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FEATURES

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NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

SLOW SCAN PROGRAMS

It is one thing to get on the air with slow scan and it is another to come to terms with this new media. You can't use it for very long the same way that you use your phone rig. The problem is the same one that has croppered commercial television – the medium eats up material at a rapid rate.

If you are careful to always make new contacts you have no problem. On the first go round you can get away with sitting there smiling into the camera, flashing your QSL, or a few hastily made posters. From there you can work up some photographs of the wife, children, the shack, house . . . but where do you go from there?

The "professionals" at the game have long since hooked up a good cassette tape recorder to their slow scan system and settled for putting their programs on tapes. As you quickly discover, it will keep you hopping if you have to change flash cards every few frames, swing the camera around and focus it on you or the shack, change your lighting, etc. You will do better to set up your programs similar to the way a television director does the job. Yes, I used to be a TV director, so I can speak with authority.

The first contact should be relatively simple, and consist of a few pictures of you smiling into the camera, a couple of the shack, one of the wife, and a QSL. In practice you'll need two different programs for the first contact, one for working stronger stations and one for weak DX work through QRM. With the weak ones all you really need is a very simple QSL with your call and location on it, probably in big white letters on black.

The second time around you may want to be able to spring something more complicated on your contact. You might do a program showing some of your interests. If you fly, drive an unusual car, have a boat, cameras, or whatever, these are all good grist for the television mill. If you are living in an area of special interest you could shoot some frames showing details about that. Don't forget your kids. You can even hoke up some shots of your baby sitting at the rig or with a mike on a tricycle – you know. The family dog is good for one DX Hound shot.

If you make any trips, keep your slow scan in mind and take some black and white pictures which you can enlarge and put on slow scan tape.

The fact is that there are unlimited possibilities for slow scan programs. I would like to be able to present some of the more interesting ones in the pages of 73. Please get your cameras and cassette recorders set up and, when you come across an interesting program, tape it and send in the pictures so we can pass them along to the readers.

By the way, it is interesting to note that the new slow scan system that has just been announced by Linear Systems (SBE) has a cassette recorder built right into the monitor! This is a logical development. We've been promised one of the new SBE systems and hope to have some interesting news of how it works for you.

The J&R unit has promise too. We did have a chance to try out an early test model for a couple of weeks just before the Dayton Hamvention and were impressed. J&R is making some changes and improvements on the unit and we expect to be able to give you full details and our evaluation before the end of the year. The J&R has a slightly smaller monitor screen than the Robot and there were some slight problems with triggering the vertical scan, but the tuning indicator was most helpful. A good deal of the time you discover a slow scan signal by virtue of the picture being sent and, unless you have a terrific ear or a tuning indicator, you have a tough time getting the picture tuned in right. Once you hear the voice you can zero in just fine, but by then you've missed a lot of pictures.

Most of the slow scan articles so far have been steeped heavily in the technical aspects of the mode. Now that Robot, with SBE and J&R close behind, has reduced much of the technical end to black box (grey, actually) practicality, perhaps we need more information on applications, techniques, use, and such. We certainly do need info on getting the units into tune. It can be most frustrating to the average black box (even if it is grey) user to plug in his camera and monitor only to be told that his contrast or something isn't set right. What to do?

Slow scan is presently limited to the Extra and Advanced segments of the lower bands. Is this a reasonable limitation? Is the use of this new mode part of the reward for getting a higher class license? Is this part of the incentive? Let's have some individual or group out there petition for slow scan on all phone frequencies and see what is what.

The band limitations right now for slow scan are 3.8–3.9, 7.2–7.25, 14.2–14.275, 21.25–21.35, and 28.5–29.7 MHz on the lower bands. All of the phone frequencies above that are open for slow scan. What do you think?

HIGHER POSTAGE

A recent publishing industry magazine revealed that the reason for the postage increases during the last few years has been an end motive of stopping the mail delivery of all magazines and making them be purchased on the newsstands.

When you consider the amount that postage for second class mailing has gone up, this seems not unlikely. It is interesting to note that recent increases have been even steeper than those in the past. The July increase was almost a 50% jump in postage rates for mailing magazines. As near as we can estimate this will make it necessary to increase the yearly subscription rate by a minimum of a dollar – and more probably two! And when you consider that there is no end in sight for this, it is frightening.

The cost of mailing a single issue of 73 has increased over 300% in the few years we have been publishing. Inflation has been serious, but nothing to match that increase.

The post office could, if they wanted, get the cost of handling magazines down to a fraction of today's costs. When you consider the number of magazines that they handle, this is an obvious candidate for automation. Yes, I know that the post office has tried automation and failed miserably – but perhaps magazines could be a different deal.

If the P.O. had a special price for magazines which would fit their automated sorting equipment, the magazines would quickly come around and make the magazines to fit the automation. I should think that something about the size of 73 would go through automatic address readers and sorters quite easily. Larger magazines might tend to bend and fold. Magnetic ink on the addresses would simplify the sorting, allowing machines to decipher the zip codes and speed them in the right directions.

With all magazines the same size, except for thickness, there would be

little difficulty in having the handling of them almost completely automatic. It is people that make for higher costs of handling mail . . . and for slower handling. A magazine sorting machine could zip through thousands of magazines an hour . . . maybe tens of thousands. If the addresses were put on the spine of the magazine they could be "read" and sorted as they moved along.

Unless something like that comes about the post office will eventually be able to force magazines out of business except for newsstand circulation.

EXPO 72

While not the dud of Expo 71, this is still not a hamfest to drag in the troops in quantities. Much of the problems facing the committee running the hamfest this year were the results of gross exaggerations made by last year's committee which resulted in enough resentment on the part of many exhibitors to keep them away in 72.

As an exhibitor in 71 it seemed to me that the 10,000 or was it 50,000 promised was in actuality a few dozen. This year they soft-pedaled the promises and few of the exhibitors were disappointed.

Expo is, by large, an FM affair. A few CB groups turned out to display, but most of those attending were FMers. CQ wisely decided not to support the hamfest this year. Ham Radio was there with a whole bunch of free subscriptions. QST did not support the hamfest either.

One of the most exciting exhibits was the two meter synthesizer at the RP Electronics booth. This gadget had the FMers waving their arms in anticipation. The prototype looked good. It had a numerical readout for the transmitter channel and the receiver was automatically 600 kHz higher. Thus all you had to do was set it for 146.16 and it would receive on 146.76 . . . etc. They are working on a model with separate dials – but since almost all repeaters today are 600 kHz spaced, by the time they get the second unit in production it may not be needed.

General Aviation was there showing off their new transceivers . . . and the pileups around the booth were as heavy as any we saw at the hamfest. Thirty watts and ten channels for only $250 may be a popular combination.

The Clegg 27A, now being delivered at long last, was on display and was a focal point of interest. It was an FM hamfest, for sure. Keith W7DXX and I manned the 73 booth. We took along a 27A for our own use in the rented car, this being a better-than-average solution to the need for a lot of new channels. The Chicago repeater situation is not all that might be hoped – with just one major repeater serving an area with thousands of amateurs. This is not to in any way put down the service provided by WA9ORC – a truly remarkable machine, with ears everywhere and fantastic coverage. But, when you consider that there are about twenty repeaters ready for instant use from Peterborough, the three or four Chicago channels seem scant.

Erickson Communications had an interesting booth, filled with nice Standard radios and Tempo amplifiers. Fred Deeg K6AEH was there from Standard, thus winning the prize for the manufacturer who came the furthest for the hamfest. Jim O'Connell W9JZK, the prexy of Erickson, asked around for a competing two meter amplifier to put alongside the Tempo so customers could see the incredible difference in design and construction between the two . . . he located one which a local amateur was anxious to dump and put it next to the comparable (and lower priced) Tempo amplifier. It wasn't too long before the word got around and the other manufacturer came by for a look. He looked . . . and looked . . . and got red in the face. "How much do you want for that?" he asked. "Oh, forty dollars will take it," said Jim – two twenties were in his hand immediately and off went the amplifier. "Don't you want the screws for the bottom?" called Jim after he stormed off.

One of the interesting items unveiled at Expo was the new Standard tone burst encoder – five channels – and designed to plug right into the back of the 826's. It is designed to mount right under the transceiver, matching it, and the price is about $80.

Another crowd gatherer was the line of rf preamplifiers shown by Crawford Electronics. The 146 MHz unit has been out for some time and has earned a very nice reputation. The new units for 220 and 450 MHz look promising.

Few HT-220 owners have not looked with desire at the very flat touchtone unit which has been available to selected cognoscenti . . they are now coming out for the hoi polloi (us). Waller Electronics in Maryland has a complete unit available for about $55 which mounts on the 220, making it about 1/8" thicker. A larger version is also available for $35 ready to connect to other hand and mobile units . . . $30 in kit form. The very small size of these units is made possible by the use of a flat touchtone pad and a tiny IC to generate the tones. Watch for ads from Waller – and an article in 73.

The little 73 FM Log Books (25¢) sold out almost in minutes when "Ev" Everett of the FCC turned up, smiling. I don't think anyone has ever seen fellows wandering around a hamfest before, making logging motions after every portable contact – and the walkie 2m FM transceivers were everywhere – in great profusion. All you had to do was say "BOO" on 94 and your voice would echo back to you from hundreds of belts.

If the Chicago group keeps up the good work, this event could turn into a major yearly hamfest.

AUTOMATIC ID

The FCC seems to be moving along inexorably toward a system of automatic identification for all transmitters. Though this may be another big step toward Big Brother, still it may have enough advantages to offset any "invasion" of privacy that might bother us.

The basic system is simple – build a miniature IC identification unit into each transmitter so it can be identified whenever it comes on the air. This would be built in by the factory on commercially made gear – would be permanently installed and supposedly tamper-proof. The module would transmit a binary blip every time the transmitter was operated and repeat it every 30 seconds. The whole process would take about 5 milliseconds, so it wouldn't be likely to bother anyone much.

Early estimates are that the identifier might cost about $10 at the manufacturers level, which might add about $30 to the ham price for a rig – but experience with IC costs indicates that competition and mass production would probably cut that substantially, probably not adding more than about $10 at the most to the end price.

Obviously the FCC problems with monitoring the many services it runs herd on will be simplified. Monitoring stations need a computer to catch the identification and compare it with license information in the memory. The problems they have with marine operators, police, business and even CB could be quickly eliminated. Rigs without identifiers could be quickly spotted and put off the air. Illegal CB contacts certainly would stop once identification became instant and positive.

As far as amateur radio is concerned, this could be the ticket to getting rid of the antiquated rule requiring us to log all transmissions. And think how fast contacts could be made if it only took 5 milliseconds to call CQ! And how great it would be to have an immediate identification of that DXpedition that forgets for hours on end to mention their call.

I can hear it now. "Blip?" "Blip — — blip!" "QSL."

"Blip?"

SSTV in QRM

Most of the slow scan pictures in the magazines have been taken under ideal conditions. The conditions on 14,230 are not invariably ideal. The result is that some of your DX slow scan contacts may be touch and go, with the DX station having to send quite a few frames before one is received that can be deciphered. My first VK contact was through quite a lot of interference and it took about twenty frames before I got one that came through well enough to call it a contact. The picture above shows what happens when the QRM begins to build up on the slow scan channel . . . this was received by K3SLJ from me on Navassa. You can read it, but that's about all.

INCENTIVES

In a recent letter to an amateur Prose Walker of the FCC Amateur Division mentioned that he was taking steps to find out why 95% of the amateurs have not obtained the Extra Class license. I am one of the 95% and perhaps my own reasons are not entirely irrelevant.

The technical aspect of the license exam looks like a breeze. I am sure that with one or two readings of our Extra Class Study Guide that I would have little trouble getting through the written part. But the code is something else.

I do miss not being able to operate on the low end of the 75m band. That was where I used to hang out, looking for DX and keeping in touch with the gang that hangs out in those waters. Once the band was taken away from me I stopped using 75m almost entirely. But I will be damned if the FCC is going to punish me into taking the Extra Class license — and I will continue to resist, even if they force me up to 1200 MHz.

If the FCC had offered me anything at all in the way of an incentive to get an Extra license I probably would have been right in there, but you do not get action from me by whipping me into submission. This was my reason for protesting the whole idea when the ARRL first suggested it — and again when they petitioned the FCC. I want some kind of reward, not just a cessation of punishment.

My interests in amateur radio are wide — very wide. I enjoy FM, repeaters, RTTY, SSTV, DXing, rag chewing, DXpeditions, and so on. One thing that I don't care for is CW. I am quite sure that if CW was voluntary I would be right in there, getting a big kick out of it. But it isn't voluntary at all — it is compulsory, and the result of that is to get my back up again. The technical exam for some reason makes sense to me — I can understand why that is needed to screen out people who want the amateur license. I don't understand what the relevancy of being able to send and receive code has to do with the matter. I have been an amateur for almost 35 years now and have used voice, RTTY and slow scan signals, but my use of code has been minimal — so why should I have to develop a useless skill of 20 wpm code for a higher phone license? Baloney!

You may wish to call me lazy — and I admit that I am lazy — very lazy when it comes to things that are a complete waste of my time and energy. I will work like hell for something that I want and seems reasonable. How many people are basically different about being lazy?

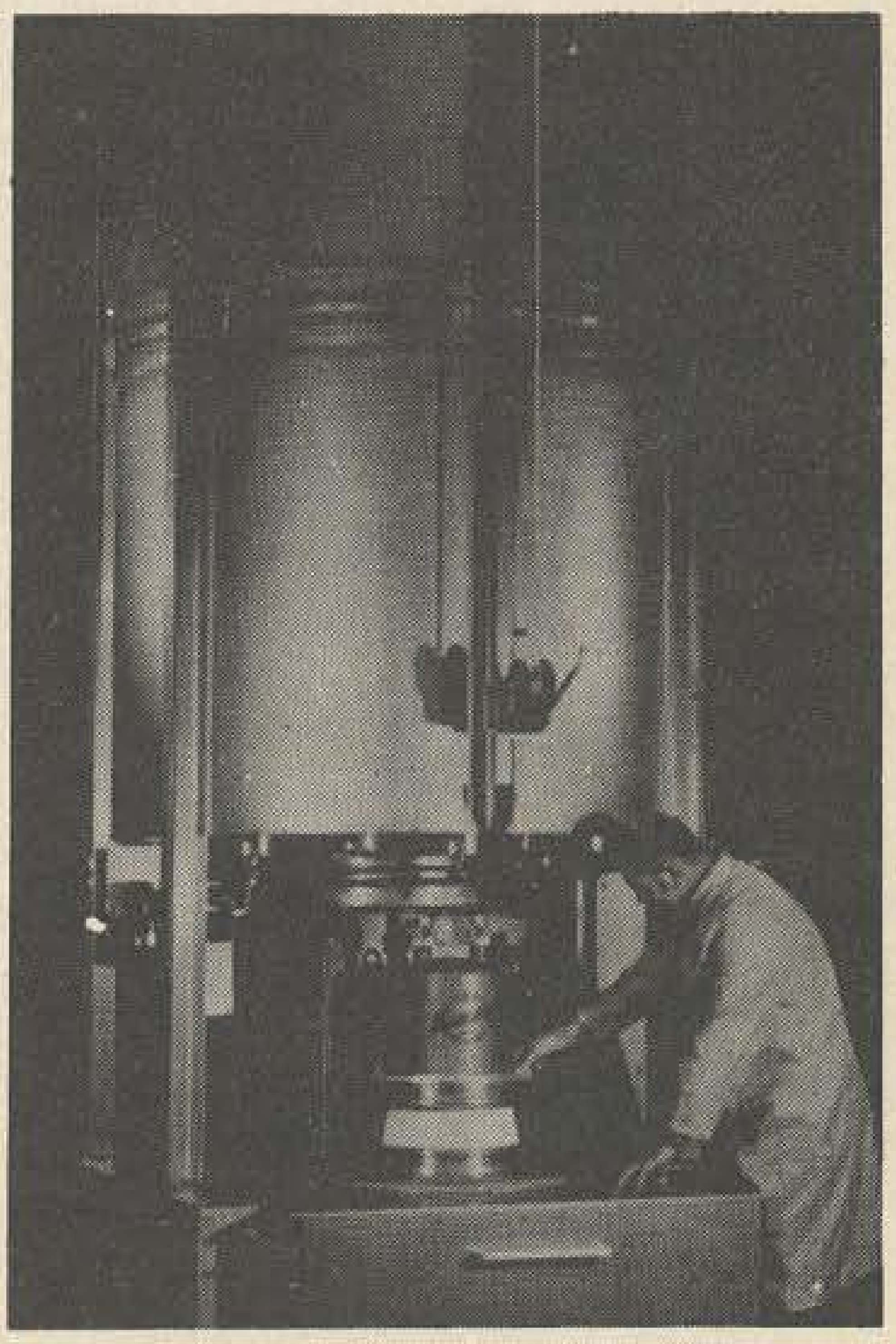
The FCC has turned me off for the time being on 75m and 15m by taking away some of my phone frequencies — but I'm still hanging in there on the other bands. If they come along and dump on me some more I will probably retreat. The psychology is so simple that it is incredible that it is so totally ignored by the FCC — if you want people to go along with you you offer rewards, not punishment.

FM EMERGENCY CHANNEL?

A few of the curmudgeon old timer FMers, inculcated with commercial practices, have been grumbling that repeaters are for emergencies and shouldn't be used for rag chewing. Pish tush and nonsense. If there are enough repeaters in the area to permit rag chewing, then why not? If there are not enough repeaters, how about setting up some more?

There is something to be said about the problem of trying to break in on a pair of inveterate rag chewers. There is a lot to be said. But what is the use of trying to say it when you can't get a word in edgewise? May I suggest an emergency priority input channel? This would allow the gabbers to talk away, repeating themselves as much as they like, pouring forth clichés and trivia, but would still enable the repeater to be used instantly in case of emergency. How about a national panic channel on, say, 145.74 MHz?

A priority channel would certainly be helpful. It would have been nice the other day when I was zipping along the interstate and came across an accident. Sensing the chance to use amateur radio for public service I got a message from the dazed woman who has been driving and wanted her father and husband to know that she and the children were on their way to the hospital. You guessed it, before I could break through on the nearest repeater I was able to phone the message from a gas station. Rats.



WA1KGO Increases Power

Alerted by several ops monitoring the 19–79 repeater that WA1KGQ in Vernon (CT) is stepping up its power in a possible first step of an escalation to take over the 79 channel, the engineering staff on Pack Monadnock swung into two shifts a day to get the new amplifier for KGQ in operation. Here you can see the new final for KGQ being tuned up on 79 by the 73 Technical Editor. Note the nice diplexer built into the plate tank circuit.

SABOTAGE?

One of our readers ran across a weirdie — he bought a piece of surplus which arrived in the original unopened package and, upon close examination, he found that a strategic wire had been cut down deep inside, rendering the unit unworkable. Since the unit had obviously never even been opened by the military, this was a factory "prank." Has anyone else run across anything like this? . . .Wayne

SSTV SCENE

A lot of newcomers have asked about operating procedures and typical picture transmissions. So, first off this month I would like to pass along some ideas to new SSTVers.

Generally most of the gang calls CQ on slow scan for a few frames, interspersed with audio IDs like "K4TWJ calling CQ on Slow Scan TV" a couple of times, then maybe another frame or two of CQ before standing by. This way your video will be noticed if perchance your audio isn't. Pictures you will probably want to record and have ready to transmit often will be pictures of yourself, the XYL, rig (with close-ups of home brew gear) and maybe your city. Plus plenty of IDs. These pictures when recorded on tapes, marked with leader tape as to their content (you can write on paper leader with a ball point pen) make positive transmission of a given picture a snap, while leaving the camera free for candid shots or "instant QSLs" (those menu boards with lettering or blank sheets for the flying spot scanner). Try to briefly explain complex pictures before transmitting them so the other fellow will know who or what you are showing. Then two or three frames of each picture are usually enough for good copy without getting dull. There is usually some of the SSTV group hanging around 14.230 kHz and most of them acknowledge breakers immediately since a group means more pictures and information in a shorter length of time. (And if you are not good friends then, you soon will be).

An item which is just starting to catch on in slow scan popularity is continuous tape loops. W1VRK mentioned this briefly in his recent QST article. Tape loops are ideal for CQs and IDs and are easy to make and use. Just mark a frame of your ID immediately before the vertical pulse (that 1200 Hz "blip") with a grease pencil on the outside of the tape. Let the tape run for 8 seconds (120 lines) and mark it again at the picture bottom (right before the next 1200 Hz vertical pulse). Now splice out the marked frame and splice the frame together to make a loop with the beginning and end of the frame butted together. Drop this loop into the tape recorder, and let the slack just dangle over the side – no spacers, rollers, or reels necessary. Since the end of the frame is spliced to the beginning the loop will play over and over across the tape recorder heads until you stop the tape. Marking the direction of feed and tape content with a grease pen will help if you make up a group of different loops. And hang the loops close by – they'll probably get quite a lot of use.

It is good to see the W7ABW/W7FEN scope adapter in the 1972 ARRL Handbook. This is still one of the least expensive and quickest ways to get on SSTV, and should inspire quite a few to put those old scopes to use as a monitor. Speaking of that, have you noticed how those old scopes are being snapped up at hamfests? It will not be long before scopes are scarce and prices up with the swing to SSTV. (P-7 cathode ray tubes have already started to climb!)

One who is making news with SSTV on 6 meters (and above) is WA1NNW. Ed has worked over 5 states and shooting for WAS/SSTV on six, using a 'scope adapter and W9NTP sampling cameras. He's another one planning SSTV use of the coming satellite. Need Massachusetts on six? Get in touch with him.

Well, I may be taking my life in my hands, but I have another item to pass along this month. Gray scale tapes. These tapes are ideal for setting up and aligning slow scan gear. They consist of 7 shades of gray, and run at 3¾ IPS, 1/2 track. I have approximately 50 of these on 3" reels, and when these run out, I'll cut you a few frames off my 7" reel, and you can splice it into a loop, like I mentioned in the first of this article. Send me a SASE, box, or manila envelope (preferably with a 3" reel of tape inside so I can just swap or dub). If I'm out of the 3" reels I'll return yours and send you some frames to splice into loops.

That's it for this month, be "seeing" you on 14.230.

. . .K4TWJ

* * *

THE COMPLETE SSTV ROSTER?

The chaps at Robot have published their list of slow scanners, and it is a formidable one, with operators in 52 countries listed. Like a repeater list, there is no way to have such a list complete and accurate – even an effort such as the one by Robot is difficult.

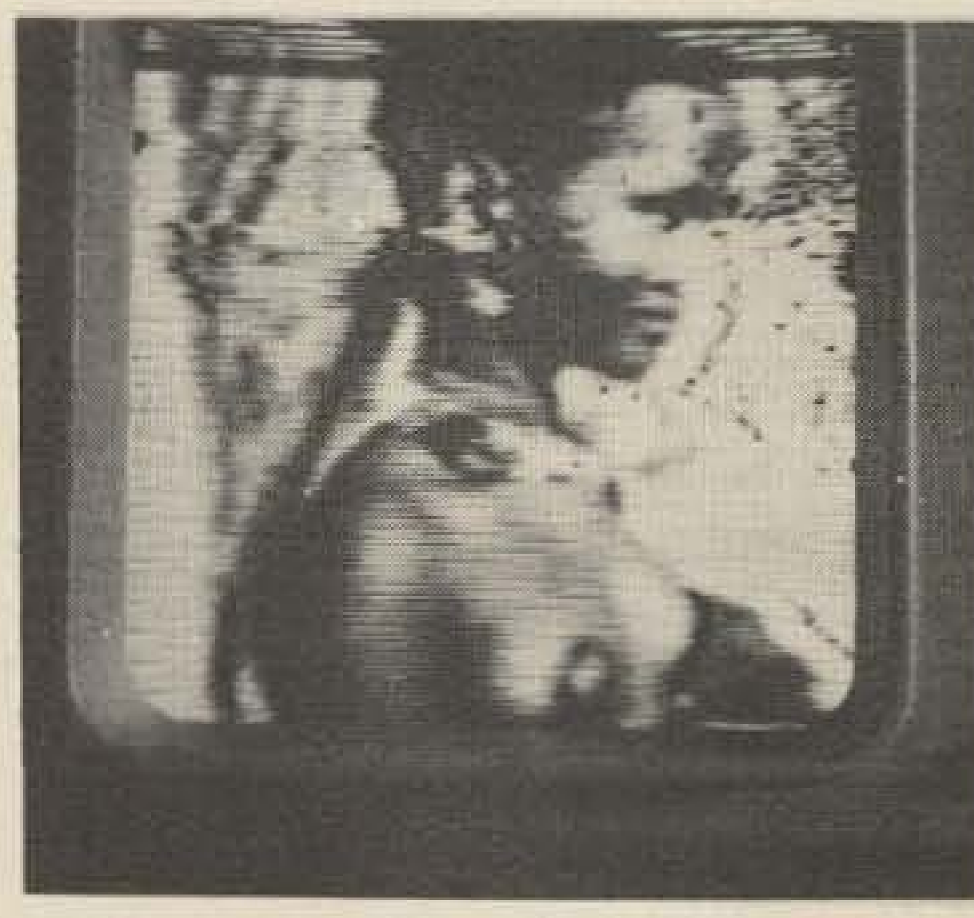
It would be nice to be able to publish an up-to-date list of the SSTVers, but I suspect that it would take more time than I could handle. Of course, if there is someone out there who digs slow scan and who is retired or has a lot of time available, perhaps he (or she?) might like to be custodian of The List? Can you ask for a more rewarding and lower paying job?

If someone would like to tackle this list I think that 73 can help. I had in mind asking via 73 for slow scanners to sit down and make a list of all the slow scan stations (two way) that they had worked. Even if only about 10% of the active slow scanners sent in the list the result would contain virtually every active TVer. For that matter, if we got a list of everyone worked by about a half dozen of the most avid scanners we would probably have 99% accuracy. Any takers?

. . .Wayne

* * *

Here are some recently submitted slow scan pictures – all received over the air and photographed from the Robot monitor.



W8YEK has his Polaroid camera ready whenever something unusual pops up on slow scan. Here is a recent picture Gene picked up from a ZS3 in South West Africa.

Postage stamp received by K4PRT. This shows you what can be done with the Nikon 55mm lens.

6Y5GB, George Benson in Jamaica, West Indies . . . photo by K3SLJ.

50 MHz BAND

Bill Turner WA∅ABI
5 Chestnut Court
St. Peters MO 63376

From most reports band conditions for the June VHF contest were rotten and at first this writer was inclined to agree but after counting all sections worked and heard it really wasn't all that bad. From this area of the midwest openings all though the summer E season were frequent and well distributed as to direction. It seemed that there was a tendency to open an area for a few minutes, close suddenly, only to open to an entirely different area moments later. On the air conversations and correspondence with numerous observers from Maine to Arizona and British Columbia to Puerto Rico indicate similar conditions to have prevailed over most of the country. There was naturally exceptions to the rule but the hours long openings to one area of years past were in general few and far between. Openings to the Pacific Northwest seemed more frequent than in recent years. Several years back the writer spent the better part of three summers attempting to work Oregon for number 48, finally working K7RWT. This year Dave was worked on three occasions and other contacts in Oregon, Washington and British Columbia were commonplace. WA7UBI was a very popular Idaho station, contacts being reported by many. K6TYW/7 was also busy passing out Idaho to the many who need it.

W4GDS says he received numerous VP5RS QSL's without an SASE, these will not be answered until the sender provides one. Bob, Joe and Hoppy made over 1000 contacts on 6 meters and 2500 on HF during their brief stay on Caicos, the cost of postage alone on this many cards is staggering, not to mention the writer's cramp involved in addressing that many cards. If you forgot to do your part, do it now if you want confirmation of this rare one.

WA1EXN reports the VE1ASJ DXpedition to Prince Edward Island didn't get off the ground due to rig problems the previous night. Hopefully Andy's second try in late July was more successful. Art also reports K7ZOK is waiting for confirmation of a New Hampshire contact with WA1GCU to complete his second WAS on 50 MHz. He already has one from previous activity in Zero land. This must be a first.

Dick, WB8GZL, told me the other evening about the Ohio 6 meter net. This group meets on 50.160 at 0100 every evening. Monday through Saturday, the net is called from Dayton; Dick is net control from Waverly on Sunday. There are an average of 25 or so check-ins from 4 or 5 states. Calls are made in all directions and additional check-ins are solicited.

Several months ago in this column, assistance was offered to anyone having a problem with equipment, TVI, getting on the air or whatever. I enjoyed hearing from many of you and trust the answers and references supplied were helpful. The offer still stands and will as long as time is available. There are only two criteria: the problem must concern 6 meters and an SASE must be enclosed. It would be helpful if as much information as possible is included. Brand of rig, schematic diagram (or the source of same if it is home brew equipment), details of what happens (or doesn't happen), are often left out requiring further correspondence and unnecessary delay.

In connection with the above, the answer to one question already asked several times is as follows. Frequency instability in early Swan 250's may usually be cured by one or both of the following. Do not operate the rig in close proximity to an open window, air conditioner, or fan. Cover the "frequency range megacycle" capacitor with a cardboard box or a plastic sandwich bag. Either, when taped to the chassis around the edges, will prevent airflow across the capacitor and the associated drift in frequency. Another problem common to this rig is instability in the carrier null setting. The best fix I know of is to replace the carrier null potentiometer with the best grade composition pot you can find. The Ohmite type AB or the Allen-Bradley type J are recommended.

Response to a previous request for source material for this column was quite good but there remain areas from which no response has been received. Active and knowledgeable hams are a very necessary part of a 6 meter column, conditions and activity vary widely from one area to another and only through reports from YOUR area can the condition of our favorite hobby be accurately evaluated. Drop me a card and I'll explain what is needed and the time factor.

The ARRL has announced a new (3rd) edition of the VHF Handbook, it has not however appeared on the shelves of the local ham emporium. A new (19th) edition of the Editors and Engineers Radio Handbook is also due shortly. Both of these volumes are required reading for any serious 6 meter ham.

WA∅ABI

AMSAT NEWS

Michael Frye WB8LBP
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Dayton OH 45429

Rescheduling of A-O-C Launch

A shuffling and rescheduling of Delta launch vehicles by NASA has caused a four-month delay in the launch of the OSCAR-6 (A-O-C) satellite. The launch of the ITOS-C meterological satellite has been cancelled, and NASA has decided to launch ITOS D (on which A-O-C was to piggyback) with the ITOS-C launch vehicle. Unfortunately, the ITOS-C booster does not have sufficient payload margin to allow OSCAR-6 to be launched with the ITOS-D. NASA has therefore rescheduled our satellite as a secondary payload on the NIMBUS-E meterological mission presently scheduled for launch in November of this year, pending approval of the NIMBUS project office. A-O-C is now expected to be placed in a 690 statute mile circular polar orbit with a period of 108 minutes and an inclination of 99.9 degrees. A sun synchronous orbit is planned with overhead passes expected around local noon and midnight each day.

Reprinted from AMSAT newsletter

This delay mentioned above will allow time for AMSAT to mold together a lot of projects it is currently involved in. Such things as a workable communications network to broadcast information direct from the launch site to amateurs all over the world. In addition AMSAT still needs volunteers to complete its ground command network. After the launch, amateurs are needed that will perform day after day. With the dependability of a net worker, to copy down the data from the telemetry unit and send it to AMSAT.

Another interesting note is that the FCC has approved the waivers sent to them by AMSAT. That is, in addition to other allowances, novices and technician class licensees can operate through the two-to-ten repeater on board A-O-C. This will allow a lot of newcomers to the field to participate in this exciting project.

Please send questions, comments, etc. as I would like to know how this column is being received.

WB8LBP

SOCIAL EVENTS and CONTESTS

The Golden Jubilee Hamfest of the Northern Alberta Radio Club is all set for the 16th and 17th of September 1972. The event will take place in the Silver Slipper Saloon on the Edmonton Exhibition grounds. Preregistration, at $9.00 per person will be accepted until August 15th. Regular registration, which will begin at the Hamfest site on the evening of Friday, September 15 will be at the rate of $10.00 per person. Children's admission to the Sunday morning breakfast in the park will be $1.00 per child.

All those attending will have a chance at valuable prizes. Also, there'll be technical and social events, bunny hunts, and other technical contests, a banquet and a casino in the saloon.

Bring along the kiddies and the XYL. You can park your trailer right nearby if you wish. There'll be special events and prizes for the ladies.

Listen on 80, 40, 20, 15, and 10, and on 2 meters for VA6NC, the special Hamfest station. We'll have special QSLs for all contacts.

* * *

The Peoria Area Amateur Radio Club, Inc. will hold its 15th annual Hamfest Sunday, September 17, 1972 at Exposition Gardens (same place as last year), located on the northwest edge of Peoria, IL. Lunch will be available. There will be plenty of activities for the entire family, beginning with the campsite opening the preceding evening and the banquet Saturday, Sept. 16 at V Junction, $5.50 per person. Door prizes for men and women, cocktail hour 5:30 to 6:30, dinner 6:40. Two motels within walking distance. Free coffee and donuts from 9:00 to 9:30 AM CDT.

Free swap section, parking, contests, cartoons for kiddies and of course the many eyeball QSO's. Advance registration $1.50, at gate $2.00. For further details and advance registration for banquet or Hamfest tickets write Wendell McWilliams, WN9DVJ, Box 1, Rome, IL 61562.

* * *

VK/ZL OCEANIA DX CONTEST 1972

WIA and NZART invite all amateurs to participate in the 1972 VK/ZL/O DX Contest. The usual contest rules apply, while the following is a summary of the important facts, condensed to aid publicity.

1. When – Phone: 24 hours from 1000gmt Saturday 7 October to 1000gmt Sunday 8 October.

2. CW: 24 hours from 1000gmt Saturday 14 October to 1000gmt Sunday 15 October.

3. Scoring: For Oceania Stations other than VK/ZL: 2 points for each qso on a specific band with VK/ZL; 1 point for each qso on a specific band with the rest of the world. For Rest of World other than VK/ZL: 2 points for each qso on a specific band with VK/ZL; 1 point for each qso on a specific band with Oceania stations other than VK/ZL.

4. Final Score: is derived by multiplying total qso points by the sum of VK/ZL call areas worked on all bands. (The same VK/ZL call area worked on different bands counts as a separate mult).

5. Serial Numbers: Will consist of five or six figures made up of the RS(T) report plus three figures which should commence with 001 and increase by one for each successive qso – 002, 003, etc.

6. Logs: (a) Must show in this order: Date, time in GMT; call sign of station contacted; band; serial number sent; serial received. Underline each new VK/ZL call area contacted and make separate log for each band used. (b) Summary sheet to show call sign; name and address (use block letters please); details of equipment used; and for Each Band, qso points for that band and VK/ZL call areas worked on that band. "All Band" score will be total qso points multiplied by sum of VK/ZL call areas on all bands while "Single Band" scores will be that band's qso points multiplied by VK/ZL call areas worked on that band. **Sign a declaration that all rules and regulations have been observed.

7. The usual attractive certificates will be awarded to each country (Call Area in W/K, JA/JH etc.) on the following basis: (a) Top Scorer using "all bands" (b) Separate awards for phone and CW and (c) Other certificates will be awarded (e.g. 2nd/3rd and separate bands awards depending on conditions and activity).

Listeners' Section to count for points, a VK or ZL station ONLY must be heard in a qso and the following details noted in the log – date, time in gmt, call of the ZL or VK station heard, call sign of the station he is working, RS(T) of the VK/ZL station heard, serial number sent by the VK/ZL station heard, band, points. Scoring is on the same basis as for the transmitting section and the summary sheet should be similarly set out.

All logs should be posted to reach: NZART CONTEST MANAGER, Box 489, Wellington, N.Z. or NZART CONTEST MANAGER, 152 Lytton Rd. Gisborne, N.Z. before 25 January 1973.

* * *

VE2CWR amateur station exhibition at Fairview Shopping Plaza, off Trans Canada Highway, Exit 33, Montreal, Canada – August 31 to September 9. Active stations on 80, 20 CW & SSB and 2m FM (146.94 and area repeaters) many displays – antique radios, VHF equipment, SSTV, etc. Special QSL information VE2CWR, 108 Florida Drive, Beaconsfield 880, Quebec, Canada.

* * *

The ILLINOIS REPEATER COUNCIL proudly announces its birth. Your Repeater Organization is needed to help us grow. Tell your President, or Trustee to contact: Ray Thill WA9EXP, P.O. Box 455, Arlington Heights, IL 60006, or call: 312-253-2058. The IRC is currently composed of member repeater and remote base organizations representing over fifteen hundred FM'ers. Membership is open to any such organization operating in the state. The next meeting will be August 17, 1972. Call or write for details.

* * *

KENTUCKY HAMFEST. The Greater Louisville Hamfest will be held August 27, 8 AM to 5 PM at Pine Grove, Otter Creek Park, S.R. 1638 off U.S. 31W near Fort Knox. Registration is $1.00, Fleamarket, $1.00, Door Prizes, Food, Picnic Tables, Auction, Ladies Program. Contact: Guy Partridge, K4KZH, 8276 Walker Rd. Louisville KY 40258.

* * *

An Operating Achievement Award Certificate signed by Governor Daniel J. Evans will be offered by the Puget Sound Council of Amateur Radio Clubs for contacts made during Washington State Amateur Radio Week, September 9th through 17th. For further information write to The Puget Sound Council of Amateur Radio Clubs, 12306 80th Avenue, East Puyallup, Washington, 98371.

