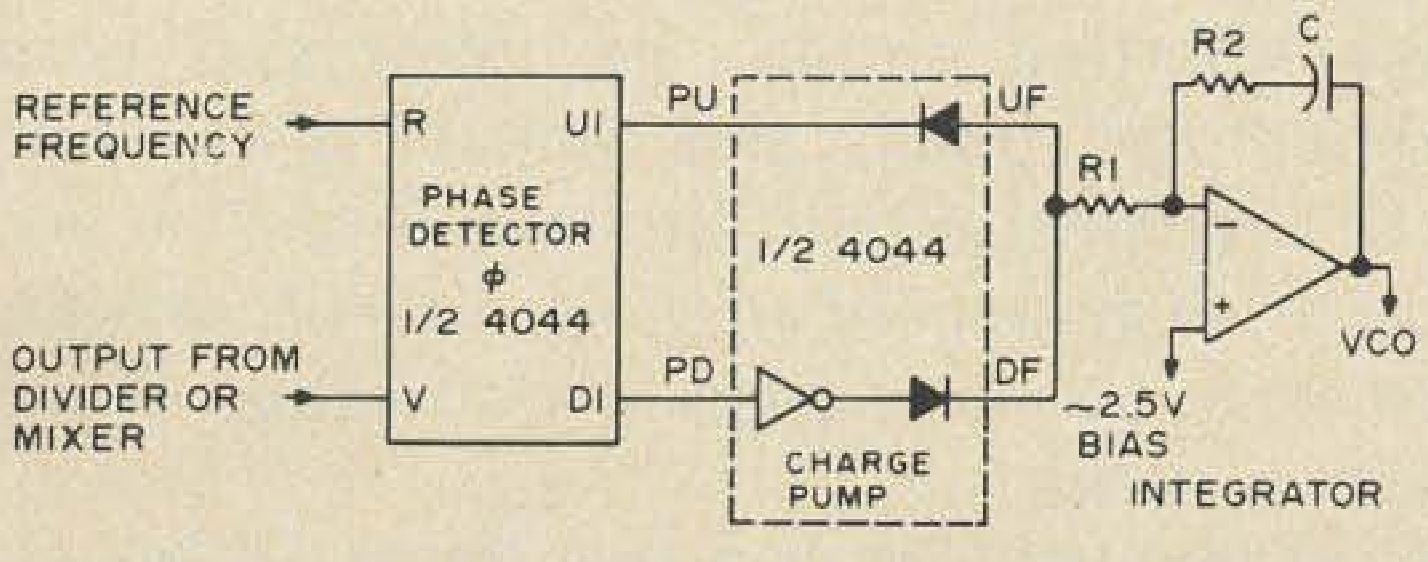

Fig. 7. 4044 phase detector.

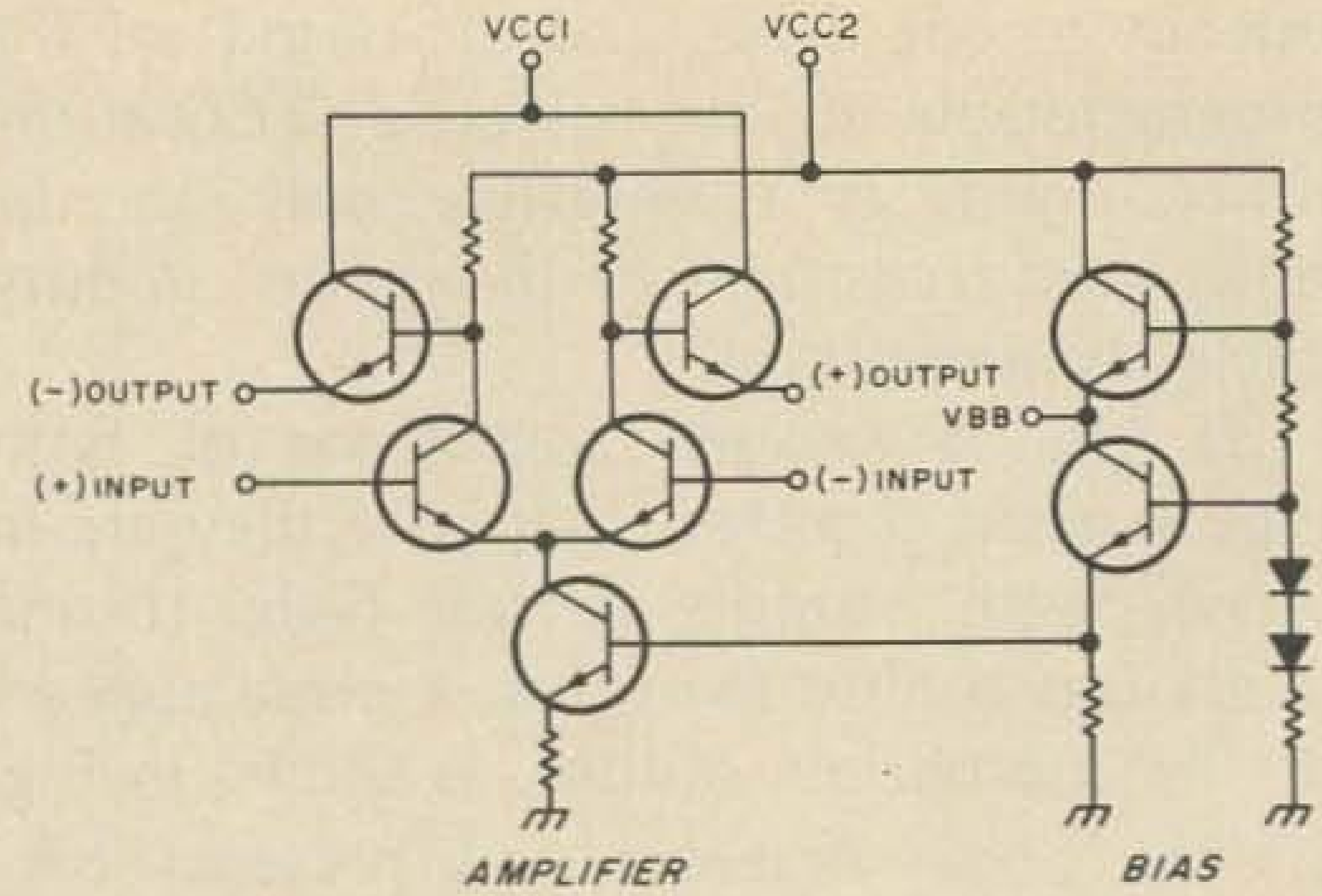

Fig. 8. 10216 amplifier.

abbreviated form below.

$$C = \frac{K}{N\,(F_{ref})^2 \cdot 25}$$

where

$$K = \frac{F^{VCO}_{MAX} - F^{VCO}_{MIN}}{V^{VCO}_{MAX} - V^{VCO}_{MIN}} \cdot 2\pi$$

$$N = \frac{F^{VCO}_{MAX}}{F_{ref}}$$

$$R_1 = 1\,k$$

$$R_2 \approx \frac{40}{F_{ref} \cdot C}$$

Line Receiver

The last IC I shall mention was not specifically designed for PLL applications, but it is nevertheless extremely useful. It is the 10216 MECL 10k triple line receiver. It contains three differential amplifiers, one of which is shown in Fig. 8. These amplifiers have a gain of 16 dB and are useful to well beyond 200 MHz. They are capable of ½ volt single ended output into 50Ω, and are of course compatible with ECL logic levels. They work well as buffers, amplifiers, and oscillators. Two rules should be observed. First, the gain from an input to the inverted output is much higher than that to the non-inverting output, so unless you need differential inputs and outputs, always use the inverting output. Second, always tie one input of an unused amplifier to VCC or VBB in order to maintain proper operation of the bias network.

Next month: Circuitry and design guidelines.

...CALVIN

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Bridging the Information Gap

A recent QST article[1] pointed out how one amateur group identified the need for and then constructed a public relations program, largely by taking advantage of available resources. While the author describes a sound and effective approach to solving a problem, he touches on only one aspect of a profession which has been given the generic title of "public relations," and one which holds important ramifications for amateur radio.

There is much more to the process than trying to keep the general public informed of our activities, and in an age when amateur radio is rapidly undergoing an identity crisis of its own, it is to the advantage of ham radio clubs at all levels to think in terms of a total information program.

Unfortunately, the term "public relations" is overworked, negative in its connotation, and erroneous in its application. Replace the concept of a smooth-talking, glad-handing PR man with that of a well-organized director of information who is concerned with three broad program elements: public information, internal information, and community relations. While these three elements are designed to meet different objectives and it is frequently hard to determine where one ends and another begins, they all eventually come together to produce some rather effective results.

Internal Information

For years amateur radio groups have worried and fretted about getting their story told to the general public. This is important and admirable, but in the rush to make certain that the local community knows all about the preparations for Field Day or how the local repeater club can serve the city rescue squad, we all too frequently overlook the information needs of amateurs themselves.

It shouldn't come as too much of a surprise to learn that not all hams are League members nor even belong to the local radio group. These individuals have a right to know what's going on in the amateur community and how it affects them, and there is probably no better way of getting the word out to everyone than through a newsletter or club newspaper.

Any internal publication should probably include at least three major sections:

1) a general section which includes news of wide relevance (meeting schedules, awards, hamfests, impending elections, etc.);

2) a special division which dwells on such specialized facets of amateur radio as repeater operations, VHF/UHF operating, and contests; and

3) a classified section in which hams can list items for sale or their individual needs. This last element might be expanded to include projects being worked on by club members. And, the classified section might be of some interest to electronic stores in the area who could be "talked into" spending a few dollars to advertise therein and thus provide the club with added revenue and a means to defray the cost of publishing the paper.

Your distribution list for the newsletter should probably include other organized amateur groups throughout the state on a reciprocal basis. It's always nice to know

[1] Keith, Don, "Getting the Story Told!", *QST*, October, 1974, pp. 49-51.

what other clubs are doing, and many local problems can be solved from a lateral cross-feed of information.

From an internal standpoint, it's generally a good practice to know the names, calls, and addresses of all hams living and operating in your "sphere of influence." Why not purchase a copy of the Amateur Callbook at least twice a year and delegate someone to pore through the listings for your call area and compile a list of the local stations. Periodically you might send non-members a copy of the club newsletter, possibly generating enough interest on their part to drop by and attend a meeting.

Public Information

No matter how you view this function, perhaps the most important rule here is that in dealing with the local print and broadcast media you want to present your news story or feature in such a manner so as to not turn them off. In other words, don't make mountains out of molehills by exaggerating the importance of the story. You fool no one, least of all a harried city editor or news director who is already overworked.

The basic objective of the public information element is informing the local community – laymen – about a particular facet of your amateur radio operation that is or should be of some interest or relevance to them. I don't think the public audience is too interested in knowing the results of your routine meetings or who participated in the last VHF Party. But there may be an angle in the composition of your group (the butcher, the baker, the candlestick maker, who are all hams) or how the new two-meter repeater will benefit the community or how the club's TVI committee responds to complaints. Be honest with yourself in your appraisal of a story's news value.

If I had to recommend one step to take before doing anything else, it is to develop contacts at each newspaper, TV, and radio outlet in the community. In the case of the newspaper it's the city editor or science editor while at the broadcast media you'll want to know the news director. Introduce yourself, present a copy of your club's fact sheet, tell him you'll be contacting him periodically with stories, and ask what you can do in preparing a story that will help in getting it published or put on the air. Don't become pushy or develop the attitude that you have a right to get publicity. Like every other special interest group in the area, you're competing for a piece of the pie and just how big that piece will be depends largely on how realistically you define your objectives, and the expertise you use in trying to accomplish them. You can succeed, but in addition to practicing the ABCs of basic journalism (accuracy, brevity and clarity) add honesty and tact.

Public information encompasses more than preparing a news release as the result of something happening or scheduled to happen; it should be continuing without being obtrusive. Information kits placed in strategic locations can accomplish this. A kit should include a fact sheet (a resume of the club's history and objectives), copies of recent articles concerning the club, an up-to-date list of officers, information about repeaters, and anything else that might be of interest to the non-amateur reader. Place copies of the kit with the local chamber of commerce and at information centers throughout the area.

As a final note about the public information aspect, I recommend strongly that if your group includes a member who has any experience at all in working with the media ask him to handle this task or go all the way and appoint him your director of information. His qualifications make him a natural for the job, and if he has any interest at all in amateur radio he'll find some way to accommodate the group's program in his schedule of activities.

Community Relations

The community relations element probably comes closest to the stereotype of the old PR concept, for the objective here is primarily one of fostering within the community an atmosphere friendly to the conduct of amateur radio operations. And after this atmosphere is established, we probably should want to capitalize on it by going one step further: proselytizing to seek new amateurs.

A comm rel project is generally designed to let the public know what we're up to in general and how this affects the community.

In this sense, comm rel approaches the public information function, except that the goal is not only to inform but to deliberately try to influence attitudes as well.

Three types of activities come to mind and ought to be included in your club's repertoire: a speaker's program, an open house, and participation in selected community-wide projects.

Service organizations (Kiwanis Club, Rotary International, Lion's Club, etc), church groups, Boy and Girl Scout meetings, high school science clubs, and women's clubs all need speakers; it isn't too presumptuous to think that each might be interested in hearing an informative presentation on amateur radio.

A club member who can speak in public, a well-written script, a 35mm slide projector, and possibly a tape recorder can be assembled to form a briefing that can highlight virtually any kind of club gathering.

Plan the briefing well, organizing in rhetorical fashion the major points you're going to cover by means of an introduction, a body, and a conclusion. Once you've introduced the topic by showing its relevance to the audience, you'll probably be speaking about two major points: amateur radio in general (what it is and a brief history) and how your club fits into the overall picture. At the end you'll summarize and point out that your club can provide more information to interested persons. This is only a very skeletal approach to developing a good briefing; there are others, but remember that the important thing is to organize the script logically and coherently.

Rather than attempt to bring an entire station to the scene of the speaking engagement (where "gremlins" invariably appear and destroy whatever measure of realism and authenticity you hope to achieve), capture on magnetic tape off-the-air QSOs as examples to work into your briefing. And while you're at it, you might as well take the extra step and shoot 35mm slides to accompany the entire briefing, including summaries of your important points (lettering kits are fairly inexpensive and easy to use) and plenty of shots of *people* operating equipment, erecting antennas, etc.

Plan for about a twenty-minute presentation and allow approximately ten minutes for answering questions. And, make certain that the speaker is an individual who is both knowledgeable about his topic and capable of speaking before an audience.

Besides an active speaker's program, the radio club can open its doors to the community once a year, assuming, of course, that the group has available a building or room where equipment can be set up and which can accommodate a large number of visitors.

Are civic exhibitions held in the community periodically? If so, then seek permission to set up exhibits – attractive booths which graphically depict the role of amateur radio in the community. Use photographs and charts as visual aids.

And finally, from time to time various groups within the area sponsor projects in which amateur radio can make important contributions. Watch for such things as Leukemia Walkathons, parades, and other projects where FM repeaters can provide needed communications links. Volunteer your services – don't wait to be asked.

In summary, every amateur group, no matter how small, can only benefit from a systematic and organized information program. With our decreasing numbers and an ever-growing public service and CB group (with their associated manufacturers' lobbies), amateurs can no longer afford to rely solely on "PR" as a means of bridging the information gap.

Now, perhaps more than ever, we need to insure that amateur radio is known by as many people as possible for what it is, not necessarily to compete with citizens band and other public service operations *per se* but rather to make certain that our interests are protected. In order to do this, we need to have a friendly environment in which to operate as well as an informed community of fellow hams and laymen alike. "PR," as anachronistic as the butch haircut and the liquid-fuel rocket, no longer meets the demands of an information-oriented society. The triangular total information program, however, is geared to meet these demands, and while the development and implementation of such a program is going to require a certain amount of effort, dedication, and even money, the results will certainly justify the expenditure.

Several Considerations for an Information Program

1) Appoint as director of information an individual who wants to succeed. While a background in advertising or journalism may certainly be helpful, it's more important that the director be well-motivated.

2) At the beginning of the year, compile a list of your information program objectives. Know what you want to do, why you need to do it, and how you'll go about doing it.

3) Meet personally with editors and news directors. Also include on your visit list the director of information for the local chamber of commerce.

4) Allow only one spokesman for your club; the group must speak with only one voice to preclude embarrassing contradictions.

5) A written story is usually more valuable to a newsman than a verbal description. The reporter can always rewrite the article, and he'll contact you if he needs more information.

6) Spend some money for a typewriter and letterhead stationery. If the club budget allows you to really splurge, invest in a decent camera and some photo supplies.

7) Publish a club newsletter on a periodic basis, sending copies to other clubs in the state and to non-members as well.

8) Develop an informative briefing about amateur radio and your club (preferably a 35mm slide presentation).

9) Actively seek out speaking engagements where you can present your briefing.

10) Don't make mountains out of molehills and expect to pass them off as legitimate news stories to the local media. Be factual, truthful, and to the point.