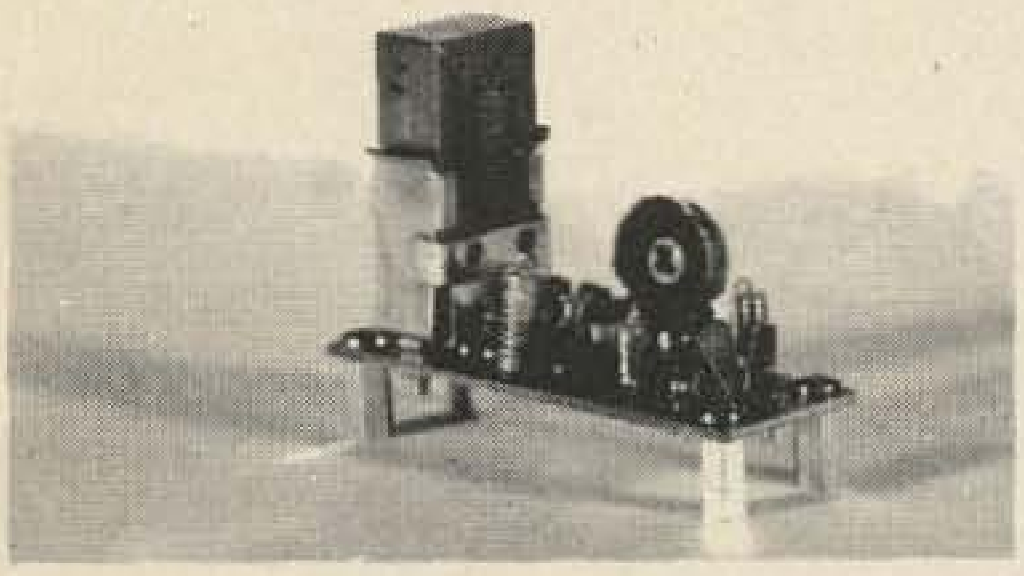
* * *

18TH. ANNUAL VHF CONFERENCE at Western Michigan University, Kalamazoo, Michigan will be held October 21, 1972 (Saturday). Flea market, speaker from AMSAT, etc. For full details write: VHF Conference, PO Box 934, Battle Creek, Michigan 49016.

NEW PRODUCTS

SUB-AUDIBLE TONE ENCODER

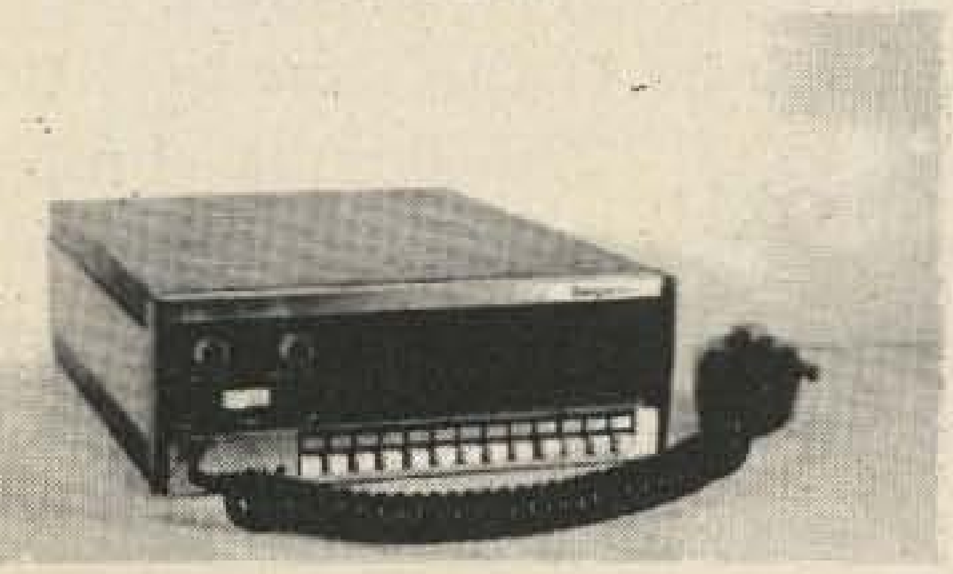
The Communications Specialists continuous tone encoder is a wee one, about 2½" long, 7/8" wide and 1¾" high. It uses the resonant reed made by Motorola or Bramco to determine the exact frequency. The oscillator will operate over the range from 67 to 3000 Hz.



The unit pictured has a Motorola 4A reed plugged in, resulting in a continuous 141.3 Hz tone being generated. There are a few repeaters that are turned on by this type of tone instead of the more ordinary carrier operated system. These are listed in the Atlas with a "PL" or "PL4A." If you run up against a PL type of repeater without knowing it, frustration can set in rapidly. You can hear fellows talking with each other over the repeater even though you cannot break through. These are in use by some repeaters who wish to be more exclusive than others such as WA2UZE on Long Island and WA2UWR in New Jersey. PL stands for Private Line, a Motorola patent and trade marked term.

The above encoder costs $14.95 wired and tested from *Communications Specialists, Box .153, Brea CA 92621.* The reed is an extra $17.50. The connections are simple – 12 volts and one audio wire. The unit is small enough to fit inside of just about any FM transceiver made.

SIMPSON MODEL B FM TRANSCEIVER



How about a 12 channel two meter FM transceiver with a full 25 watts output? The Simpson Model B has been getting rave notices in the VHF marine field, but has not been formally introduced to the amateur market yet.

The Model B Simpson uses the same boards as the well known Model A – and beauties they are, too – plus a 25 watt transistor power amplifier. No tube here, this is all solid state power. The receiver output goes into a front speaker with two full watts of audio power so you can turn up the volume control and hear this speaker clearly and without distortion even in a tractor. It's designed to be heard over the roar of a boat engine. The front speaker is a great advantage as the sound from the big oval speaker comes straight out at you, not via the floor of the car or from under the dashboard.

In the low power position the rig puts out one watt – which is handy now and then. The 25 watts will help your signal to go over hills, around buildings, and generally get into the repeater a whole lot more than the lower powered transceivers will.

The instruction manual is a marvel of clarity – complete with blown up layouts of the circuit boards which show the profusion of test points and clue you into the schematic diagram. This manual is put together for a technician, not an appliance operator.

The price for this gem – about $300 – how can they do it? By selling direct and cutting down the normal markup substantially.

Note that they have not skimped in the area that several manufacturers have: trimmers for the receiver. The fact is that most crystals will not hit the receive frequency exactly and if your receiver is at all sharp the chances are very good that you will be listening off to one side of the repeater. This rig has trimming capacitors on both the transmit and receiver crystals – and not those inexpensive compression types either, these are miniature (and expensive) air padders! Each one has a plastic shield so you won't bend it when you stab it with a screw driver and miss the first time or two. This is just typical of the attention that Simpson has lavished on this rig.

The amateur who has any enthusiasm for getting into a rig and modifying it can have a ball with the Model B. With a little prodding it might be possible to buy an extra oscillator board from Simpson which provides a second set of twelve push buttons. This can be mounted immediately under the present board, giving you a 24 channel transceiver. At least one such modification has been made, so this is not pure conjecture.

The enterprising amateur interested in whomping up a repeater could do a lot worse than start with the Model B. Indeed, one commercial firm has done exactly that, though they apparently have run into some difficulties doing this in production quantities, judging from the complaints. Nevertheless, the B boards are suitable for such a modification, the transmitter being on one side of a completely shielded box and the receiver on the other. Even the little 25 watt amplifier is in its own box, connected by coax cable, complete with a plug in the cable.

It is unlikely that any article submitted to *73* on modifying the Model B (or, indeed, the Model A, which is very similar to the B, but runs a mere ten watts) for repeater use would be given short shrift. *Simpson Electronics, Inc., 2295 NW 14th St., Miami FL 33125.*

GENAVE 2m FM TRANSCEIVER

The General Aviation GRX-2 FM transceiver will have some of the other manufacturers getting a little on edge. Here is a ten channel push button rig that is solid state and has a full 30 watts output!

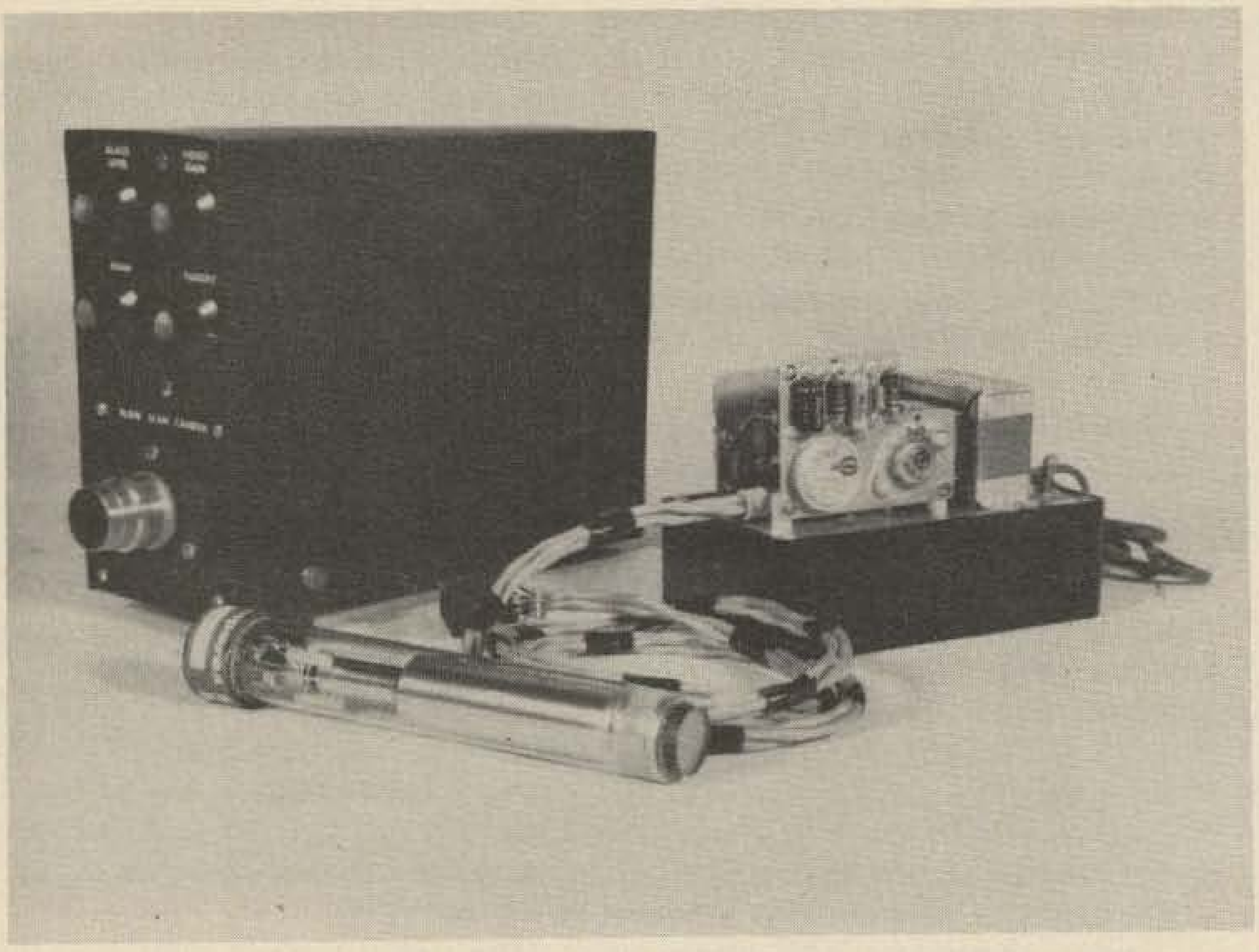
The size is small – only 2½ x 6½ x 10" deep. It should fit just about anywhere in the car – and that 30 watts should get the user into the repeater, even if the repeater has a bigger mouth than ears – which many have.

The layout is clean. The bottom is wave soldered so there is little chance that parts are going to be cold soldered or break loose. The trimming capacitors are right out there in the open where you can get at them easily to tweak onto channel. The high-low-off power switch is a nice deal in that you don't have to lose your volume setting every time you turn off the rig. It gets to be a bother to have to turn off the squelch and adjust the volume every time you turn on a rig. Hooray for a separate power switch. The low power position is handy for saving your car battery or for use if you decide to make a shoulder portable out of this unit with a few rechargeable nicads.

The mike plugs into the side of the rig, which many seem to prefer now to front jacks. It does keep it out of the way. This rig is so clean inside that even a rank amateur (pardon the term) would have no problem in moving the mike jack to the back of the rig, if he wanted. The chap who likes to fool around and add things will have a ball with this transceiver – for despite its small size, there is all sorts of room inside to play.

The loudspeaker is immense for a wee transceiver, four inches in diameter, and the audio power is there to push it – 1.5 watts! They don't have a jack to feed this to the car radio speaker, but it shouldn't take you ten minutes to put one in. There is plenty of room on the back of the rig to drill

(Continued on page 106)



Louis Hutton K7YZZ
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Bellevue WA 98006

Construction of a PLUMBICON SSTV Camera

Introduction

The use of fast scan vidicons in slow scan TV cameras was described by Taggart in *QST* for December, 1968 and by Hutton in *73* Magazine for February, 1969. Several amateurs have experimented with fast scan vidicons in SSTV camera circuits but the overall results have not been as good as expected. The problem is one of dark current, i.e. the inability of the vidicon's target to discharge properly when scanned at slow rates causing a picture to be gray and white, not black and white. The resulting pictures do not have the full range of gray scales as those generated with a flying spot scanner or a 7290 vidicon slow scan TV camera. The only sucessful use of a fast scan vidicon in the slow scan mode has been in the sampler type of operation as described by Stone in *Ham Radio* for July, 1971, or by Miller in *CQ* for August, 1969.

A new camera tube suitable for use in amateur SSTV cameras has appeared on the scene and is called a Plumbicon[1]. This tube was developed in Europe by The Phillips Company and is used in many color TV cameras in this country. The first use of this tube in a SSTV camera known to me is by Art Backman SMØBUO and was briefly described in *ATA International* for May 1969. Bob Taylor W4YHC was able to acquire several of these tubes and I, along with several other SSTV experimenters, have been building cameras using the Plumbicon. The camera described in this article is the results of experiments carried on by Bill Briles W7ABW and me. The pictures produced by this camera are of the same quality as that produced by a 7290 vidicon equipped SSTV camera. The construction is very straightforward and the adjustment is no more critical than for any vidicon equipped camera.

1. Plumbicon is a registered trademark of the North American Phillips Company.

How It Works

In the camera block diagram, the vertical oscillator and amplifier is used to generate a sweep voltage at 1/8 Hz to deflect the

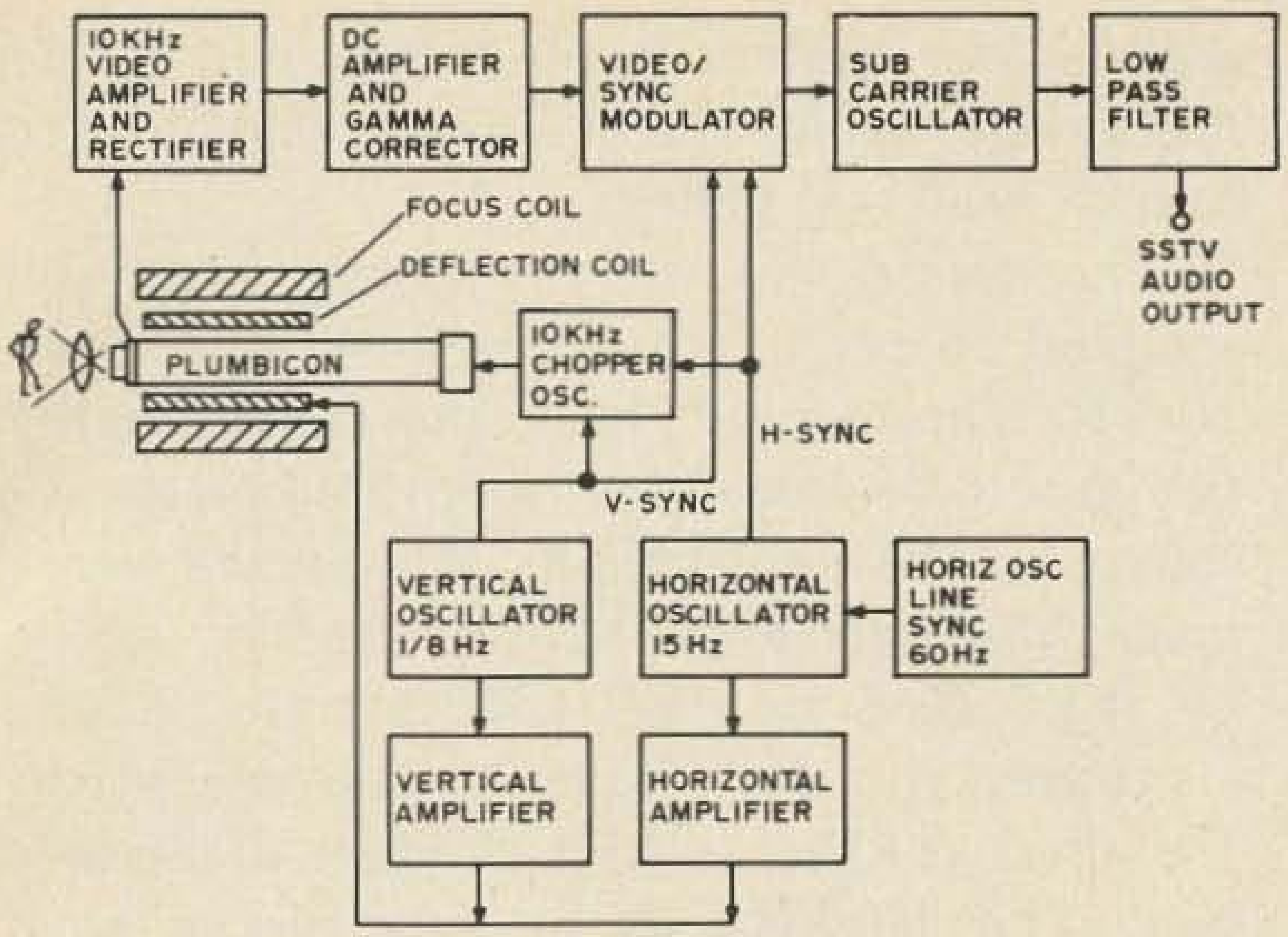


Fig. 1. Block diagram.

electron beam in the Plumbicon vertically. The horizontal oscillator which is synchronized to the 60 Hz power line is amplified in the horizontal amplifier and is used to deflect the electron beam in the horizontal direction at 15 Hz. This deflection will generate a scanning raster on the back side of the camera tube target of 200 lines in 8 seconds. The electron beam is chopped at a 10 kHz rate by the sync keyed 10 kHz oscillator.

The target voltage appearing at the output of the Plumbicon is an ac signal which is amplified in a two stage amplifier. The output of the "video" amplifier is rectified and the signal is then amplified in a dc amplifier whose response is controlled by a Gamma corrector. This is done to correct the response of the camera tube to that more like the human eye. (Similar to the standard vidicon response). The amplified dc signal is fed to the video/sync modulator where the polarity of the video signal will cause the subcarrier oscillator to swing anywhere between black (1500 Hz) and white (2300 Hz) depending upon the picture content. Vertical and horizontal sync pulses are sent from the sweep oscillators to the video/sync modulator which causes the subcarrier oscillator to swing down to 1200 Hz during the presence of either a vertical or horizontal sync pulse. The square wave output of the subcarrier oscillator (a free running multivibrator) is filtered in the output and the SSTV audio signal is now ready for transmitting over the air on a SSB transmitter, monitoring, or recording on a tape recorder.

Construction

The camera shown in the photographs is the second version constructed. The first

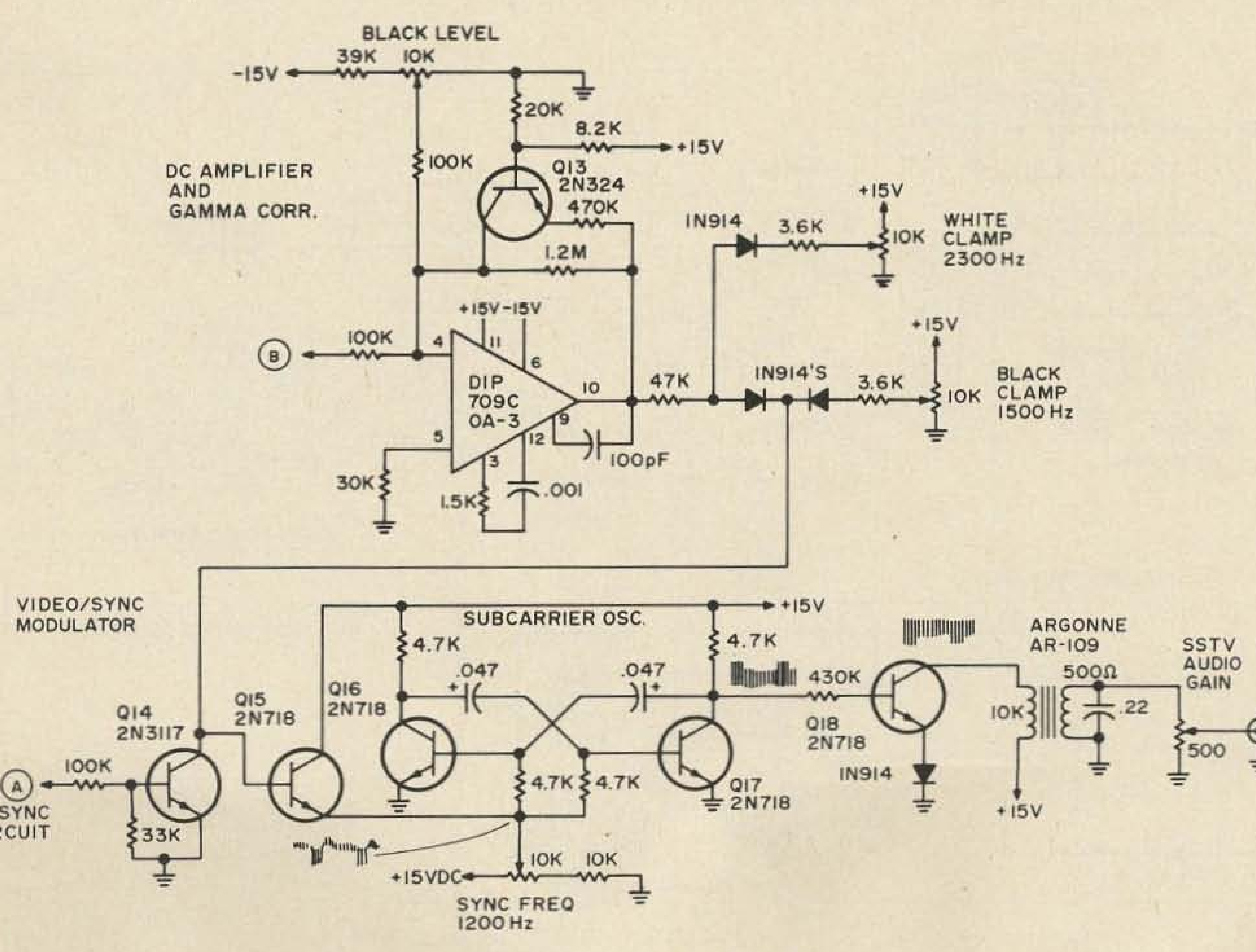
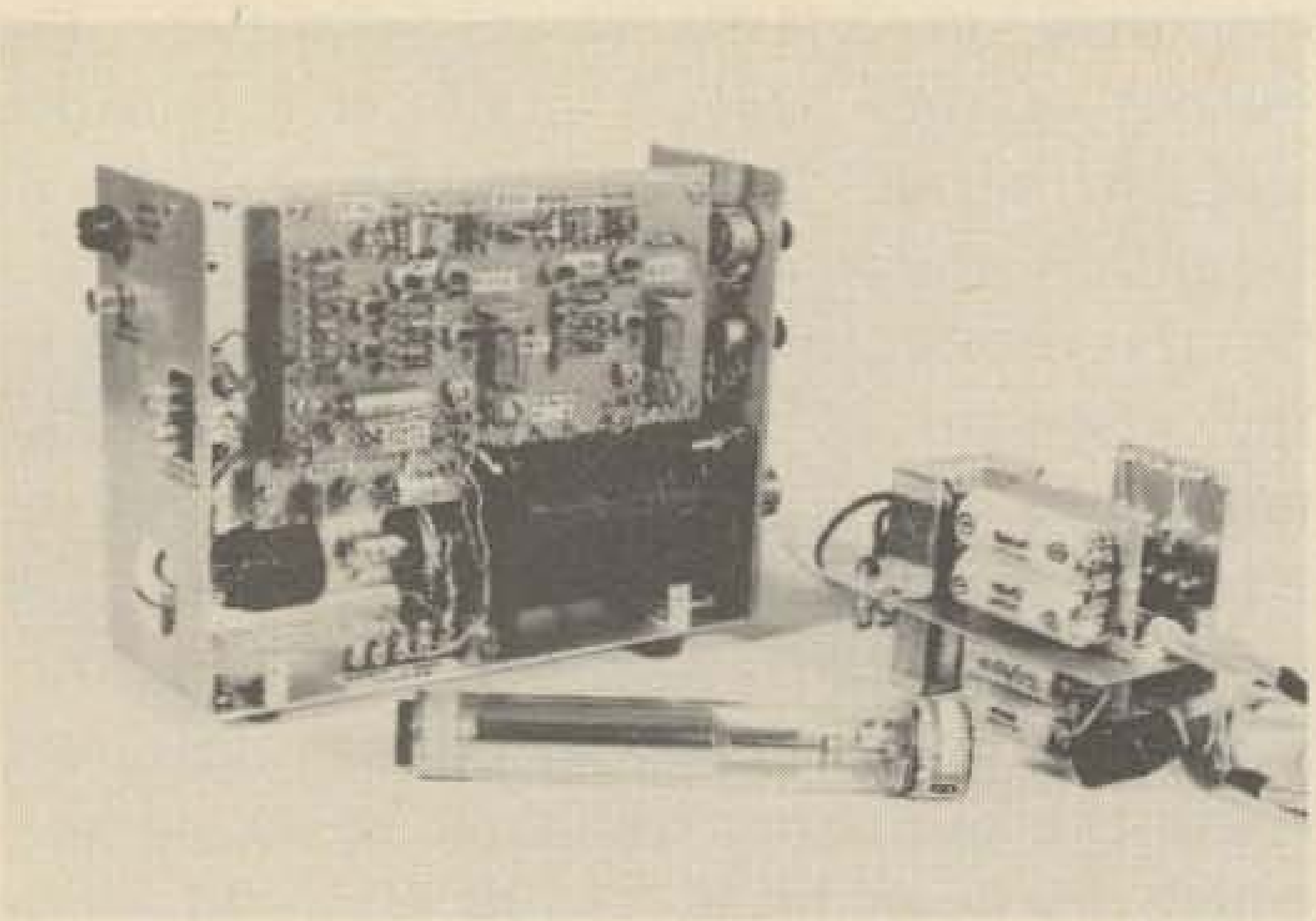


Fig. 2. Schematic (Part 1).



Innards of Plumbicon camera.

model had an integral power supply, but it gave nothing but trouble from its strong magnetic field. Extensive shielding of the transformer compartment with conetic material failed to reduce the interference to an acceptable level. The Plumbicon is very susceptible to stray magnetic fields which show up in the monitor as vertical stripes. The power supply was moved to a separate chassis and the camera rebuilt. It then produced excellent hum-free pictures. The camera electronics assembly is 3½" wide by 7½" high by 9¾" deep. The power supply is built on a plastic instrument case 3¾" wide by 2" high by 6¼' deep. Power from the unit to the camera head is provided by a multi-wide cable and a Jones plug at the camera head rear panel.

The electronics for the camera was assembled on perfboards using push pins. The 10 kHz chopper oscillator and video amplifier should be assembled in shielded boxes as shown in the photographs. The boxes were made from galvanized tin and are 3¾" wide by 4¼" deep by 1¼" high for the video amplifier, and 1¼" wide by 4¼" deep by 1¼" high for the 10 kHz chopper oscillator box. The 10 kHz chopper oscillator, the video amplifier, the dc amplifier and gamma corrector, the subcarrier oscillator, the video and sync modulator, and the SSTV audio output stage are mounted on one side of the camera. On the other side of the unit, the circuit board containing the 60 Hz line sync, vertical and horizontal sweep oscillators and amplifiers, the magnetic and electrostatic focus circuit are mounted.

Sockets for Plumbicons are usually difficult to locate, so one was easily made from an old octal socket, by drilling out the center to pass the glass seal on the base of the camera tube and also, drilling out one of the socket pins for the alignment pin.

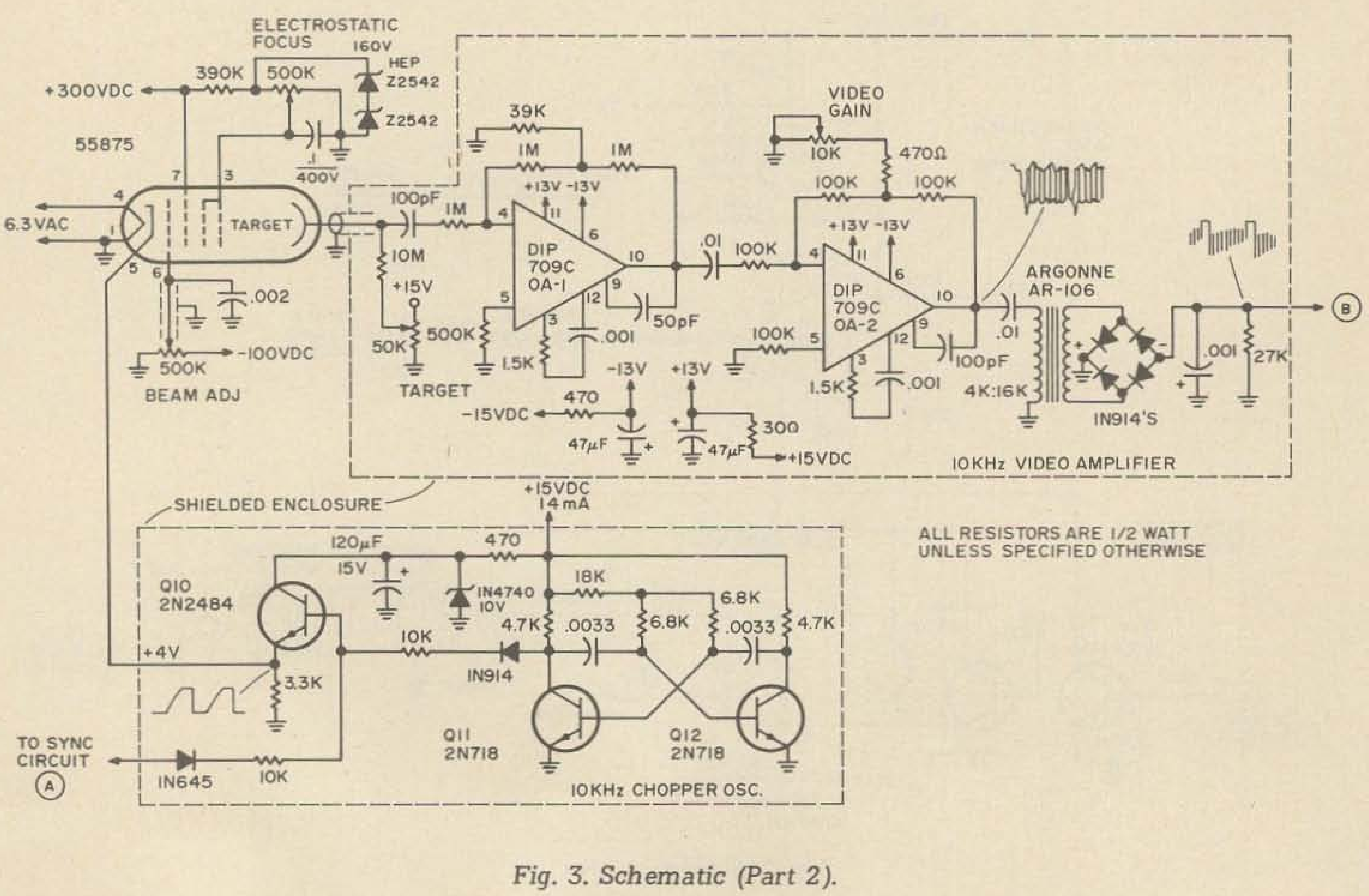
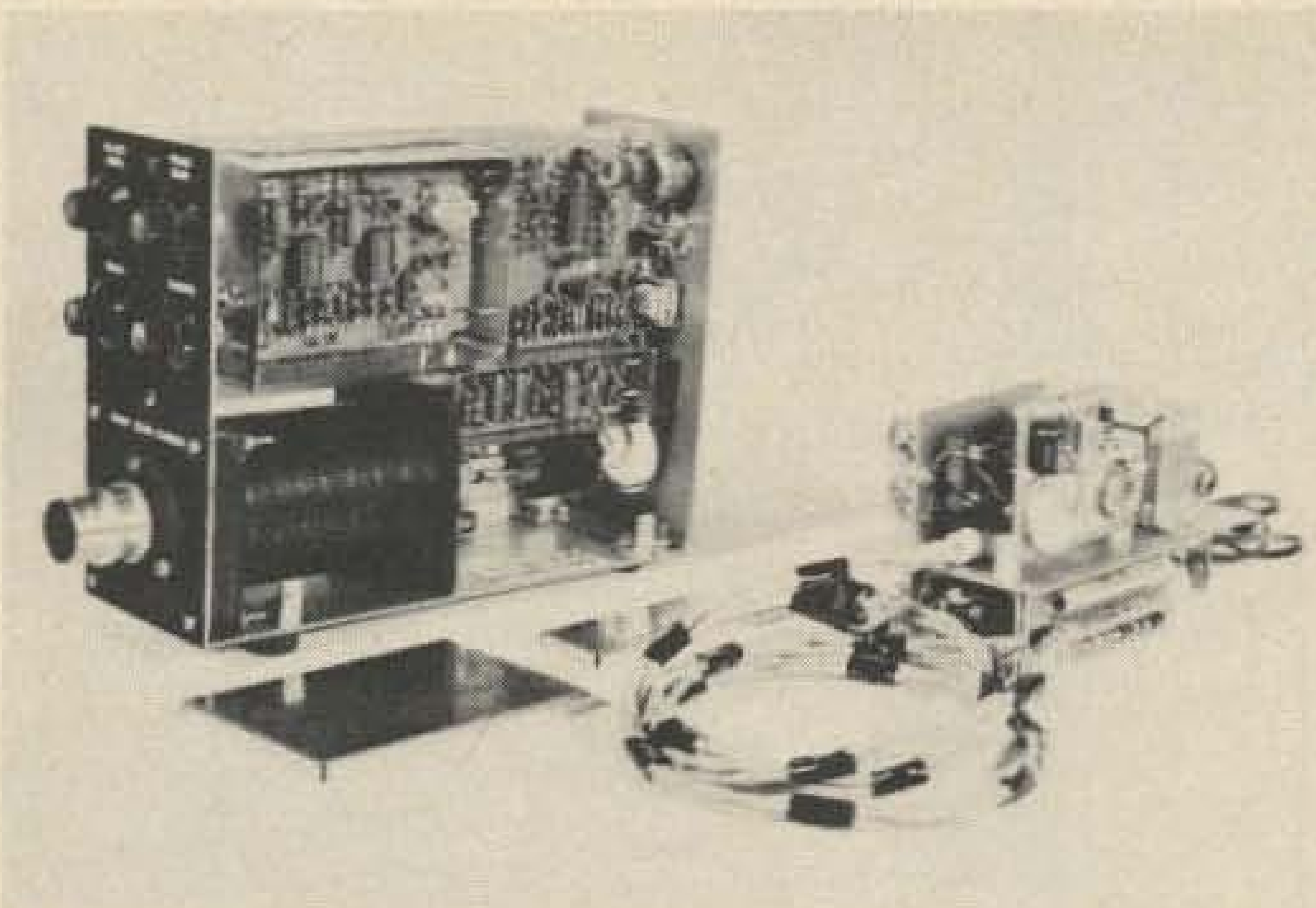


Fig. 3. Schematic (Part 2).



Plumbicon camera with video amplifier and 10 kHz chopper oscillator exposed.

The Plumbicon deflection yoke and focus coil were handmade, as there are no kits for this type of assembly. Information on the techniques of making camera tube deflection components may be found in *ATV Anthology* available from *73* Magazine. The focus coil form was made from a cardboard mailing tube 4½" long with an inside diameter of 2". The focus coil plywood end bells are 3-1/8" by 3-1/8" by 1/4" thick, and are glued over the ends of the cardboard tube making the coil winding area 3¾" long. This form was wound with approximately 5000 turns of number 32 wire. The dc resistance was around 400 plus 50 or minus 100 ohms.

Due to the lower vertical and horizontal sweep frequencies used in SSTV, the deflection coils will contain more turns of wire than those used in fast scan TV. The deflection coil window form was 1½" by 3/4" by .050" thick. Each vertical coil has approximately 620 turns of #36 wire. Each horizontal coil has approximately 800 turns of #36 wire. The series dc resistance of the two vertical deflection coils is 320 plus or minus 20 ohms and the resistance of the two horizontal coils in series is 220 plus or minus 20 ohms. The important thing is that each pair of coils be matched in individual resistance (same number of turns) or you will have unequal deflection in that particular plane. The Plumbicon is a bit larger in both diameter and length than the standard vidicon and will require a deflection coil form with an inside diameter of approximately 1¼". Such a form may be found inside a box of plastic sandwich bags, and should be cut to a length of around 5 inches. Install the Faraday shield, and deflection coils on the form as per the procedures in the *ATV*

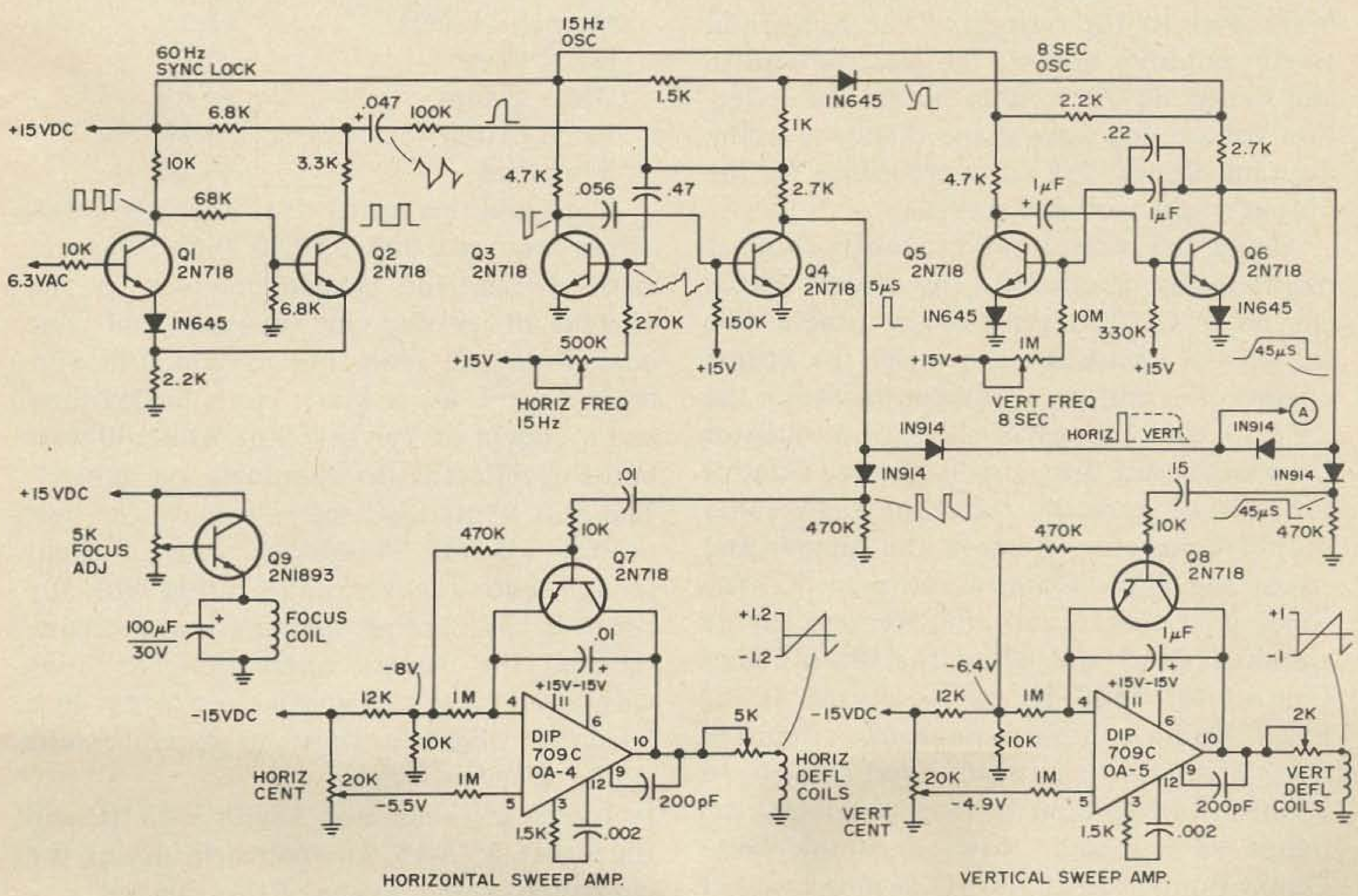


Fig. 4. Schematic (Part 3).

Anthology. Watch out when you phase those coils as I connected my vertical coils out of phase and had no vertical deflection when the camera was first tested. (I had built over a half dozen of these vidicon deflection assemblies and became over- confident!)

The lens of this camera was salvaged from a surplus gun camera. It is of 25mm FL and required a spacer of about 3/8" between the front of the focus coil assembly and the back of the front panel. The exact spacer required for each camera will depend upon the lens used and its focal length.

Camera Adjustment

It is a good idea to check out the various circuits of the camera before plugging in the camera tube. Using a dc oscilloscope, check for proper wave forms and voltages at the junction of the two resistors in the collector of Q-2. This is to confirm that the 60 Hz lock-in pulses are being generated. Observe the output of Q-4 and adjust the Horizontal Frequency Control to 15 Hz. While monitoring the output of Q-6, adjust the Vertical Frequency Control to one pulse every 8 seconds. I use a stop watch to check the timing of the vertical oscillator. Now move over to the output of the horizontal sweep amplifier and set the Horizontal Size and Centering Controls to obtain the deflection voltage and wave shape as shown on the diagram. Repeat the same procedure for the output of the vertical amplifier.

Check the output of the 10 kHz chopper oscillator by monitoring the output at the emitter of Q-10, or pin 5 of the camera tube socket. To adjust the subcarrier for proper operation, connect a jumper between the collector and emitter of the sync modulator Q-14 and adjust the Sync Frequency Control for 1200 Hz as monitored at the SSTV audio output connector. Remove the jumper and adjust the White Clamp Control so that the wiper is at the 15 volt end. Remove the dc amplifier OA-3 and adjust the Black Clamp Control for 1500 Hz as monitored at the SSTV audio output connector. Reinstall OA-3 and adjust the Black Level Control to about 2/3 of its control rotation toward the minus 15 volt end. Now adjust the White Clamp Control for 2300 Hz as monitored at the SSTV audio output connector. Adjust

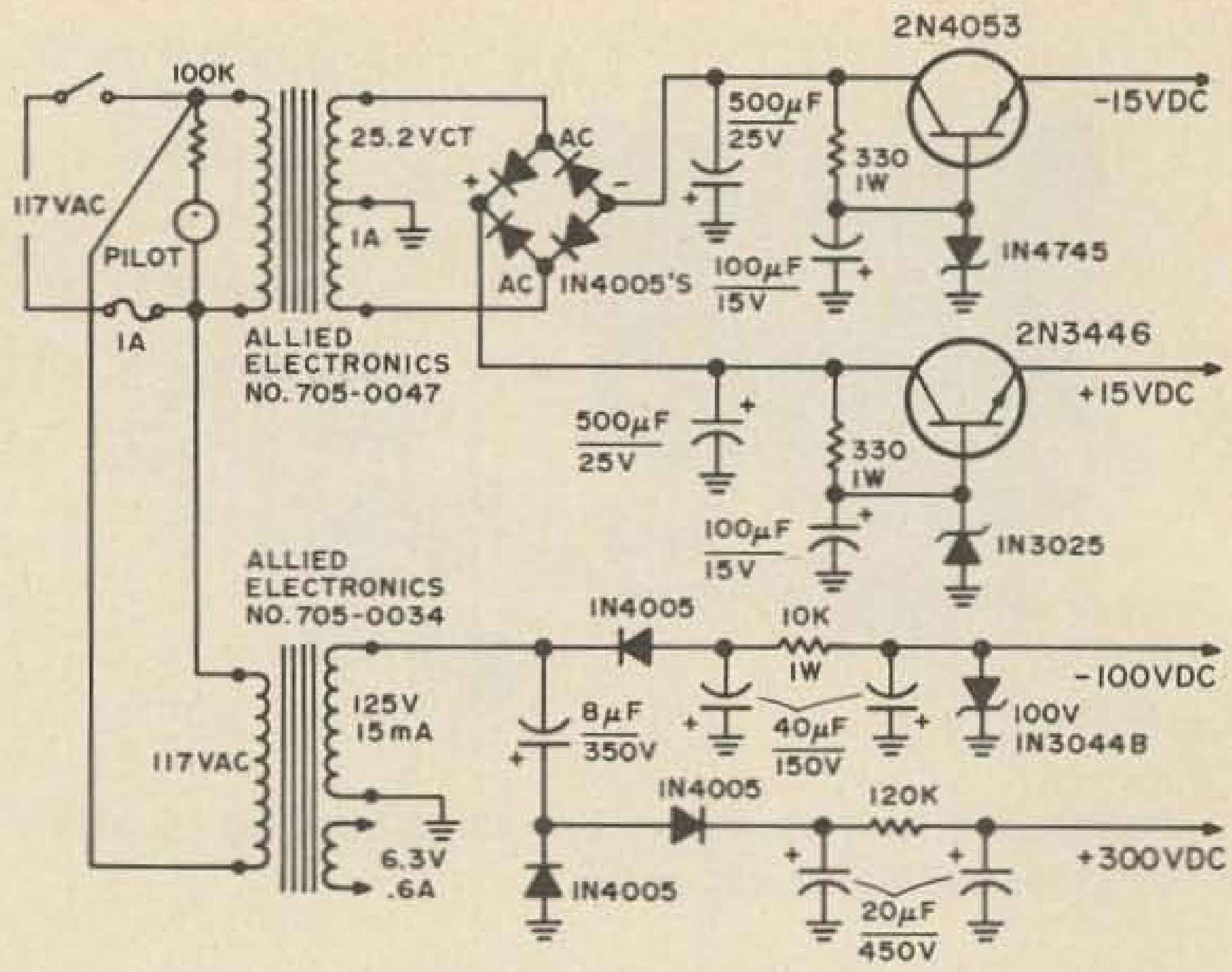


Fig. 5. Power supply unit.

the Black Level Control back to a point where the SSTV audio output is 1500 Hz.

Turn off the power now, and install the socket on the camera tube. The following table is a list of the control settings and voltages at critical points as found in the K7YZZ SSTV camera. They will provide the builder with a good starting point when beginning final tests and adjustments.

Beam	-41.5V
Target	+15V
Electrostatic Focus	+62V
Magnetic Focus	+5.3V
Black Level	-.40V
White Clamp	+4.8V
Black Clamp	+3.8V
Sync Freq	+3.0V

It should be noted that there is interaction between the optical focus, electrostatic focus, and magnetic focus in the process of getting the sharpest and best quality picture from the camera. For portrait work I use a black cloth background and a couple of Sylvania Soft White 40 watt bulbs in reflectors to illuminate the subject. The Soft White light seems to have the best output for the Plumbicon tube. I spent around two weeks experimenting with the controls and lighting, learning how each one affected the camera operation. The thing with slow scan cameras is to not get in a hurry but take your time and the end results will be very gratifying.

I wish to thank Bob Taylor W4YHC and Bill Briles W7ABW for their help during the construction and testing of this camera.

. . .K7YZZ

Ernest P. Manly W7LHL
429 10th Avenue
Kirkland WA 98033

WWVB 60 kHz FREQUENCY COMPARATOR RECEIVER

This system uses a heterodyning and intergration process to display the error between WWVB at 60 kHz received frequency and a local frequency standard on a linear phase versus time plot. Before describing the theory of the system there were certain design criteria requirements.

1. Low cost ($50) exclusive of recording system.
2. Straightforward construction and no critical circuit adjustments.
3. Resolution to 1 part in 10^{10}.
4. All solid state using readily available RTL IC devices.

Introduction

Many frequency control system applications dictate the use of secondary frequency standards sharacterized by fractional frequency stability better than a few parts in 10^8. Instrumentation packages which employ internal secondary frequency standards include digital counters, frequency synthesizers and communication equipment. Low cost frequency standards and most instrument packages employ a quartz-crystal controlled oscillator having stabilities better than a few parts in 10^8.

All secondary frequency standards exhibit frequency drift characteristics which, over a period of time, result in cumulative frequency errors. The term "aging rate" is used to describe the time rate of change of the oscillator frequency. For quartz-crystal standards the aging rate itself is a variable which tends to decrease in magnitude with time (when the oscillator is operated continuously without interuption of power). Practical means for calibrating secondary frequency control devices against reliable sources of known frequency (primary standards) are required in order to maintain reasonable limits of output frequency uncertainty.

HF and LF Propagation

The hf transmissions from the National Bureau of Standards (NBS) stations WWV and WWVH are radiated at precisely known frequencies: however, due to the relative instability of hf propagation, variations of a millisecond or more in path delay are experienced. Changes in path delay in turn cause apparent received carrier frequency fluctuations. These effects cause measurements of the hf carrier frequency, or of the time-tick modulation period, to become very time consuming. Resolution of a part in 10^9 requires about two weeks.

The lf transmissions from NBS station WWVB at 60 kHz are far more stable because the signal is propagated as if it were in a waveguide (i.e. the surface of the earth and the lower regions of the ionosphere forming the wave guide). Since the ionosphere acts as a boundary rather than as a direct reflector, its variations have a much reduced influence. Variations in propagation conditions due to the ionosphere do, however, exist and techniques are available for

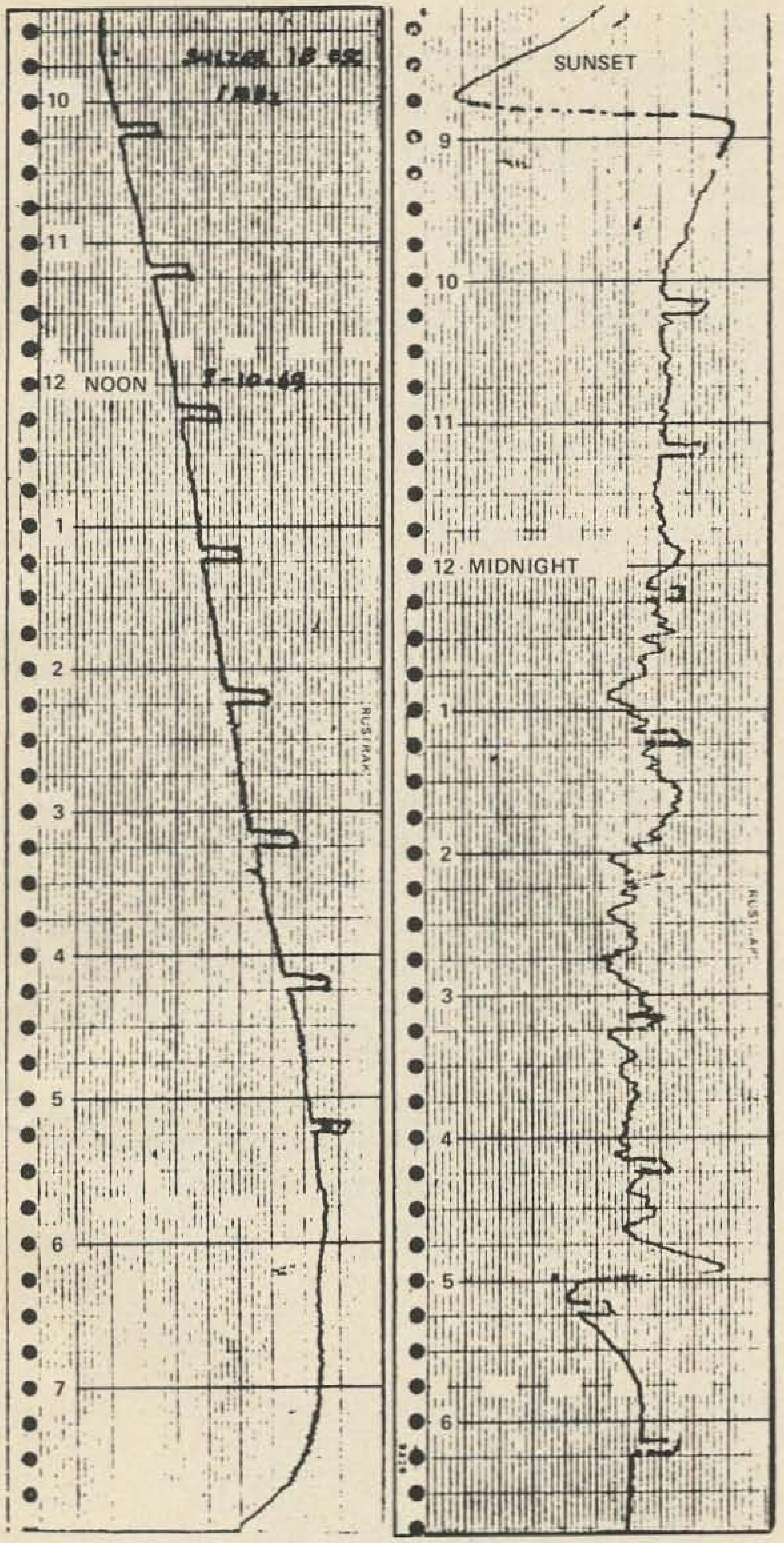


Fig. 1. Chart recordings.

working around them. Factors affecting path phase velocity include ionospheric conditions (diurnal shift-phase shifts occurring at sunrise and sunset), ground conductivity, and surface roughness. Since the phase velocity of long range lf signals depends to an extent upon the effective height of the ionsphere, sudden atmospheric disturbances such as those occurring during solar flare events will cuase sudden phase anomalies. Diurnal phase shifts and other anomalies are not a serious problem provided the user is aware of them. Resolution of part in 10^{10} requires less than a day using lf frequency transfer techniques.

Frequency

Frequency tolerances are normally expressed in some part in 10ths. The following example shows the relationship between parts in 10ths and cycles per second.

$$\text{Total } \mu\text{sec per day} = \frac{1{,}000{,}000\ \mu\text{sec}}{\text{SEC}} \quad \frac{60\text{ sec}}{\text{MIN}} \quad \frac{60\text{ min}}{\text{HR}} \quad \frac{24\text{ hrs}}{\text{DAY}}$$

$=86{,}400{,}000{,}000$ μsec per day
OR $86{,}000 \times 10^6$ μsec per day
OR $8{,}640 \times 10^7$ μsec per day
R 864×10^8 μsec per day
OR 86.4×10^9 μsec per day
OR 8.64×10^{10} μsec per day

In frequency comparison the following term is used.

8.64 μsec = 1 PART IN 10^{10} per day
17.28 μsec = 2 PARTS IN 10^{10} per day
86.4 μsec = 1 PART in 10^{10} per day

As an example consider a 1 MHz oscillator which has drifted 6 parts in 10^{10} during a24 hour period. This represents a total of 51.84 μsec. Average frequency of the oscillator during the measurement period is:

Fav = Fnom 1 + $\triangle$F/F Where Fav = average frequency

Fnom = nominal oscillator frequency

$\triangle$F/F = average frequency error parts in 10ths

$Fav = 10^6 (1 + 6/10^{10})$

= 1,000,000.006 Hz

Indeed a small error.

Chart Recorder

The lf Phase Comparator plots the phase difference of a local frequency standard vs. that of the received carrier by means of the Rustrak strip chart recorder. Full scale chart width is 16 2/3 μsec phase difference. If radio propagation phenomena were perfectly stable, (no noise or other error causing factors) and the local standard is in exact agreement with WWVB at 60 kHz, the chart trace resembles a continuous straight line. If the standards are not operating on exactly the same frequency scale, then the phase of one relative to the other will change with time, thus the chart trace will be a saw-tooth wave shape if the drift is more than 16 2/3 usec.

Referring to Fig. 1 a typical chart recording, the steep phase shifts at 5 AM and 8 PM are associated with differences in daytime and nighttime propagation characteristics. Also, greater phase noise is observed at night due to spheric activity. These factors make it advisable to perform calibration on the basis of daytime data taken either during one day, or taken at the same time on several consecutive days. In the following example, we are using data taken at 11 AM to 5 PM, for six consecutive hours. At 11 AM the chart read 5 μsec and at 5 PM 13.5 μsec. Total drift of the standard is 13.5 − 5 = 8.5 μsec. To use this data enter the charts of Fig. 2 vertically from the bottom (microseconds) to where the line intersects with the slanting 6 hours line. Then project horizontally to the left from the intersection and read fractional frequency error. In this

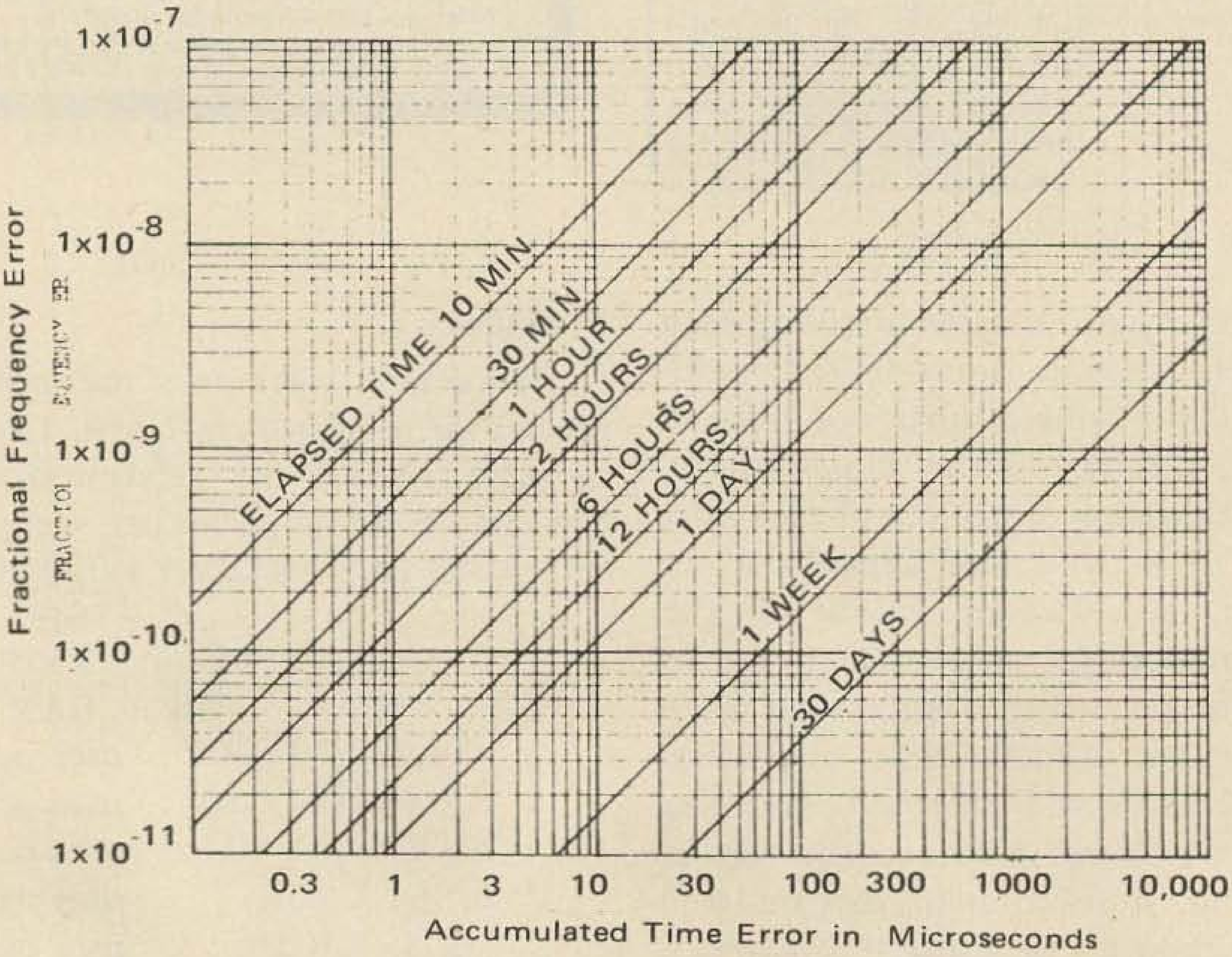


Fig. 2. Accumulated time error vs. fractional frequency error.

Clegg

Go anyplace
Do anything.
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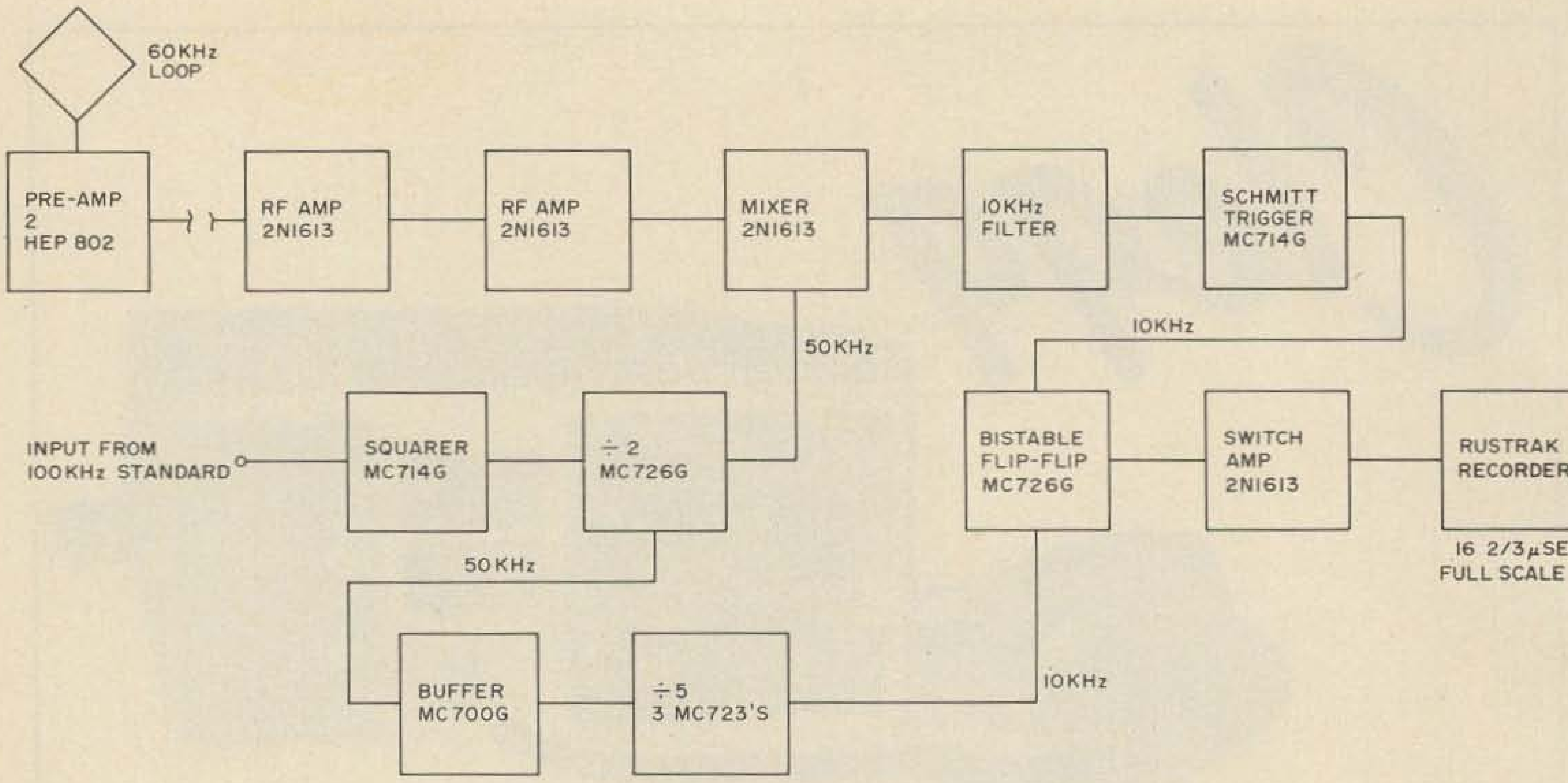

Fig. 3. Block diagram.

case the oscillator drifted 4 parts in 10^{10}

Gaps in the trace are caused by once-an-hour 45 degree phase shifts introduced into WWVB carrier for identification purposes. These gaps begin ten minutes after the hour and end fifteen minutes after the hour. If daylight fading should occur, it is a certain indication that ionosphere disturbances are taking place and are likely to be accompanied by apparent received phase instabilities.

WWVB Signal

Code information is also transmitted along with the continuous carrier. Time code information is presented by means of a level-shift carrier code. The time signals are indicated by 60 drops in the power level per minute, one marking each second and the amount of each drop is 10 dB. Also WWVB is off the air every other Tuesday during the daytime for maintenance.

Since this frequency comparator would operate best from a steady 60 kHz carrier, the 10 dB drop in carrier level does, unfortunately, affect the quality of the recorder trace when approaching either side of the chart.

Theory of Operation

Refer to the block diagram and the schematics for the following description (Fig. 3, 5 and 6).

The loop antenna is a balance unshielded type, wound with plastic covered wire on a wooded frame. Two square loops three and six feet on a side with 30 and 24 turns respectively were constructed and tried with satisfactory performances. The larger loop did furnish a greater signal level to the receiver.

The pre-amp is followed by two rf stages and a linear mixer. An rf gain control R2 is used to control the gain of the two rf stages. The background noise level at lf is quite high due to atmospheric noise, lightning strokes and man-made noise. For this reason the system should include a noise suppressor and a very narrow bandwidth filter in order to maximize the signal-to-noise ratio. A pair of silicon diodes, connected back to back to the base of the linear mixer makes an effective noise suppressor and clipping level is controlled by the rf gain control.

A 10 kHz filter follows the mixer. The one shown using the cup cores has a bandwidth of 100 Hz. Several filter configurations were tried including a Q multiplier. Cores salvaged from 88 mhy coils used for RTTY gave a 200 Hz bandwidth. A more optimum bandwidth would be approximately one Hz.

The pre-amp, two rf stages and mixer are the only linear stages used in the receiver. The rest of the stages are either saturated or turned off. This is one panel control and two

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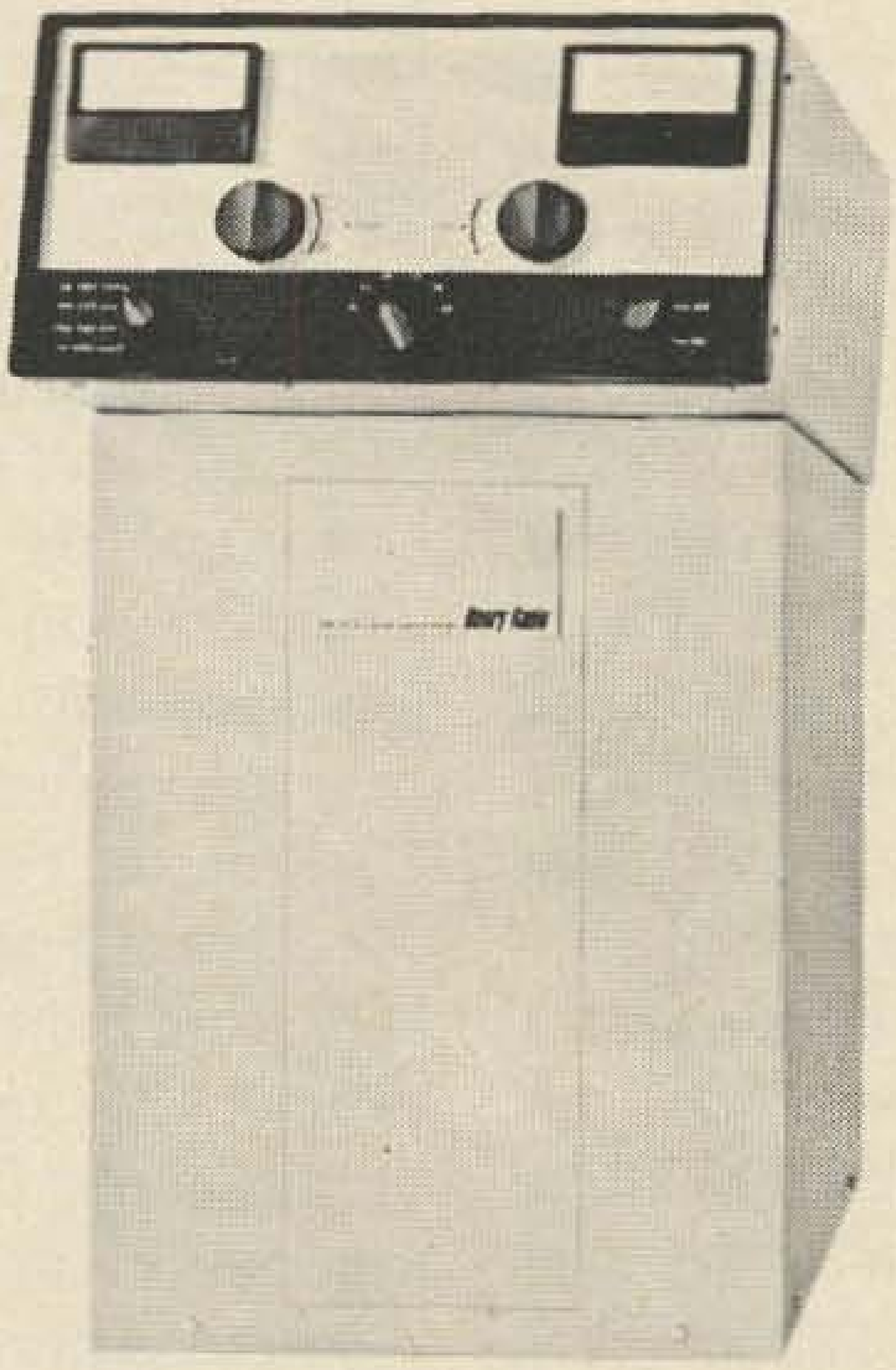

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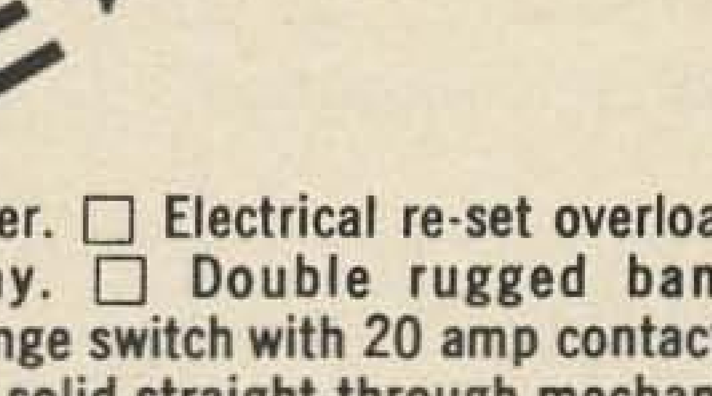

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trimmer controls located on the chassis.

Local oscillator injection to the mixer is derived from the 100 kHz frequency standard. A dual RTL IC gate converts the 100 kHz waveform to a fast-fall time square wave to act as a clock pulse for the divide-by-two RTL flip-flop. CR1 is to protect the IC from negative-going inputs. One of the two 50 kHz outputs from this flip-flop drives a 50 kHz tuned circuit to change the square wave to a sine wave for the mixer. The other output is fed into a divide by five circuit which generates a 10 kHz output.

The output from the 10 kHz filter drives a dual gate IC that functions like a low-hysterics Schmitt trigger whose threshold level is adjusted by R3. The Schmitt trigger drives one input of a MC726G flip-flop that is used as a Bistable flip-flop. The 10 kHz output from the divide-by-5 circuitry drives the other input to the Bistable flip-flop.

A Bistable flip-flop has two stable states and is forced from one state to the other by turn-off pulses received from WWVB or from the local frequency standard at a 10 kHz rate. When the two inputs are 180 degrees out of phase the integrated output current would be 50 percent duty cycle. As the phase changes between the two inputs, the average current would change and this is the purpose of the 2N1613 transistor and associated components to integrate the Bistable flip-flop output. A 01mA full scale, 1 inch per hour Rustrak recorder is used to display the integrated current.

Construction Hints

Only basic details and approximate dimensions will be covered since the diagrams and pictures are self-explanatory. The pre-amp is built on a 2 by 4-¾" one sided copper-clad printed circuit board and housed in a 5 by 2-¼" Bud CU-2104-A minibox. The receiver used a 4-½ by 9-½" printed circuit board. Scrub the foil side of the board with fine steel wool, soap and water. Rinse in clear water and dry. After the board is completely dry, spray the foil side with clear Krylon and the Krylon does not interfere with soldering. Nearly all components are mounted on the copper foil side of the board. Transistor sockets were used for the 2N1613 transistors but the leads on the IC's were bent and soldered directly. USECO type 1425 terminals were used to mount components onto and for tie points. Coils are mounted, using nylon screws and fiber washers. Approximate parts layouts is shown in Fig. 4.

Acquiring the required cores for the coils may be difficult because they are not across-the-counter or mail order items. The manufacturer usually has a $25 minimum order charge. Therefore, most builders will

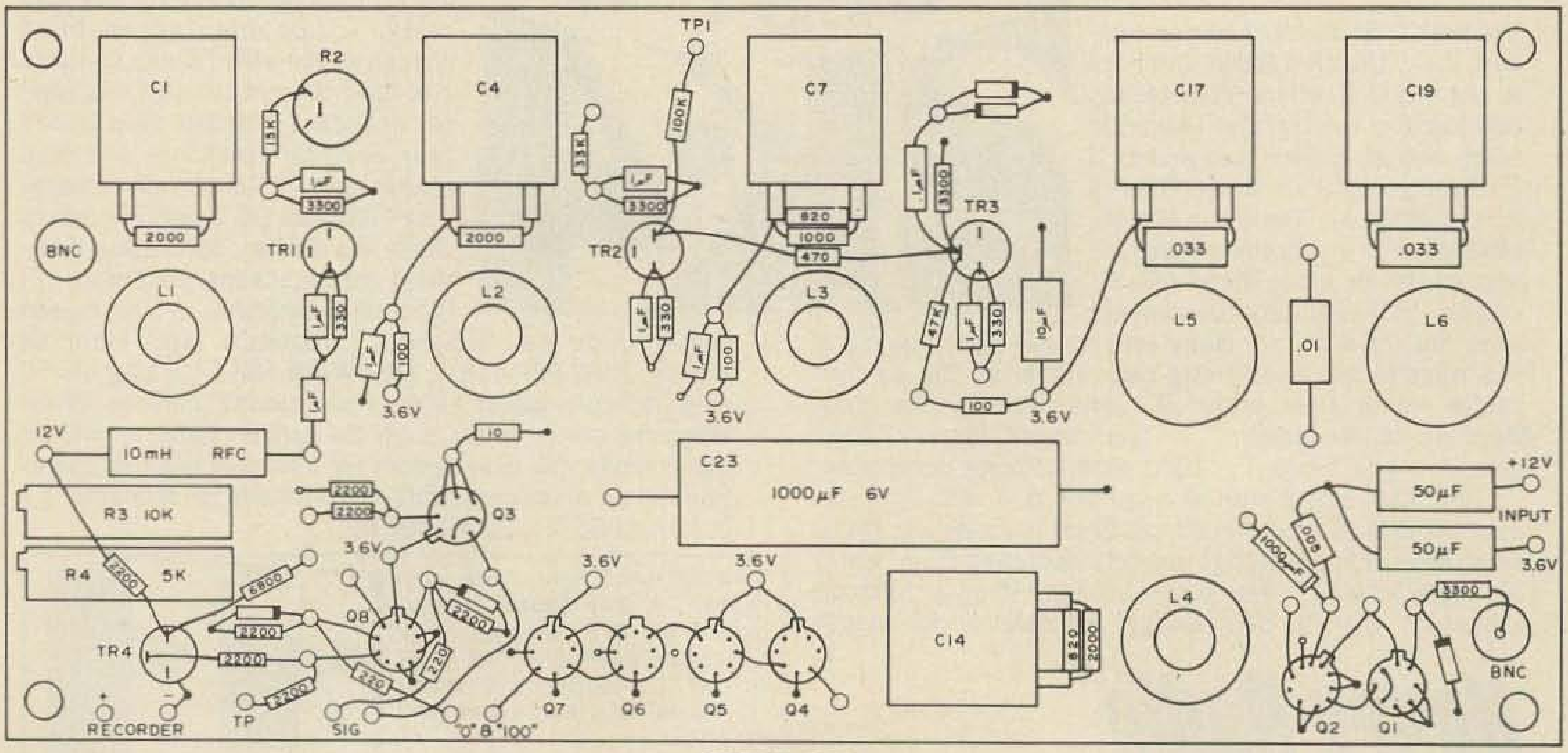

Fig. 4. Components lay-out.