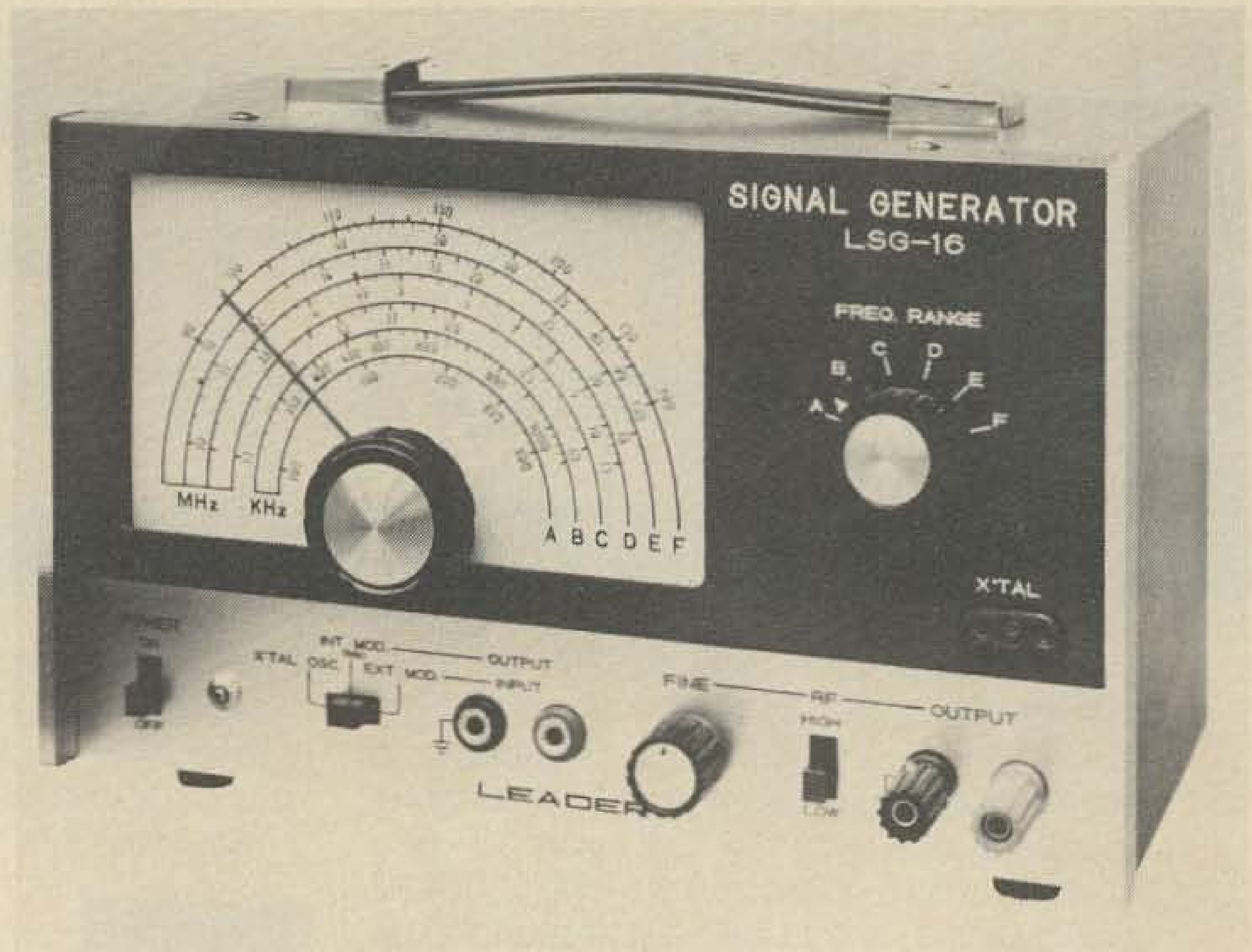
11) Avoid shouting matches with local CB groups; there's sufficient room for both activities, and bear in mind that while a stereotype of a CB operator has emerged, we have our own problem children.

12) Find projects that will benefit the local community – a massive campaign which tells what you can do in all types of future disasters is fine, but it's the present that counts.

...K3DSQ/4

NEW PRODUCTS

from page 19



LSG-16 RF WIDE BAND SIGNAL GENERATOR

The LSG-16 wide band signal generator, pretty darn good for service, hobby, education or industrial use, is now being made available by Leader Instruments Corp. of Plainview, N.Y.

The new product features an FET oscillator circuitry for high stability performance, plus an accurately calibrated frequency dial. Frequency range is 100 kHz to 100 MHz, and up to 300 MHz on harmonics. Internal modulation is 1 kHz at 30% or higher, while external modulation is 50 Hz–20 kHz at less than 1 Vrms.

The LSG-16 is capable of functioning as a marker-generator when used in conjunction with a sweep generator, and will check and align rf and i-f circuits in TV, FM and communication-type receivers and transmitters. Use of the product is further extended by provisions to accommodate a 1–15 MHz crystal.

The LSG-16 offers a 115/230 V, 50/60 Hz, 3 VA approx. power supply. Measuring 6"H x 10"W x 5"D, and weighing 5.5 lbs, it sells for $109.95.

HICKOK FUNCTION GENERATOR

So who needs a bunch of functions, you ask? Better yet, what is a function in the first place, and what on earth do we need with 'em?

In olden days we had sine wave oscillators . . . a sine wave was one type of function. Then some smart guy came along and invented square waves . . . another function. Oscilloscope fans developed an insatiable need for sawtooth waves . . . still another function. The problem came when one piece of equipment could develop a lot of different types of waveforms . . . should they call it a sine-square-sawtooth-pulse-etc generator? No. So now we have function generators and they are getting pretty common . . . and the price has been going against the grain, being one of the few items to drop in cost.

Hickok, one of the older names in test equipment, has come out with a ham-priced function generator . . . model 270 . . . weighing in at only $166. This doohinky does not wash the dishes, but that's about its only limitation. From 1 Hz to 1/2 MHz in six push-button selected ranges, it will turn out sines, triangles, squares, and a variety of pulses, FM, AM/FM mixed, high/low combinations for testing filters, FSK for setting up RTTY gear and computer driven cassettes, AM, swept sine waves, etc.

Also built in is an attenuator going down to -60 dB for checking gain and filter action.

How much longer are you going to suffer along without a modern piece of test gear in your ham shack?

Further details are available from Hickok, 10514 Dupont, Cleveland OH 44108.

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☐ **14 WPM** Code groups again, at a brisk 14 per so you will be at ease when you sit down in front of the steely eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test you'll thank heavens you had this back breaking tape.

☐ **6 WPM** This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly – under pressure – faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five. Practice this one during lunch, while in the car, anywhere and you'll be more than prepared for the easy FCC exam.

☐ **21 WPM** Code is what gets you when you go for the Extra Class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape. No one who can copy these tapes can possibly fail the FCC test. Remove all fear of the code forever with these tapes.

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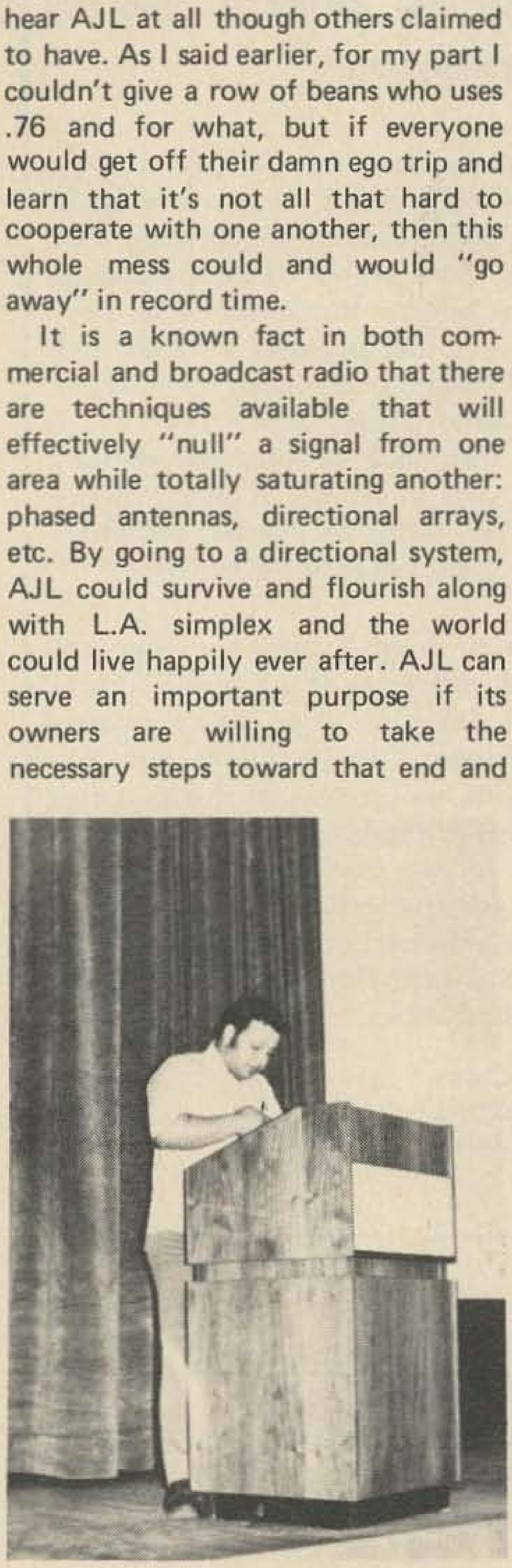
Looking West

from page 11

It's funny, but there is a simple solution to this problem, and maybe because I am just an onlooker I can see it. First, for the record, I can and do hear WR6AJL here in the Van Nuys area of the San Fernando Valley, and with the spring-summer inversion with us, their signal strength measured on a Hammarlund HQ-110AC using an Ameco CN-144 converter and Antenna Specialists ¼ wave Six Meter Vertical is S-8 to S-9 plus 10 dB since early May. Before approximately May 10th, I did not hear AJL at all though others claimed to have. As I said earlier, for my part I couldn't give a row of beans who uses .76 and for what, but if everyone would get off their damn ego trip and learn that it's not all that hard to cooperate with one another, then this whole mess could and would "go away" in record time.

It is a known fact in both commercial and broadcast radio that there are techniques available that will effectively "null" a signal from one area while totally saturating another: phased antennas, directional arrays, etc. By going to a directional system, AJL could survive and flourish along with L.A. simplex and the world could live happily ever after. AJL can serve an important purpose if its owners are willing to take the necessary steps toward that end and



SANDRA delegate responds to SCRA Technical Committee report and announces SANDRA's withdrawal from SCRA.

On tour of JPL after SCRA meeting, Bill Carpenter WA6QZY, SCRA Technical Committee Chairman, explains exhibit.

if, when the AJL signal disappears from LA on .76, so does the AKC signal on .16. All parties have the nation watching them at this moment. If action by either one of them causes failure within the SCRA, then I bid them both beware that such a failure here can and probably will have the most awesome consequences nationally. If the SCRA fails, then most probably it will be the lead for each individual who dislikes something within his area's coordinating body to work towards its destruction. Such would mean the quick end of relay type communication and a return to the "old days" where a VHF mobile could hardly work out of his backyard. I for one have no intention of sitting by and watching this happen.

It's about time we all realize that though we may not love one another as brother and sister, we are by federal decree neighbors in the same relay sub-band — repeater, simplex and remote. There is but one way for us to survive and that is through total open mutual cooperation. Mutual cooperation takes the form of area frequency coordinating groups such as SCRA and its counterparts throughout the nation. These are organizations built on naught more than a handshake, and if the handshake becomes a fist of rage, and each individual or group goes his own way because a decision made in the interest of all does not suit an individual, then all that we have worked for is lost and we might as well pack it in.

To all involved in the present confrontation, beware: The eyes of the nation are watching every move you make. There is a heavy burden on your shoulders, that of risking the destruction nationally of relay type communications by your actions here. There will be no replay of the old days; this time every move is being watched and being reported. If either party destroys it for the rest of us, then the world will quickly know who is responsible.

A late note: It has been announced that some 15 San Diego Area systems have written to SCRA pledging their support of the organization. SCRA has also stated that it will continue to take whatever steps are necessary to insure a quick solution amicable to all parties.

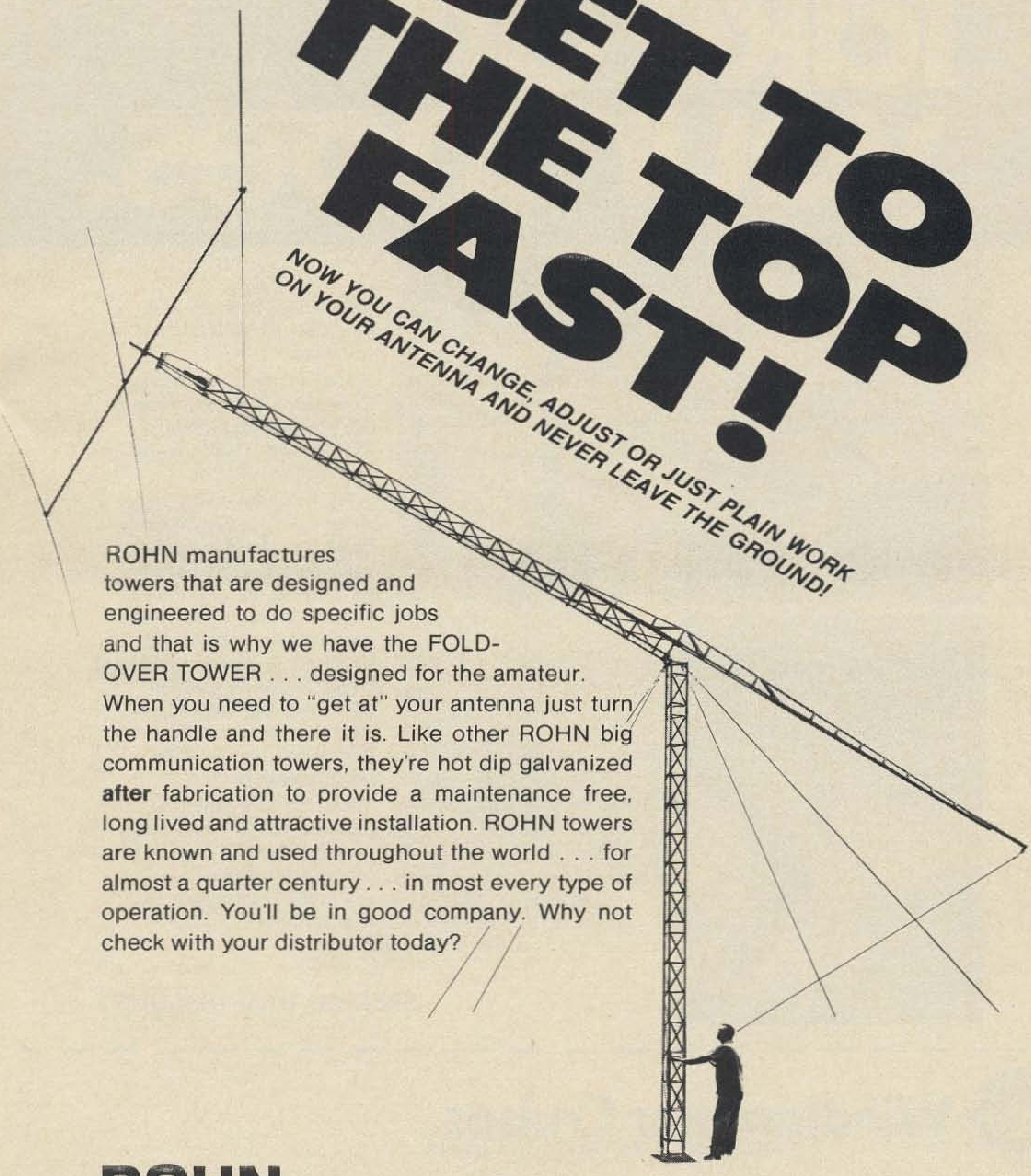
Other matters covered at the recent SCRA meeting included setting definite jurisdictional boundaries for the organization to administer, action on docket 20282 and the SCRA proposal to the FCC to take part in repeater licensing for Southern California. As to the latter, in a letter exploring such possibilities sent to the FCC, the SCRA proposes that VHF repeater Form 610 applications would be pre-processed and sanctioned by the SCRA prior to FCC filing for a one year test period.

Finally, in answer to a load of mail that all but broke the back of our local postal delivery person, following the publication of my dissertation on split-split repeater systems, the following is the information that I have on where to get some narrower filters for radios using the Mu-Rata brand filters. The address I have is: Mu-Rata Corp. Ltd., Elmsford NY. Thanks to Lou K2VMR for supplying this information. Till next month, that's all there is for now from the "Hot" Southland.

. . . WA6ITF

GET TO THE TOP FAST!

NOW YOU CAN CHANGE, ADJUST OR JUST PLAIN WORK ON YOUR ANTENNA AND NEVER LEAVE THE GROUND!