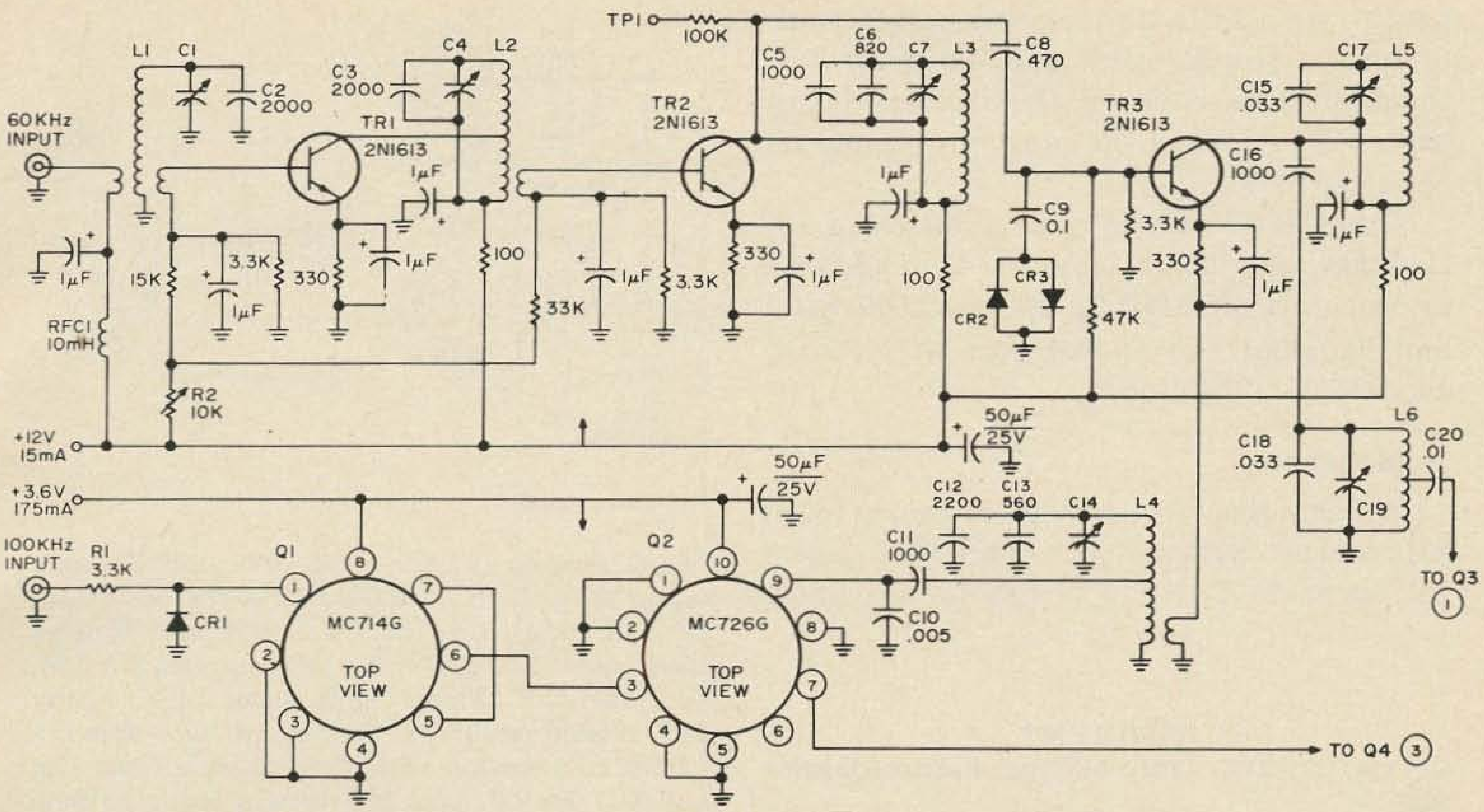

Fig. 5a.

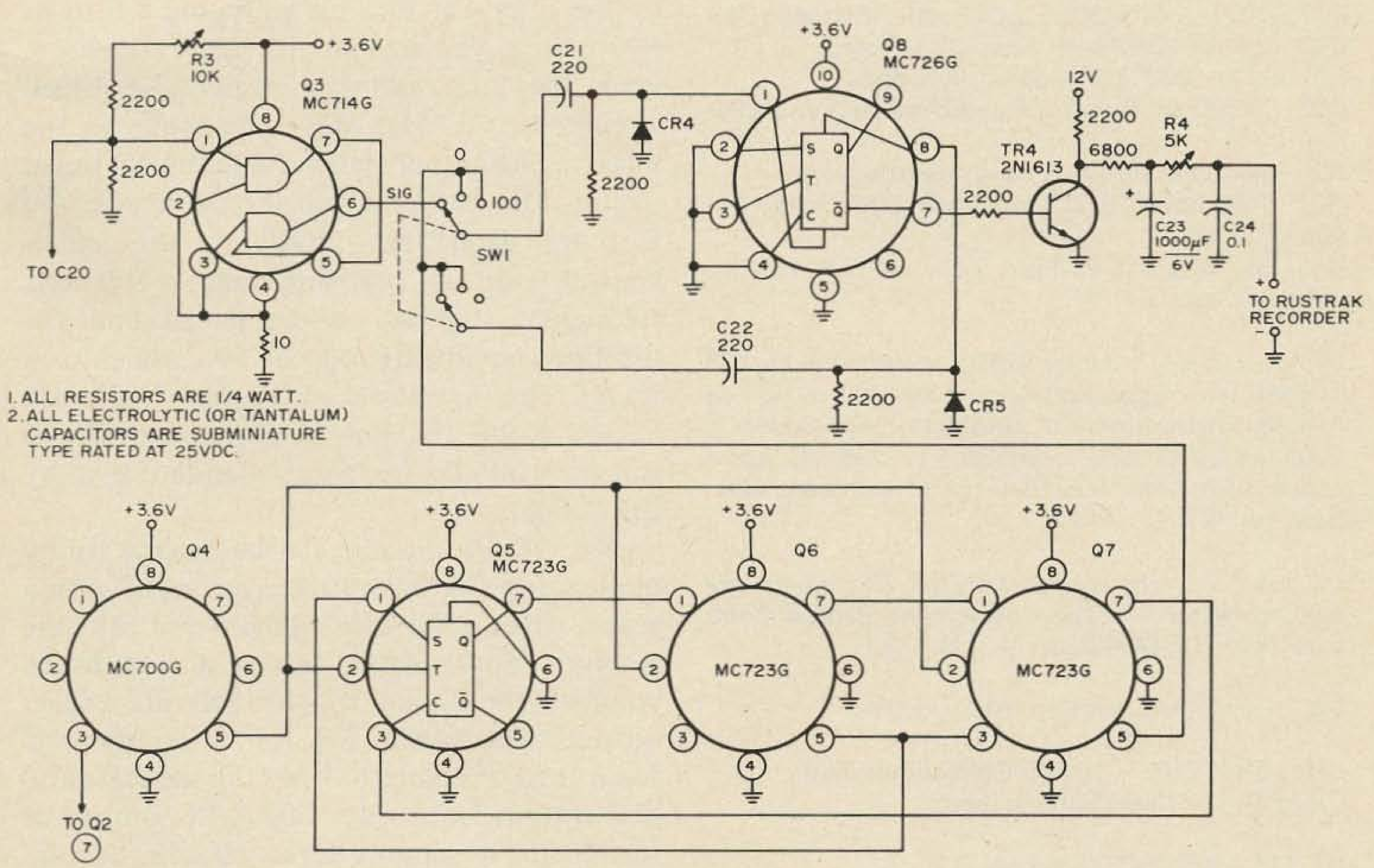

Fig. 5b.

Schematic.

have to do a little scrounging among friends or surplus stores to find suitable cores. The three 60 kHz coils on the receiver board have a Q of 70 and the pre-amp output coil has a Q of 200.

Other RTL IC's may be substituted for the ones specified, such as the Fairchild 914 or Motorola MC724P for the MC714G gates and Fairchild 923 or Motorola MC723P for the MC723G flip-flop.

Adjustment

A signal generator capable of tuning to 60 kHz and an oscilloscope is required. Connect the scope to TP1 and couple the generator to the loop antenna by wrapping a turn or two of test lead around one side of the loop. Peak the loop and the 4 60 kHz tuned circuits to 60 kHz. Move the scope to the mixer emitter and peak the 50 kHz tuned circuit. The 50 kHz signal should be adjusted for approximately 1VPP at the mixer emitter (this is assuming that a 100 kHz frequency standard is connected and the flip-flop is putting out a 50 kHz square wave). The input level of Q1 gate should not exceed 4VPP and may be adjusted by R1 to suit the 100 kHz frequency standard used by the builder.

The 10 Hz circuits can be peaked up by monitoring the Schmitt trigger input with a scope when a 60 kHz signal is fed into the receiver input. After this is accomplished connect the scope to the Schmitt trigger output and adjust R3 for a symmetrical wave form (be sure to keep the generator 60 kHz output level low). Check the output of the divide by circuit for a 10 kHz output. Switch Sw is used for calibrating the Rustrak recorder when the switch is placed in positions 0 and 100. The recorders full scale indication may be adjusted by R4 when the switch is placed in the 100 position. There is no adjustment for zero scale indication.

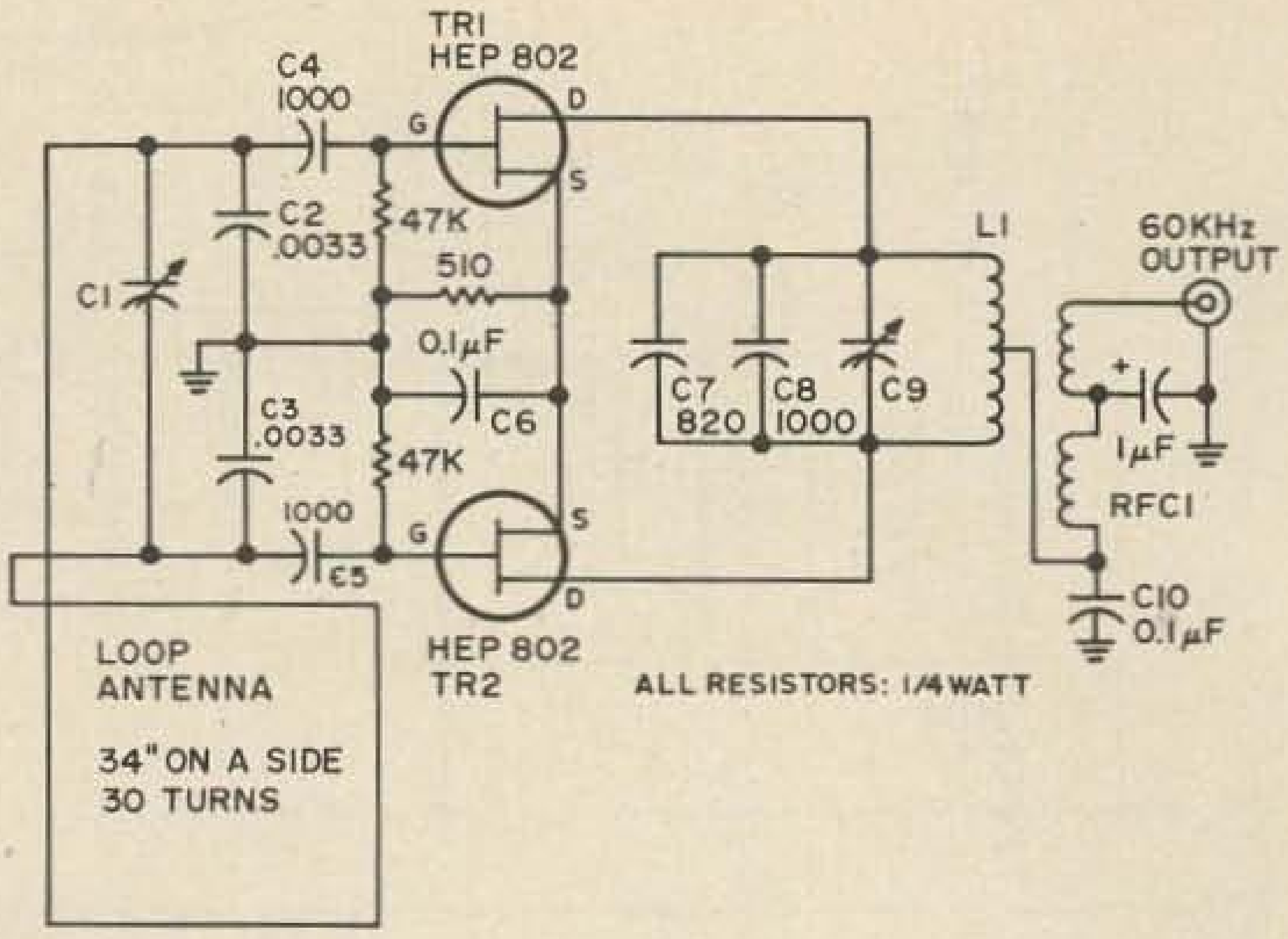

Fig. 6. Preamp. C, C9 – 275–970 μμF Elmenco padder 306; C2, C3 – 0.0033 μF Mylar (2200 μμF for 6 ft loop); C4, C5, C8 – 1000 μμF Dippled Silver mica; C6, C10 – 0.1 μF Centralab CK-104; C7 – 820 μμF Dipped Silver mica; L1 – 3 mhy C.T. Wound with No. 26 magnet wire approximately 85 turns on an Indiana General Corp. cup core TC7-04-400. Link is 3 turns of insulated wire; RFC1 – 10 mhy Ferrite core rf choke; TR1, TR2 – Motorola HEP 802 transistors or RCA 3N128.

PARTS LIST

C1, C4, C7, C14 – 115–550 μμF Padder Elmenco 304
C2, C3, C12 – 2000 μμF Dipped silver mica
CG, C11, C16 – 1000 μμF Dipped silver mica
C6, C13 – 820 μμF Dipped silver mica
C9, C24 – 0.1 μF Centralab Type CK Ceramic
C15, C18 – .033 μF 100 volt Mylar
C17, C19 – 1400–3055 μμF Padder Elmenco 315
C20 – .01 μF Centralab Type CK Ceramic
C21, C22 – 220 μμF Dipped silver mica
C23 – 1000 μF 6 volt Cornell-Dubilier Type BBR

R2 – 10K Ohmite AS ½ watt potentiometer
R3 – 10K Bourn E-Z Trim Type 3067-S 15 turn potentiometer
R4 – 5K Bourn E-Z Trim Type 3067-S 15 turn potentiometer

L1, L2, L3, L4 – 3 mhy Bifilar wound with No. 28 magnet wire approximately total 200 turns on Arnold Engineering Co. toroidal cores 206068-2. O.D. 0.8", I.D. 0.5", Permeability 125. All input and output links are 10 turns of insulated wire. Each coil is C.T.

L5, L6 – 7.5 mhy wound with No. 26 magnet wire approximately 140 turns on Indiana General Corp. cup cores TC7-04-400. Each coil is C.T.

SW1 – 2 poles 3 position rotary switch

CR1, CR4, CR5 – 1N155 Germanium diode
CR2, CR3 – 1N660 silicon diode

Q1, Q3 – MC714G Motorola RTL IC
Q2, Q8 – MC726G Motorola RTL IC
Q4 – MC700G Motorola RTL IC
Q5, Q5, Q6 – MC723G Motorola RTL IC

TR1, TR2, TR3, TR4 – 2N1613 Transistors

RFC1 – 10 mhy Ferrite core rf choke

Disconnect the generator and test lead from the loop antenna. Connect the scope to the mixer base and adjust the rf gain control R2 until clipping of the received 60 kHz signal occurs.

Experience has indicated that best results are obtained when a minimum number of manual corrections are made to the frequency standard to bring it within tolerance. It is desirable to over-compensate, rather than set the standard exactly on frequency. This results in the maximum time period between adjustment in order to maintain the standard within specific tolerances.

Local Frequency Standard

The frequency comparator requires 100 kHz from a local frequency standard with a minimum output of 4 VPP. Crystal calibrators similar to those used in communication receivers are not stable enough for use in this system (the same is true for most crystals mounted in snap action type ovens). A good frequency standard employ a crystal mounted in a proportional control type oven. Most crystals used in frequency standards are 1, 2.5 and 5 MHz with appropriate signal conditioners.

Performance

The performance of the frequency comparator described in this paper meets all of the design criteria requirements. The system phase shift caused by a 20 dB drop in input signal level is approximately 0.33 μsec. The rf gain control will introduce approximately 1.6 μsec phase shift over its full range but this is a fixed shift. With a stable frequency standard the system will phase track a part in the 10. There are limitations to this type of frequency comparator (compared to a complex phase-locking type), but never the less, this system will out perform any hf systems presently in use.

Two common questions have been asked whenever I have demonstrated the 60 kHz frequency comparator receiver and these are:

1. Would there be an error in the comparator measurements as the 100 kHz standard is being divided down to 50 and 10 kHz.

2. Where should the loop antenna be located?

Let's assume that a 100 kHz standard has drifted 10 Hz. A one Hz at 100 kHz is 10 usec long in time and 10 Hz at 100 kHz would be 100 usec. Dividing 100 kHz down to 50 kHz would also divide the drift by two but one Hz at 50 kHz is 20 μsec long and 5 Hz at 50 kHz would be 100 μsec. Thus by dividing a frequency it never changes the error but only the number of cycles.

Referring to the block diagram (Fig. 3), let us assume that the 100 kHz standard did drift 10 Hz high over a period of time. The output from the divide by two circuit will be 50 kHz plus 5 Hz. The 50 kHz plus 5 Hz does however mix with the received 60 kHz signal to produce a 9.995 kHz and this signal drives one input of the bistable flip-flop.

The 50 kHz plus 5 Hz is further divided by five to 10 Hz plus 1 Hz and this signal drives the other input of the bistable flip-flop. The bistable flip-flop counts a difference of 6 Hz between the two input signals. Since everything is in reference to the 60 kHz signal (one Hz at 60 kHz is 16-2/3 μsec) the 6 Hz in μsec would be 6 x 16-2/3 μsec = 100 μsec and this indicates that the 100 kHz standard did drift 100 usec.

As with any antenna the loop should be located clear of all structures, etc. To avoid regeneration, the loop should be at least 30 feet from the comparator receiver. The loop should be pointed edge wise toward Ft. Collins, Colo.

With the 3 foot loop located in the basement the comparator did phase track but the 60 kHz signal level was down. I compromised by installing the loop in the attic and this also solved the weather problem.

This project was for Area 5 MTS of the Air Force MARS program for updating methods of calibrating frequency standards. The writer would like to express his appreciation to Dick Bingham, W7WKR for his assistance in the write up, Bob Ellis, W7FNA/AF7FNA and Fred Reid Jr., W7EJD/AF7EJD for their assistance in the project.

. . .W7LHL

William F. Splichal, Jr. WA6QVQ
1160 Brace Avenue
San Jose, CA 95125

CIGAR TUBE GE Audio-RF Signal Generator

Miniature audio-rf signal generator (Fig. 1) for injecting signals into audio amplifiers or receivers can be constructed with a dozen components and contained in an aluminum cigar tube slightly larger than a pen. The circuit will operate with almost any pair of NPN or PNP transistors, whether silicon and/or germanium, by merely changing the battery polarity for the type transistors used. Surplus computer circuit boards or junked transistor radios can provide almost all the components necessary to construct this simple generator.

CIRCUIT

Circuit

The generator, Fig. 2, is basically an astable multivibrator which oscillates at approximately 1000 Hz. The sharp edges of the audio square wave signal are rich in harmonics up to approximately 200 MHz. and a single 1.5 volt penlight cell supplies the necessary power. Battery polarity for the various types of small signal PNP or NPN transistors is as listed in the table below:

Transistor Pair Type	Battery Polarity
A. 2 NPN silicon	As shown on diagram
B. 2 PNP silicon	Reversed
C. 2 NPN germanium	As shown on diagram
D. 2 PNP germanium	Reversed
E.1 NPN silicon and 1 NPN germanium	As shown on diagram
F.1 PNP silicon and 1 PNP germanium	Reversed

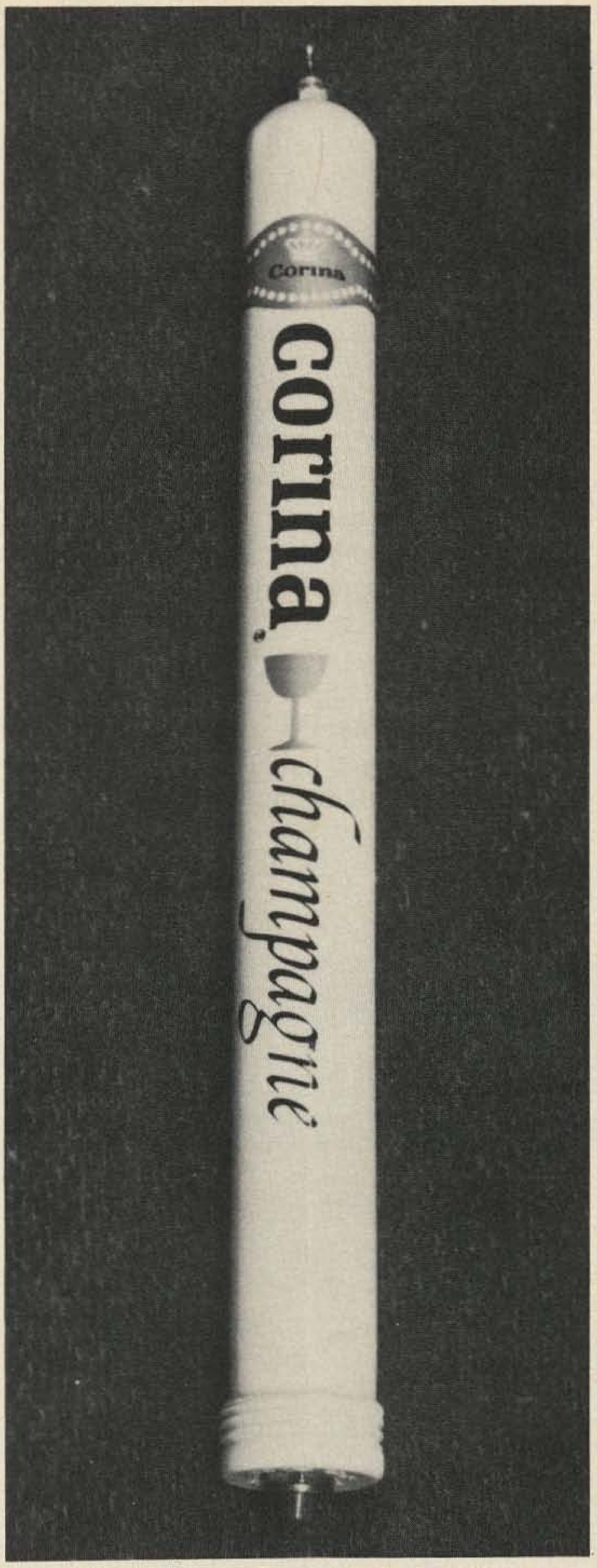

Fig. 1. Cigar tube audio-rf generator.

Construction

An aluminum cigar tube slightly larger in diameter than a penlight cell is used to house the generator. The generator as shown in Fig. 3 was fabricated on a small piece of Vector-Board and wrapped with electrical insulation tape. If more desirable

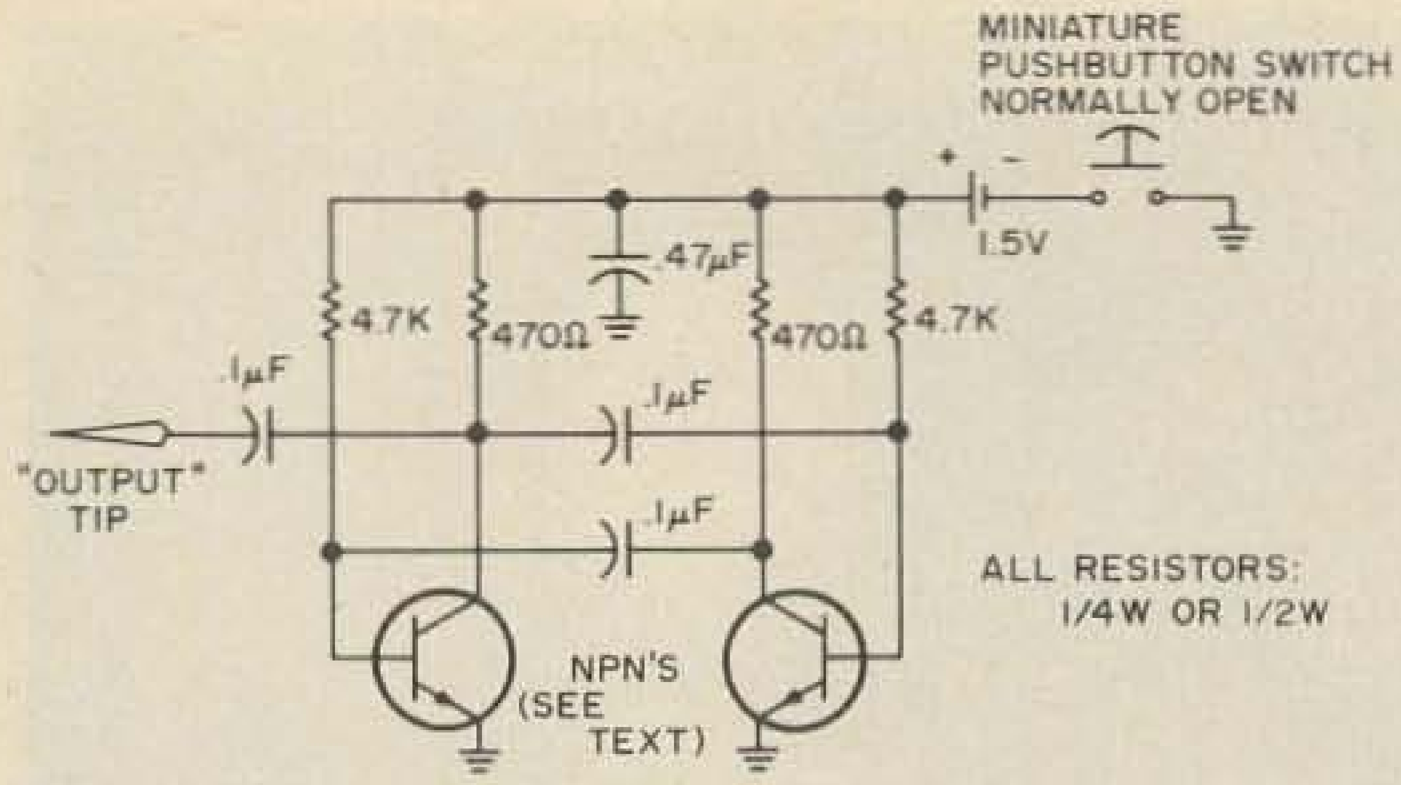

Fig. 2. Note All resistors—¼ or ½ watt.

the generator may also be constructed on a small printed circuit board or soldered together in a string arrangement and wrapped with insulating tape. A feed-thru insulator with a small pointed tip is attached to one end of the tube to inject the output signal into circuits under test. A small male pin from a scrapped connector could be soldered onto the end of the feed-thru insulator to provide a longer extending output tip. Layout of the components inside the aluminum tube is not critical. A miniature push-button switch is located in the other end to apply power to the multivibrator.

Fig. 3 Component layout.

Operation

The signal generator is operated by simply placing the pointed output tip of the generator on the electronics circuit to be tested and depressing the push-button switch on the other end. A wire lead may be connected between the case of the aluminum cigar tube and ground of the circuit to be tested. Grounding may also be accomplished by holding the signal generator with one hand and touching ground of the circuit being tested with the other hand. Signal injection into rf circuits may not necessitate the use of a grounding circuit from the generator to the rf circuit under test.

...WA6QVQ

Parker C. Cope W2GOM
RD 1
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the CW EXcavator

Digging signals out of the noise was a problem when Hertz made his experiments, and it's still a problem when we communicate with the astronauts. It's not just your QSO's that fade into the noise or get buried in the confusion. It only seems that way. One of the best tools for digging out a signal is a filter with a response that just matches the spectrum of the signal. The closer the match the better the digging. The CW excavator is an audio filter that really digs a signal out of the mud, and does it without ringing like a bell.

A filter that matches phone signals is nothing like a match for CW signals. A phone signal has a bandwidth of about 2.5 kHz to 2.8 kHz, while a CW signal has a bandwidth of less than 50 Hz. The actual bandwidth is directly proportional to dotting speed, and when the going gets tough most operators slow down so that the actual bandwidth required for communicating drops. Consequently, a receiver with a beautiful response for phone has a bandwidth more than fifty times wider than necessary for CW signals. When your QSO is the only one going, the extra bandwidth may not hurt much, but when the band is crowded it makes more than 50 more chances for interference. That is a lot of unnecessary QRM.

Ideally, only the signal within the filter's passband should be heard; all other off-frequency signals should be completely attenuated. A real world filter attenuates the off-frequency signals, but not completely. Fig. 1 shows how several typical filters perform. The dotted curve results from a single resonant circuit with a Q of ten tuned to 800 Hz. The 3 dB bandwidth is 80 Hz but the 40 dB bandwidth is 8000 Hz. If the Q were increased to 20, the 3 dB bandwidth would decrease to 40 Hz and the 40 dB bandwidth would decrease to 4 kHz off-frequency.

The dashed curve in Fig. 1 shows the result of cascading a similar resonant circuit with Q of 10 and also tuned to 800 Hz. The second cirsuit really helps. Increasing the Q of both circuits to 20 reduces the 3 dB bandwidth to 25 Hz and the 40 dB bandwidth to 400 Hz. This represents a big

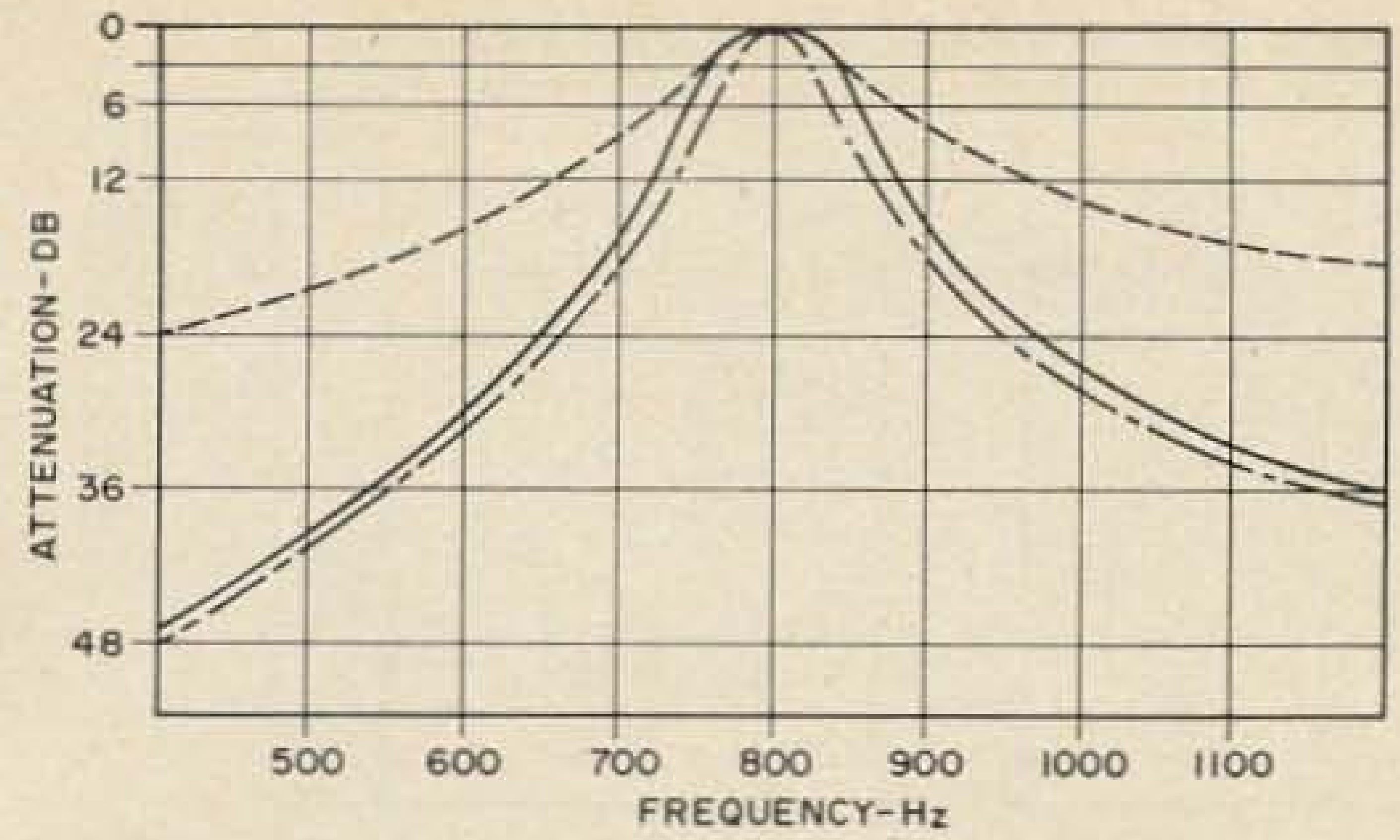

Fig. 1. Response of one and two tuned circuits.

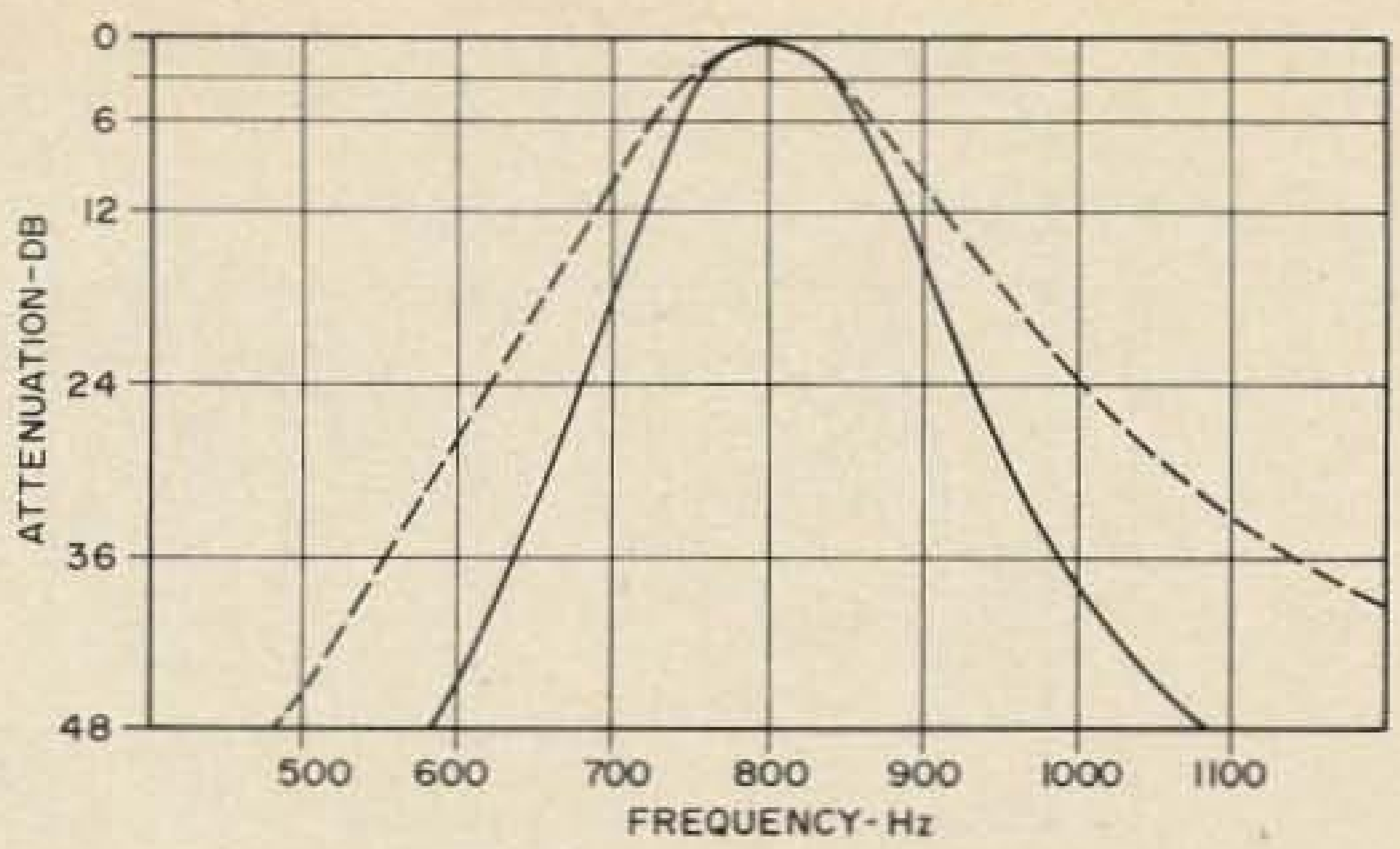

Fig. 2. Response of four stages.

improvement in cutting QRM but tuning and receiver stability become much more demanding and you may even notice a bell-like quality in the signal. Even a 50 Hz bandwidth makes receiver tuning touchy, and if your receiver is a little drifty, keep your transmissions short.

There is a way to have your cake and eat it too. Relatively high Q circuits tuned to slightly different frequencies increase the 3 dB bandwidth without giving up too much off-frequency attenuation. The solid curve in Fig. 1 results when two tuned circuits are stagger tuned; that is, one is tuned to a frequency above 800 Hz while the other is tuned below 800 Hz. The tuned frequencies are 772 Hz and 828 Hz and the Q's are 14. The 3 dB bandwidth, 80 Hz, is as wide as a single circuit with Q of 10 but the skirts are about as steep as two stages.

Since two tuned stages are better than one, and stagger tuned is better than synchronous tuned, we might conclude that the more stagger tuned circuits the better. They are – if they are on the right frequency and the Q's can be achieved. The CW Excavator uses four tuned stages arranged to form two staggered pairs. Fig. 2. compares the response of two staggered pairs, the solid curve, to four synchronously tuned stages; that is, four stages all tuned to the same frequency of 800 Hz. In both cases the 3 dB bandwidth is arranged to be 100 Hz.

To avoid the problems of tuning and loading coils and maintaining the proper impedances, the CW Excavator uses active filters. The active filter achieves the effects of L and C with R's and C's and an operational amplifier. Unlike the LC resonant circuit, the active filter is relatively immune to load changes, and it can provide gain as well. Although the CW Excavator has limited power output, it can easily drive a pair of high impedance phones.

The schematic of the CW Excavator, shown in Fig. 3, may not look like a filter so let's take it apart and see how it works. The componenets shown within area "B" make an active bandpass filter 85 Hz wide tuned to 756 Hz. The components within area "A" make an active bandpass filter 93 Hz wide tuned to 844 Hz. These two stages make a staggered pair with a bandwidth of 125 Hz centered at 800 Hz. Cascading two such pairs produces a filter with a 3 dB bandwidth of 100 Hz centered at 800 Hz. The theory behind the active filter is rather new and the derivation of the working equations is quite involved. Fortunately the qualitative description of an active filter is straightforward, even though the quantitative analysis is something else. Basically, the active filter is a feedback amplifier in which the magnitude and phase of the signal fed back determine the overall frequency response.

A brief discussion of the workings of a feedback amplifier will help in understanding the active filter. The block diagram, Fig. 4, shows a general amplifier. For the sake of discussion, the amplifier is assumed ideal: The input impedance is very high; that is, no significant signal current flows in the input. The gain of the amplifier is very large. The output of the amplifier is exactly out of phase with the input. The output impedance is very low; that is, the output voltage is independent of the load. Since the voltage gain is very large, a minute voltage, e, at the input causes a very large output voltage. Since there is no signal current flowing in the input of the amplifier and the voltage e is essentially zero, the current I m must be

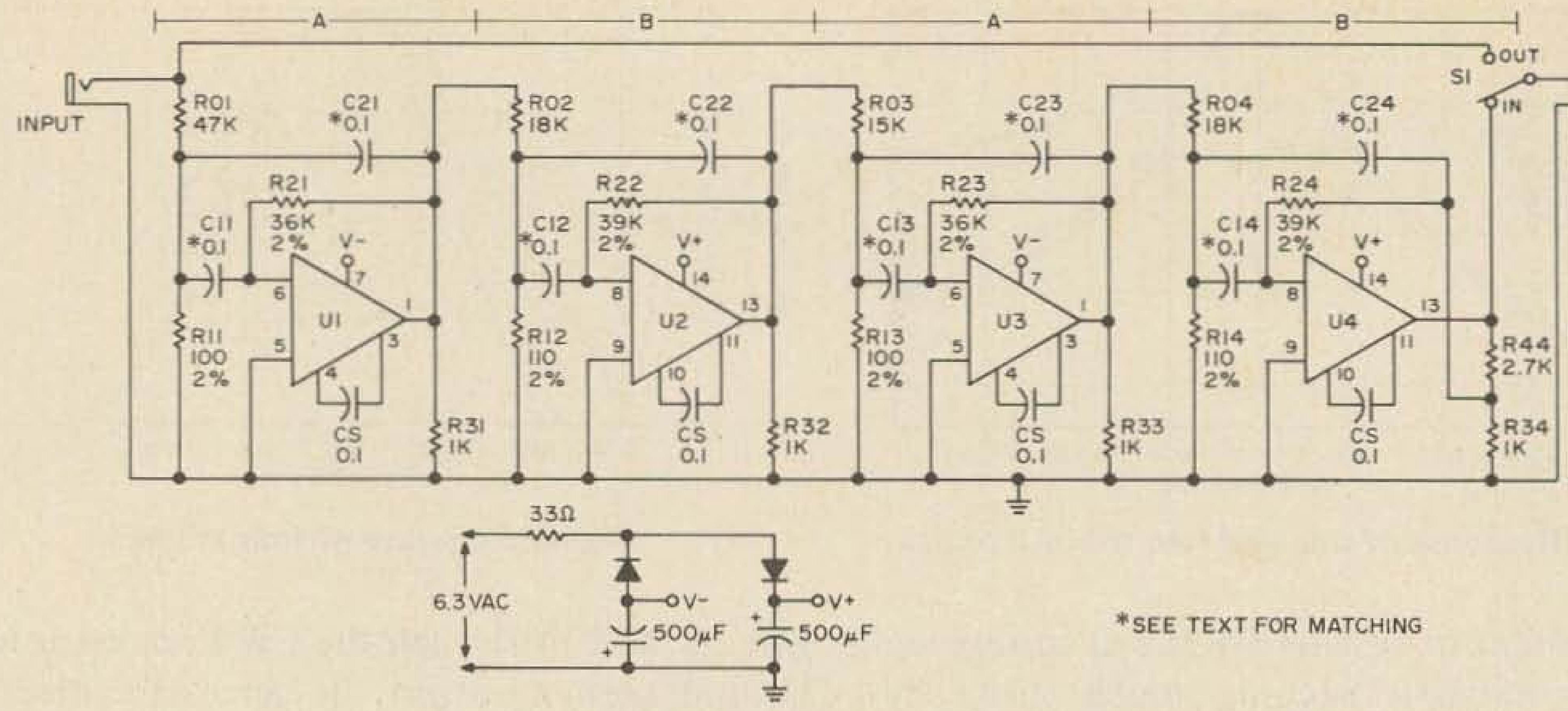

Fig. 3. CW Excavator.

equal and opposite to the current Ifb. Consequently, the voltage gain may be expressed as:

$$G = \frac{E_o}{E_s} = \frac{Z_{fb}}{Z_{in}}$$

If Zfb or Zin vary with frequency, the gain of the amplifier with feedback will vary with frequency. The IC operational amplifier fills the requirement of gain block so the secret of designing active filters reduces to designing feedback networks that vary with frequency in a prescribed way.

A qualitative description of the active bandpass filter shown in Fig. 3 area A is typical of all four stages. R11, R21, C11, and C21 make up the frequency sensitive feedback network around the operational amplifier U1. Cs and R31 stabilize the amplifier so that it can not oscillate under any feedback conditions. R01 and R11 form a voltage divider that sets the gain of the stage. The first stage is arranged to have a loss of 10 dB, the second and third stages have unity gain, and the fourth stage has a gain of 10 dB. Consequently, the overall gain is about one. R34 and R44 increase the gain and maximum output level of the amplifier while maintaining an acceptable feedback level.

At very low frequencies the reactance of C11 is large compared to R21 and the voltage gain is low. At very high frequencies the reactance of C21 is low compared to R11 and the gain is again low. At some in-between frequency the reactance of C21 is large compared to R11 and the reactance of C11 is small compared to R21. Consequently, the voltage gain is high at this in-between frequency. Specifically, the frequency of maximum gain or center frequency of the passband is:

$$f_{01} = 1/\,2\pi\sqrt{R_{11}R_{21}C_{11}C_{21}}$$

The maximum gain, relative to the voltage across R11, is:

$$G_{11} = R_{21}C_{21}\,/R_{11}\,(C_{11} + C_{21})$$

The 3 dB bandwidth is:

$$B_1 = 1/2\pi R_{11}(C_{11} + C_{21})$$

In designing an active bandpass filter, any absolute values of R or C can be used that satisfy the above equations. If you need a special audio filter for your RTTY or repeater control experiments, these equations should put you on your way. Since odd values of resistors are more readily available than odd values of capacitors, pick a standard capacitor value and go from there. The calculations may be laborious but they are straightforward. These are the steps in calculating the values of any particular filter.

1. Calculate the product R1 and R2 from the chosen values of C1 and C2 and the desired frequency.

$$R_1R_2 = 1/(2\pi f_0)^2C_1C_2$$

2. Calculate the value of R1 from the desired bandwidth and the chosen values of C1 and C2.

$$R_1 = 1/2\pi B_1(C_1 + C_2)$$

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3. Calculate the value R2 from the R1R2 product obtained in step 1 and the value of R1 obtained in Step 2.

$$R_2 = R_1R_2/R_1$$

4. Calculate the gain from the values of R1, R2, C1, and C2.

$$G_1 = R_2C_2/R_1(C_1 + C_2)$$

5. Calculate the value of R0 from the desired gain, G0, and the value for G1, and R1 obtained in Steps 2 and 4.

$$R_0 = R_1(G_1 - G_0)/G_0$$

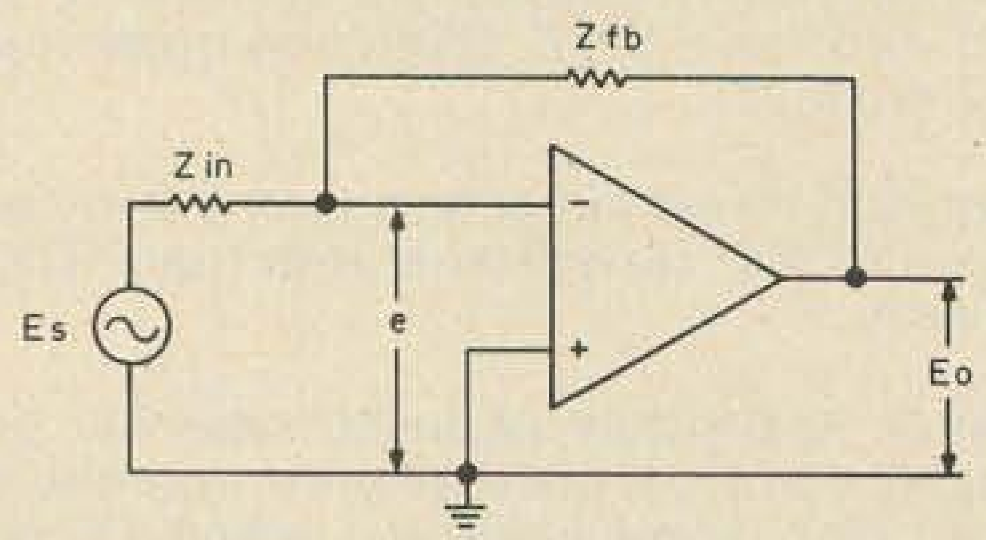

Fig. 4. General feedback amplifier.

If you are designing a new filter remember that the calculated value for R1 results from paralleling the physical R with R0 in series with the input's source resistance.

The effects of component variation and tolerance on the individual stage, and consequently, on the overall filter performance, are rather critical. Center frequency, bandwidth, and gain all vary with R1, R2, C1 and C2. Gain variation is not particularly important since it doesn't effect the filter's performance in digging signals out of the bedlam. On the other hand, only small variations in center frequency can be tolerated. In general, increasing the frequency separation of the stages making up the staggered pair increases the overall bandwidth and produces a double peaked response. Decreasing the bandwidth of the individual stages also produces a double peaked response. Reducing the frequency separation of the stages reduces the overall bandwidth and produces a single peaked response. Increasing the bandwidth of the individual stages increases the overall bandwidth and also produces a single peaked response. The stage bandwidth variation caused by gross component tolerances barely effects the overall response. For example, reducing the stage

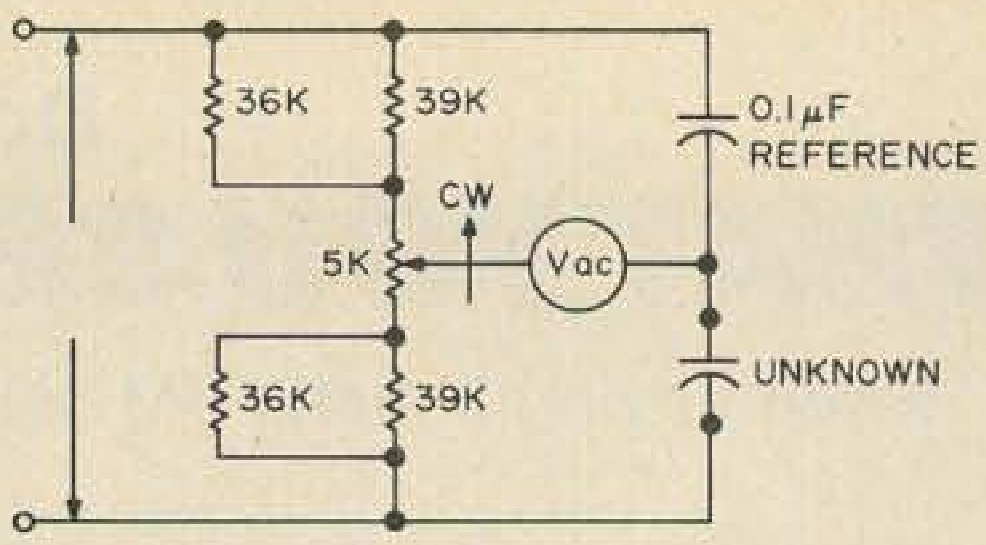

Fig. 5. Comparison bridge.

bandwidth to half only causes 2 dB peaks and a bandwidth change of about 7%. The center frequencies of the individual stages in the staggered pair and are very critical and normal component tolerances result in drastic performance changes. For example, if either R1, R2, C1 or C2 were 10% low, the center frequency would be 10% high. If this were the high frequency stage, the peak would shift from 844 Hz to 928 Hz. If one of the components in the low frequency stage were 10% high, the center frequency would shift from 756 Hz to 670 Hz. The bandwidth of the pair would consequently be about 250 Hz. Obviously, steps must be taken to make sure the stages are tuned to the proper frequencies.

One way to put the stages on-frequency makes R2 variable, but that requires an audio generator that can very accurately set to frequency. Using close tolerance parts avoids the problem but the availability and cost may rule out that solution. A compromise uses semi-precision resistors with 2% tolerances and ordinary mylar capacitors with 10% tolerances. The capacitors used in a particular stage are paired so that their product is near 0.01×10^{-12} to put the stage on-frequency. As a consequence of this pairing, the sum is also very near the desired 0.2 µF required to produce the proper bandwidth. The secret is to pair a high plus tolerance with a high minus tolerance and a low plus tolerance with a low minus tolerance.

If you have access to a good capacitance bridge and a stock of 0.1's you've got it made. Even if you don't have a big stock of capacitors and don't have a bridge, there is a way out. With twelve 0.1 µF's required for the complete filter, the laws of probability favor your finding four good pairs. The problem is to find which capacitors are relatively high and which are relatively low so they can be paired. The technique I used doesn't take special equipment, just time and patience. A 5K pot, and an ac voltmeter plus the parts needed for the filter can be used to make a comparison bridge.

The relative capacity of the 0.1 μF's can be determined by temporarily using the semi-precision resistors as part of a bridge as shown in Fig. 5. The meter used to detect the null can be either a VTVM or a 5000 Ω per volt meter with a 3V range. The pot should have a linear taper just to make life easier, and a dial or pointer on the shaft helps in judging the relative position of the pot's arm. Arbitrarily pick any one of the 0.1μF's to use as the reference in the bridge.

The procedure for determining the relative capacities is as follows: Connect the capacitor to be evaluated into the "unknown" position in the bridge and adjust the pot for a null on the meter. The farther CCW the arm is from mid-position the samller the unknown capacitor is relative to the reference capacitor. Measure each of the capacitors and identify them according to their relative capacity. To determine the location of the reference capacitor in the overall order, replace it with the smallest measured capacitor and repeat the measurement.

Matching the capacitors is essential to making a filter with predictable characteristics. If the dial on the pot doesn't provide much resolution, use the following method to recheck the capacitors. Check the capacitors in increasing order of capacitance and note that the pot must be turned a little more CW to null each capacitor. If the pot must be turned CCW to null, the capacitor being measured is smaller than the one previously measured. After the capacitors are arranged in order of capacitance, they can be paired.

The two largest and two smallest capacitors are used as the stabilizing capacitors, Cs (Fig. 3). Only the middle eight capacitors are used in the frequency sensitive feedback networks. Of these eight capacitors, pair the largest with the smallest, the next largest with the next smallest and so on. Use any pair in any stage of the filter; that is, C_{1-} and C_{2-} must be a pair.

Power for the unit is not critical; the supply shown as part of Fig. 3 need not be used if you have other sources. Any supply voltages between ±5 volts and ±15 volts can be used, and they need not be balanced. The current drain is only 8 mA with 6 volt supplies and about 20 mA with 15 volt supplies. Ripple on the supplies can be pretty high without adverse effect; the supply shown in Fig. 3 has about 0.25 volts ripple and there is no detectable hum in the output.

Any construction technique can be used, the layout is not critical. In fact, the leads to the filter bypass switch S1, need not be shielded. I put my filter on a 2" x 5" piece of Vectorboard in a min-box. I used μA739's because that's what I had, but the '709 should work as well. If you want to use 709's, remember to stabilize the amplifier for unity gain; for the 709A that would be 5000 pF in series with 1.5K between pins 1 and 8, and 200 pF between pins 5 and 6.

There is no trick to using the filter but its extreme skirt selectivity can produce some puzzling effects until you think about it awhile. For example, with the filter "in," you can't tell when the receiver or filter are overloaded. The great selectivity rejects the distortion products, so there is no change in the sound of the audio, even under severe overload. The only solution I've found is to reduce the receiver's gain until the output is obviously less than maximum. With my 2000Ω phones the maximum output is uncomfortably loud, so I know that a comfortable level is below overload.

The effects on a phone signal may cause some head scratching too. The gain of the filter is about unity for 800 Hz, so there is little change in the level of an 800 Hz note when the filter is switched "in" or "out," but a comfortable level signal with filter "out" The reason: the energy in the 750 Hz to 850 Hz segment of the phone signal is very small compared to the total energy. This is probably the most dramatic demonstration of the CW Excavator's ability to reject off-frequency signals and cut the QRM.

If you want to dig CW, the CW Excavator is the tool. It will improve a good receiver and give an ordinary AM or SSB receiver CW selectivity that is as good as any. If the QRM discourages you, build the CW Excavator and be prepared for a change.

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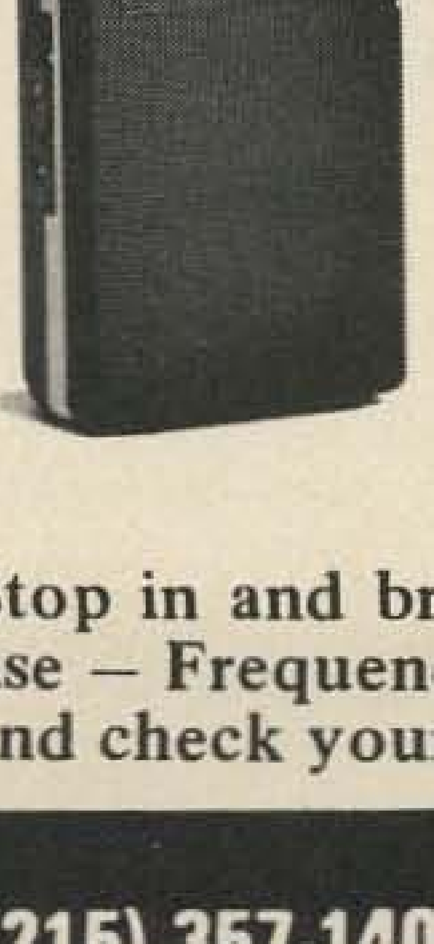

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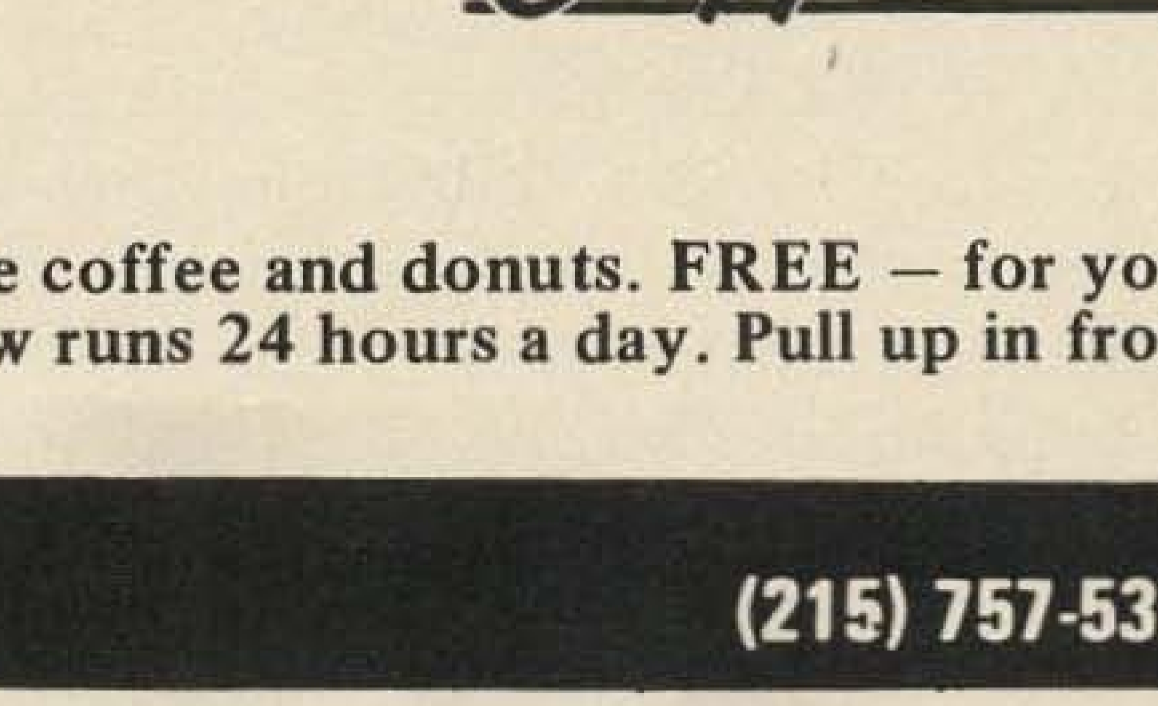

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ANTENNAS and TEST RECEIVERS for 1296, 2300 and 3500 mHz

Using the oscillators described in 73[1] along with the diode receivers described here, it is possible to set up a working UHF amateur station for the 1296, 2300 and 3500 MHz amateur bands. The oscillators first will help you tune the antenna and receiver, then will work as a transmitter and as a local oscillator for superhet receiver operation.

The 1296 Diode Receiver

At this frequency you should begin to take care or you won't finish up with a good tunable receiver. The following notes and precautions should help you to line up a workable unit for the band.

1. Looking at Figs. 1A, B, C and D, the nylon bolts used for tuning and adjusting screws must be held firmly by a bakelite or other insulating strap that uses two bolts, as in detail in Fig. 1C.

2. The spacing of L1 to the baseboard should be small.

3. C1 should be made up with care, as in detail shown in Fig. 1C, keeping in mind that the inductance of the movable tab part of C1 should be as low as possible. You could use penny tuning between the baseboard and L1 but that gets more involved mechanically.

4. The adjustable input coupling capacitor C2 should be made up as in Fig. 1D, which shows one continuous piece of spring copper strap from J1 over to the movable part on top of L1.

5. Again, the diode must be a good one. I haven't had much luck with UHF diodes such as 1N82's and the like. The TV and radio people furnish some dandy low-cost

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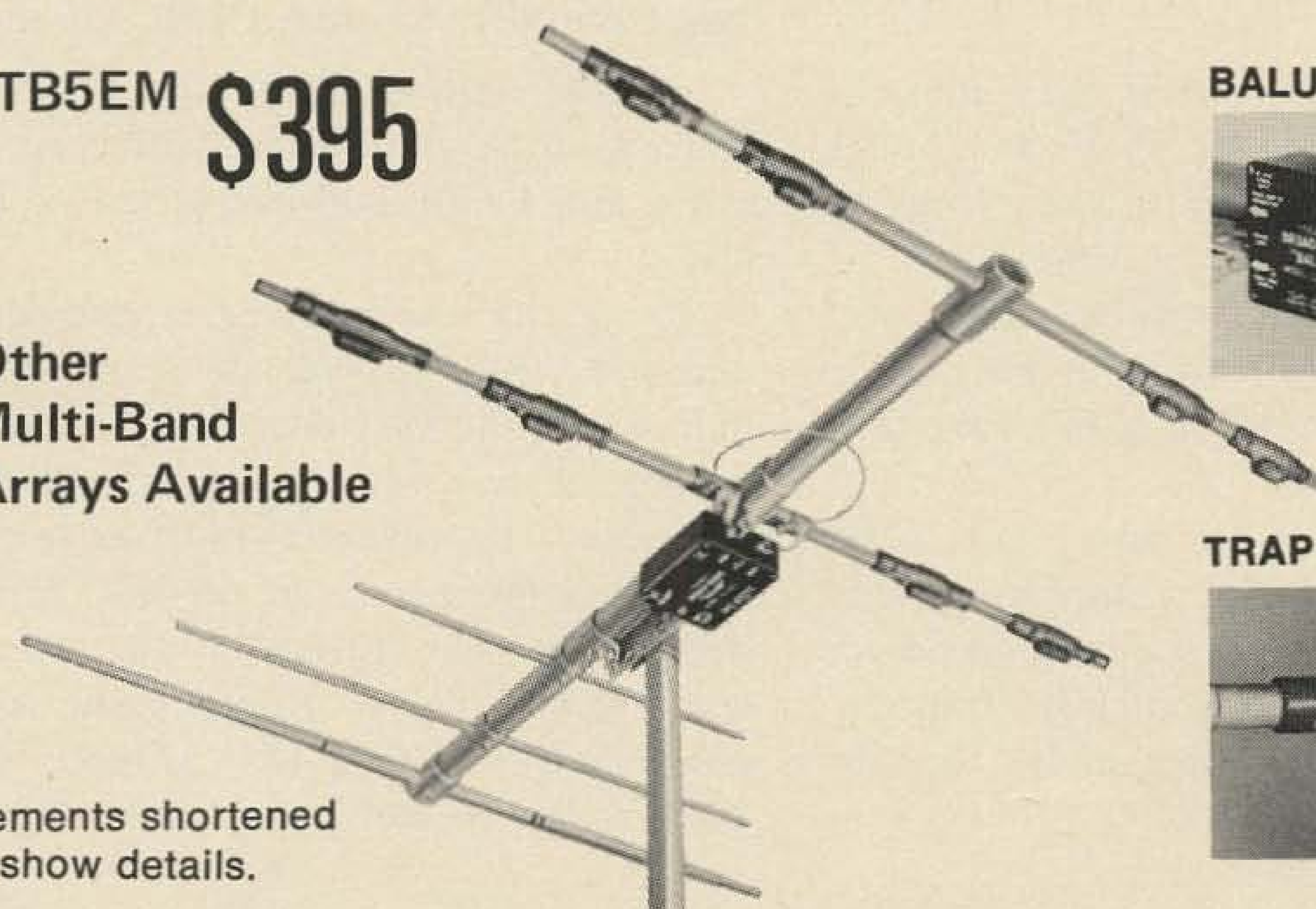

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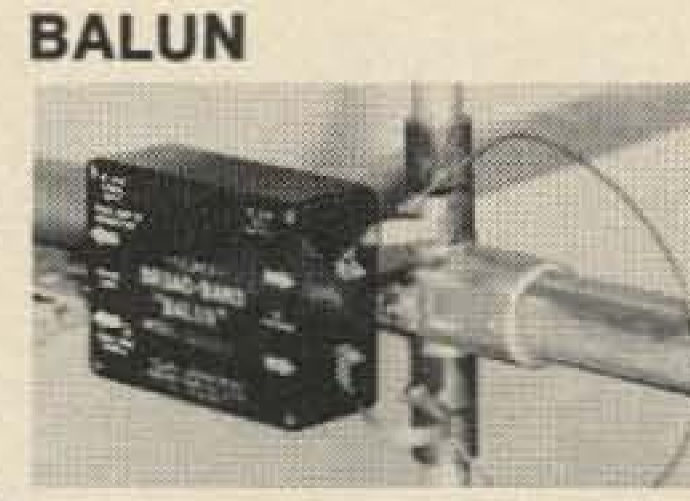

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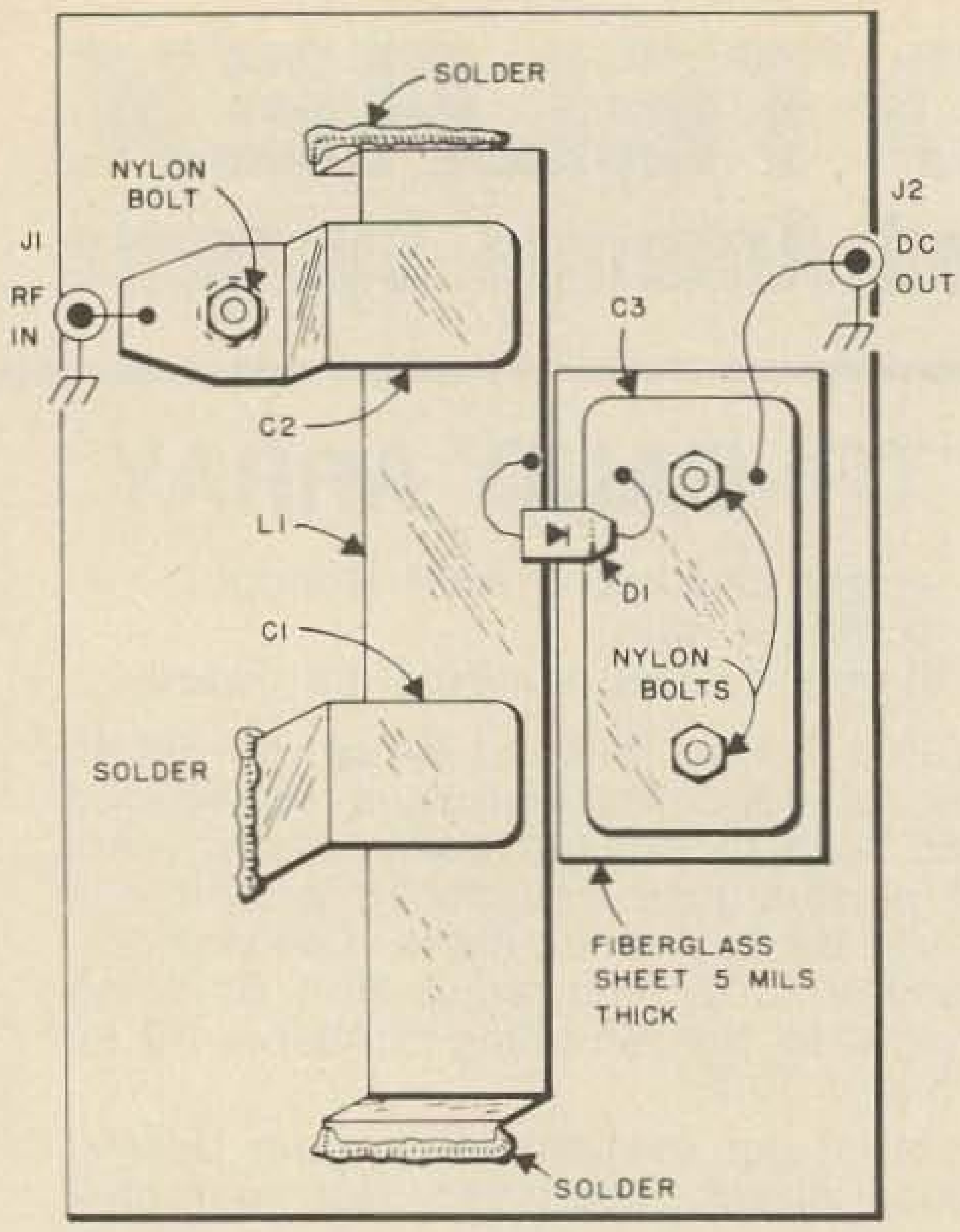


Fig. 1A. Top view of the 1296 MHz diode receiver. L1=2 1/4" long, to first bends (top); 9/16" wide brass strip; C1= spring copper strap, 1/2" wide, top part 3/4" long, vertical section 1/4" long; C2= spring copper strap, 3/8" wide, part above L1 1/2" wide; C3= brass plate, 1" x 1/2".

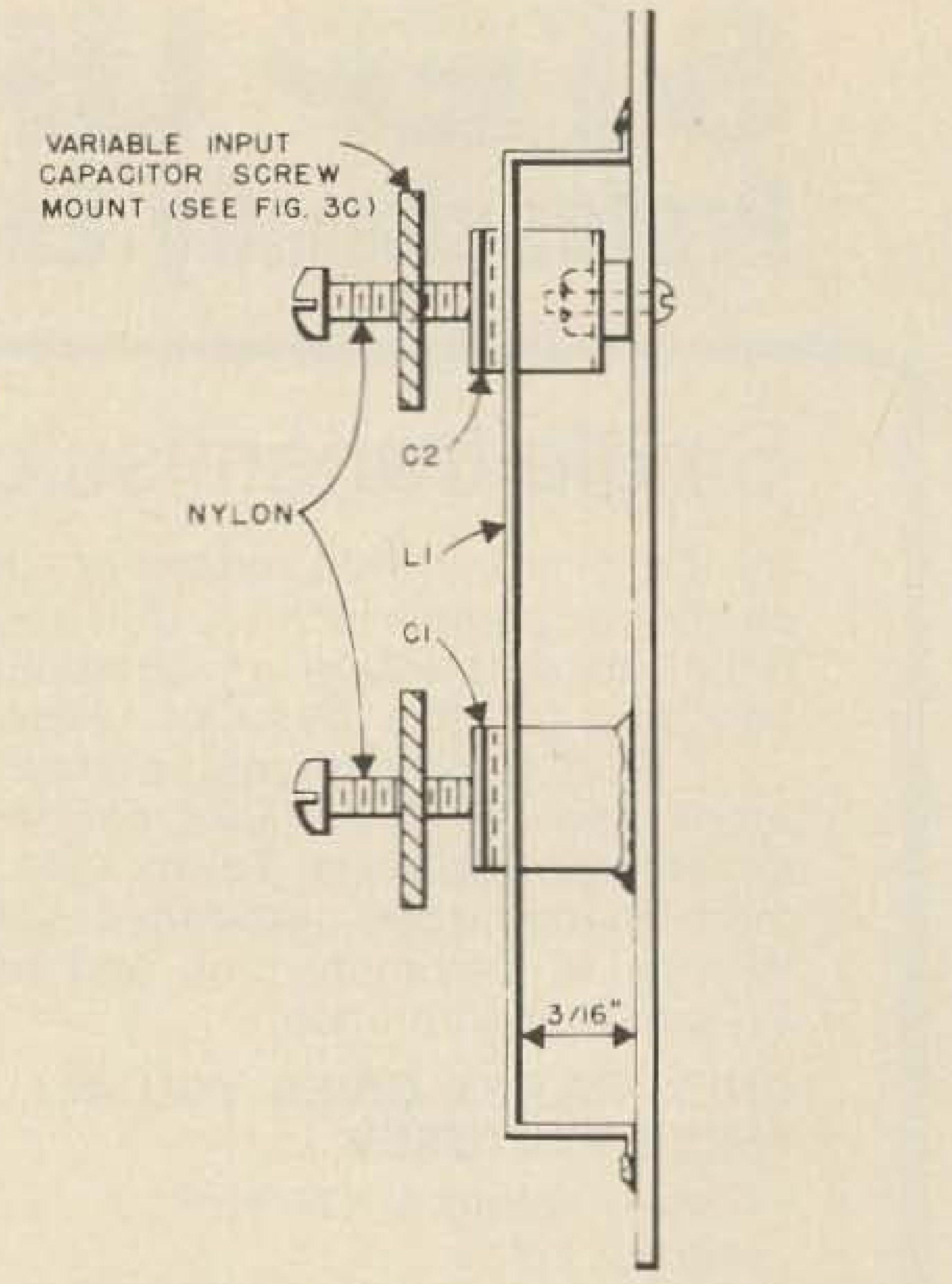


Fig. 1B. Side view of the 1296 MHz diode receiver.

items for us amateurs, but if they make a diode good for channel 83, that's as far as it will go. It may just meet a spec (one of which I've seen called for a noise figure of 14 dB for 890 MHz) and be practically worthless for 1296 MHz amateur use. Use a good X band diode, and you won't have that item to worry about.

That about does it for this little 1296 MHz plank. The size suits a minibox and it will start you off on 1296, checking power out of oscillators, antenna tuneup, frequency measurements, antenna gain by the distance method, etc.

The 1296 MHz Standard Test Antenna

A little scaling down, dividing by three, and a snip here and there with a dentist's tin snips, and I soon had two antennas ready for test.