ROHN manufactures towers that are designed and engineered to do specific jobs and that is why we have the FOLD-OVER TOWER . . . designed for the amateur. When you need to "get at" your antenna just turn the handle and there it is. Like other ROHN big communication towers, they're hot dip galvanized **after** fabrication to provide a maintenance free, long lived and attractive installation. ROHN towers are known and used throughout the world . . . for almost a quarter century . . . in most every type of operation. You'll be in good company. Why not check with your distributor today?

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Take off your shoes.

Hit the deck in shorts and a tee shirt. Or your bikini if you want.

You're on a leisurely cruise to remote islands. With names like Martinique, Grenada, Guadeloupe. Those are the ones you've heard of.

A big, beautiful sailing vessel glides from one breathtaking Caribbean jewel to another. And you're aboard, having the time of your life with an intimate group of lively, fun-loving people. Singles and couples, too. There's good food, "grog," and a few pleasant comforts...but there's little resemblance to a stay at a fancy hotel, and you'll be happy about that.

Spend ten days exploring paradise and getting to know congenial people. There's no other vacation like it.

Your share from $245. A new cruise is forming now. Write Cap'n Mike for your free adventure booklet in full color.

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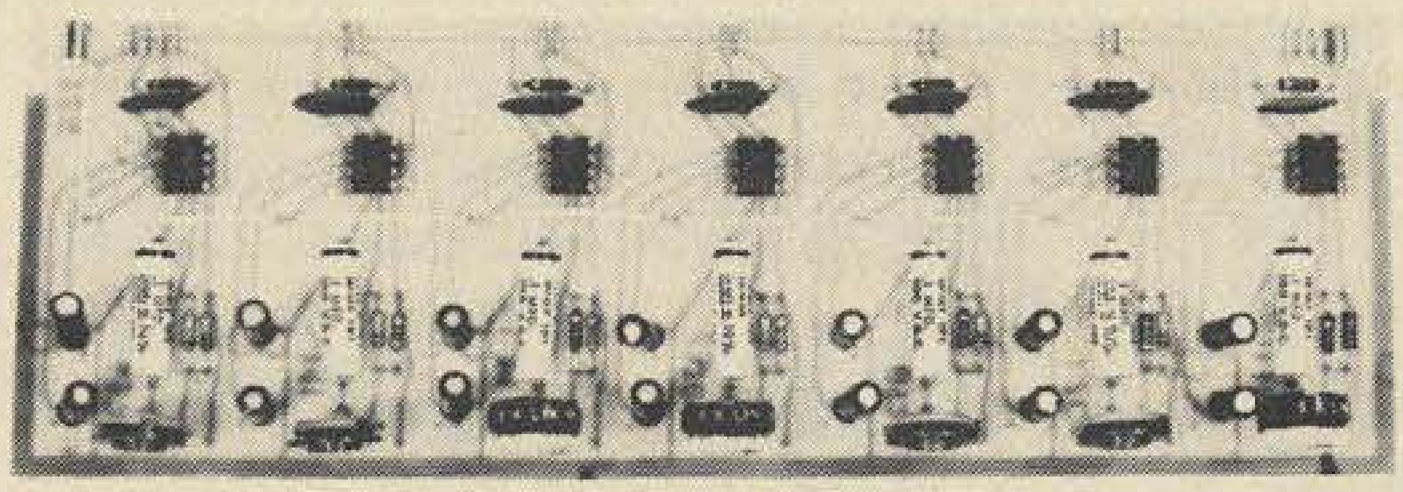
watch this space for SPECTACULAR ANNOUNCEMENT

WOW! SURPRISE! ZOWIE!



TDC (Tone Decoder Card)

Primary function: to detect touch-tone signals
(0 through 9 and the star & number keys)

A multitude of applications

A. Touch-tone repeaters
B. Electronic locks
(access to regenerators, base stations, auto-patch, repeater control, antenna control)

TDC comes completely assembled on a 9" x 3" PC Board. Each Tone Decoder is individually adjustable – easy calibration.

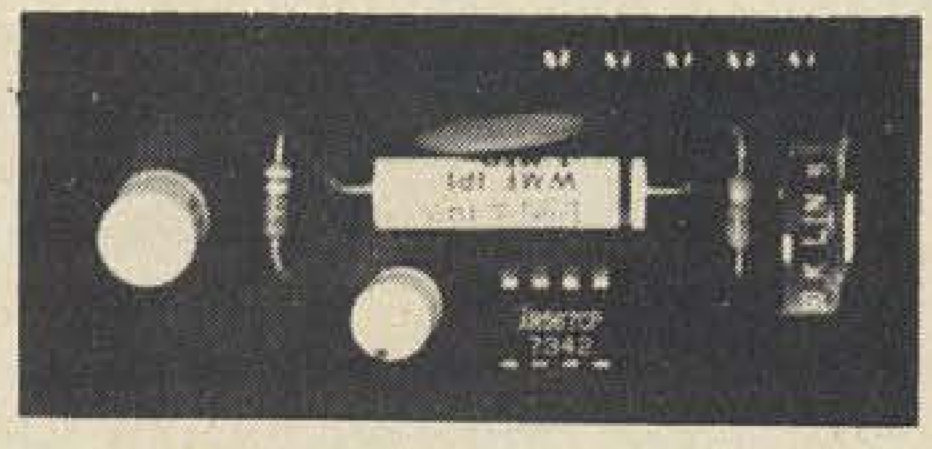
Electronics are centered around the NE567Z. Phase lock loop dip package for fast reliable tone detection. The output of each tone decoder is a logic low (zero volts) when the appropriate tone is detected.

Applications, literature, circuit descriptions, component layout drawing, specific circuits for various applications supplied with the card.

Factory calibrated. Power requirements +5 to +18. **$139.00/each**

TD MODULE (Tone Decoder Module)

The TONE DECODER MODULE is identical in circuitry with the TD Card, except that only one tone may be detected. The Module can be tailored to detect most any frequency.



Applications:

A. FSK detection
B. Antenna Control
C. Repeater control
D. Tone detection
E. In conjunction with the TDC a user can obtain full 2 x 8 touch tone detection (16 keys).

$29.95/each

Telecommunication Control SYSTEMS

Div. of Communications, Inc.
Haverhill and York Sts.
Andover, Mass. 01810

CONTESTS

from page 15

316). DX stations may be worked, but do not count as multipliers.

AWARDS:
All amateurs contacting 5 amateurs in each of the 4 states comprising the Division will receive the Delta Achievement Award. Certificates will be awarded to the 3 highest scoring stations in each state in the Delta Division. Fourth and fifth place awards if warranted. Outside the Division, certificates will go to the high scoring station in each ARRL Section and country (second and third if warranted). A plaque will be awarded to the high scoring station both inside and outside of the Division. Plaques will also be awarded to the high scoring portable and mobile stations operating in the Division. A portable or mobile station is here defined as a station operating outside of his home county for the purpose of operating in the Delta QSO Party. Any station disrupting a working Delta Division traffic net or whose log exhibits obvious irregularities will be disqualified from award consideration.

LOGS:
Logs must include date/time, station worked, exchange, band, emission and multiplier. Logs must be postmarked no later than October 21, 1975, to be eligible for award consideration. Logs will be returned if requested. Send logs to Malcolm P. Keown W5RUB, 213 Moonmist, Vicksburg MS 39180.

1975 RTTY ART CONTEST
Contest period runs from October 1st to end of November

PRELIMINARY RULES:
Original RTTY art must have been transmitted during this two month period, with copies and prints being mailed on or before a deadline of November 30th. The contest is sponsored by the RTTY Journal. Mail entries to: Donald Royer WA6PIR, 16387 Mandalay Drive, Encino CA 91436.

CALIFORNIA QSO PARTY
Starts: 1800 GMT Saturday, October 4
Ends: 2400 GMT Sunday, October 5

The 1975 California QSO Party is sponsored by the Northern California Contest Club. Of the thirty hour period, the maximum operating time shall not exceed 24 hours. Times on/off must be clearly marked in the log. Each time off shall not be less than 15 minutes. All amateur bands may be used, and stations may be worked once on phone and once on CW on each band. A California station which changes counties is considered a new station and may be contacted again on each band and mode.

EXCHANGES:
California stations send QSO number and county. All others send QSO number and state, province or country. California stations may work each other.

FREQUENCIES:
CW: 1805, 3560, 7060, 14060, 21060, 28060. SSB: 1815, 3895, 7230, 14280, 21355, 28560. Novice: 3725, 7125, 21125, 28125. Try 10 meters on the hour and 15 meters on the half hour between 1800 and 2200 GMT.

SCORING:
Each completed QSO counts 2 points. California stations multiply QSO points by the total number of states and Canadian call districts (VE/VO 1-8; max. of 8). California stations may count the State of California as one multiplier and DX stations may be worked for QSO points but not multipliers. All other stations multiply total QSO points by the number of different California counties worked (58 maximum).

AWARDS:
Certificates will be awarded to the highest scoring station in each California county, state, province, and country. Second and third place awards may be made where justified. In addition, certificates also will be awarded to the highest scoring mobile station, portable station, multi-single, and multi-multi entries. A certificate will be awarded to the club submitting the highest aggregate score.

LOGS:
Log information should include date, time, band, mode, callsigns worked, and exchanges sent and received. Please number each new multiplier as worked. A summary sheet should be included showing your callsign, name, address, number of QSOs on each band and mode, total QSOs, total multiplier, claimed score, and whether the entry is single or multi-operator. All entries must be sent to the NCCC, c/o John Minke W6KYA, 6230 Rio Bonito Drive, Carmichael CA 95608, and must be postmarked not later than October 31, 1975. A large, business-size SASE is requested with each entry. All comments and suggestions will be appreciated.

ROCKY MOUNTAIN QSO PARTY
Starts: October 4
Ends: October 5

The contest is sponsored by the Rocky Mountain Division of the ARRL. The states participating in this QSO Party are Colorado, New Mexico, Utah and Wyoming. Each state is having a separate QSO Party.

CONTEST PERIODS:
2100 GMT to 2400 GMT October 4
0100 GMT to 0500 GMT October 5
1800 GMT to 2100 GMT October 5

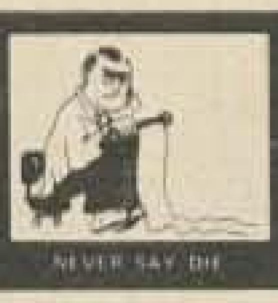
EXCHANGE:
Serial number, RST, state and county for stations in the Rocky Mountain Division, while others may omit the county. Stations may be contacted only once per band regardless of mode, except that mobiles may be contacted again if they change counties. Intradivision and intrastate contacts are valid for stations in the Rocky Mountain Division.

FREQUENCIES:
CW: 65 kHz up from the bottom. Phone: Near the edge between General and Advanced. Novice: Near the middle of each band. Stations from outside the division please refrain from calling CQ Contest near these frequencies.

SCORING:
Score 1 point per QSO. Multiplier for Rocky Mountain Div. stations is the sum of states, VE provinces, countries, and Rocky Mountain Div. counties. For all others, the multiplier is the number of counties worked in the state in whose party he is participating. There will be 4 different multipliers, one for each state, for those that enter all 4 contests.

AWARDS:
Appropriate awards will be given.

LOGS:
Send full log data, including exchanges, to Bill Wageman K5MAT, 35 San Juan, Los Alamos NM 87544, no later than November 1, 1975. Include SASE for awards and/or copies of the results.



... de W2NSD/1

NEVER SAY DIE

EDITORIAL BY WAYNE GREEN

from page 12

73	*223*
QST	*181*
HR	*128*
CQ	*77*

That comes to about 23% more ads in 73 than the next magazine. This may be of interest to amateurs getting ready to start new companies in the ham field who are looking for the magazine which provides the lowest cost ads in terms of sales results . . . and that is the bottom line. It may also interest the sales managers of the few firms which are not advertising in 73 because they disagree with the editorial policy and hope to force a change with economic sanctions. Ads in 73 outsell anyone else . . . which is the reason there are more in 73.

YOUR PROTECTION

Another major firm has been kicked out of the 73 pages . . . for a variety of reasons. Since they are threatening to sue us to force us to accept their ads, we'll have to keep mum on the situation for legal reasons. We really can't even tell you who they are . . . but if any readers have been having any problems with Emergency Beacon for any reasons it wouldn't hurt to drop us a line with the details . . . we may be able to help.

FREE PHONE CALLS

For a period of several years (alas, no more), those in the know were able to make long distance phone calls for free. It seems that when you put in a TWX system it came with a telephone connected to it, said phone having a solid cover on the mouthpiece since the teletype machine was to be used over the phone wires. Now it further appears that Bell was having a lot of trouble with TWX systems getting wrong numbers as a result of less than diligent servicing of the switching equipment, and the resulting misbilling was cured by having the computer bill only for calls to TWX numbers. TWX users, upon discovering this cute system, unscrewed the solid part of the handset and put in a regular microphone, thus enabling them to make calls at will over the TWX line, knowing they would not have to pay because the computer would reject the billing. This little game went on for several years, claim people who took advantage of it.

. . . W2NSD/1

1st Ad In?

The big companies in amateur radio today were, for the most part, started by one or two amateurs . . . and many grew very rapidly as a result of the low ad rates in 73 and the wide circulation among active (buying) hams. We'll give you 10% of the first ad run by a new company if you let us know about them and they advertise first in 73. Do yourself and the new firm a big favor — drop a note to 73 Advertising, Peterborough NH 03458.

73 PRODUCTS

Startling Learning Breakthrough

NOVICE THEORY TAPES
Set of 4 Tapes only $13.95

You'll be astounded at how really simple the theory is when you hear it explained on these tapes. Three tapes of theory and one of questions and answers from the latest Novice exams give you the edge you need to breeze through your exam.

73 is interested in helping get more amateurs, so we're giving you the complete set of four tapes for the incredibly low price of ONLY $13.95.

Scientists have proven that you learn faster by listening then by reading because you can play a cassette tape over and over in your spare time – even while you're driving! You get more and more info each time you hear it.

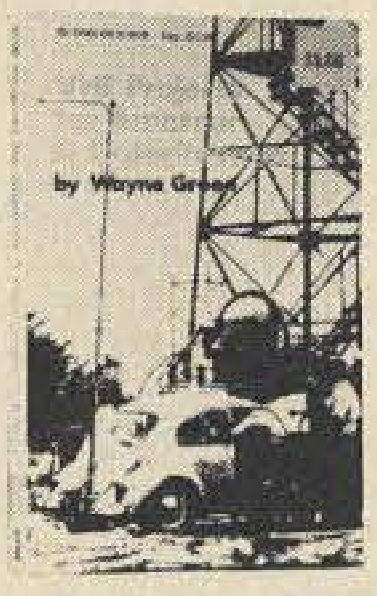
You can't progress without solid fundamentals. These four hour-long tapes give you all the basics you'll need to pass the Novice exam easily. You'll have an understanding of the basics which will be invaluable to you for the rest of your life! Can you afford to take your Novice exam without first listening to your tapes?

Ham radio is too great a hobby for us to keep it to ourselves. Let's tell the whole world about it! And what better way than by sporting this attractive lime-green bumper sticker on your car! It's only 50¢ – and it's phosphorescent so you can see it even at night. Go ahead . . . SPREAD THE WORD! Order yours TODAY!

SOLID STATE PROJECTS

$4

More than 60 projects of interest to anyone in electronics. The devices range from a simple transistor tester to a ham TV receiver. This collection will help you become more intimately acquainted with zeners. ICs and varactors, etc.



VHF PROJECTS FOR AMATEUR AND EXPERIMENTER

$4

A must for the VHF op. Opening chapters on operating practices and getting started in VHF, both AM and FM, followed by 58 chapters on building useful test equipment, modifying existing and surplus gear.

2M FM HANDBOOK

hardbound $7
softbound $5

Contains almost every conceivable circuit that might be needed for use with a repeater. All circuits explained in detail. All aspects covered, from the operator to the antenna.

4 STUDY GUIDES
NOVICE – $4 GENERAL – $6
ADVANCED – $4 EXTRA – $5

FCC exams got you scared? Frustrated by theory fundamentals? There's no need to worry. 73's four License Study Guides will help you breeze through any of the four tough exams! They are the ONLY guides which cover ALL the material you will have to know. Many amateurs find that one quick reading through our guides is enough to get them through with no sweat.