Using the oscillator previously described, and the 1296 MHz diode receiver with the half wave line just detailed, the test system of Fig. 2 was set up. The meter began to move and the antenna tuning was started in the same manner as in the 432 MHz procedure. However, things don't always work that easily. There didn't seem to be any great amount of "soup" around the room. The new receiver was checked against a

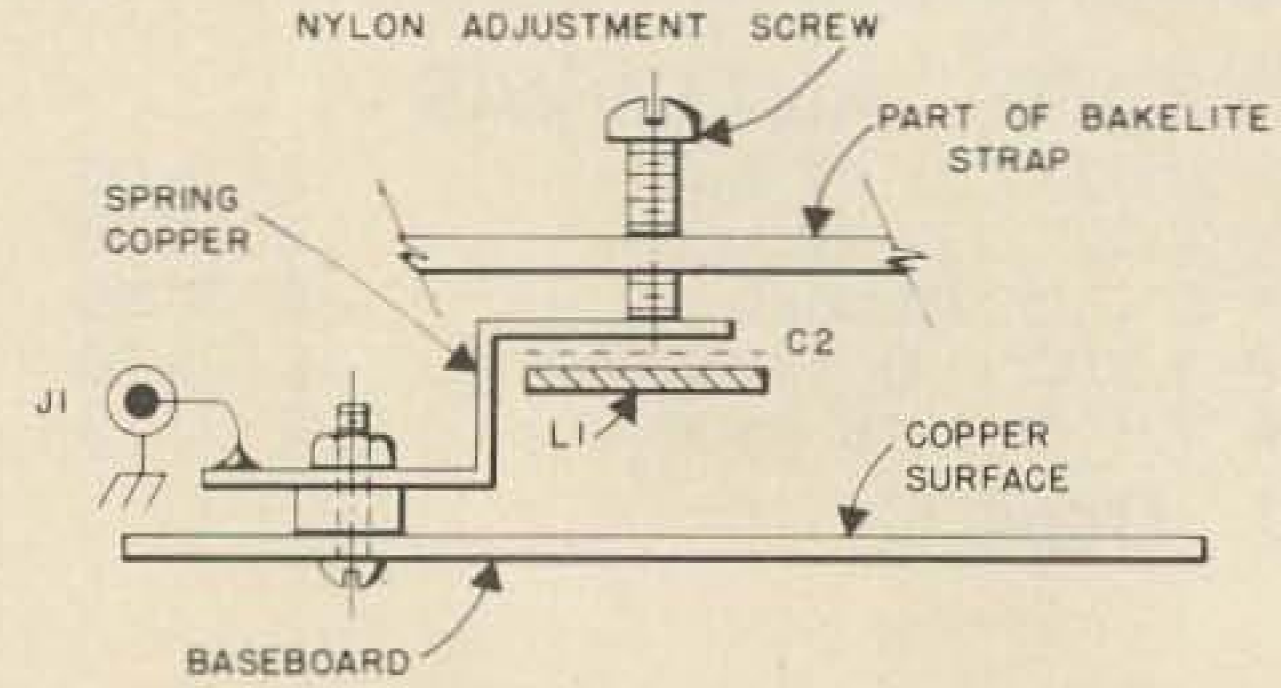


Fig. 1C. End view of the 1296 MHz receiver and C1 detail.

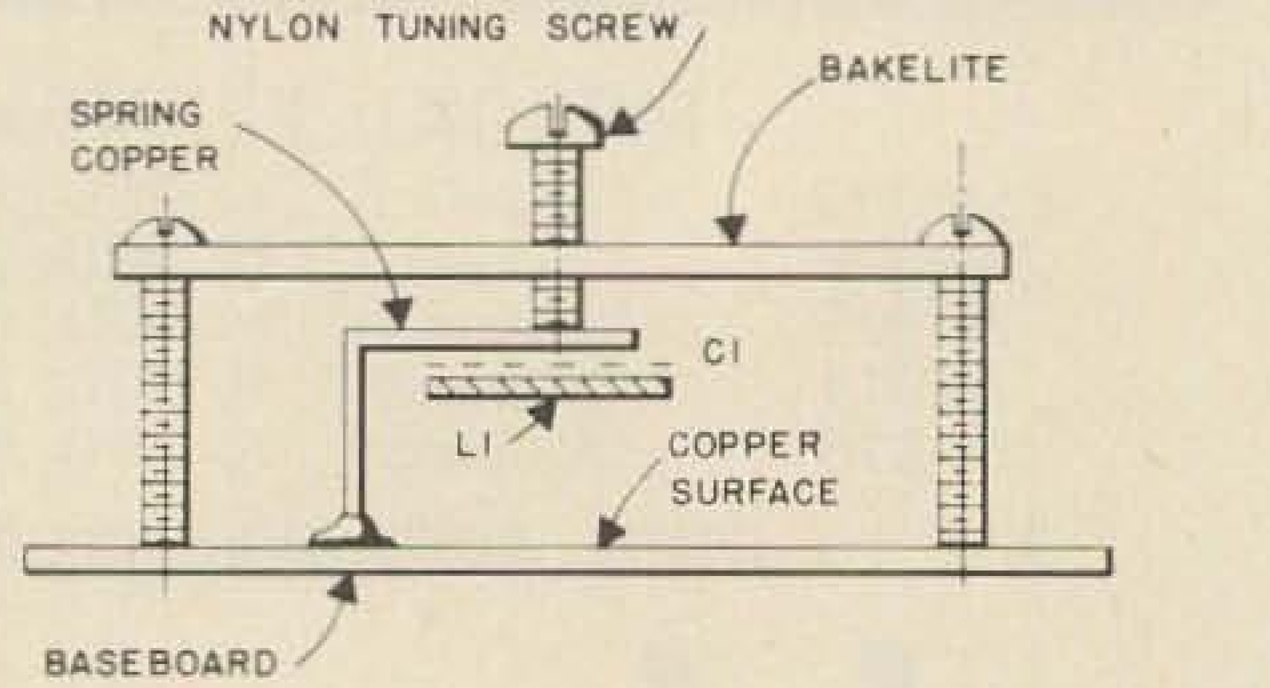


Fig. 1D. Side view of the 1296 receiver, and detail of C2.

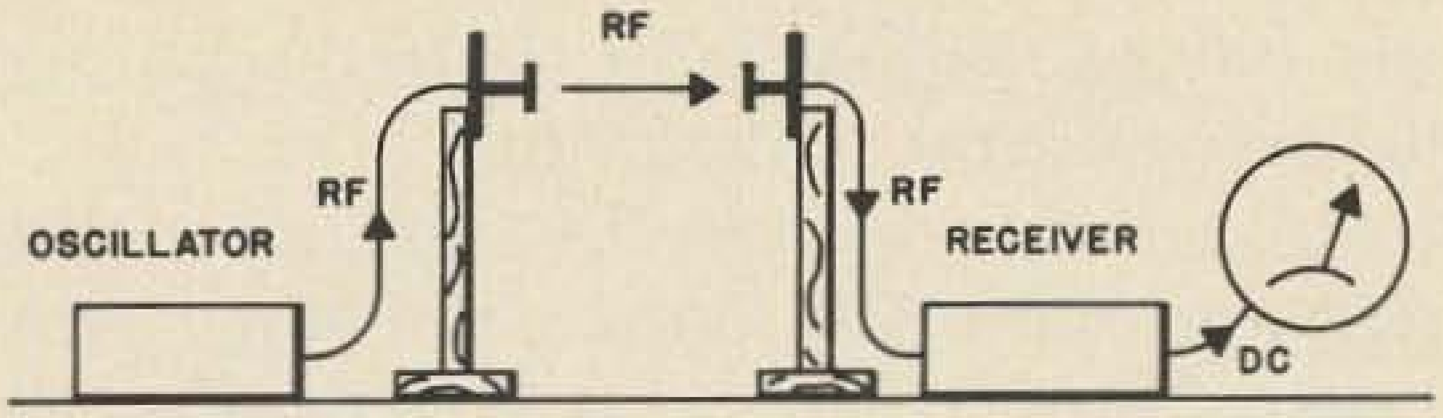


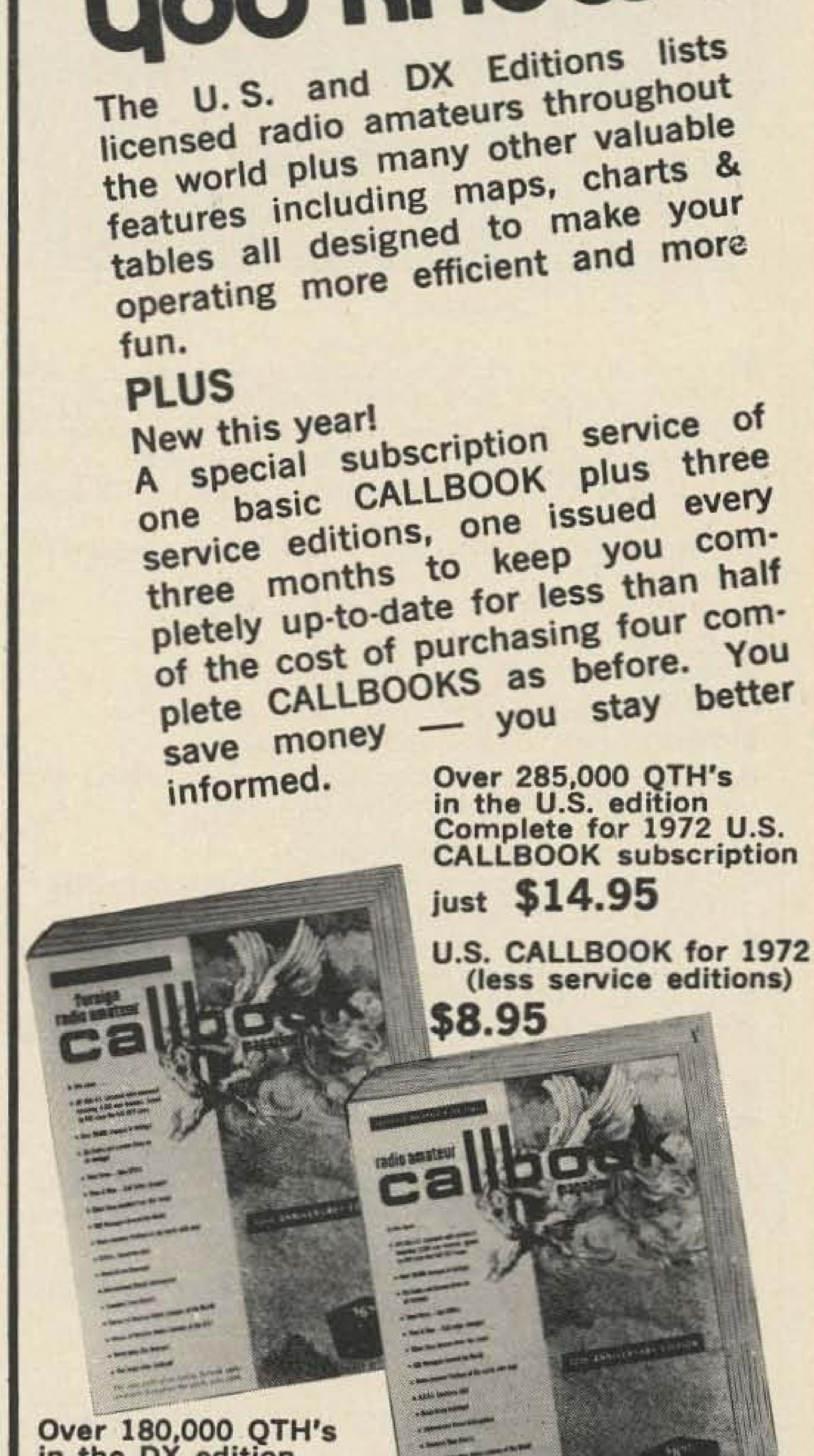
Fig. 2. Test setup.

couple of others using cavities, and straplines in rectangular boxes, and was found to be their equal for dc output for a given amount of rf. It was just this rf that didn't want to "give." All kinds of chokes in the emitter and other arrangements were tried in the 1296 MHz test oscillator to bring up more power, but to no avail. I finally had to resort to taking out the Motorola HEP56 transistor and putting in a KMC H104. The HEP56 shows good power on 432, lights a bulb and all, but on 1296 MHz it just doesn't seem to cut the mustard. After all, it's only $1.50 and it wasn't made for 1296 MHz use.

The KMC H104 does the job though, and there is one other item I found while working on the oscillator to bring it up to maximum power. I have referred several times to a sliding short under the collector strapline L1, for rough tuning. It does that all right but for maximum Q, starting oscillation every time, and trying for maximum output into small test antennas it appears to be better to cut L1 to the desired length and solder it down tight to the baseboard. The high rf currents and extreme low impedance at the ends of the half wave line L1 demand good soldered and wide-strap joints in order to have the highest Q.

Tuning can then be done by changing L1's spacing from the baseboard, with higher frequencies resulting from closer spacing. Further tuning can be achieved by using the grounded tab type of tuning capacitor shown as C1 in the following Figures, and used on the 1296 MHz receiver described.

Getting back to the antenna tests, now that good oscillator power was achieved, Fig. 3A shows the top view and Fig. 3B the front view of this convenient piece of test equipment for the band. It is of the same general type as the 432 MHz antenna described earlier but you will have to pay more attention to details, such as keeping the



reflector sheet rigid, adjusting C2 correctly, and finding the best value for D, the spacing between radiator and reflector.

C1 is made by tapping the copper-clad reflector sheet and installing a shiny new brass 6/32 bolt two inches long, which you can get in most household hardware stores now by paying about 10¢ a piece, putting a locking nut on it, and soldering the nut to the reflector copper sheet after adjusting for the desired locking tension. On the end of the bolt facing the radiator solder a brass nut and file it flat. This makes up C1 which is tuning good now, and is spaced about 1/8th in. from the radiator, using the dimensions of Figs. 3A and 3B.

Any flexibility in the reflector sheet makes it difficult to tune up with C1, which is of course sensitive to any changes in its spacing. Use thicker copper-clad, a wood backing, or a nylon bolt between the radiator and the reflector to hold it in an exact and steady position.

That should get you started on the air, at least across the room. It's not as easy as all

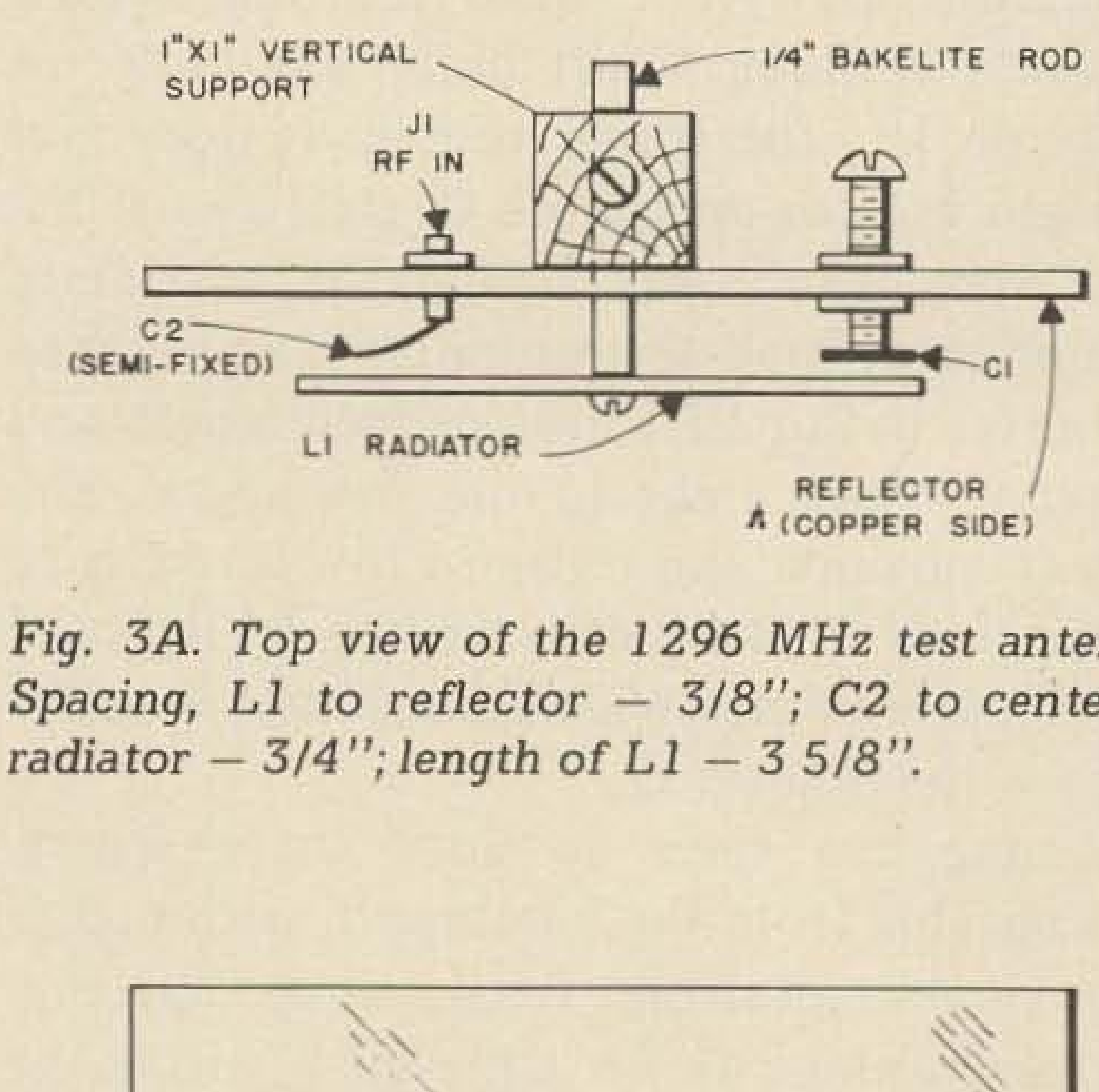


Fig. 3A. Top view of the 1296 MHz test antenna. Spacing, L1 to reflector – 3/8"; C2 to center of radiator – 3/4"; length of L1 – 3 5/8".

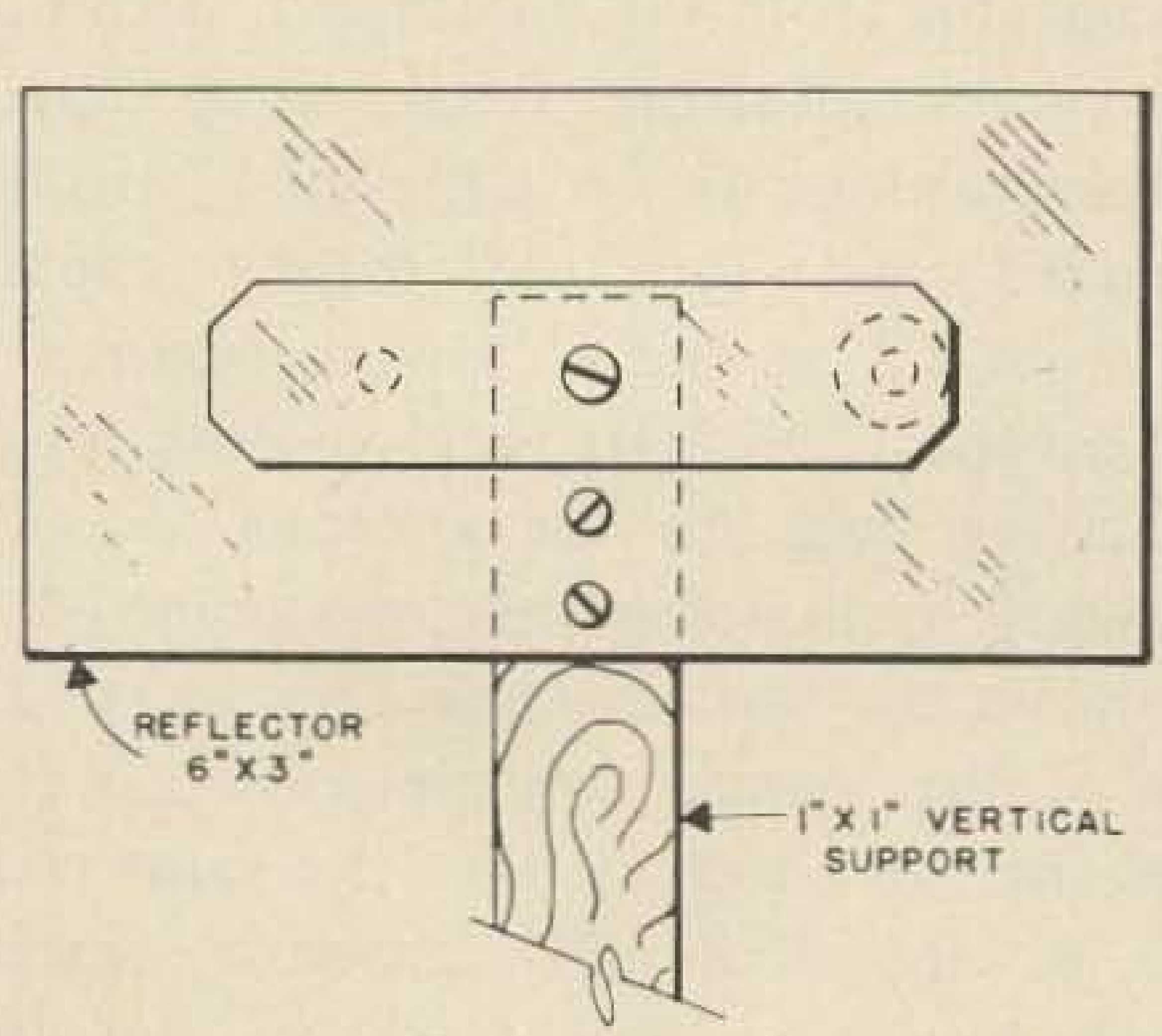


Fig. 3B. 1296 MHz test antenna, front view.

that every time, though. You can light off the oscillator, it shows power, with the H104 transistor collector meter dipping on 1296 oscillations like the good old tubes used to do on five meters, hook up one antenna to the oscillator, the other to the receiver, face them up across the bench, throw the "On" switch, and the receiver output meter may not even budge.

This has happened several times here, so don't worry. Providing you have built the four items mentioned as described here, it just means that one or more of them are not on frequency. Remember, that's four items to be on frequency. The same frequency. Recheck the receiver and transmitter frequencies with a cable and loose coupling, put the antennas close together, almost touching, and the receiver should take off. As mentioned above, don't worry, it will eventually. It's one of the laws of nature! One part of that law just happens to require that all those four items must be on the same frequency, or close. How close, you'll soon find out.

This 1296 MHz band is a real transition for antennas. The two-element job herein can start you off on tests. Then you can reduce the size of the reflector and point the assembly into a skeletonized parabolic dish (see Lafayette Radio, $16 for a five footer, $26.50 for a seven footer – I'm only reading out of their catalog). You may have to cover the reflector rods with copper or aluminum screen though, because, once again, those TV lads have it tuned up for 890 MHz only, channel 83. After that, the higher frequencies may start to leak through those too widely spaced rods.

You can also rig up nice compact phased arrays, and such.

Receiver 2300 MHz

This little gem is quite similar to the 1296 job, with everything a little smaller. Figure 4 shows the layout. While L1 shows as only 35 millimeters, or 1 3/8 in. long, don't forget that the bent down or vertical portions of L1 counts also, making L1 35 plus another 12 millimeters, for a total length of 47 millimeters. This works out to be near 7/10ths of the half wavelength, which is

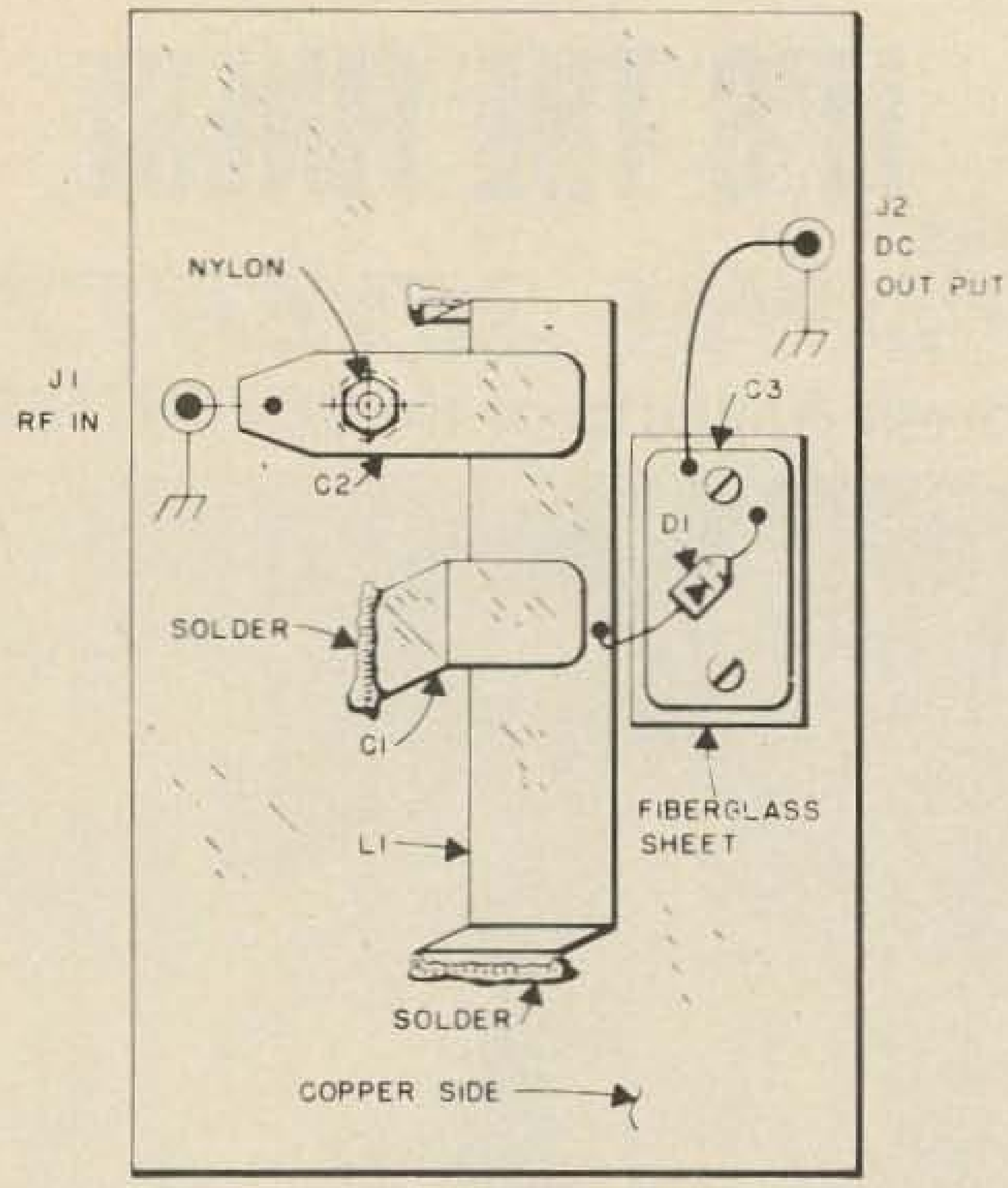


Fig. 4. Diode receiver for 2300 MHz. L1 = 1 3/8" long on top, spaced 4 mm (5/32") from baseboard; C1 and C2 adjusted by nylon bolts as in the 1296 MHz receiver.

reasonable enough considering the parallel capacitor C1, and the shunt diode D1. For the rest, pay attention to the items as listed for the 1296 job and you should be in tune with the 2300 MHz oscillator.

This is the band where parabolic dishes really begin to show power gains. Just a hint – we tested an old 23 in. aluminum dish which has been carried in our 45 ft junkbox since the good old Canal St., NY, surplus days of the late '40s, and found a gain of around 144 times a dipole. See what I mean?

Just in case I didn't mention it lately, I use a 50 microamp meter on the receiver dc output, again, Lafayette Radio, $4.75, with a switch for times one, times 10, and times 100. You can also set it up to read .5 and 5V if you like. Beyond that voltage, better watch those $3 diodes! Or just move the antennas further apart. Or cut down on the oscillator power with that emitter pot I keep talking about.

This frequency is part of the S band of microwave radar and I consider it to be past the transition stage and well into the field of parabolic reflectors, although my favorite antennas, the lenses, don't show up in a startling fashion till we reach the X band (You know by now, just keep reading!)

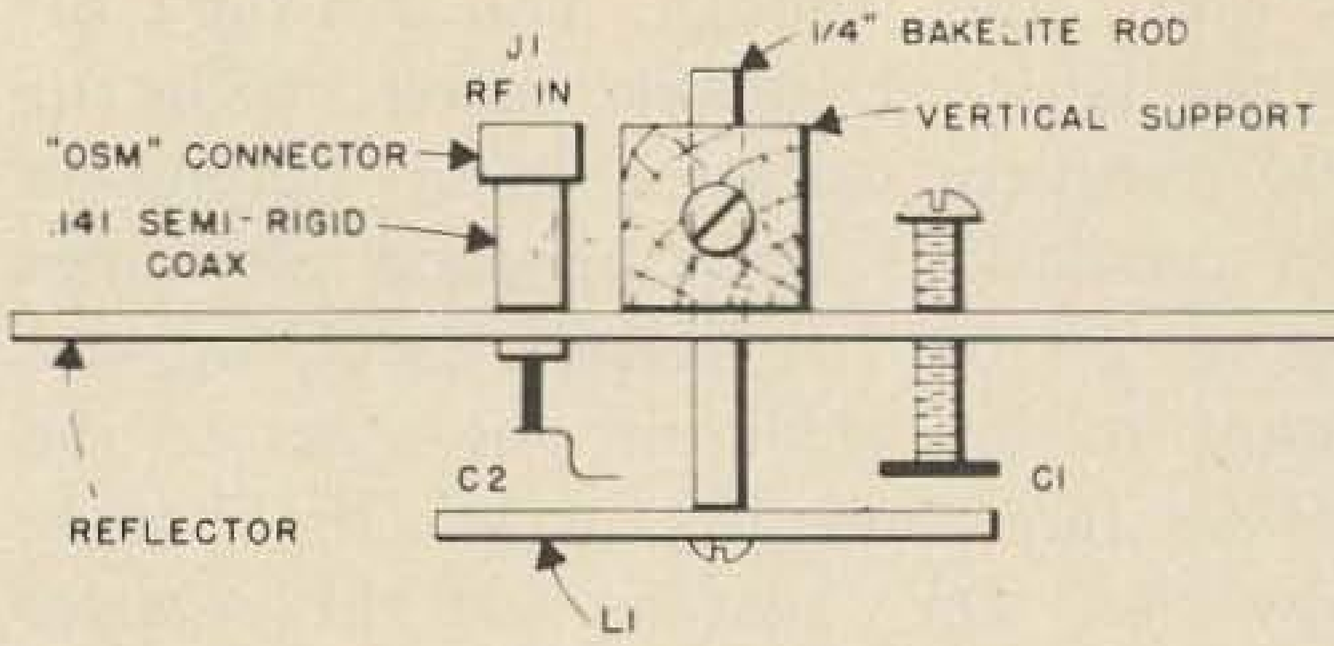


Fig. 5. Test antenna for 2300 MHz. L1 is copper strap, 1 13/16" long by 3/8" wide; reflector is 6" by 3"; spacing of L1 to reflector is 5/16"; distance from C2 to center is about 3/8" (should be maximized on test).

Test Antenna 2300 MHz

Just for fun, as I look at the 1296 and the 2300 MHz antennas on their little walnut test stands (I happen to live near an instrument case manufacturer) in front of me, the ratio of the lengths of their radiators was checked against the ratios of their frequencies, to see how the scaling down was progressing.

The 1296 MHz radiator L1 is 91 millimeters long, and the 2300 one is 46, which is almost exactly double. But twice 1296 is 2592, so there is probably a shortening factor working there somewhere. Let's check the 3500 MHz antenna, to jump ahead a little. It is 32 millimeters long. Three times 32 is 96 millimeters, close to 1/3rd of the 1296 MHz antenna length, and three times 1296 is 3888 MHz. Works out fairly close. With C1 operating in shunt, you probably could scale them exactly, although there are other factors, like the width of L1, end effects, etc. Just interested, so assume you might be also.

Figure 5 shows the details of the 2300 MHz test antenna. I used .141 in. OD semi-rigid coax for the cable input, and chickened out with an OSM connector instead of a phono jack. After all, this is microwave frequency! I'm still working on the idea of a low-cost connector for you (and me too).

To use this antenna as a feed to work into a parabolic dish for high gain, cut down the size of the reflector sheet, as your energy coming out of the dish has to go out forward past the primary feed. See Fig. 6 for diagram of element placement.

With gains of well over 20 dB for a 23 in. dish, you can begin to see some reasons for this band. Think about radar on your present license, DX from mountain tops with the battery supply for these rigs, etc.

3500 MHZ Receiver

Here I chickened out again. Not for long though. It's just that here is another transition region, this time between open-air strapline and enclosed coaxial cavities.

It's a real project to make a comparison between the two methods and that will be another story.

So, for the time being, I used the diode-equipped coaxial wavemeter, as a receiver for this frequency. It works very well of course, but the coaxial tuner part is a little difficult for the homebrewer to make. I hope to have some of these made up, but this may take a while. Maybe you'd want to jump all the way to X band anyway?

Figures 7A and 7B show the layout of the top side, and some inner details for reference. This piece of equipment can be very useful. It measures frequency from 1 to 12 GHz, and makes a nice mixer for those frequencies also. And a diode test receiver for uses such as the present one being described.

What more can I say about it? There is a tremendous world of microwaves for amateurs ahead of us. We have the bands, at least today, and now with $5 transistors we can make battery portables to use them. Let's go!

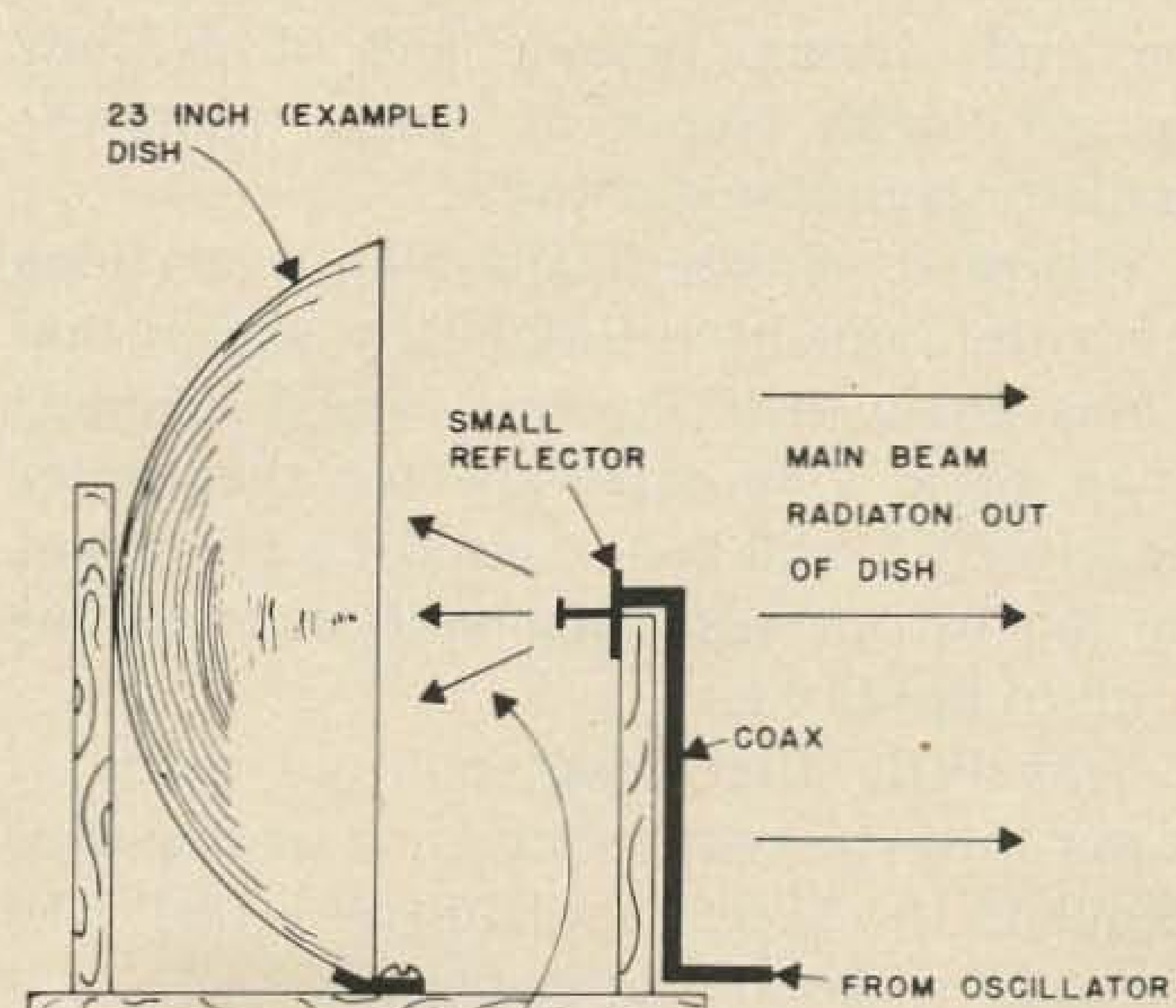


Fig. 6. Element placement, parabolic antenna, for 2300 MHz.

3500 MHz Test Antenna

As mentioned earlier, oscillator for the 3500 MHz amateur band, you may not need this band for a few years, but it is interesting to see how it works, so a test antenna was built and tested.

About two millimeters was trimmed off one end during tuneup and it is now operating with plenty of "sock" using the oscillator mentioned above.

Figure 8 shows details with everything about the same as at 2300 MHz except that it was about half the size, and I dropped down to a 2/56 size bolt for the tuning capacitor C1, and had to cut off a portion of the one-by-one red cedar vertical mounting stand to install J1.