LATEST RELEASES from 73 publications

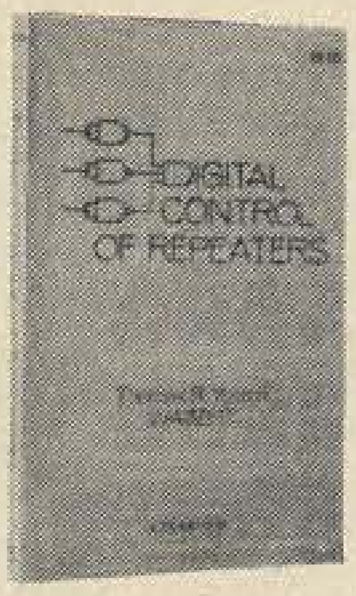
RF and DIGITAL TEST EQUIPMENT YOU CAN BUILD

RF burst, function, square wave generators, variable length pulse generators – 100 kHz marker, i-f and rf sweep generators, audio osc, af/rf signal injector, 146 MHz synthesizer, digital readouts for counters, several counters, prescaler, microwavemeter, etc. 252 pages. $5.95

PRACTICAL TEST INSTRUMENTS YOU CAN BUILD

37 simple test instruments you can make – covers VOMs, VTVMs, semiconductor testing units, dip meters, watt meters, and just about anything else you might need around the test lab and ham shack. $4.95

DIGITAL CONTROL OF REPEATERS



softbound $5 hardbound $7

Here's a book for the FMer who wants to design and build a digital repeater control system. Contains sections on repeaters, basic logic functions, logic circuit design, control systems, support circuits, mobile installations, touch-tone, plus a special section on a "mini" repeater control system.

- ☐ Novice Theory Tapes $13.95
- ☐ Bumper Stickers .50 ea.
- ☐ Solid State Projects $4.00
- ☐ VHF Projects $4.00
- 2M FM Handbook
  - ☐ Hardbound $7.00
  - ☐ Softbound $5.00
- ☐ Rf and Digital Test Equip. $5.95
- ☐ Practical Test Instruments $4.95
- ☐ Novice Class Study $4.00
- ☐ General Class Study $6.00
- ☐ Advanced Class $4.00
- ☐ Extra Class Study $5.00
- Digital Control of Repeaters
  - ☐ Hardbound $7.00
  - ☐ Softbound $5.00

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Order from: 73 MAGAZINE, Peterborough NH 03458

Caveat Emptor?

from page 16

CALL LETTER LICENSE PLATES — still being collected by 73 Magazine for possible cover use. Please send in an old call letter plate — most treasured are out-of-district plates such as W2NSD/NH, etc. Got any real oldies? 73 Magazine, Peterborough NH 03458.

TECH MANUALS — $6.50 each: R-220/URR, SP-600JX, USM-34, GRR-5, URM-25D. Thousands more available. Send 50¢ (coin) for large list. W3IHD, 7218 Roanne Drive, Washington DC 20021.

MANUFACTURERS, Distributors! The Memphis Hamfest will be bigger than ever. The dates are Saturday and Sunday October 4 and 5. Best location possible — State Technical Institute, Interstate 40 at Macon Road. Security. Contact Chairman, Harry Simpson W4SCF, Box 27015, Memphis TN 38127, phone (901) 358-5705.

RADIO ARCHIVES, amateur ANECDOTES (then & now) solicited for proposed (SASE subscription) monthly PR newsletter. Electronic Avocations, 3207 fourth St. N., Mpls., Mn. 55412.

HT220 HI-BAND 4 freq. universal $250.00 D.M. Herlihy, 2338 Berry St., Lemon Grove, Calif. 92045.

POLICE AND FIRE Scanner Special — Regency ACT — R — 10 H/L/U 10 channel 3 bands, combined ac/dc 10 free crystals included $169.00 prepaid, dealer inquiries invited, Four Wheeler Communications 10-F New Scotland Avenue, Albany NY 12208.

NEW EBC 144 JR: The dream machine costs $599.00. First cashier's check for $495.00 gets it shipped the same day. Still under warranty. M. T. Henry, 5173 North Hampton Ridge, Norcross, Georgia 30071.

LOOKING FOR JAN 1961 issue 73 Magazine. Please write, stating price, only mint condition. All letters answered. R. H. Wilson, 4011 Clearview Drive, Cedar Falls IA 50613.

FOUNDATION FOR AMATEUR RADIO annual Hamfest Sunday, 19 October 1975 at Gaithersburg Maryland Fairgrounds.

FOREIGN LANGUAGE cassettes. 2 — 60 minute quality tapes per set. French, German, Italian, Spanish. $6 a set, 4 sets $20. Royal, Box 2174, Sandusky, Ohio 44870.

WANTED: CX-7 Dead or Alive, write price, condition, symptoms. SELL: VRM26A, manual, spare tube. Trade for 2 mtr or HF rig. Rob Pohorence, 2334 Regal Court, Lawrenceville, Ga. 30245. WB4RSK.

SSTV ZOOM LENS, 12-48 mm, F 1:8 focusing C mount, (Robot, Venus, HCV, etc.) brand new, closeout, $64.95 each postpaid, UHF, Box 504, Huntington Station, New York 11746.

TWO PLASTIC HOLDERS FRAME and display 40 QSL's for $1.00 or 7 holders enhance 140 cards for $3.00 — from your Dealer, or prepaid direct: TEPABCO, Box 198M, Gallatin, Tennessee 37066.

WANTED: Mobile telephone equipment such as Delco, GE, etc. Also heads, decoders, duplexers. Greg Hyman, WA2OTG, 19 Sicard Ave., New Rochelle, New York 10804, (914) 636-2494.

FM RECEIVER, preamp, scanner, UHF converter kits. Hamtronics, Inc., 182 Belmont, Rochester NY 14612.

HAM HELP

According to long-standing policy, *73 Magazine* makes a continual effort to match those in need of technical help or instruction with those who feel they can offer it. If you find yourself in one of these two categories, please do yourself and amateur radio a favor by contacting Ham Help, *73*, Peterborough NH 03458.

Lawrence R. Harrington
1503 E. Walnut Avenue
El Segundo CA 90245

Steve Dobrenchuk WN3YQB
122 Grafton Street
Chevy Chase MD 20015
(301) 652-3150

Freeman Dodsworth
5302 Pooks Hill Road
Bethesda MD 20014
(301) 530-3674

James F. Reuter, Sr.
2595 Marlborough
Detroit MI 48215
(313) 821-0395

Edward A. Smith
55 East End Avenue (82nd St)
Apartment 4G
New York, NY 10028
(212) 879-6580

Add my name and address to your list of those willing and able to give constructive assistance to those that need help – W9EQG dates from 1954. I can help in amateur radio and basic and advanced electronics.

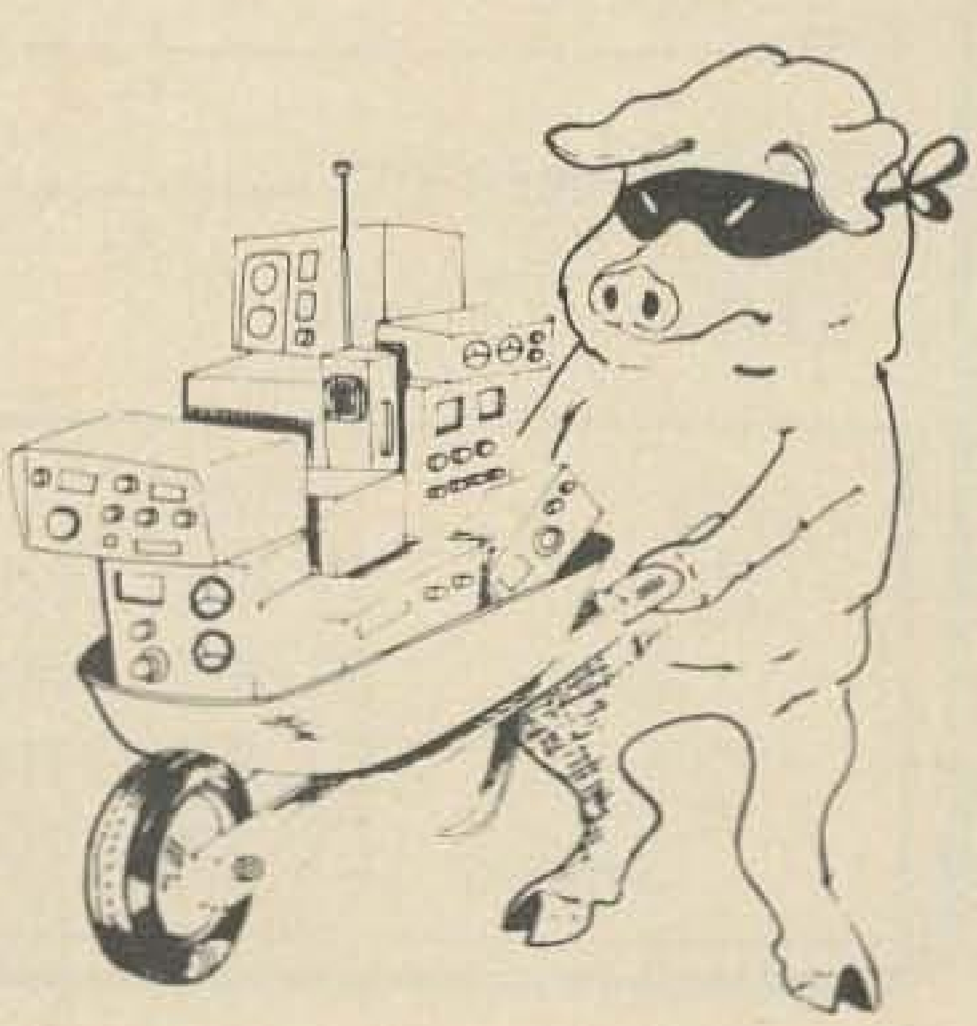
David R. Halliburton
WA3ZOR/ex-W9EQG
726 Tiffany Court
Gaithersburg MD 20760

The Hamburglar STRIKES AGAIN!

STOLEN: Two miniature GE portable radio transmitter/receivers; model number PE56RAS66, S/N 2210672 and 4351289. Contact John E. Dillon, LtCol, USAF, Chief, Security Police, Department of the Air Force, 3800th Air Base Wing (AU), Maxwell Air Force Base, Alabama 36112.

TAKEN: SB-144 was stolen from locked auto on June 28, 1975 at the "Tradewinds" Shopping Center at Barrington and Irving Park Road in Hanover Park, Illinois. S/N 620952. Internal speaker is removed and a Data Engineering Pre-amp is installed in its place. Contact Mr. D. L. Holdeman W9HJL, 1510 Birch Avenue, Hanover Park, Illinois 60103. Phone: (312) 289-1919.

RIPPED OFF: Tempo One & AC PS and Drake TR-22 taken on June 14, 1975. Contact Dennis J. Gazak WA3SZD, 321 Stevens Street, Philadelphia, Pennsylvania 19111.



The New Hy-Gain 270 brings state-of-the-art design to 2 meter mobile.

The Hy-Gain 270 is specifically designed to solve the problems of gain 2 meter mobile antennas... hard tuning, high VSWR, poor pattern due to irregular ground plane; and fade from whip flex.

The all white fiberglass and chrome design develops 6 db gain through the use of 2 stacked 5/8 wave radiators with a self-contained 1/4 wave decoupling system. Because the Hy-Gain 270 operates independent of the car body ground, you get minimum pattern distortion for maximum range in all directions. Independence from the car body also means the end to tune-up problems. The fiberglass design solves the fading problem due to upper whip flex. Since the antenna and feedpoint are sealed in fiberglass, the Hy-Gain 270 will deliver top performance year after year without loss due to corrosion. The Hy-Gain 270 can be mounted anywhere ...bumper, cowl, deck or mast...for fixed, land mobile or marine service using Hy-Gain mounts listed below.

- 6.0 db gain.
- 250 watt rated.
- 144-148 MHz.
- VSWR less than 1.5:1 at resonance, 6 MHz Bandwidth.
- 96″ whip height.
- No pruning required, completely factory tuned!
- 50 ohm input.
- 3/8 x 24 standard mobile thread.
- Comes with 18′ coax and PL-259 connector.

Order No. 270

Mounts—Universal No. 271
Flush Body No. 499
Bumper No. 415

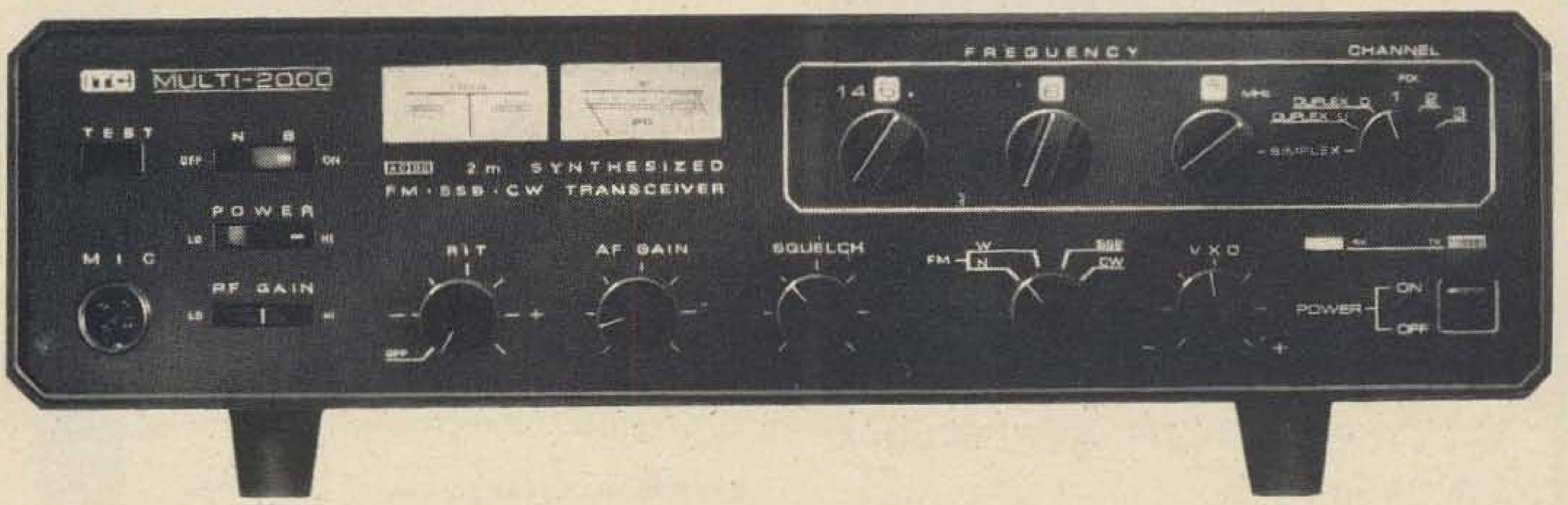
Get maximum range...get a Hy-Gain 270!

For prices and information, contact your local Hy-Gain distributor or write Hy-Gain.

hy-gain

Hy-Gain Electronics Corporation; 8601 Northeast Highway Six; Lincoln, NE 68507; 402/464-9151; Telex 48-6424.
Branch Office and Warehouse; 6100 Sepulveda Blvd., #322; Van Nuys, CA 91401; 213/785-4532; Telex 65-1359.
Distributed in Canada by Lectron Radio Sales, Ltd.; 211 Hunter Street West; Peterborough, Ontario.

MEET THE STATE OF THE ART ON 2 METERS... THE ITC MULTI-2000 CW/SSB/FM TRANSCEIVER



Whether your interest is simplex, repeater, DX or OSCAR the new ITC MULTI-2000 lets you get into all the action on all of the band. Fully solid-state and employing modular construction, the MULTI-2000 enjoys features found in no other 2m transceiver.

FEATURES

- PLL synthesizer covers 144-148 MHz in 10 kHz steps
- Separate VXO and RIT for full between-channel tuning
- Simplex or ± 600 kHz offset for repeater operation
- Three selectable priority channels
- Multi-mode operation (CW/SSB/NBFM/WBFM)
- Built-in AC and DC power supplies, noise-blanker squelch and rf gain control
- Selectable 1W or 10W output
- Separate S-/power and frequency deviation meters
- Built-in test (call) tone and touch-tone provision
- Excellent sensitivity (.3 μV for 12 dB SINAD)
- Superior immunity to crossmodulation and intermodulation
- Introductory price: $695.

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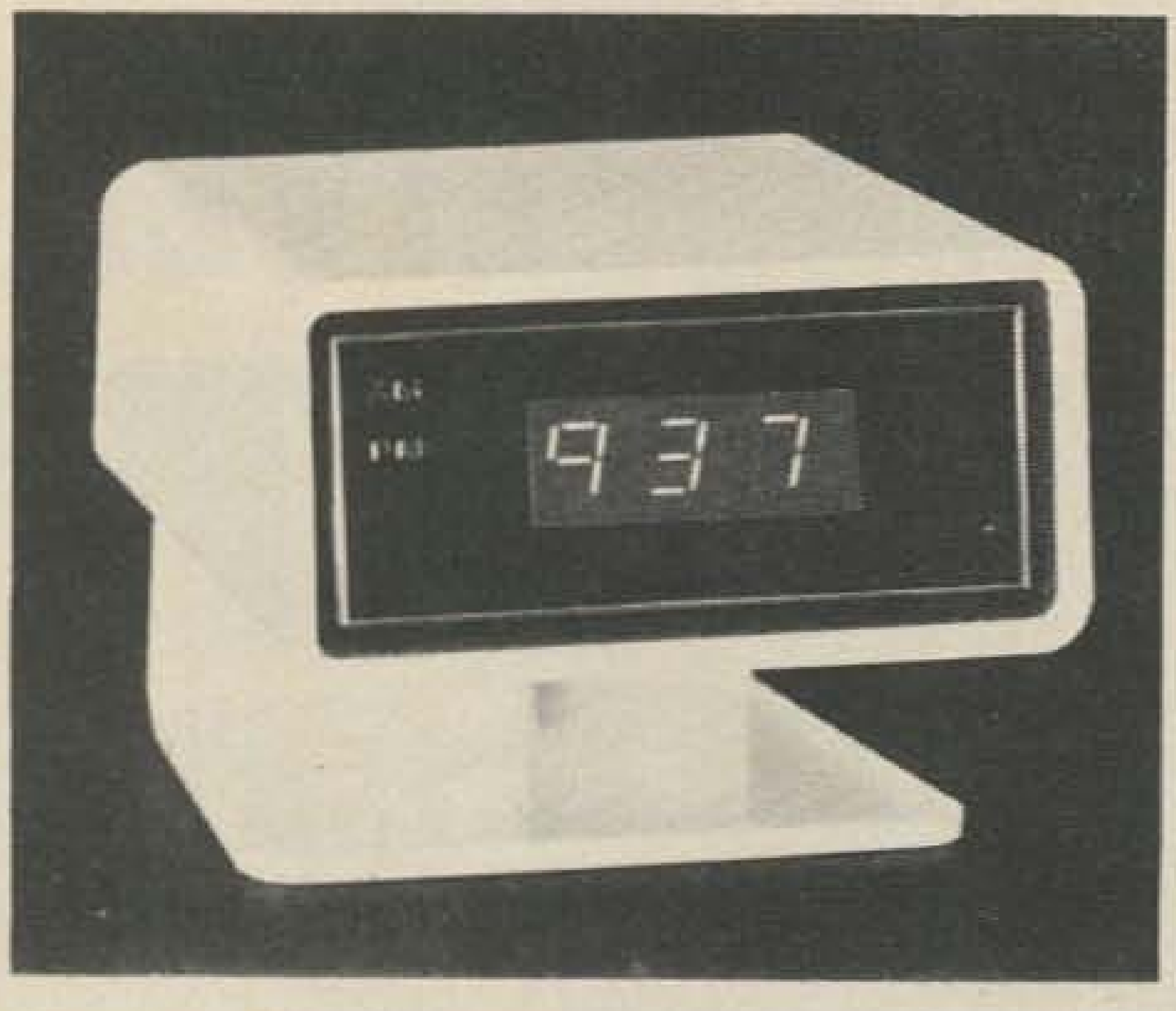
Telex 22–8411

digital clock



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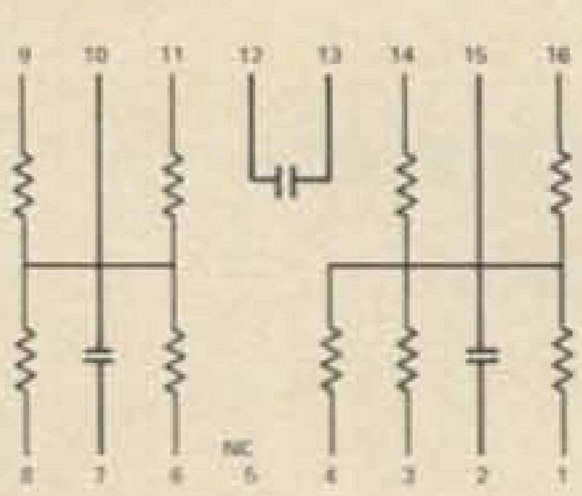
75492	Hex digit driver	.80	.65
2102	1024X1 RAM	4.50	3.75
1101	256X1 RAM	1.25	1.00
5314	Clock chip	4.95	3.95
5312	Clock chip	3.75	3.00

•



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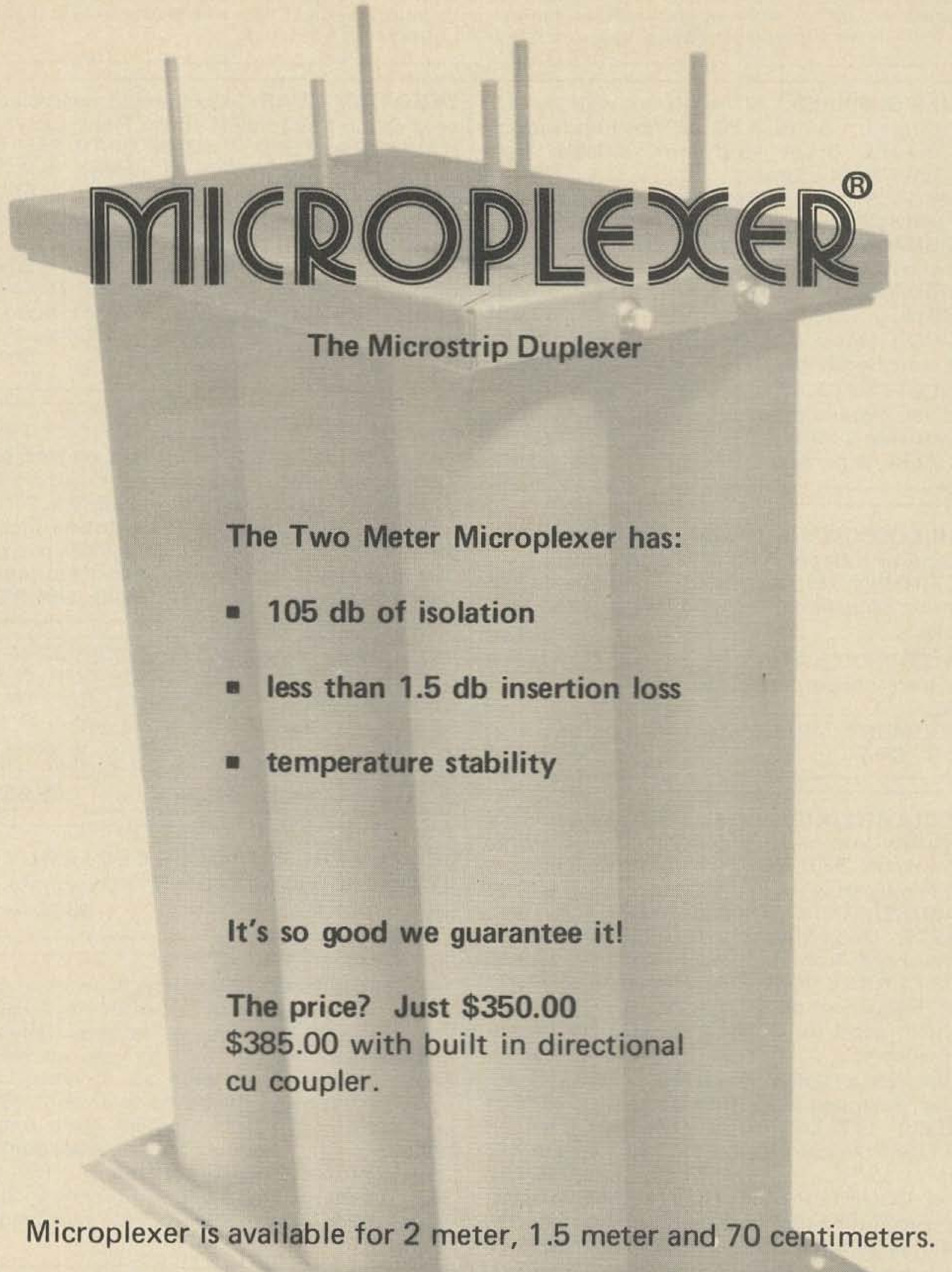

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13 — NPN and PNP Driver Transistors
2 — Push Button Switches for time set
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1 — IN914 Diode
2 — .01 Disc. Caps
9 — Carbon Resistors

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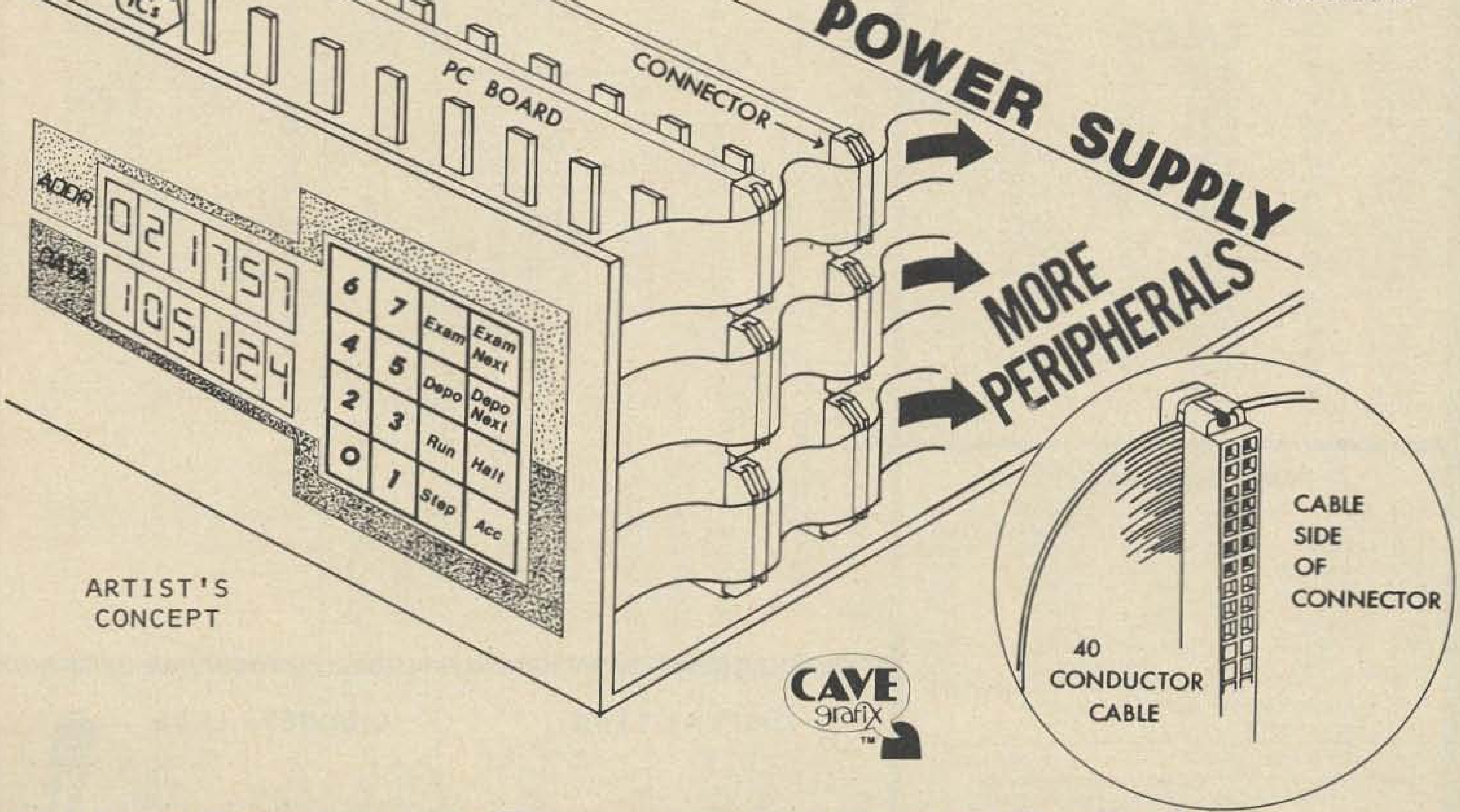

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SN7406N	.45	SN7472N	.39	SN74160N	1.75
SN7407N	.45	SN7473N	.45	SN74161N	1.45
SN7408N	.25	SN7474N	.45	SN74163N	1.65
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LM320K-12	1.35	LM709N	.29	75491CN	.79
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8 pin	$.30	.27	.24
14 pin	.35	.32	.29
16 pin	.38	.35	.32
18 pin	.52	.47	.43
24 pin	$.70	.63	.57
28 pin	1.10	1.00	.90
36 pin	1.55	1.40	1.26
40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
10 pin	$.45	.41	.37
14 pin	.46	.42	.38
16 pin	.55	.50	.45
18 pin	.75	.68	.62
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36 pin	1.59	1.45	1.30
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8200	2.59	8281	.85	8831	2.59
8210	3.49	8288	1.15	8836	.49
8214	1.69	8520	1.29	8864	2.00
8220	1.69	8551	1.65	8880	1.35

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	1-24	25-49	50-100
8 pin	$.19	.18	.17
14 pin	.23	.22	.21
16 pin	.27	.26	.24
18 pin	.46	.41	.37
22 pin	.65	.59	.53
24 pin	$.68	.62	.56
28 pin	.89	.81	.73
36 pin	1.10	.99	.90
40 pin	1.25	1.13	.93

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin	$.30	.28	.26
16 pin	.33	.31	.29
18 pin	.42	.39	.37
24 pin	.59	.54	.49
28 pin	$.99	.90	.81
36 pin	1.39	1.26	1.15
40 pin	1.59	1.45	1.30

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CD4002	.29	CD4030	.65	74C30N	.65
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CD4017	1.35	CD4051	2.98	74C157	2.15
CD4019	.69	CD4053	2.98	74C160	3.25
CD4020	1.69	CD4060	3.25	74C161	3.25
CD4022	1.25	CD4066	1.75	74C163	3.00
CD4023	.29	CD4069	.45	74C164	3.25
CD4024	1.50	CD4071	.45	74C173	2.60
CD4025	.34	CD4081	.45	74C193	2.75
CD4027	.85	74C00N	.39	74C195	2.75
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22 pf	.05	.04	.03	.0047	.05	.04	.035
47 pf	.05	.04	.03	.01	.05	.04	.035
100 pf	.05	.04	.03	.022	.06	.05	.04
220 pf	.05	.04	.03	.047	.06	.05	.04
470 pf	.05	.04	.035	.1	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

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.15 35V	.28	.23	.17	2.2 25V	.31	.27	.22
.22 35V	.28	.23	.17	3.3 25V	.31	.27	.22
.33 35V	.28	.23	.17	4.7 25V	.32	.28	.23
.47 35V	.28	.23	.17	6.8 25V	.36	.31	.25
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1.0 35V	.28	.23	.17	15 25V	.63	.50	.40

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1	50	.16	.14	.11	.47	50	.16	.14	.11
3.3	50	.15	.13	.10	1	16	.15	.13	.10
4.7	25	.16	.14	.12	1	25	.16	.14	.11
10	25	.15	.13	.10	1	50	.16	.14	.11
10	50	.16	.14	.12	4.7	16	.15	.13	.10
22	25	.17	.15	.12	4.7	25	.15	.13	.10
22	50	.24	.20	.18	4.7	50	.16	.14	.11
47	25	.19	.17	.15	10	16	.14	.12	.09
47	50	.25	.21	.19	10	25	.15	.13	.10
100	25	.24	.20	.18	10	50	.16	.14	.12
100	50	.35	.30	.28	47	50	.24	.21	.19
220	25	.32	.28	.25	100	16	.19	.15	.14
220	50	.45	.41	.38	100	25	.24	.20	.18
470	25	.33	.29	.27	100	50	.35	.30	.28
1000	16	.55	.50	.45	220	16	.23	.17	.16
2200	16	.70	.62	.55	470	25	.31	.28	.26

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DL 33	Com. Cath.	.125	1.95
DL 747	Com. Ano.	.625	2.50

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MV 5024	Yellow	4/$1.00
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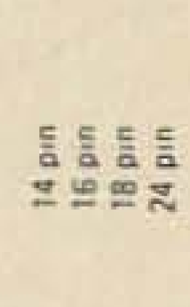

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ASST. 8	3 ea.	SN7400 SN7410	7401 7430	7402 7438	7403 7440	7404 7472	SSI/TTL	$5.95 ASST.
ASST. 9	2 ea.	SN7447 SN74145	7490 74175	7491 74180	74100 74191	74121 74193	MSI/TTL	$9.95 ASST.
ASST. 10	2 ea.	CD4001 CD4016	4002 4017	4011 4019	4012 4023	4013 4030	CMOS	$9.95 ASST.
ASST. 11	2 ea.	LM301T LM311T	301N 565T	302T 567T	307T 741T	309K 741N	LINEAR	$10.95 ASST.

4' POWER SUPPLY CORDS ....

Black

.59¢ ea.

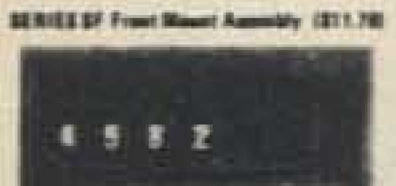
THUMBWHEEL SWITCHES

THUMBWHEEL SWITCH ONLY
SF – Front Mount SR – Rear Mount

Part No.	Description	Price
SF-12	Single Pole 10 Position	$2.50
SR-12	Decimal	3.00
SF-21	10 Position BCD only	2.50
SR-21		3.00

Snap together – No Hardware

SERIES SF Front Mount Assembly ($11.78)



Note: Picture to the left has the following 4 ea. SF-12, 1 ea. SF-EP, 1 ea. SF-BB, 1 ea. SF-DP and 1 ea. SF-HB.