This little firecracker pût out a lot of power into the room, but some of that may be due to the $200 Fairchild transistor! ($50 in *steady*, 1000 lot purchases)

Just a little touch of trouble while tuning up the 3500 mHz antenna. Not with the antenna, though. The oscillator has an OSM connector on it, and I wasn't getting any rf

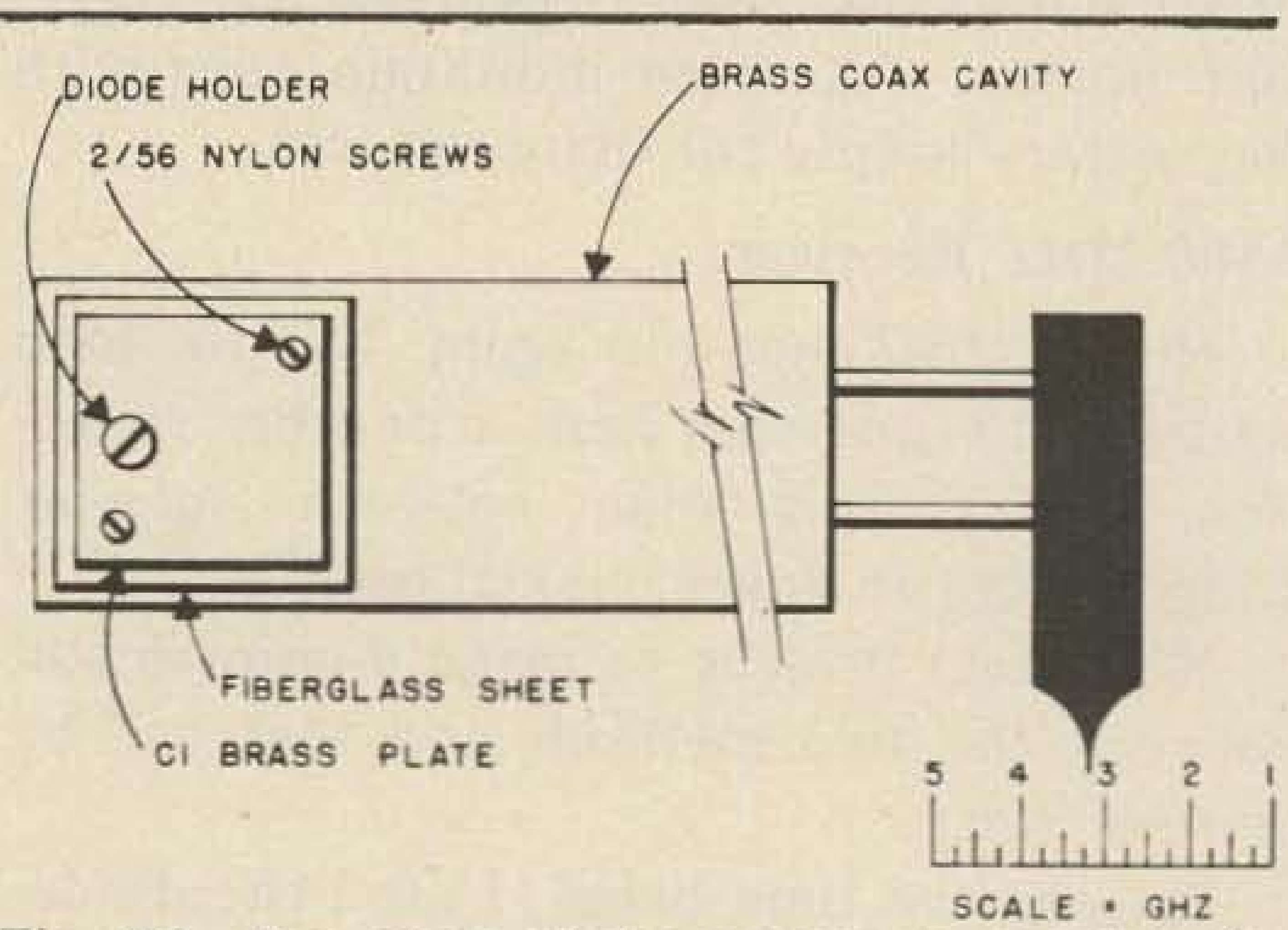
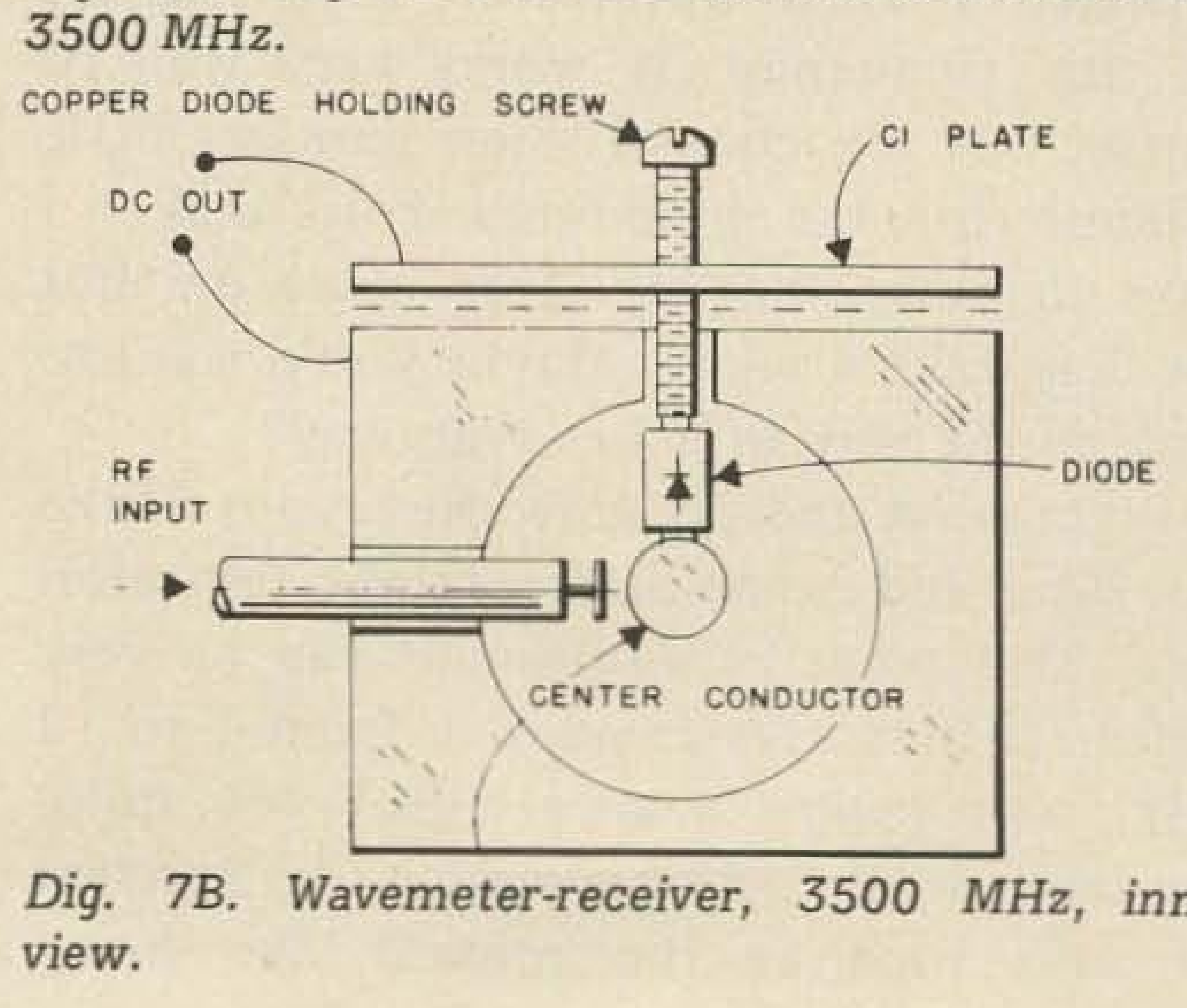


Fig. 7A. Top view of the wavemeter-receiver for 3500 MHz.



Dig. 7B. Wavemeter-receiver, 3500 MHz, inner view.

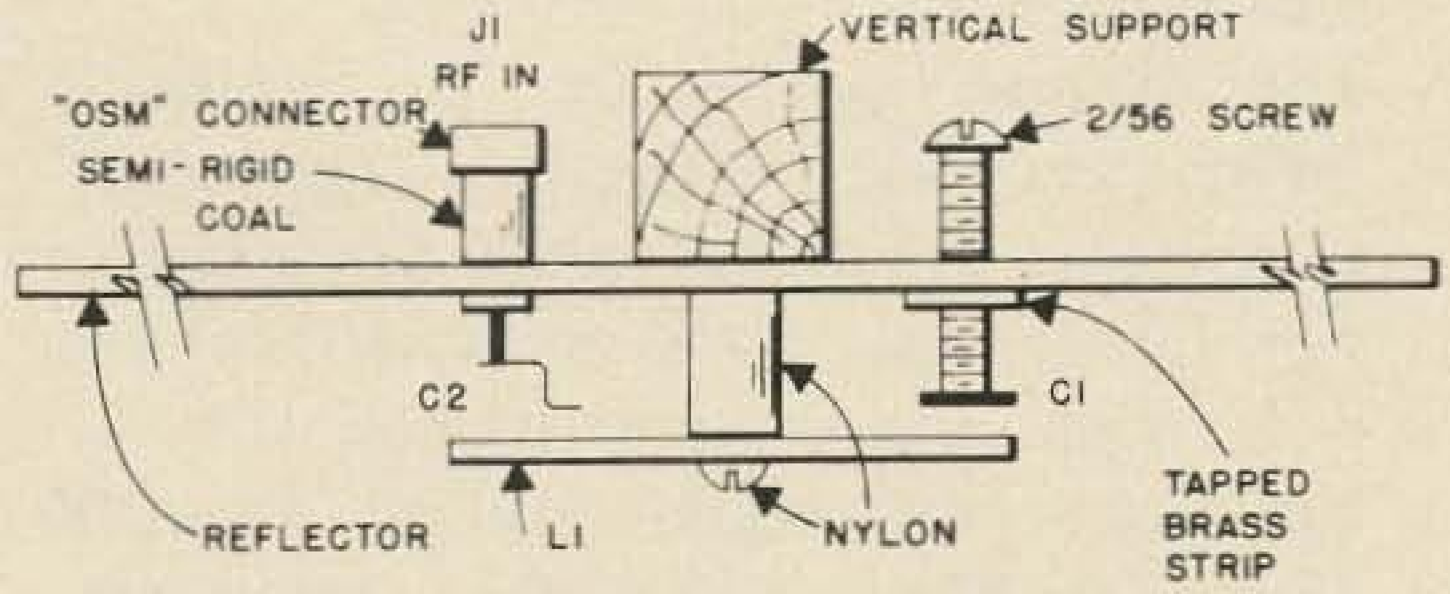


Fig. 8. Test antenna for 3500 MHz. L1 is a copper strap, 1 9/32" long by 1/4" wide; distance of C2 from center is 5/16"; spacing L1 to reflector is 3/16"; reflector size is 4 1/2" by 2 1/2".

out at all, although I could see by the collector meter that it was oscillating strongly. All of a sudden the center of the connector fell out in my hand. I unsoldered it, pushed it way in tight, resoldered a pickup loop back on, and wham over to the pin went the meter. It happens!

Have fun with this one, too, if you can afford it. I can't really myself, so will stick to 432, 1296, and maybe pulse on 2300 mHz for now.

Frequency Measurements With The Interferometer

Admittedly, in order to make frequency measurements by this method you need an oscillator, receiver, and two antennas. And in order to have these you need a frequency meter. Cheer up, it's not quite impossible. The main purpose here is to start you off with just those items. With the dimensions given you will be able to tune up somewhere near the desired band and then by using the simple interferometer method described you can put your oscillator near the middle of the band and go on from there.

The interferometer itself dates from several hundred years back, long before Maxwell or Hertz, and has some good solid basic features to recommend it.

1. It measures the length of your oscillator's waves right out in the open air which, although not precisely a vacuum as in free space, is so close in wavelength that you or I could not possibly check the difference.

2. Thus you do not have a wire velocity factor to account for.

3. You can perform this measurement right on your bench-top.

4. For equipment all you need besides the oscillator, receiver, and the two antennas, is a couple of plane sheet reflectors which can be 10 x 10 in. aluminum chassis, or similar, standing on end on the table, a 10¢ plastic ruler, and the frequency-wavelength chart of Fig. 10.

Steps to follow

1. Set up as shown in Fig. 9, "Frequency measuring setup for 432, 1296, 2300, and 3500 MHz."
2. Put reflector A and B in the same plane and about 3 or 4 ft from the transmitter and receiver, which should be close to each other but pointing toward the reflectors.
3. If you're using some power and your receiver is sensitive enough you may need some nonreflecting material between the T and the R. Normally you don't, but it's handy to have around anyway.
4. Set up the T and the R so that an equal amount of power falls on reflectors A and B, and so that an equal amount of power comes back to R, the receiver. You can tell when this is so by a good sharp null on the receiver meter when operating.
5. Leaving A fixed, move B toward T and R keeping its surface parallel with that of A. At the half wave point there should be a deep null with R's meter dropping to zero.

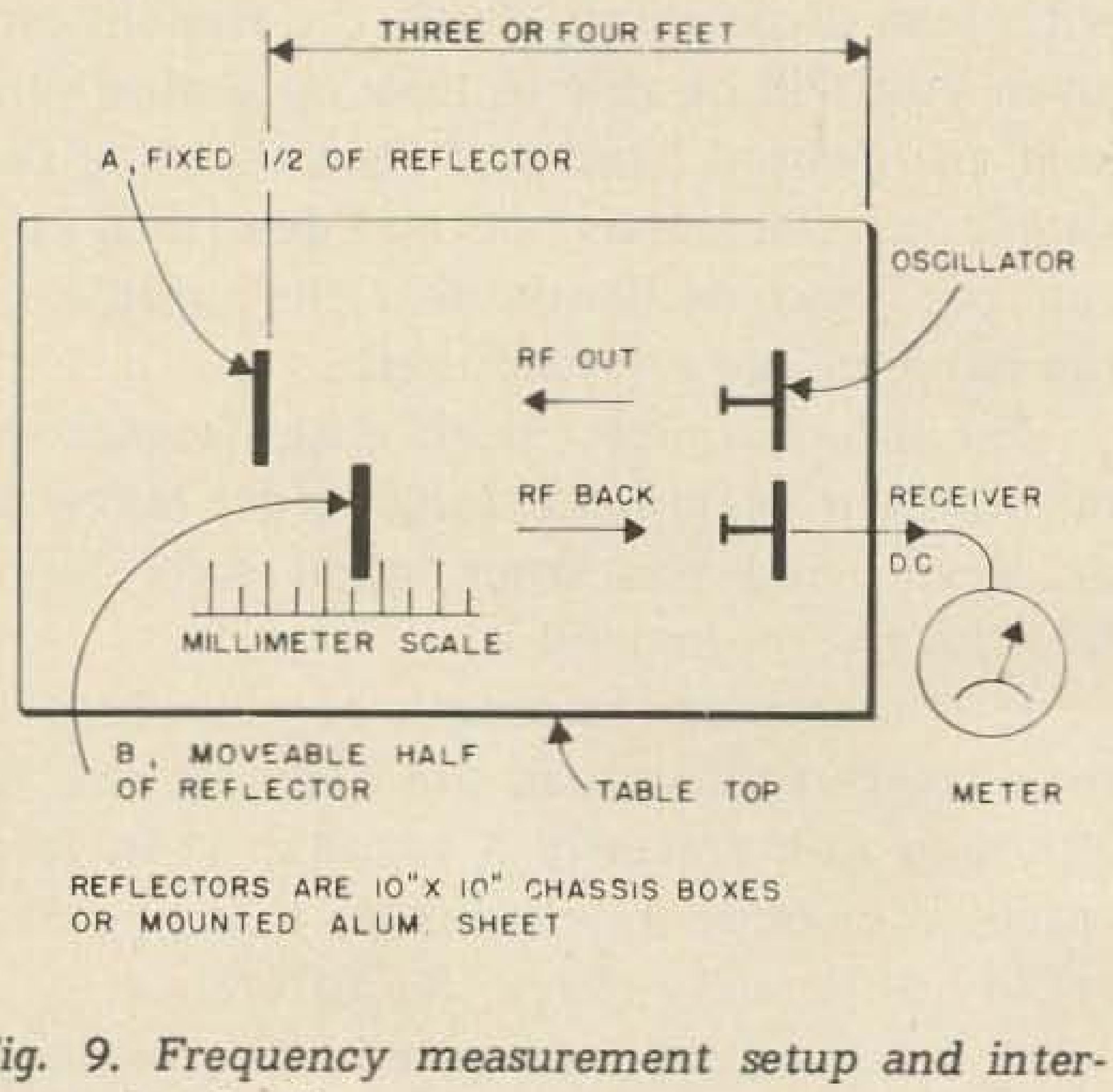


Fig. 9. Frequency measurement setup and interferometer details.

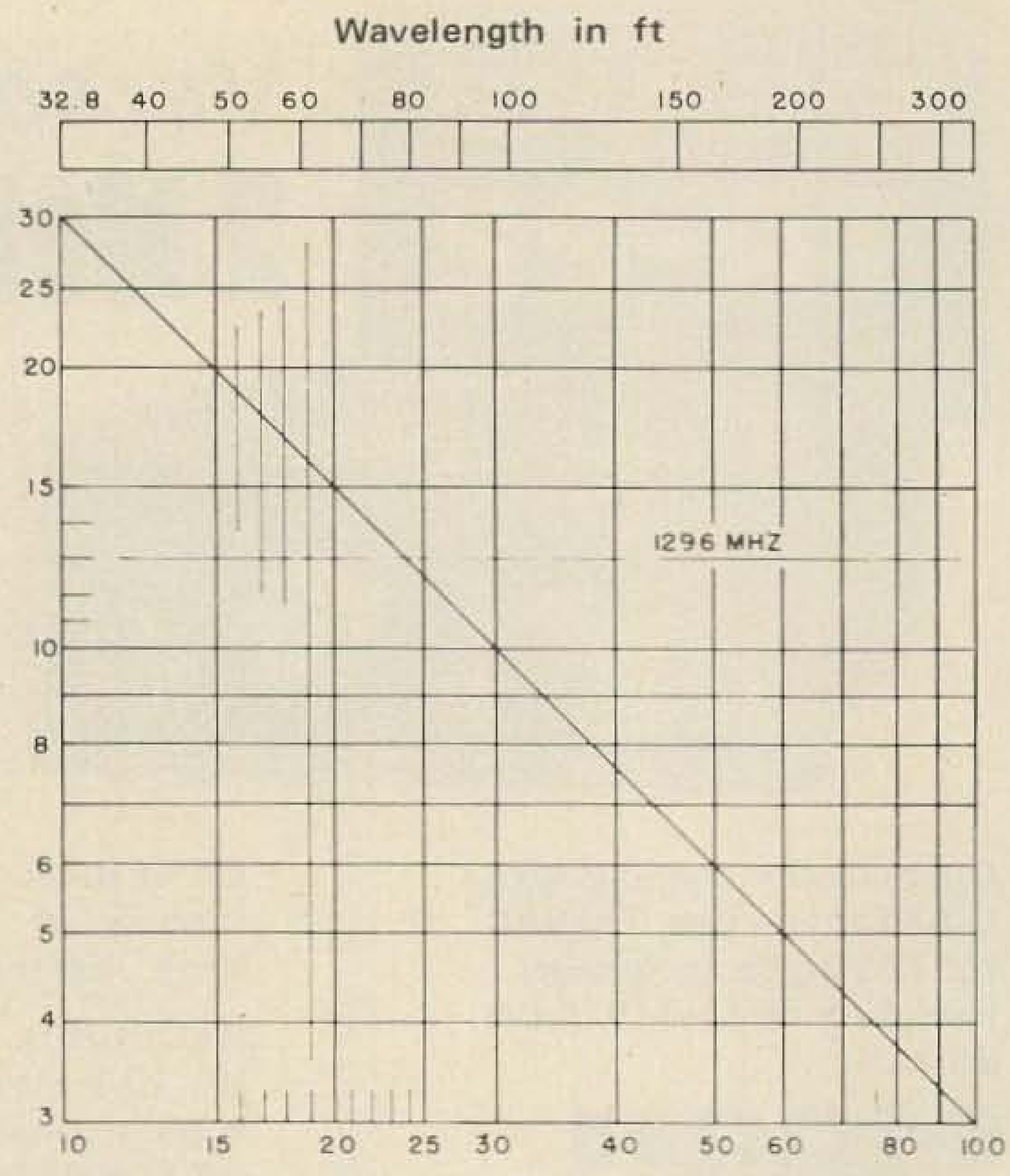


Fig. 10. Chart illustrating the wavelength frequency conversion.

6. Repeat the process several times, continuing to move B a number of half waves toward T and R, taking millimeter readings along the scale at each null.
7. The average spacing between nulls, in millimeters, will be the half wavelength. Convert to frequency with the chart of Fig. 10, or use a conversion factor if you wish. For instance the frequency in cycles per second equals 300,000,000,000 divided by the wavelength in millimeters. For example, 10 centimeters, which is 100 millimeters, equals 3,000,000,000 cps, or, 300 MHz, or 3 GHz. That's it. Happy millimeters.

Just about everything has been said, for a room-type start on solid state amateur UHF and microwaves for the average amateur to get going, and, as soon as he converts to a superhet receiver, work long distances from those hilltops with just a lantern battery for power. Think about interstate relays using this method.

An interesting feature of these bands is the geographic separation provided by two sharp high gain beams, from 23 in. dishes, pointed at each other. Who can butt in?

. . .K1CLL

E. W. Wagner G3BID
5 Ferncroft Avenue
London N.W 3, England

BALUN UP or BALUN DOWN?

The use of the balun, now that these are available in small and fairly inexpensive forms, is becoming more and more common, and the question of whether the balun should be placed in the center of the driven element itself and the feed line from there on consisting of a coax, or whether the antenna should be fed with twin lead and the balun used at the bottom in the shack, becomes a question of some importance.

It might, therefore, be worth analyzing the advantages and disadvantages of the two systems. Figure 1 shows the balun at the top in the antenna itself. There are two advantages to this setup: 1) Simplicity, it eliminates the central insulator in wire antennas, and does not require the 72Ω feed line; and 2) The feed line can be made less lossy, as the best air-spaced coax has lower losses than 72Ω twin lead.

The disadvantages are in weight and weatherproofing. The balun with the weight of the coaxial cable usually weighs down the center of the driven element, so that it appears more as Fig. 2 than Fig. 1. It puts additional strain on the supports and, above all, lowers the center of the antenna, which, in most antennas using half wave driven elements, reduces the efficiency. Where the center can be supported independently (by a third pole or a conveniently placed tree) this factor does not apply. In the case of the inverted V which is supported in the center, obviously, this certainly does not apply.

If the balun is placed at the top in all the weather, it must be very thoroughly weatherproofed. This is especially important where the coaxial cable is connected to the balun. Not only will any water from rain, or snow, or ice which can seep into the joint, go down into the airspaced coaxial cable, but also corrosion can soon develop in the

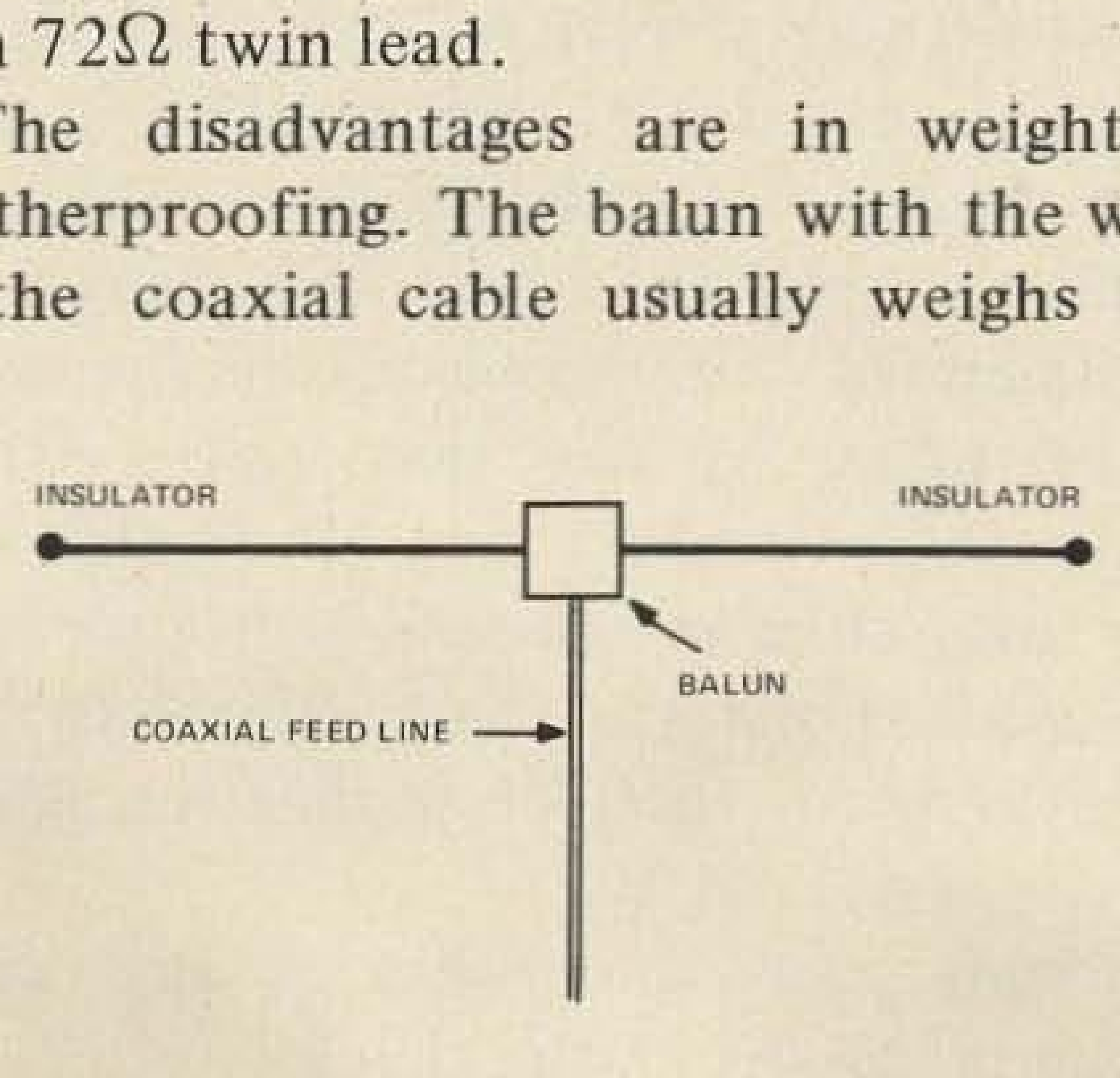


Fig. 1. The balun at the top in the antenna itself.

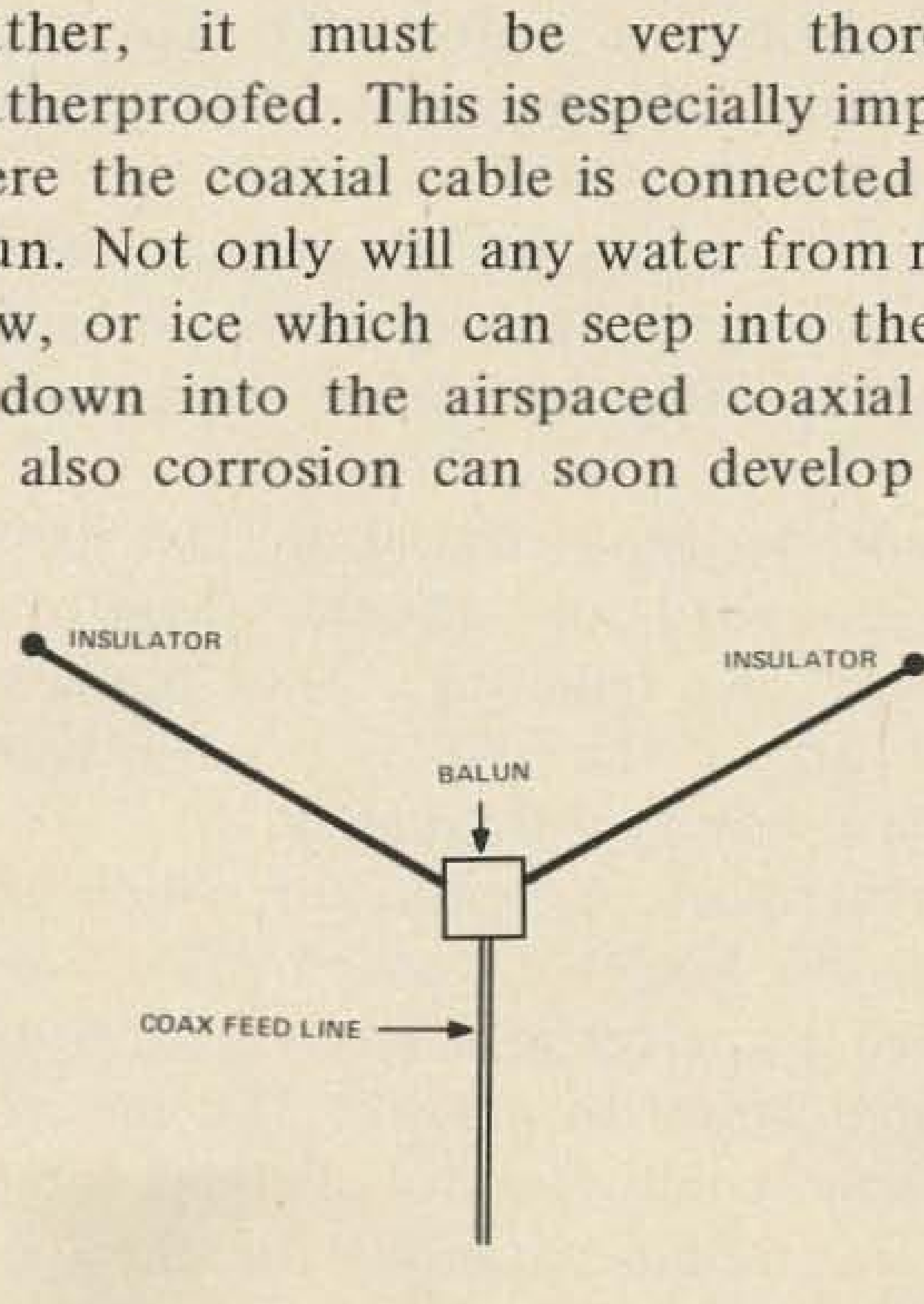


Fig. 2. The balun with the weight of the coaxial cable usually weighs down the center of the driven element.

connectors themselves, involving either frequent inspection and maintenance, or poor connections, giving rise not only to lower efficiency but, above all, to TVI problems.

Figure 3 shows the balun at the bottom, in the shack. In this case, if no central support is used, the central part of the antenna will be higher due to less weight in the center. This can increase efficiency noticeably where half wave driven elements are used. There is also less weatherproofing problem. The connection to the 72Ω feed line can be soldered to the element, then covered with a weatherproofing compound, and even slight water leakage is not likely to impair the soldered joint for a long time. The 72Ω line is waterproof. The balun with its connections are nicely in the dry in the shack, and no weatherproofing problem exists. It is nice and convenient for inspection.

But, the feed line if long can give greater attenuation. The best airspaced coaxial cable is definitely less lossy than 72Ω twin, and in the case of beams designed for 52Ω feed line, there will be a mismatch of 52 to 72, or, roughly 1.4:1 SWR. (In the case of beams, of course, the weight of the balun can be supported on the mast, though the weatherproofing problem remains.) Except in the case of beams designed for a 52Ω impedance many antennas, like dipoles, show impedances nearer 72Ω than 52Ω, in these cases an improved SWR may be achieved.

Apart from the advantages and disadvantages mentioned above, there is another problem worthy of consideration, namely TVI.

Theoretically, a coaxial line has its outer braid grounded and should, therefore, be incapable of radiating. This applies, of course, only if the SWR is 1:1 which it can only be at one spot frequency.

Furthermore, a conductor which grounded, is no longer grounded once one has travelled a quarter of a wavelength from the grounded point. In practice, this means that few outer conductors of coaxial cable are truly a ground potential for their entire length.

When I mentioned SWR of 1:1, I referred, of course, to the fundamental. How

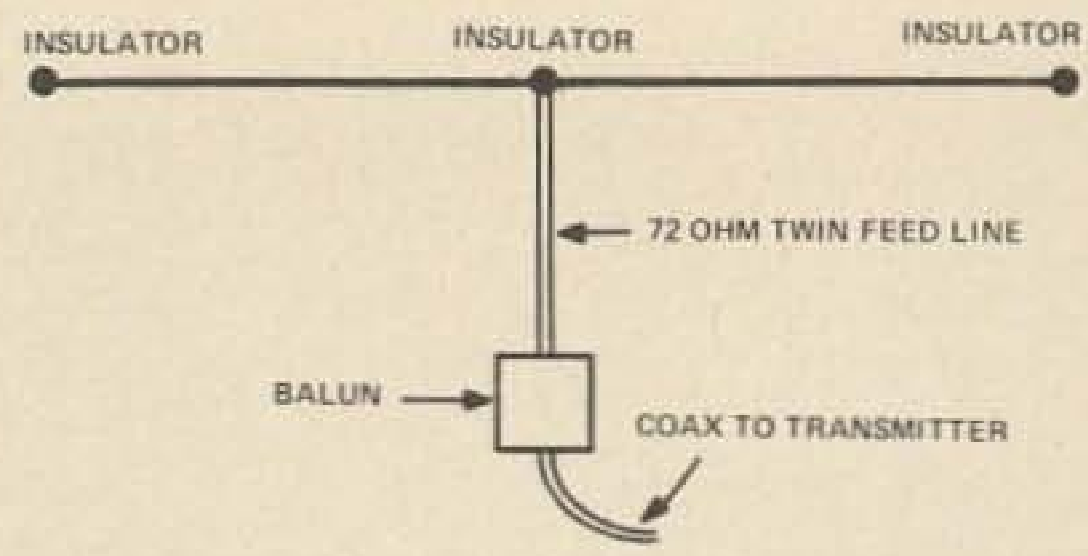


Fig. 3. The balun at the bottom, in the shack.

many feed lines show a 1:1 SWR at a harmonic frequency? Here is where a TVI problem may be created. If the outer conductor of the coaxial cable is hot to rf at the harmonic frequency, it may well radiate and cause TVI.

In the case of a twin line, the current in one leg is 180° out of phase with the current in the other leg, and they thereby cancel one another. This applies equally at the harmonic frequency as it does to the fundamental. So that the twin line gives the advantage of cancellation of any radiation from the feed line.

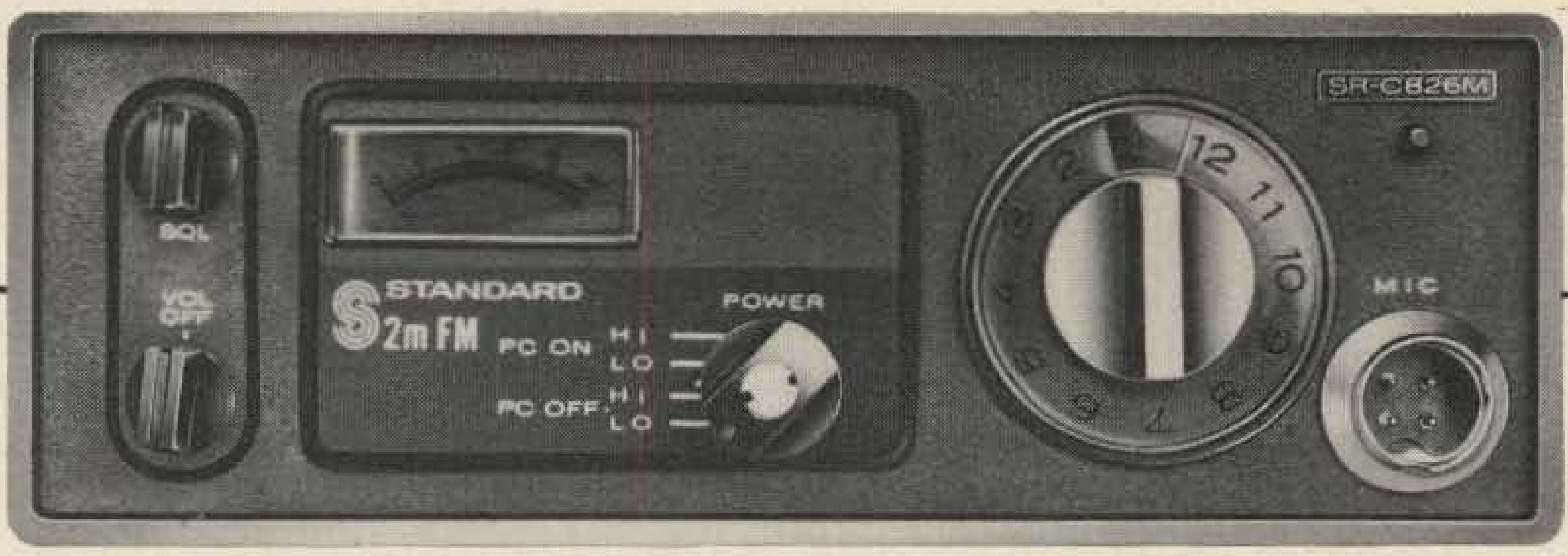
Of course, only in theory are the currents in the two legs of twin feed *exactly* equal and 180° out of phase. But in most cases, in practice, this is near enough effectively to reduce any radiation at the fundamental or at a harmonic frequency effectively to reduce the radiation to negligible proportions.

For the purists there is, of course, screened twin feed line – sometimes called twin coax. Here the radiation from the two legs of the twin feed line cancels out, but any slight unbalance in the current resulting in a small amount of radiation (either on the fundamental or the harmonic) is screened by the outer braid. This need not be grounded as it acts as a Faraday screen, and only has to deal with very small amounts of radiation resulting only from any possible lack of balance in the two legs of the twin line.

This screened twin feed is, however, only recommended for beams where the weight can be taken by the mast, as it is even heavier than normal coax. It is also often more lossy than unscreened twin unless very large dimensions are used. It is only mentioned here for its TVI application where I found it very effective.

In this case the balun is also at the bottom in the dry in the shack.