ACCESSORIES

Part No.	Description	Price
SF-EP	End Plate (Pair)	.50
SF-DP	Divider Plate (each)	.40
SF-BB	Blank Body (each)	.40
SF-HB	Half Body (each)	.40

SERIES SR Rear Mount Assembly ($12.78)

Note: Picture to the left has the following 4 ea. SR-12, 1 ea. SR-EP, 1 ea. SR-BB, 1 ea. SR-DP and 1 ea. SR-HB.

ACCESSORIES

Part No.	Description	Price
SR-EP	End Plates (pair)	$ .50
SR-DP	Divider Plate (each)	.40
SR-BB	Blank Body (each)	.40
SR-HB	Half Body (each)	.40

Ordering: Order desired switch or switches and add necessary accessories for your particular application.

POCKET CALCULATOR KIT

5 function plus constant – addressable memory with individual recall – 8 digit display plus overflow – battery saver – uses standard or rechargeable batteries – all necessary parts in ready to assemble form – instructions included. 3" x 5¼" .... $17.50 each
OPTIONS –
115VAC Transformer .... 4.95 each
6 each "N" Alkaline Batteries ...... 2.50 lot

.394" DIAM. TRIMMER

STANDARD RESISTANCE VALUES
MODEL 100Ω 500Ω 1K
2K 5K 10K 20K
100K 200K 1Meg

Model TR 11

RESISTANCES (OHMS)	1–9	10–24
STD100Ω 1 MEGΩ	.35	.30

1/16 VECTOR BOARD

P-Pattern
0.1" Hole Spacing

MATERIAL	STOCK NO.	LONG	WIDE	PRICES 1	PRICES 30
PHENOLIC	64P44-062XXXP	4.50	6.50	1.72	1.54
	169P44-062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44-062	4.50	6.50	2.07	1.86
	84P44-062	4.50	8.50	2.56	2.31
	169P44-062	4.50	17.00	5.04	4.53
	169P84-062	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44-062C1	4.50	17.00	6.80	6.12

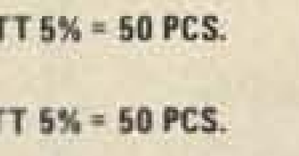
NEW PROTO BOARD-100

Here's a low cost, big 10 IC capacity breadboard kit with all the quality of QT Sockets and the best of the Proto-Board series . . . complete down to the last nut, bolt and screw. Includes 2 QT-35S Sockets; 1 QT-35B Bus Strip; 2 5-way binding posts; 4 rubber feet; screws, nuts, bolts; and easy assembly instructions.

COMPLETE KIT . . . $19.95

WALL or T.V. DIGITAL CLOCK

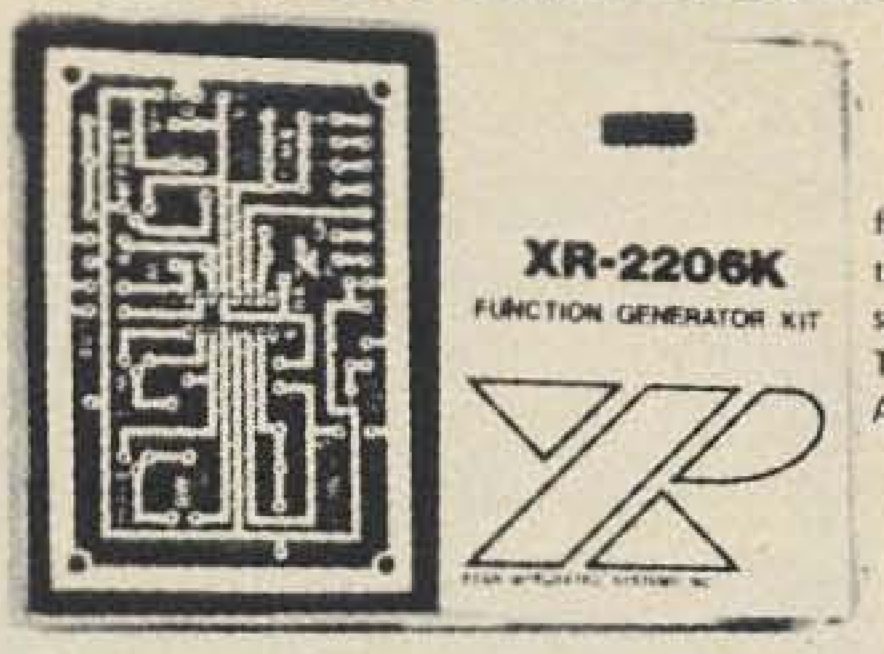
12 or 24 Hour
25' VIEWING DISTANCE
Walnut Case-6" x 3" x 1"
Hr. & Min.-6" High
Seconds-3" High



KIT - All Comp. & Case $39.95
Wired & Assembled 115 Vac $44.95

IC'S EXAR KITS

FUNCTION GENERATOR KIT



features sine, triangle and square wave; THD 0.5% typ.; AM/FM capability

XR-2206KA **$19.95**
Includes monolithic function generator IC, PC board, and assembly instruction manual.

XR-2206KB **$29.95**
Same as XR-2206KA above and includes external components for PC board.

TIMERS		
XR-555CP	Monolithic Timer	$ 1.10
XR-320P	Precision Timer	1.55
XR-556CP	Dual-555 Timer	1.85
XR-2556CP	Dual Timing Circuit	3.20
XR-2240CP	Programmable Counter/Timer	4.80
PHASE LOCKED LOOPS		
XR-210	FSK Demodulator	5.20
XR-215	High Frequency PLL	6.60
XR-567CP	Tone Decoder (mini DIP)	1.95
XR-567CT	Tone Decoder (TO-5)	1.70
STEREO DECODERS		
XR-1310P	PLL Stereo Decoder	3.20
XR-1310EP	PLL Stereo Decoder	3.20
XR-1800P	PLL Stereo Decoder	3.20
WAVEFORM GENERATORS		
XR-205	Waveform Generator	8.40
XR-2206CP	Monolithic Function Generator	5.50
XR-2207CP	Voltage-Controlled Oscillator	3.85
OTHER EXAR IC'S		
XR-1468CN	Dual + 15V Tracking Regulator	3.85
XR-1488N	Quad Line Driver	5.80
XR-1489AN	Quad Line Receiver	4.80
XR-2208CP	Operational Multiplier	5.20
XR-2211 CP	FSK Demodulator/Tone Decoder	6.70
XR-2261	Monolithic Proportional Servo IC System w/4 ea. Driver Transistor	3.79

Special Requested Items

RC4194	Dual Track V Reg	$5.95	N8T97	$3.00	2533	$11.85
RC4195	± 15v Track Reg	3.25	4024P	2.25	8263	5.95
MC1741	High Slew Op Amp	4.00	2513	11.00	8267	2.75
MC4044P		4.50	2518	7.00	8288	1.15
CA3130	Super CMOS Op Amp	1.49	2524	3.50	8826	3.00
40410	3w PNP	1.75	2525	6.00	8880	1.35
40673	3w NPN	1.75	2527	5.00	7497	5.00

DIODES

(Zener) TYPE	VOLTS	W	PRICE	(Rectifier) TYPE	VOLTS	W	PRICE
IN746	3.3	400m	4/1.00	IN4003	200 PIV	1 AMP	.10
IN751A	5.1	400m	4/1.00	IN4004	400 PIV	1 AMP	.10
IN752	5.6	400m	4/1.00	IN3600	50	200m	6/1.00
IN753	6.2	400m	4/1.00	IN4148	75	10m	15/1.00
IN754	6.8	400m	4/1.00	IN4154	35	10m	12/1.00
IN965B	15	400m	4/1.00	IN4734	5.6	1w	.28
IN5232	5.6	500m	.28	IN4735	6.2	1w	.28
IN5234	6.2	500m	.28	IN4736	6.8	1w	.28
IN5235	6.8	500m	.28	IN4738	8.2	1w	.28
IN5236	7.5	500m	.28	IN4742	12	1w	.28
IN456	25	40m	6/1.00	IN4744	15	1w	.28
IN458	150	7m	6/1.00	IN1183	50 PIV	35 AMP	1.60
IN485A	180	10m	5/1.00	IN1184	100 PIV	35 AMP	1.70
IN4001	50 PIV	1 AMP	.09	IN1186	200 PIV	35 AMP	1.80
IN4002	100 PIV	1 AMP	.10	IN1188	400 PIV	35 AMP	3.00

TRANSISTORS

MPS-A05	5/$1			2N3905	4/$1
2N918	.25	2N2906A	4/$1	2N3906	4/$1
2N2219A	3/$1	2N2907A	5/$1	PN4249	4/$1
2N2221	4/$1	2N3053	2/$1	PN4250	4/$1
2N2222A	5/$1	2N3055	.95	2N4409	5/$1
2N2369	5/$1	2N3725A	2/$1	2N5129	.19
2N2369A	4/$1	2N3903	5/$1	2N5139	.19
2N2484	4/$1	2N3904	4/$1	C106B1-SCR	2/$1

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea:	10 OHM 27 OHM	12 OHM 33 OHM	15 OHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM	1/4 WATT 5% = 50 PCS.
ASST. 2	5 ea:	68 OHM 180 OHM	82 OHM 220 OHM	100 OHM 270 OHM	120 OHM 330 OHM	150 OHM 390 OHM	1/4 WATT 5% = 50 PCS.
ASST. 3	5 ea:	470 OHM 1.2K	560 OHM 1.5K	680 OHM 1.8K	820 OHM 2.2K	1K 2.7K	1/4 WATT 5% = 50 PCS.
ASST. 4	5 ea:	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	1/4 WATT 5% = 50 PCS.
ASST. 5	5 ea:	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	1/4 WATT 5% = 50 PCS.
ASST. 6	5 ea:	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	1/4 WATT 5% = 50 PCS.
ASST. 7	5 ea:	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	1/4 WATT 5% = 50 PCS.

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Desk top calculator by well known mfgr. These are rejects, 8 digit, 4 function, liquid crystal display. Fully assembled, some factory reject, some customer returns. Most are repaired in a few minutes. Sold "as is." Ship wt 3 lbs.

Battery portable model $11 each 3 for **$30.00**

SINGLE CHIP ASCII ENCODER

A hot item today. We furnish full data booklet with each order. $10 each 3 for **$25.00**

8 CHAN MULTIPLEX SWITCH

Solid state 16 pin IC MOS. 8 channel w/output enable control & one-of-eight decoder in chip. With data. Fairchild 3705. . . ~~$5.00~~ **$3.00**

RC OSCILLATORS

16 pin IC chip contains 4 RC osc. Ideal for touch tone encoder. TCA 430. . . ~~$5.00~~ **$3.00**

PHOTO-STROBE

Made for Instamatic but useful on any camera with instructions provided. Info also on trick uses, automotive strobe, slave strobe, automotive strobe, Psychedelic repetitive strobe, etc. Complete with charger & Nickel Cadmium batteries.

$8.00, 3 for $22.00

COLUMBIA 4 CHANNEL SQ

Solid state SQ 4 channel adapter, 2 amps built in. Decodes 4 channel or synthesizes 4 channel.

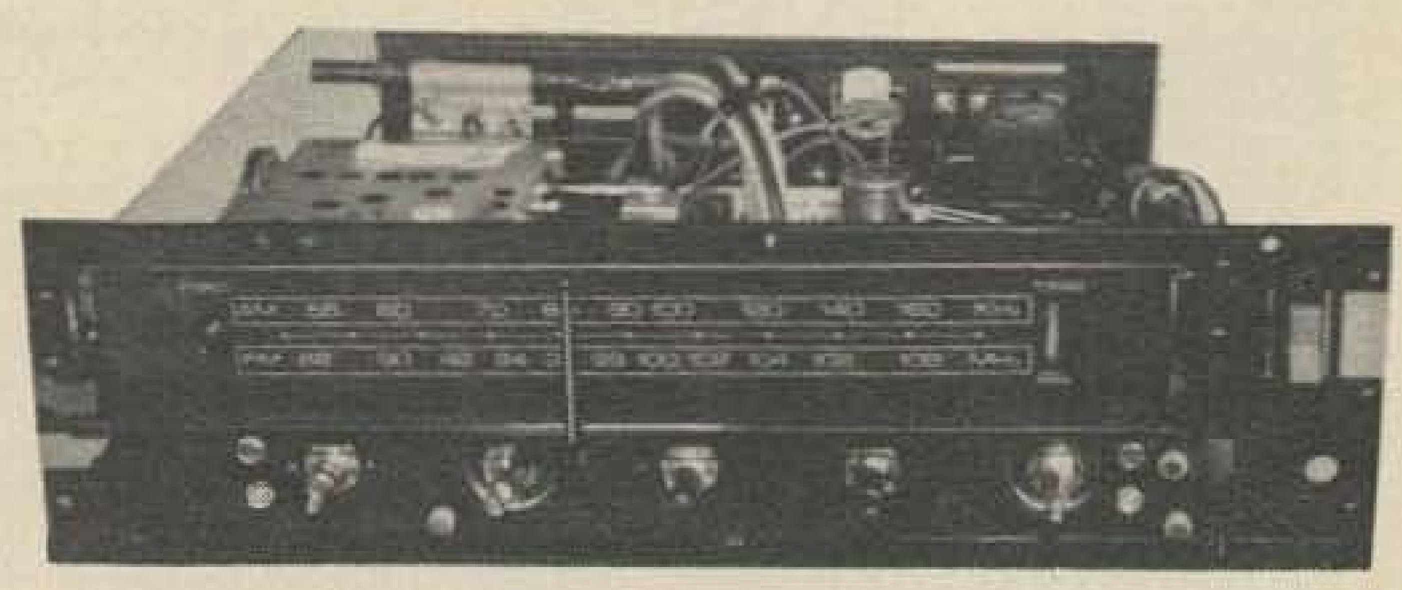
$20.00

LED READOUTS 5/$1.00!

The price is not a mistake. We have some hobby variety with some segments out. Ukinbuyem for as low as **5 for $1.00**

DUAL 16 BIT MEMORY

Dual 16 bit memory, serial MOS by Philco TO-5 case, brand new with 2 page specs.
#PLR 532 $1.00 each $10/12



Beautiful AM-FM Stereo Multiplex radios made to sell in the over $100 range. Picture shows typical unit. Solid state. AC powered, made for famous US manufacturer. Ship wt 10 lbs. **$35.00**

AM–FM RADIO

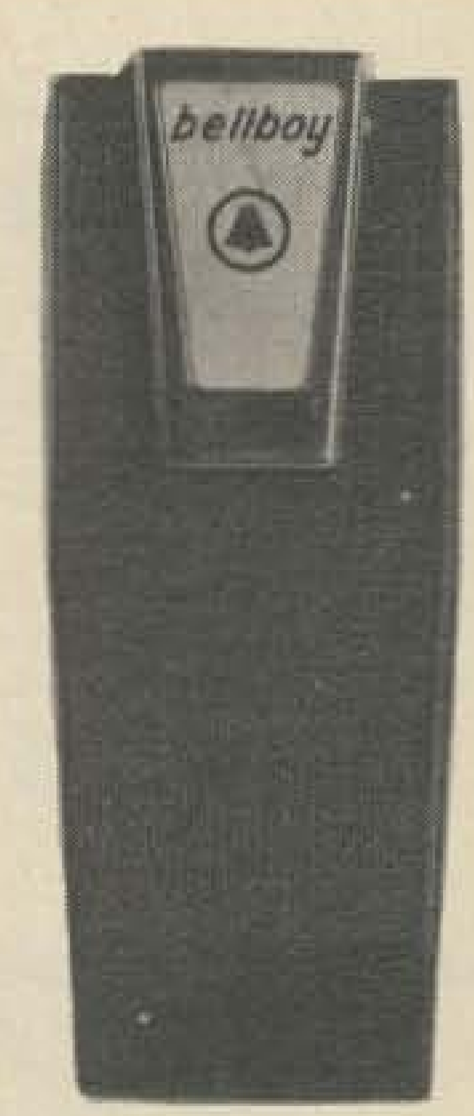
For console installation, w/face plate, no knobs. Stereo amplifiers for tape or turnable playback. **$15.00**
Pair of matching speakers w/xfmrs for above **$5.00**

CALCULATOR CHASSIS

Fully assembled pocket calculator chassis less calculator chip. Uses LED readouts not included. **$1.00 each, 6/$5.00**

BELLTONE PAGER

Genuine "Ma Bell" belt clip radio receiver beeper. Picks up specific radio signals in 35 MHz area, encoded by internal reed encoder. Seems to be a "natural" for construction jobs, in-plant calling. An interesting experimental gadget. Self contained antenna, adjustable coding by shifting wires on coding module.
#SP-125 $5.00 each,6/$25.00



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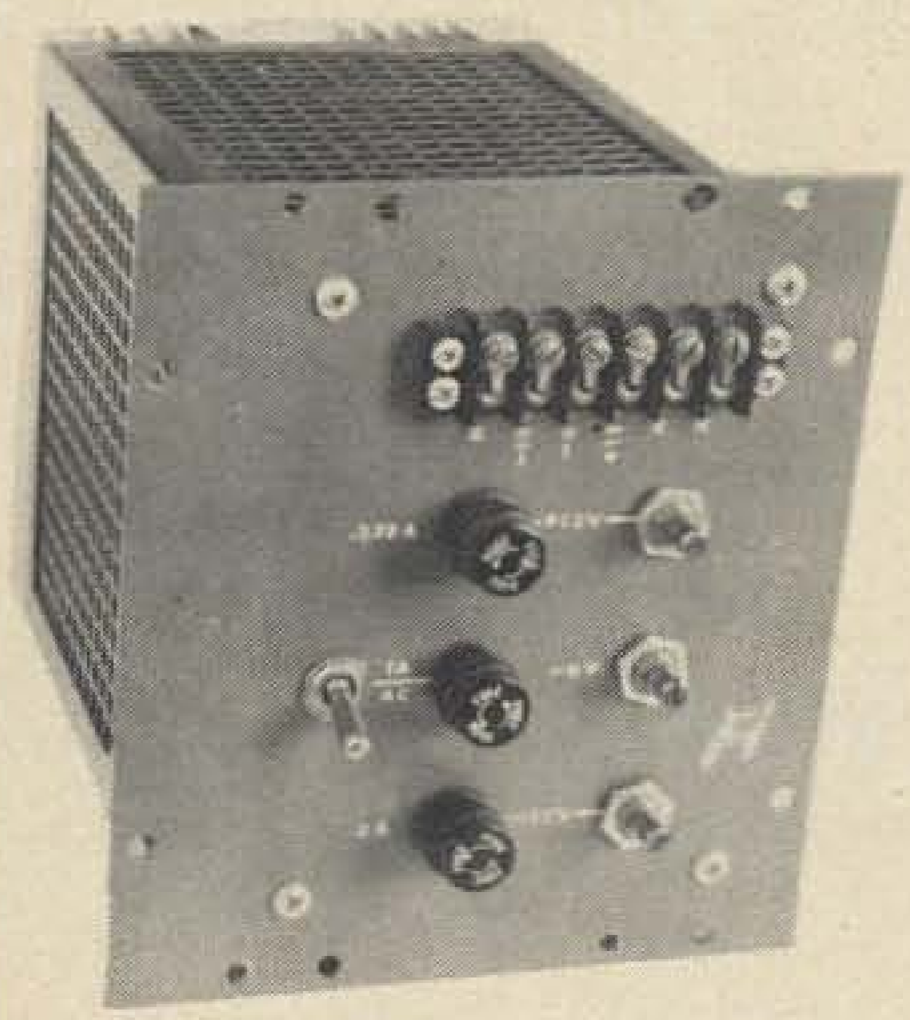
KEYBOARD $35.00

One of the nicest keyboards we've found. Mounted in modern design wood grained enclosure for desk-top use. Magnetic reed relay bounceless keyswitches, Encoder board mounted within. Fine Biz. for Morse Code Generators — TV Typewriter — computer terminals, etc.

7 lb #SP-153L $35.00



GENERAL PURPOSE POWER SUPPLY

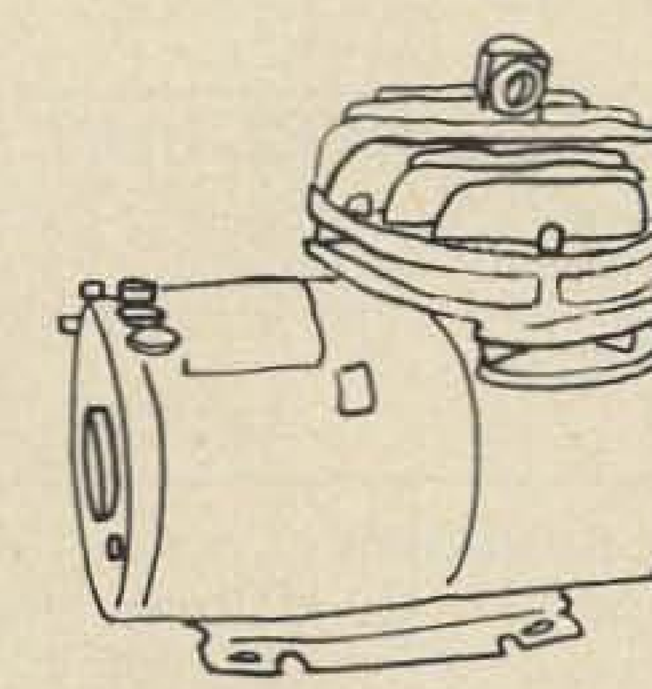
Well designed transistorized, regulated power supply with many uses. Each voltage adjustable by pot. Each voltage fused. 115 volts ac input. Output (minus) 12 volts at 1/3 Amp, 12 volts (plus) at 3 Amps, 6 volts at 1 Amp. Three output voltages. Many uses . . . as battery charger, op amp (plus & minus 12 volts), 5 volt logic (adjust 6 volts to 5 volts), operate your car radio, tape player, CB set in the house, etc. A commercially built supply for less than the price of kit.

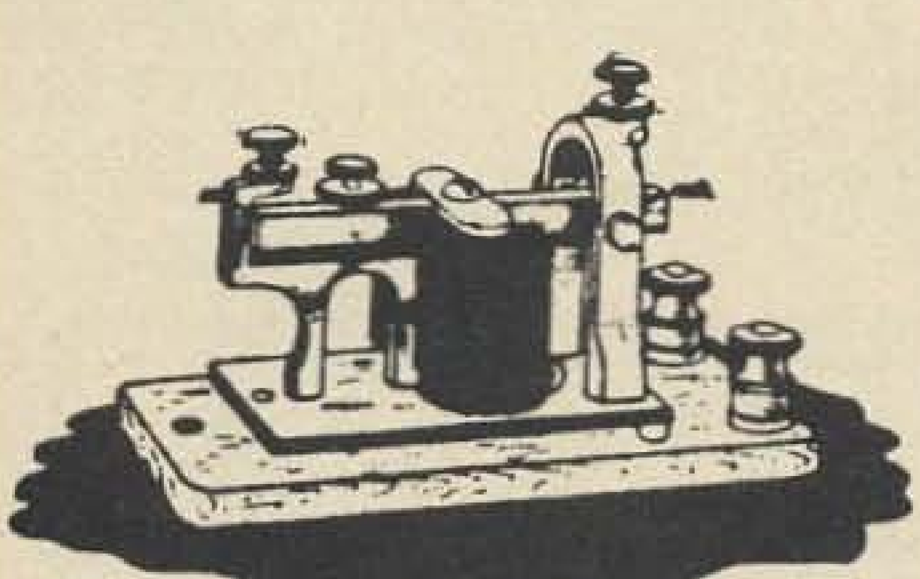
10 lb #SP-152L $12.50 5/$50

AIR COMPRESSOR $19.00

Diaphram compressor slightly used surplus from the computer industry. Built-in 115 volt ac motor ball bearing for long life. Puts out 17 PSI with volume 0.7 SCFM. For general paint spraying, air cleaning, bubble bath for PC etching tank, etc. Many uses in lab or home.

14 lb #SP-148L $19.00





ANTIQUE SOUNDER

Takes you back to the Pony Express days. A genuine antique relic dating back to the old days. A real beauty, polished brass, wood base, bright and shiny new despite its age. In original packing as issued to the US Navy Dept. Already worth more than our asking price. Makes an unusual gift or desk top conversation piece for the man who has almost everything.

#SP-115 $15.00 2/$25.00

SPERRY 9 DIGIT DISPLAY $2.50

180 volt 9 digit, 0.25 inch height character. Brand new and we include free with each, the $1.50 mating socket. The price an astounding new low . . . $2.50

#SP-145 $2.50 5/$10.00

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7-Segment Readout 12-PIN DIP

Three digits with right-hand decimal
Plugs into DIP sockets
Similar to (LITRONIX) DL337
Magnified digit approximately .1"
Cathode for each digit
Segments are parallel for multiple operation
5-10 MA per segment
EACH $1.75 4 (12 DIGITS) $6.00)

RCA Numitron

EACH............$ 5.00

SPECIAL: 5 FOR $20.00

DR2010

MOS MEMORY 2102-2

1024 Bit Fully Decoded Static MOS Random Access Memory

- fast access 650ns
- fully TTL compatible
- n channel silicon gate
- single 5 volt supply
- tri-state output
- 1024 by 1 bit
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- no clocks or refreshing required

Brand New Factory Parts

16 PIN DIP Each $5.00
8 for $34.95

Power Supply SPECIAL!

723 DIP variable regulator chip 1-40V, + or - output @ 150 MA 10A with external pass transistor--with diagrams for many applications.
EACH $1.00 10 FOR $8.95

5001 Calculator

40-Pin calculator chip will add, subtract, multiply, and divide. 12-digit display and calculate. Chain calculations. True credit balance sign output. Automatic over-flow indication. Fixed decimal point at 1, 2, 3, or 4. Leading zero suppression. Complete data supplied with chip.

CHIP AND DATA........ONLY $2.49
DATA ONLY (Refundable)... $1.00
5002 LOW POWER CHIP AND DATA $12.95

High Quality PCB Mounting IC Sockets

8-PIN, 14-Pin, 16-Pin and 24-Pin PCB mounting ONLY--no wire wrap sockets.

8-Pin.............$ .22
14-Pin........$ .26
16-Pin........$ .30
24-Pin........$ .75
40-Pin..........$1.25

All IC's are new and fully tested. Leads are plated with gold or solder. Orders for $5.00 or more will be shipped prepaid Add $ .55 for handling and postage for smaller orders; residents of California add sales tax. IC orders are shipped within 2 workdays--kits are shipped within 10 days of receipt of order. $10.00 minimum on C.O.D.'s.

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Dale Trimmer

- 12 turn trimpots which plug into a DIP socket
- 5K and 200K
- ¼" x ¼" x ¼"
- 4 leads spaced .3" x .2"

Each $1.00 10 for $8.95

1000 MHz Counter

11C05 Fairchild 1GHz Divide By Four

- DC to 1000 MHz operation
- AC or DC coupled
- Voltage compensated
- TTL or ECL power supply
- 50 ohm drive output
- Lead compatible with Plessy SP613
- True and complement ECL outputs
- 14 pin DIP
- Data and application notes

Each $49.95

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MV50 Red Emitting $ .20
10-4 MA @ 2V 10 FOR $1.25

MV5024 Red TO-18 $ .35
High Dome 10 FOR $2.95

MV10B Visible Red $ .30
5-7 MA @ 2V 10 FOR $2.50

CMOS

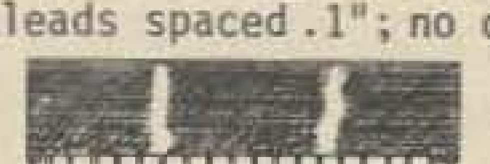
CD4001	$ .45	CD4023	$ .45
CD4002	.45	74C20	.65
CD4011	.45	74C160	3.25
CD4012	.45		

3-Amp Power Silicon Rectifiers

MARKED EPOXY AXIAL PACKAGE

PRV	PRICE	PRV	PRICE
100	$.10	800	$.30
200	.15	1000	.40
400	.18	1200	.50
600	.23	1500	.65

DIODE ARRAY 10-1N914 silicon signal diodes in one package. 20 leads spaced .1"; no common connections.

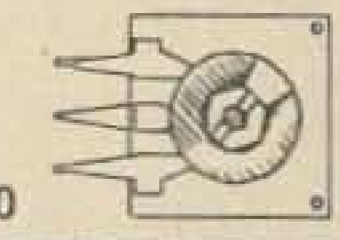


EACH.....$.29
10 FOR $2.50

7400	.20	74H51	.25
74H00	.30	7453	.20
7401	.20	7454	.20
74H01	.25	74L54	.25
7402	.25	74L55	.25
7403	.25	7460	.16
7404	.25	74L71	.25
74H04	.30	7472	.40
7405	.30	74L72	.60
7406	.40	7473	.35
7408	.30	74L73	.75
74H08	.30	7474	.45
7410	.20	74H74	.75
7413	.75	7475	.80
7417	.40	7476	.55
7420	.20	74L78	.70
74L20	.30	7480	.50
74H20	.30	7483	.70
74H22	.30	7489	3.00
7430	.20	7490	1.00
74H30	.30	7492	.65
74L30	.30	7493	1.00
7440	.20	7495	.65
74H40	.30	74L95	1.00
7442	1.00	74107	.35
7447	1.50	74145	1.25
7450	.20	74180	1.00
74H50	.30	74193	1.50
7451	.20	74195	.65

7400 Series DIP

25K Trimmer



PRINTED CIRCUIT BOARD TYPE
EACH $.20 10 FOR $1.50

Rectifiers

VARO FULL-WAVE BRIDGE

VS647 2A 600V $1.10

MR810 Rectifier 50V 1A $ .10

Special 811: Hex Inverter

TTL DIP Hex Inverter; pin interchangeable with SN 7404. Parts are brand new and branded Signetics and marked "811."

DATA SHEET SUPPLIED

EACH $ .16
10 FOR 1.50
100 FOR 14.00
1000 FOR 110.00

1 AMP RECTIFIER

1N4007 1KV PRV

EACH $ .15

SALE 10 for $1.00

MAN 4

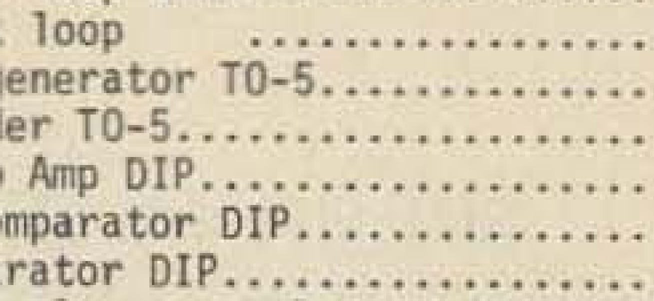
7-Segment, 0-9 plus letters. Right-hand decimal point. Snaps in 14-pin DIP socket or Molex. IC voltage requirements. Ideal for desk or pocket calculators!

EACH $1.20 10 OR MORE $1.00 EACH

CD-2 Counter Kit

This kit provides a highly sophisticated display section module for clocks, counters, or other numerical display needs. The unit is .8" wide and 4 3/8" long. A single 5-volt power source powers both the ICs and the display tube. It can attain typical count rates of up to 30 MHz and also has a lamp test, causing all 7 segments to light. Kit includes a 2-sided (with plated thru holes) fiberglass printed circuit board, a 7490, a 7475, a 7447, a DR2010 RCA Numitron display tube, complete instructions, and enough MOLEX pins for the ICs... NOTE: boards can be supplied in a single panel of up to 10 digits (with all interconnects); therefore, when ordering, please specify whether you want them in single panels or in one multiple digit board. Not specifying will result in shipping delay.

COMPLETE KIT ONLY $10.95
FULLY-ASSEMBLED UNIT $15.00



Boards supplied separately @ $2.50 per digit.

L I N E A R S

NE555	Precision timer	.90
NE560	Phase lock loop DIP	2.95
NE561	Phase lock loop DIP	3.00
NE565	Phase lock loop	2.95
NE566	Function generator TO-5	3.50
NE567	Tone decoder TO-5	3.50
709	Popular Op Amp DIP	.40
710	Voltage comparator DIP	.60
711	Dual comparator DIP	.45
723	Precision voltage regulator DIP	1.00
741	Op amp TO-5/MINI DIP	.45
748	Op Amp TO-5	.80
CA3018	2 Isolated transistors and a Darlington-connected transistor pair	1.00
CA3045	5 NPN transistor array	1.00
LM100	Positive DC regulator TO-5	1.00
LM105	Voltage regulator	1.25
LM302	Op Amp voltage follower TO-5	1.25
LM308	Op Amp TO-5	2.00
LM309H	5V 200 MA power supply TO-5	1.00
LM309K	5V 1A power supply module TO-3	1.00
LM311	Comparator Mini	1.75
LM370	AGC amplifier	1.75
LM380	2-Watt Audio Amp	1.75
LM1595	4-Quadrant multiplier	1.70
MC1536T	Op Amp	1.35

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9-FUNCTION, 8-DIGIT MEMORY CALCULATOR KIT

It's the easiest multi-function kit today!

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- **Percent, Constant, Display Restore**

$16.95

4-Function Arithmetic
- **22 KEYS!**

EASY TO PUT TOGETHER! You bet it is . . . imagine no resistors, capacitors, but it **ONLY REQUIRES 2 CHIPS and a READOUT!** How's that for simplicity? The 2 Memory keys are MS Memory Storage and MR Memory Recall (requires very little soldering). The display restore key is to conserve battery life. Your display on panel shuts off 25 seconds after the last operation. By depressing "D" key, the display is restored! Uses 6 N cell batteries. Red decimal appears on left to show when batteries need replacement or charging. Has Decimal, Clear, Constant, Percent, and arithmetic key red, white and blue colors. Lightweight, pocket size 5¼ x 3 x (2" at back side) x 1¼" front side of angular display panel black case. Nifty unit for business, school, home, and for the youngsters. Slips into any pocket, briefcase with ease. Easy-to-understand pictoral instruction booklet and how-to-use-book.

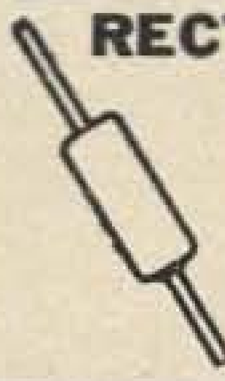
AC/DC too!

KIT INCLUDES: case, 22-key keyboard kit, ON-OFF switch (part of keyboard) PC board, driver and memory calculator chips, 9-digit "bubble" magnifier LED array, array cable, AC adapter jack & wires, battery case, 6 battery card display, instruction and pictoral step-by-step construction booklet.

MICROPROCESSORS! ROMS! RAMS! MEMORIES!

☐ **8008**	Microprocessor	$39.95
☐ **8080**	Super 8008	250.00
☐ **2102**	1024 Static RAM	3.95
☐ **1101**	256 bit RAM	1.50
☐ **1103**	1024 bit RAM	2.95
☐ **MM5260**	1024 RAM	2.95
☐ **MM5262**	2048 bit RAM	6.50
☐ **2513**	Character generator	12.50
☐ **MM5203Q**	Eraceable PROM	19.95
☐ **MM5202Q**	Eraceable PROM	19.95
☐ **1702A**	Eraceable PROM	19.95
☐ **8223**	Programmable ROM	2.95

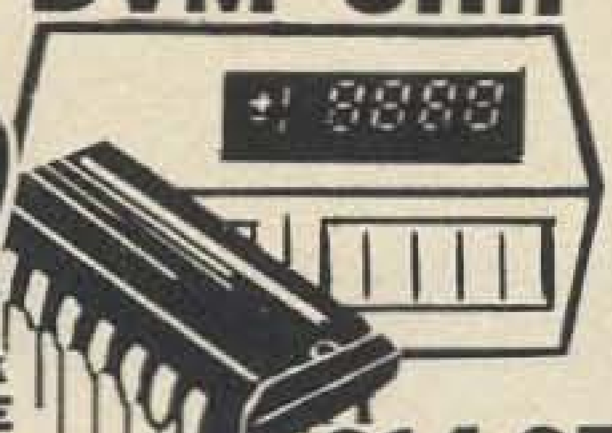
'BLASTAWAY' ON 1N4000 RECTIFIER PRICES



Type	PIV	Sale
☐ 1N4001	50	10 for 45c
☐ 1N4002	100	10 for 55c
☐ 1N4003	200	10 for 65c
☐ 1N4004	400	10 for 75c
☐ 1N4005	600	10 for 85c
☐ 1N4006	800	10 for 99c
☐ 1N4007	1000	10 for 1.29

4½ DIGIT DIGITAL VOLTMETER DVM CHIP

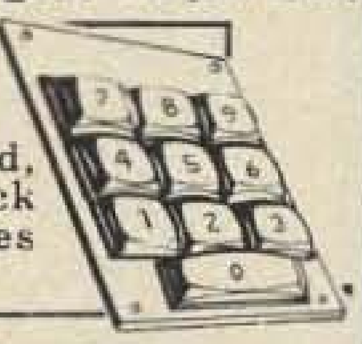
Money-Back GUARANTEE on all items



$14.95

Type MM5330 by National utilizes P channel low-threshold enchancement mode devices and ion implanted depletion mode devices. Provides logic circuit for 4½ digit DVM. All logic for four decade counters, a divide by four counter, a divide by two counter for over-range blanking, latches for all counter stages, an output ROM to generate BCD to 9's complement BCD of the latches and a module 4 counter to sequentially present each of decade latches thru ROM to the BCD outputs plus four outputs to indicate which decade is display. A reset for all counter stages, transfer pulse generator to set the latches. To 400 Khz operation. TTL compatible With instruction sheets and diagram on "how-to-build a 4½ digit DVM". Ideal with our Litronix ½" single, 1½" and dual digits. 16-pin DIP.

Touch Tone KEYBOARD KIT ☐ $4.95



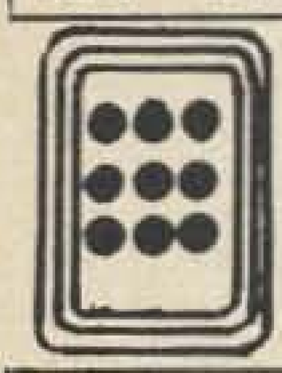
Kit includes 4 x 2½" G-10 glass etched pc board, with 10 OAK "smooth touch" white keys with black numerals, plus diagram on "touch tone encoder". Makes many "keyboard systems" readily available. *0-to-9*

☐ 555 Timer **2 for $1**

OR

☐ 558 Dual 741 **3 for $1**

POSTAGE STAMP MOBILE SPKR MIKE ☐ $1.98



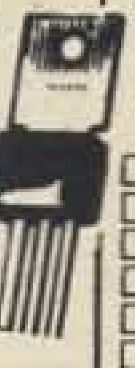
This unit is not advertised — anywhere! Made for Motorola Communications at the original cost of $4.50 each (for insertion in their Walkie Talkie Program). It's a 60-ohm imp MIKE. It's an excellent speaker too, covering broad range in sound. Extremely well-made.

NATIONAL LM-340T VR's

- TO-220 Case
- 1 Amp
- POSITIVE VOLTAGE

$1.75 Each

Buy 3 — Take 10%



Type	Volts
☐ LM-340-05T	5 v
☐ LM-340-06T	6 v
☐ LM-340-08T	8 v
☐ LM-340-12T	12 v
☐ LM-340-15T	15 v
☐ LM-340-18T	18 v
☐ LM-340-24T	24 v

INDUSTRIAL SPEED CONTROL ☐ $4.95

A $30 item from G.E. Model 533A (made for Xerox) that controls home, shop and industrial lighting too! A very elaborate circuit for controlling many electrical and electronic devices. Easily controls speeds of electric drills, brush type motors, etc. 115vac, rated at 1100 watts. With variable speed or dimming control in heavy-duty aluminum case. 3 x 2¾ x 2. With diagram and hookups.

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☐ Red	☐ Red
☐ Green	☐ Yellow
☐ Yellow	☐ Green
☐ Amber	☐ Amber
☐ Clear	☐ Clear

Micro	.210x.125
☐ Red	☐ Yellow
☐ Green	☐ Amber

Micro (Axial) MV-50 style

- ☐ MV-50 Clear . . . . 10 for $1.
- ☐ MV-55 Red . . . . . 6 for $1.

7-SEGMENT READOUT SALE!

- Up to 20 mils per seg. at 5V.
- All fit into 14-pin IC socket.

Type	Size	Color	Sale	3 for
☐ MAN-1	.27	Red	$2.50	$6.00
☐ MAN-3MA	.12	Red	.69	2.00
☐ MAN-4AB	.27	Red	1.95	5.00
☐ MAN-5	.27	Green	1.50	4.00
☐ MAN-6	.6	Red	4.50	12.00
☐ MAN-64	.4	Red	3.50	9.00
☐ MAN-7	.27	Red	1.00	2.50
☐ MAN-8	.27	Yellow	1.50	4.00

ALL ABOVE BY MONSANTO

Type	Size	Color	Sale	3 for
☐ SLA-1	.33	Red	$1.95	$5.00
☐ SLA-1	.33	Green	1.95	5.00
☐ SLA-1	.33	Yellow	1.95	5.00
☐ SLA-3	.7	Green	4.95	12.00
☐ SLA-3	.7	Yellow	4.95	12.00
☐ 707	.33	Red	1.95	5.00
☐ 704A	.33	Red	1.95	5.00
☐ 701C	.33	Red	1.50	3.00
☐ FND-70	.25	Red	1.50	3.00

A—Common Cathode, others Common Anode
B—With bubble magnifier
C—Plus or Minus 1

LITRONIX "JUMBO'S"

- Singles size: 1 x 3/4 x 5/16
- Duals size: .8 x .9 x .29
- 7-Segment, 25-mils per segment

Type	Size	Color	Sale	3 for
☐ 721D	.5	Red	$5.95	$15.00
☐ 727E	.5	Red	5.95	15.00
☐ 746F	.6	Red	3.95	11.00
☐ 747	.6	Red	3.95	11.00

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E—Dual digits
F—Plus or Minus 1

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☐ SN7405	.19	☐ SN7448	.99	☐ SN7494	.95	☐ SN74161	1.25
☐ SN7406	.35	☐ SN7450	.16	☐ SN7495	.79	☐ SN74163	1.35
☐ SN7407	.35	☐ SN7451	.17	☐ SN7496	.79	☐ SN74164	1.50
☐ SN7408	.19	☐ SN7452	.17	☐ SN74100	1.40	☐ SN74165	1.50
☐ SN7409	.19	☐ SN7453	.17	☐ SN74104	.44	☐ SN74166	1.50
☐ SN7410	.16	☐ SN7454	.17	☐ SN74105	.44	☐ SN74173	1.45
☐ SN7411	.25	☐ SN7455	.22	☐ SN74106	.52	☐ SN74174	1.39
☐ SN7413	.59	☐ SN7460	.17	☐ SN74107	.44	☐ SN74175	1.30
☐ SN7414	1.65	☐ SN7462	.22	☐ SN74108	.89	☐ SN74176	1.20
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21	22	23	[24]	25	26	27
28	(29)	[30]				

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ARGENTINA	14	7	7	7	7	7	14	14	14	14	14A	14A
AUSTRALIA	14	7B	7B	7	7	7	7	7	7	7	14	14
CANAL ZONE	14	7	7	7	7	7	7A	14	14	14	14A	14A
ENGLAND	7	7	7	7	7	7	7	14	14	14	14	7
HAWAII	14	7B	7B	7	7	7	7	7	14	14	14	14
INDIA	7	7	7B	7B	7B	7B	14B	14	14	7	7	7
JAPAN	14	7B	7B	7	7	3	7	7	7	7	7	14
MEXICO	14	7	7	7	7	3A	7	14	14	14	14	14
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PUERTO RICO	7	7	7	7	7	3A	7A	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7B	7A	14	14	14A	14	14	14
U. S. S. R.	7	3	3	3A	3A	7	7	14	14	14	7	7
WEST COAST	14	7	7	7	7	3A	7	7A	14	14	14	14

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ALASKA	14	14	7	7	3	3	3	7	7	7A	14	14
ARGENTINA	14	14	7	7	7	7	7	14	14	14	14A	14A
AUSTRALIA	14	14	7B	7	7	7	7	7	7	7	14	14
CANAL ZONE	14	7A	7	7	7	7	7	14	14	14	14A	14A
ENGLAND	7	7	7	7	7	7	7	14	14	14	14	7
HAWAII	14	14	7B	7	7	7	7	7	14	14	14	14
INDIA	7	7	7B	7B	3B	3B	7B	7	7A	7A	7	7
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PHILIPPINES	14	14	7B	7B	3B	3B	3B	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	3	7A	14	14	14	14	14A
SOUTH AFRICA	7	7	7	7	7B	7B	7A	14	14	14	14	14
U. S. S. R.	7	3	3	3	3	3B	7	7	14	14	7	7

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
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ARGENTINA	14	14	7B	7	7	7	7B	14	14	14A	14A	14A
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PHILIPPINES	14	14	14	7B	7B	7B	3B	7	7	7	7B	14
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U. S. S. R.	7	3B	3	3	3	3B	3B	7	7A	7A	7	7
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A = Next higher frequency may be useful also.

B = Difficult circuit this period.

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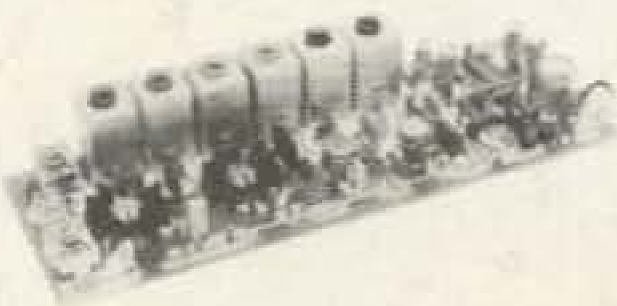

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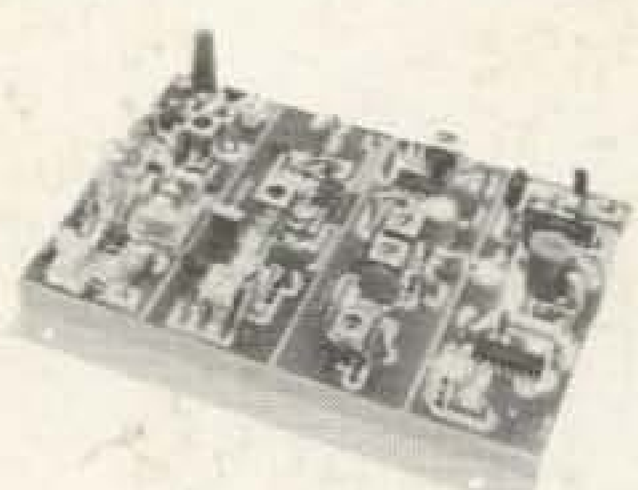

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RX144C W/T .	factory wired / mounted	114.95
RX220C	210-240 MHz rcvr w/2 pole xtal 10.7 filter	69.95
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PA4010H W/T	factory wired	74.95
PA144/15 Kit .	similar to PA1501H less case, connectors & switching	39.95
PA144/25 Kit .	similar to above – 25w	49.95
PA220/15 Kit .	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit .	NEW – similar to PA144/15 except 10w and 432 MHz	39.95
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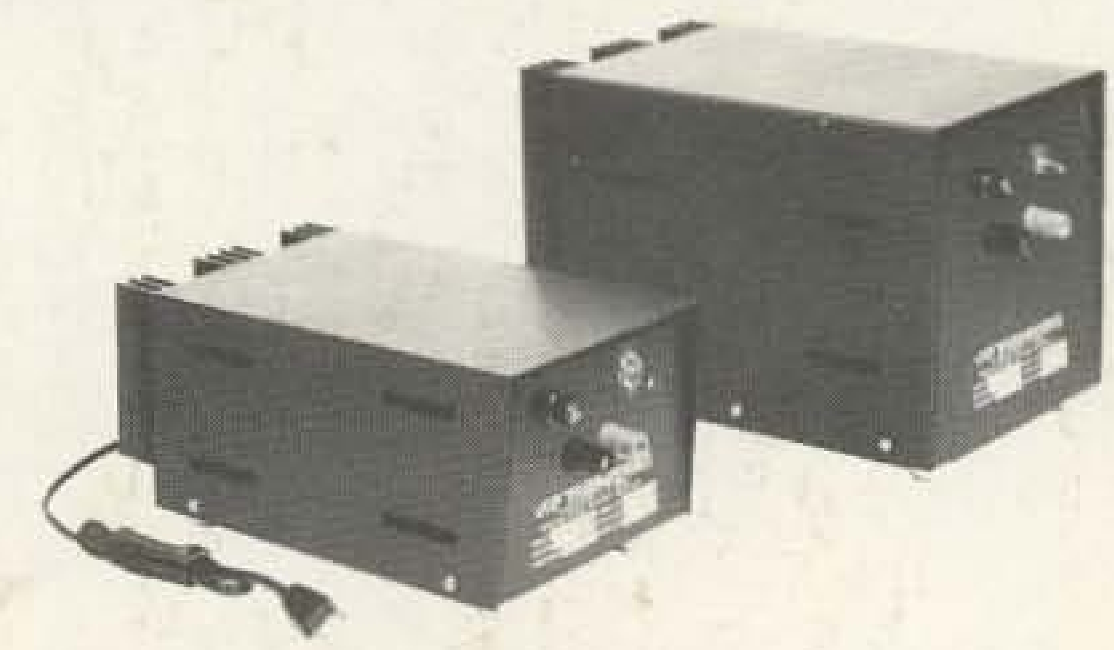
PA140/30 . . .	NEW – 30w in – 140w out 2 meter amp – factory wired . .	159.95



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*DPLX-220 . .	220 MHz, 6 cavity duplexer tuned to frequency	399.95

SHIPPING INFORMATION: All shipments are F.O.B. Binghamton, N.Y. 13902. Shipments will be made by the most convenient method. Please include sufficient funds to cover shipping and handling. Figure shipping charges on a minimum weight of 2 pounds per unit with the exception of the following: PS 12C – 13 lbs., PS 24C – 25 lbs., Repeaters – 25 lbs.

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