. . .G3BID



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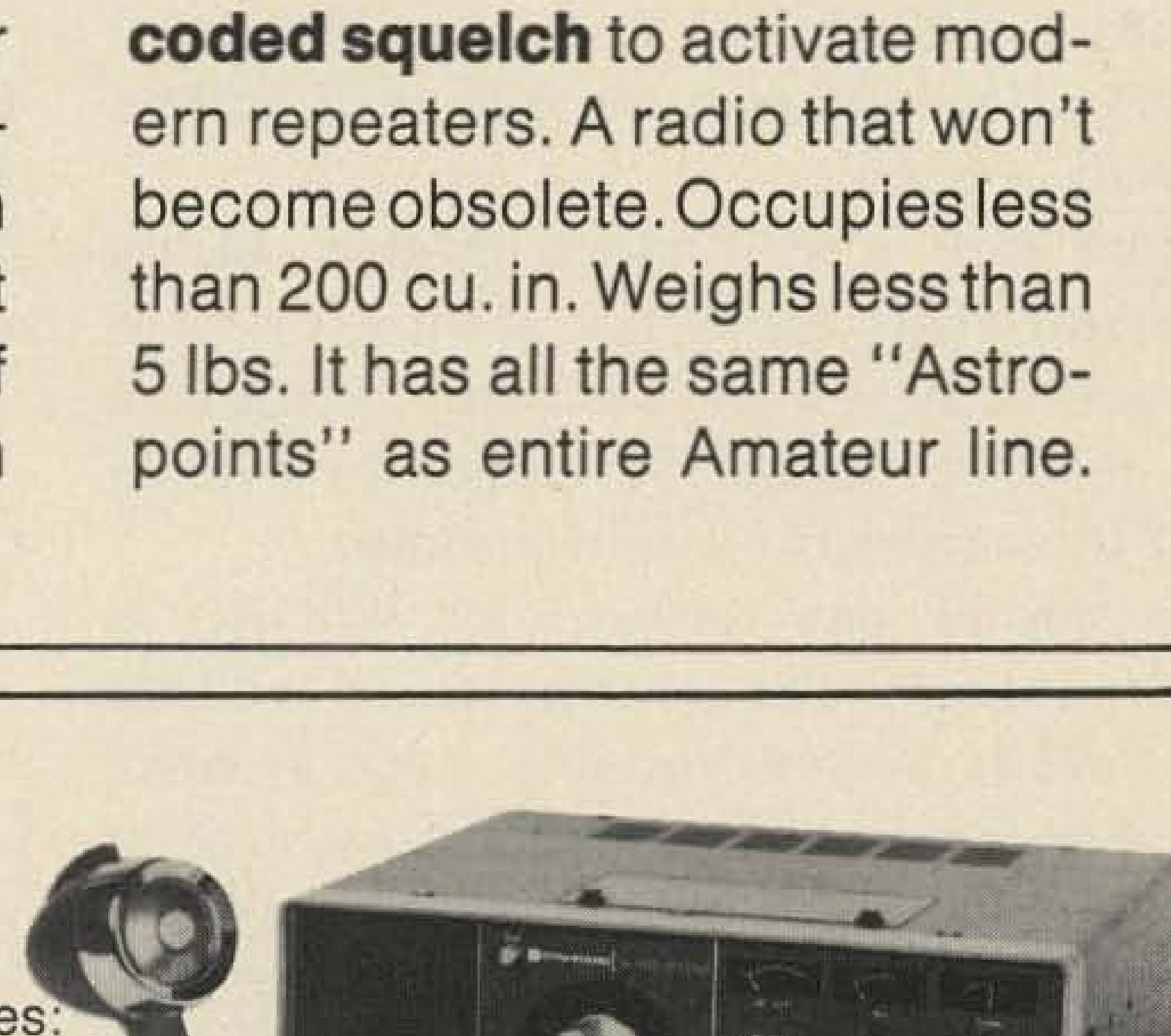

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Another Solid State Power Supply article

Arvid G. Evans K7HKL
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Over the last few years I've run the usual course in power for my low voltage projects. Everything from a string of D cells to a leaky wet cell under the bench, including several partially suitable ac units with and without regulation.

The main trouble is that the designs available for ac powered supplied are usually for one output voltage only. The few that have regulated output over a wide voltage range are: (1) hopelessly complicated; (2) very expensive; (3) have poor regulation characteristics; and (4) protective current limiting circuitry is not included.

After absorbing an article by W6GXN (*73* December 1966) and information published by Editors & Engineers Ltd, (*The Transistor Radio Handbook*) and several cups of coffee, here is my answer.

Before you read further though, please understand that this is not a blow-by-blow construction article. It is a basic circuit idea which may be further developed by evaluation of the contents of your junkbox.

The circuit put forward by W6GXN is that of Fig. 1. This is fine for a voltage which needs to be variable over a small range. For larger voltage excursions, such as those required when working up an experimental circuit, several problems arise. The main trouble is that D1 needs to be at least 1/2 the rectifier output voltage to provide adequate regulation at the lower settings of R2. This high D1 potential then limits the minimum voltage to approximately 1/2 the maximum output. Also, no current limiting

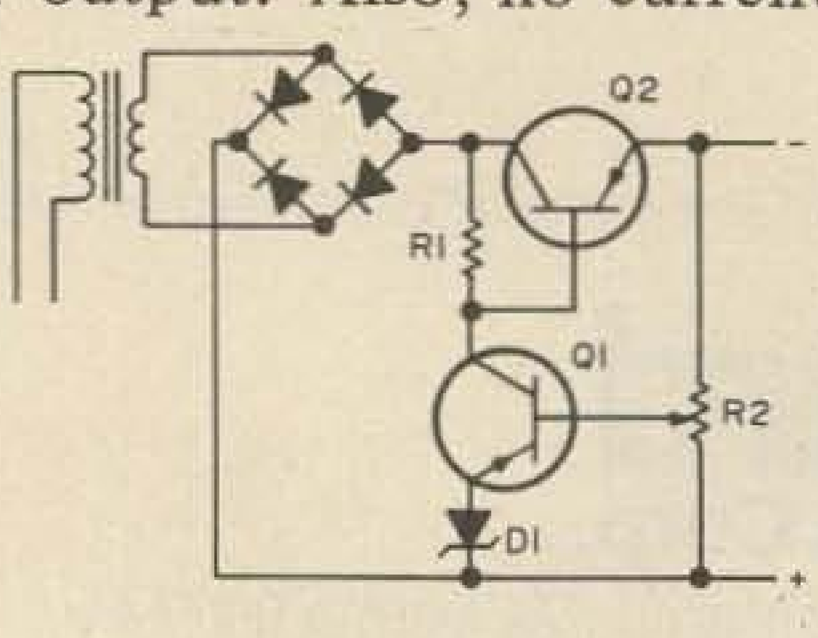

Figure 1.

is provided for those accidental short circuits.

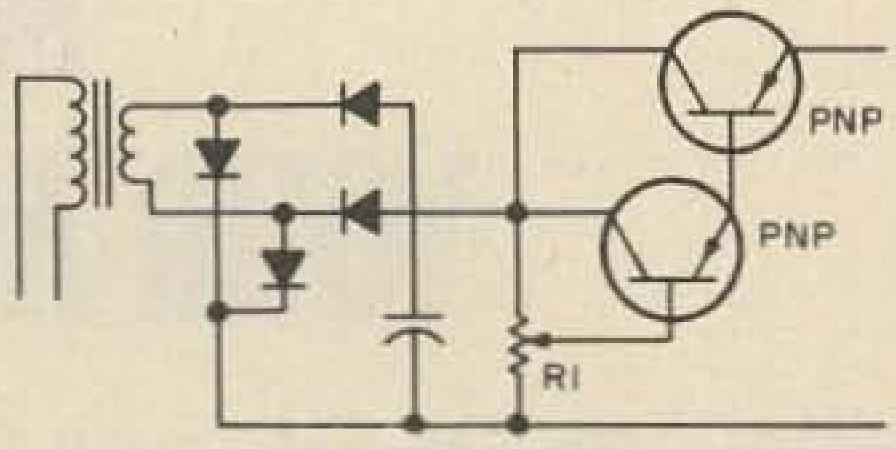

Figure 2.

Other sources propose circuitry similar to Fig. 2. This provides a full range variable output but defeats part of the idea as there is no feedback loop to provide adequate regulation under varying load currents.

Remembering Fig. 2 but going back to Fig. 1, it was deduced that if D1 rather than R2 were the variable element, a part of the difficulties would be overcome. Figure 3 was hastily thrown together to prove this point.

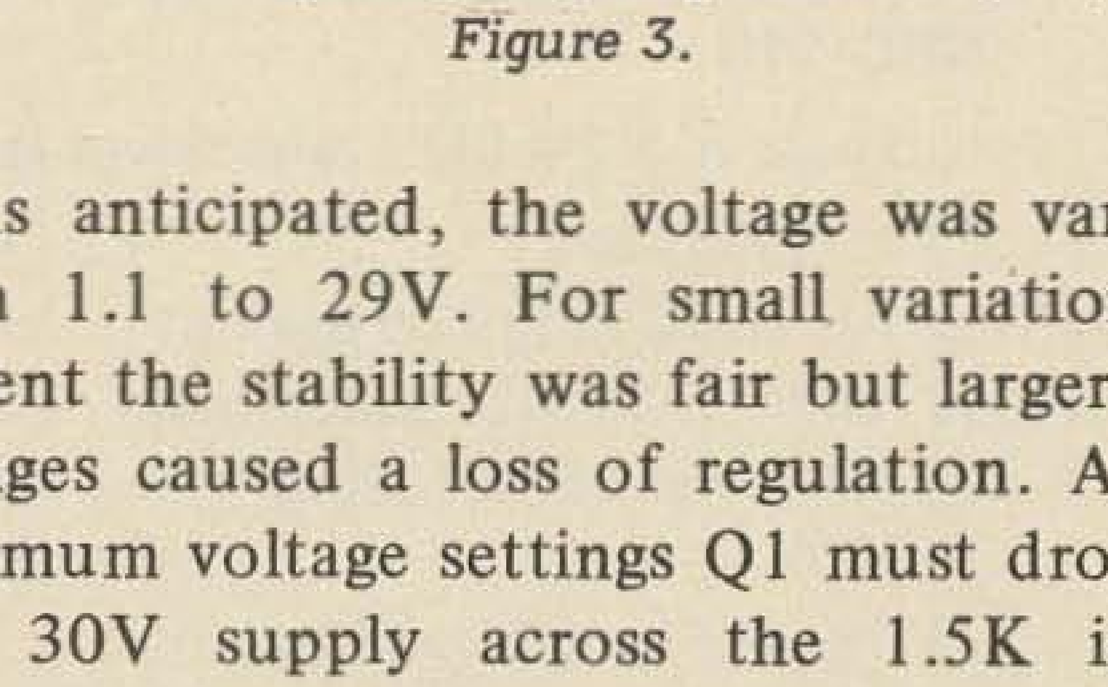

Figure 3.

As anticipated, the voltage was variable from 1.1 to 29V. For small variations in current the stability was fair but larger load changes caused a loss of regulation. At the minimum voltage settings Q1 must drop the full 30V supply across the 1.5K in its collector circuit. This current (20 mA) is put across a part of the 3K pot and thus the regulation of the emitter supply is degraded (so is the future usefulness of the pot)!

After several more cups of coffee, a few unsuccessful circuits, and a couple cooked transistors, the connections in Fig. 4 proved promising.

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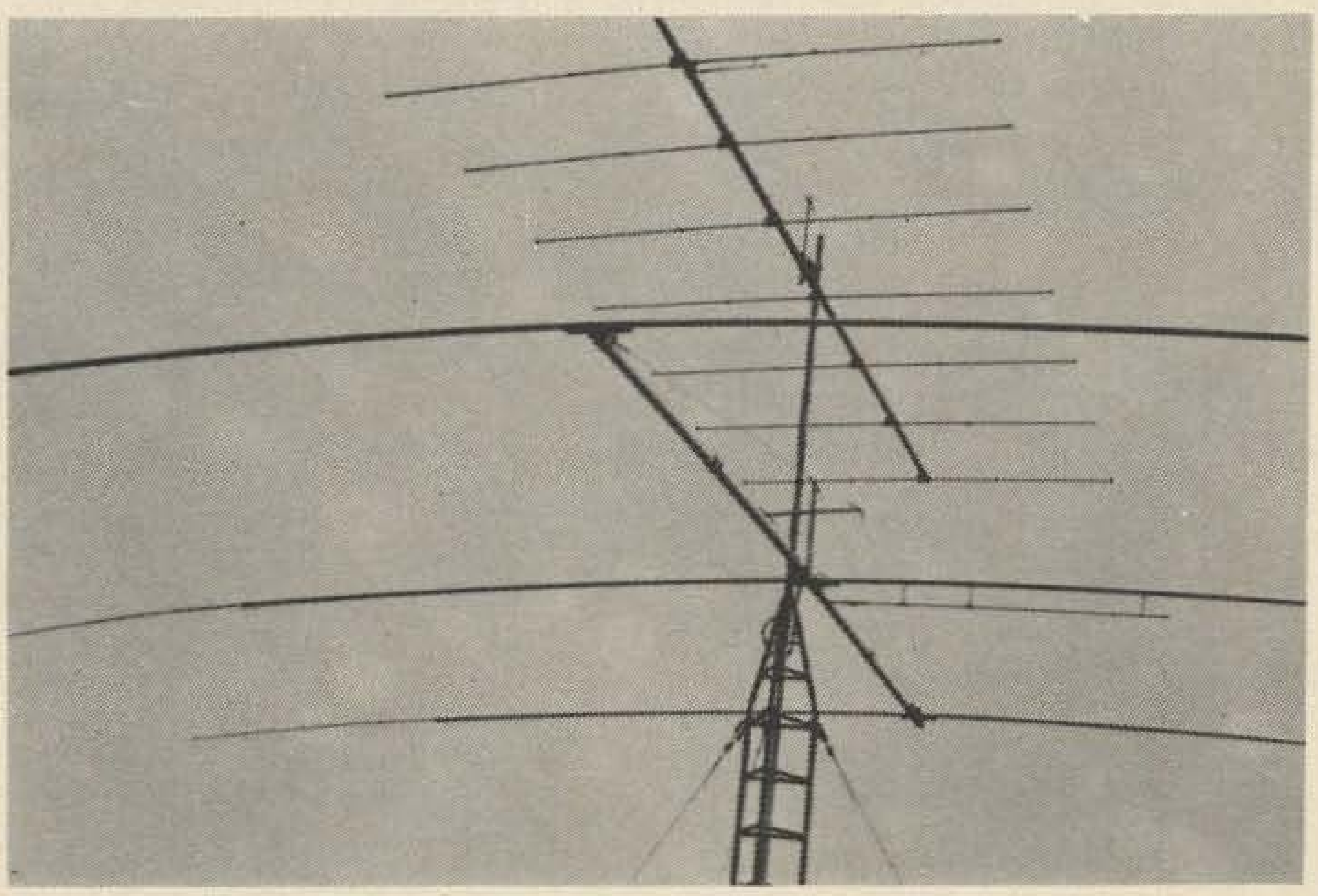

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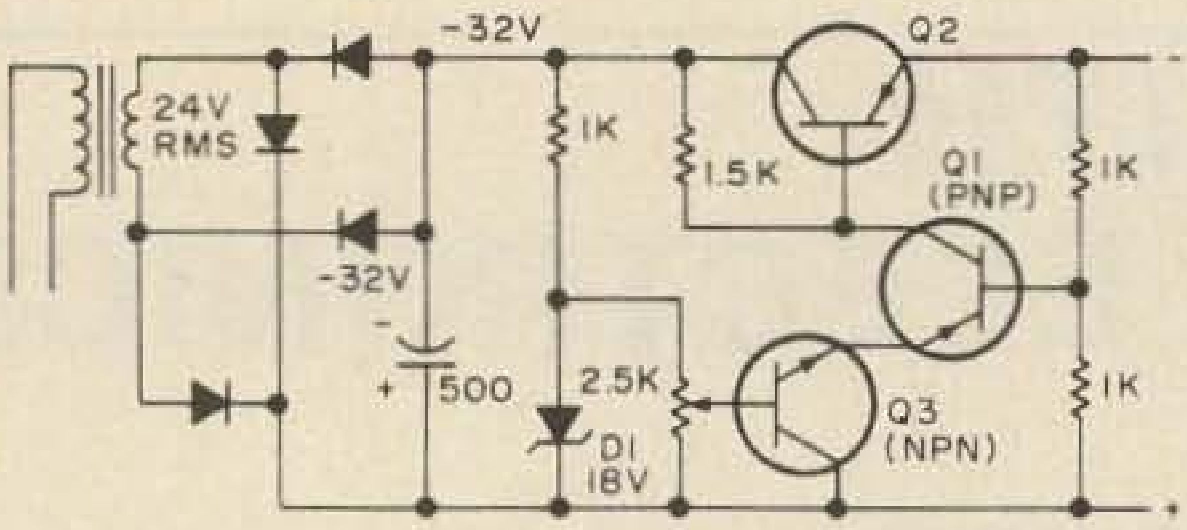

Figure 4.

Emitter follower Q3 provides a very stable regulated reference voltage for the emitter of Q1. This voltage is variable over 0.8 to 18 volts. Since the base of Q1 samples 1/2 the output of Q2's emitter, this lets us vary the output from 1.4V to the full output of the rectifier.

Extensive tests of the voltage change under load were not made but spot checks indicate adequate regulation at any set output.

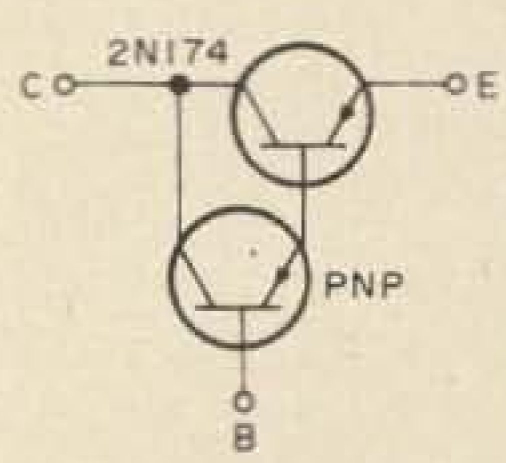

Figure 5.

Of course percent regulation is a function of the gain of your particular transistors. Another PNP might be connected to the 2N174 to make a darlington pair (Fig. 5) but this was not tried here. This would allow you to increase the resistance of the 1.5K and thus lower the current thru Q1 and Q3. It might be worthwhile if you feel a need for better regulation.

So much for the variable voltage part of the supply. Now for a simple and reliable current limiter design.

Here several circuits were tried which would provide a current sampling network

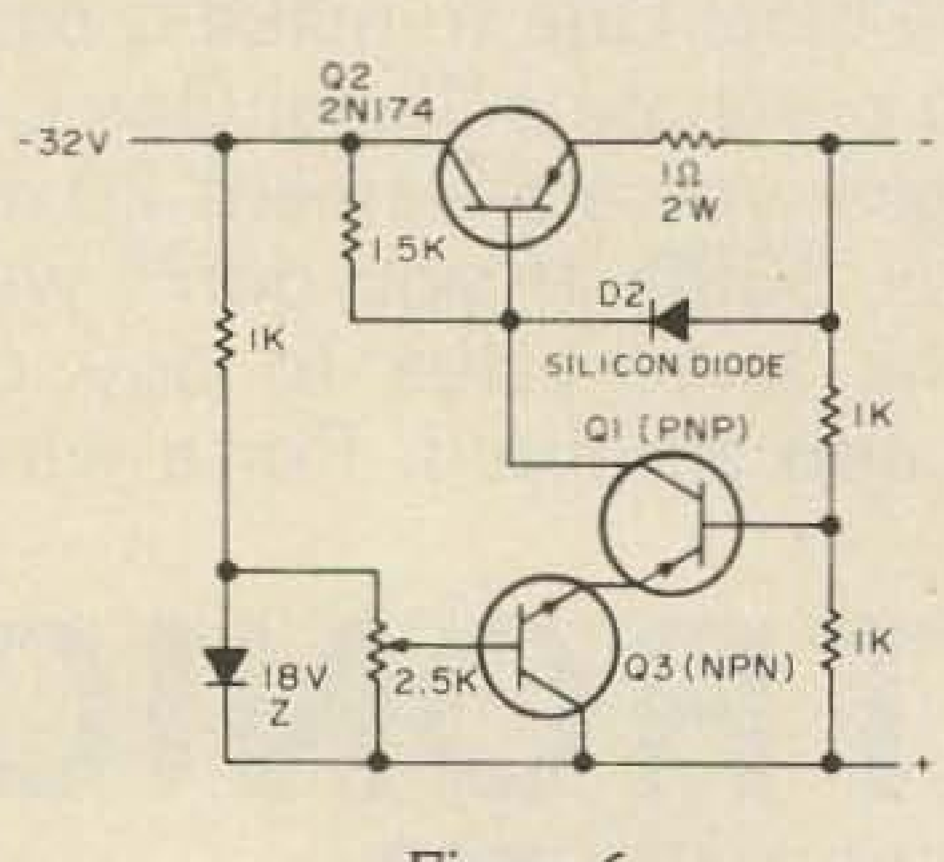

Figure 6.

and cause a voltage droop in the emitters of Q1 and Q3. All were discarded because they, affected regulation, did not limit current, or blew transistors, and/or a combination of all three!

Figure 6 grew out of desperation and as usual this simplest way proved to be the best.

Diode D2 is normally reverse biased by the emitter-base voltage of the 2N174. At a current of approximately 420 mA the drop across the 1Ω resistor is adequate to overcome this bias. At that point D2 conducts and limits the current flow to this level. Make that a 1Ω rheostat and you have variable current limiting.

Now as a final filter, add a 100 MFD across the output and you have 1.4 to 32V at up to 420 mA.

Other voltages could be built up with a change in transformers. Just keep the zenner at about 1/2 the total output volts.

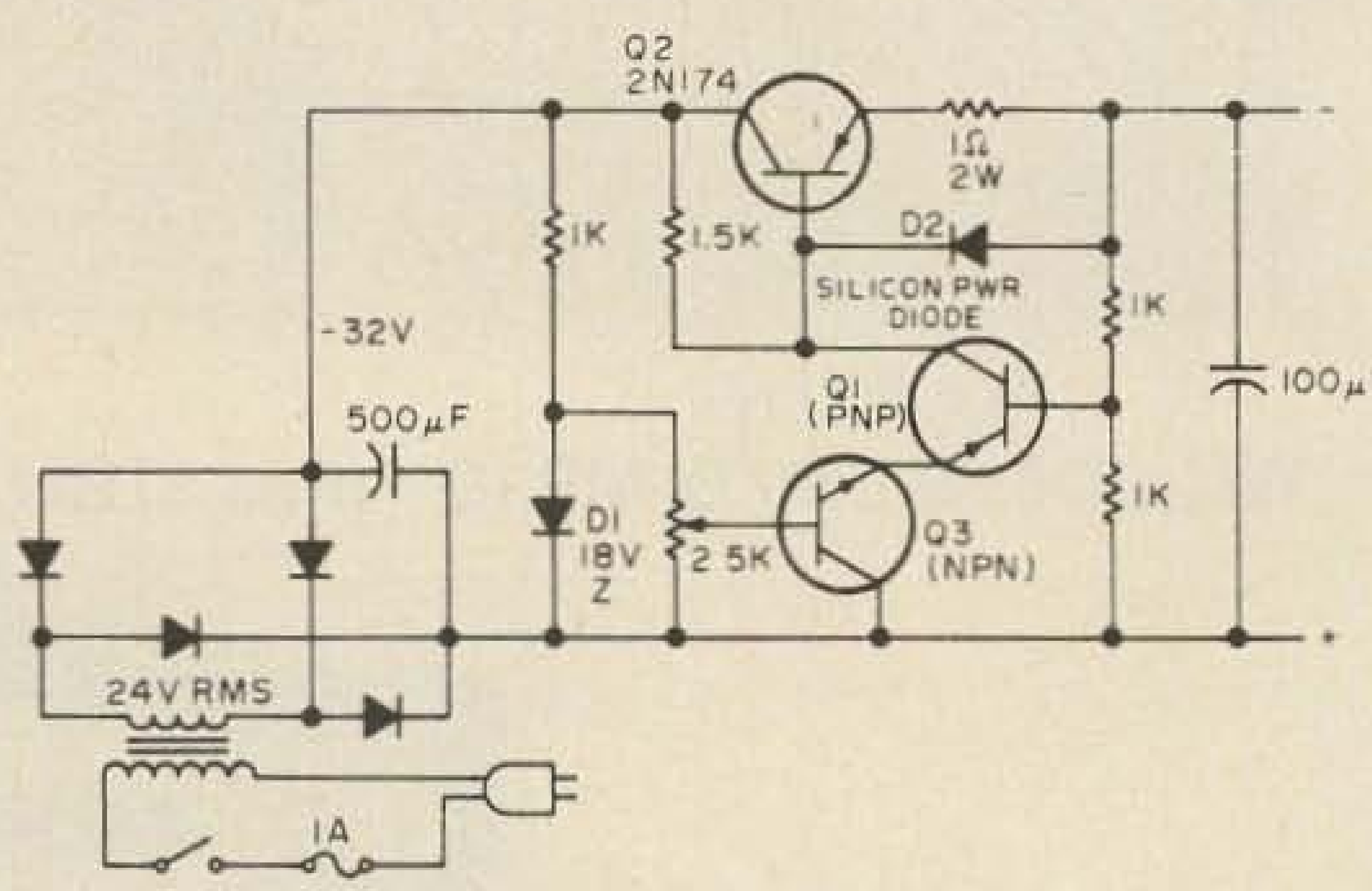

Figure 7.

Higher current could be achieved with parallel transistors for the series regulator. Here the darlington pair idea mentioned earlier might be of use. Remember to adjust the value of the current limiting resistor accordingly. The complete schematic of my supply is shown in Fig. 7, but as I stated earlier, this is a junkbox project so your's may develop significant differences.

DISCLAIMER: I cannot offer a bibliography of references for the circuitry presented here as most of it evolved from memories of various commercial, industrial, and amateur equipment I've encountered over the past 10 years. My only claim to originality is the particular component values used for my supply.

. . .K7HKL

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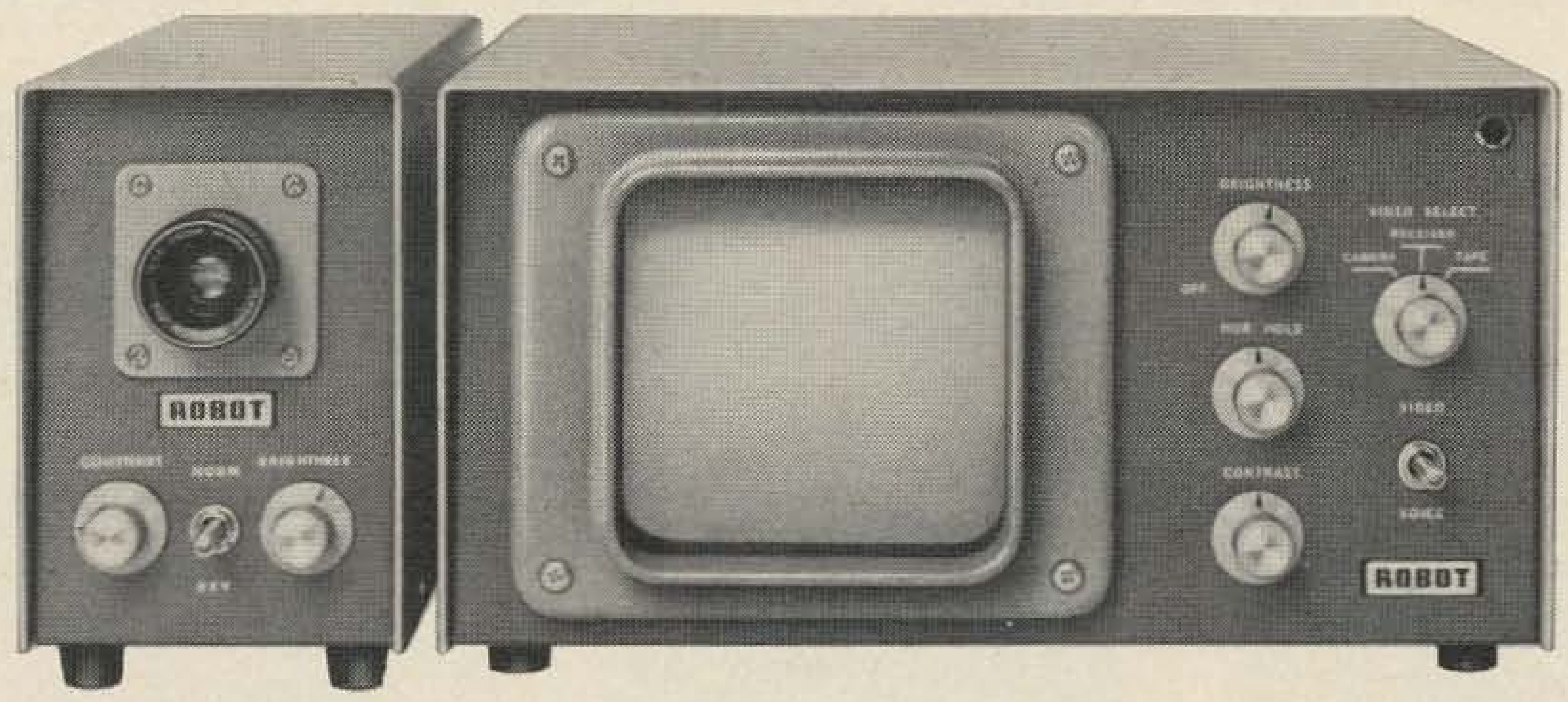

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IC Six Meter Receiver

This is about a six meter receiver that uses a high-gain IC (integrated circuit) in the rf stage, another for the i-f, and a third for the af. If that sounds like a lot of high-gain-ICs, you're right! As I write this (happens to be 3 am), K1YNU is talking. He is in Rhode Island, a mere 105 miles airline away from here in Peterborough, N.H. For some reason – not completely figured out as yet – this receiver is extremely sensitive and you can hear everyone that comes on the band. Part of this may be the relatively broadband i-f stage. As a battery-operated complete, single conversion superhet, easy to homebrew, it certainly warrants attention, as you will see. Here we will describe the ICs used, the breadboard operation, and results. Later we will go into getting maximum selectivity with the 1.65 MHz i-f section, avc circuitry, gang tuning, packaging in miniboxes, narrowband i-f, and a companion transmitter to go with it, with several watts output.

As you can see from Fig. 1, this is a single conversion, tunable superhet. The Motorola IC HEP 590 has over 30 dB gain and is probably the main item contributing to the high sensitivity. Not having (so far) a mixer and oscillator IC, the universal (my name for them) HEP 55 transistors were used here. Another 30 dB in the i-f, with excellent gain control characteristics, is achieved by the second HEP 590.

The demodulation was given an extensive workout because this item has to be just right for DX work. The demodulation is done with a 1N295 diode, connected across a separately tuned circuit on 1.65 MHz. The details are in Fig. 7. The af is quite good, using the Amperex eleven transistor audio IC. Be sure and check the details. The 8Ω loudspeaker is a Lowell which has quite a magnet on it. It is direct-coupled to the 1W af output circuit, and contributes to the good audio obtained.

Figure 2 shows the overall schematic, which is a happy combination of two types of ICs and two discrete transistors. This unit needs gang-tuning and the narrowband i-f to make it into a deluxe receiver, but these are not difficult to add. As a breadboard unit it is extremely interesting to use and generates plenty of thinking about communication ICs and their future amateur use.

Rf Stage

These little Motorola HEP 590 IC units are beginning to show up as really amazing for rf and i-f work. The gain is high, even at 50 MHz, the noise figure is good, the freedom from feedback is as low as they

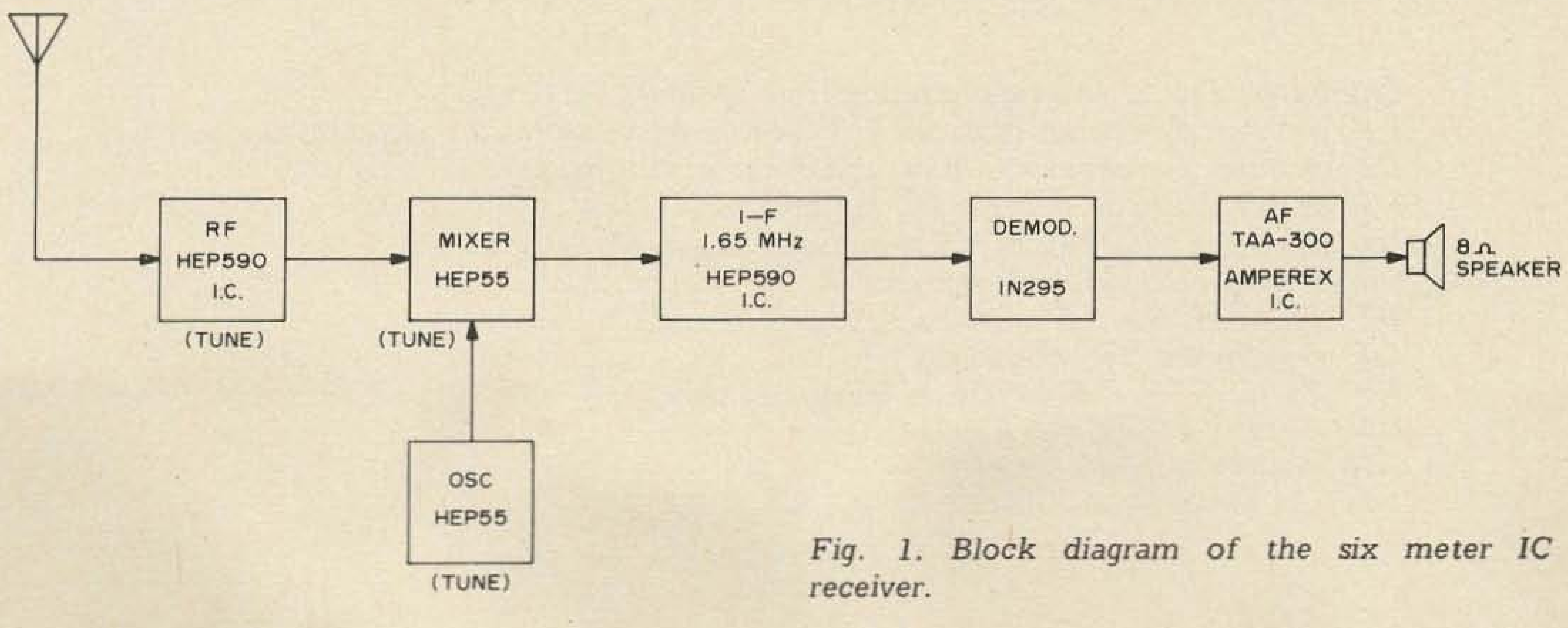

Fig. 1. Block diagram of the six meter IC receiver.

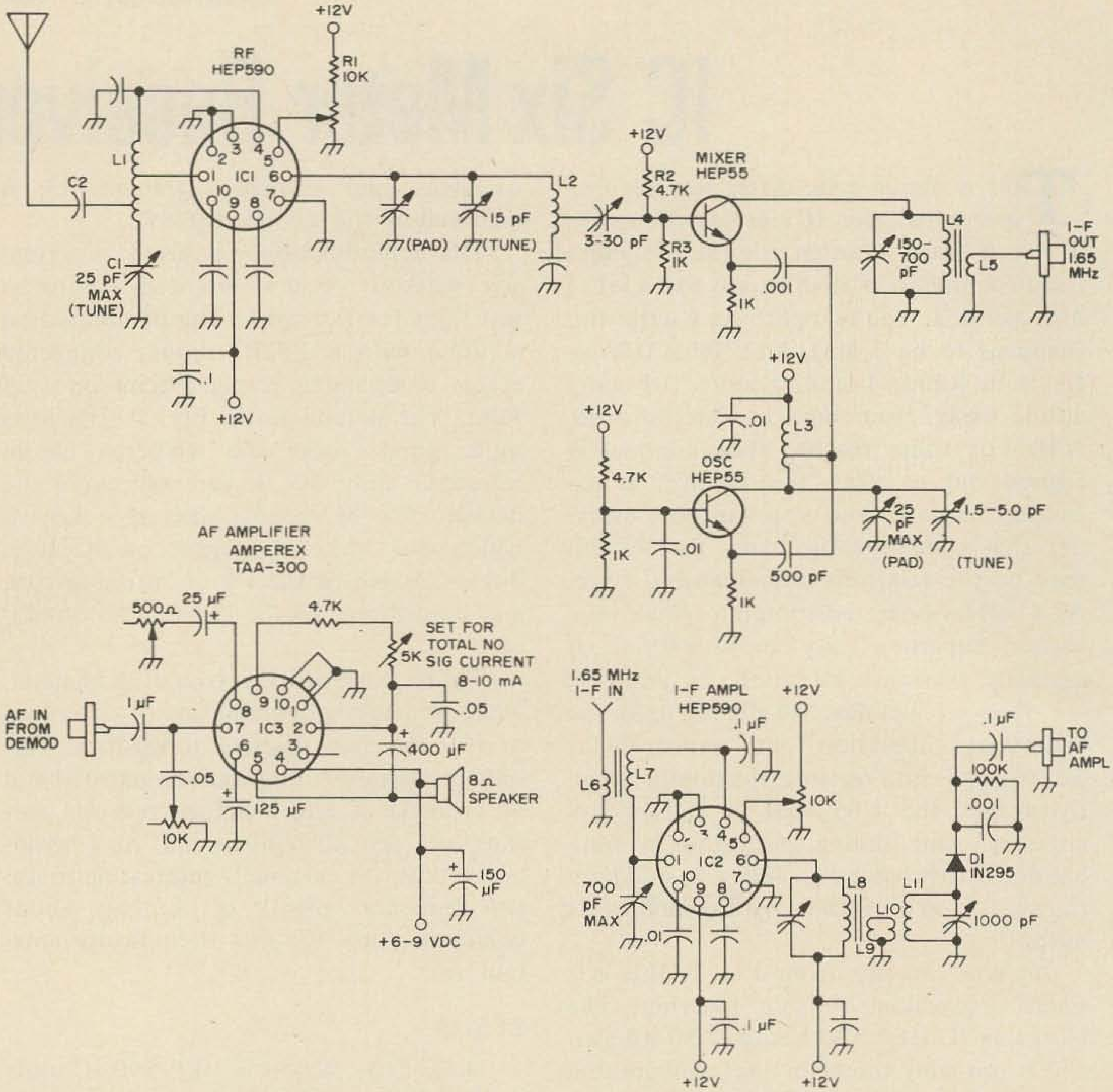

Fig. 2. Schematic.

Coil Table, Fig. 2. (All taps counted from ground [cold] end.)

L1 7 turns, airwound, 8/per in. 5/8 O.D., antenna tap at 3 turns, 590 tap at 4 turns.
L2 6 turns, airwound, 4 per in., mixer tap at 2 turns.
L3 5 turns, airwound 8 per in., tap at 1 turn.
L4 35 turns (No. 30), in Miller cup core (from No. 10c I.F.T.).
L5 5 turns, No. 32, wound over L7.
L7 35 turns, No. 34, in Miller cup core.
L6 3 turns No. 30, wound on L7.
L8 35 turns No. 34, wound in Miller cup core.
L9 3 turns wound over L8.
L10 4 turns wound on L11.
L11, 64 turns, air wound, 32 per in., 5/8 O.D.

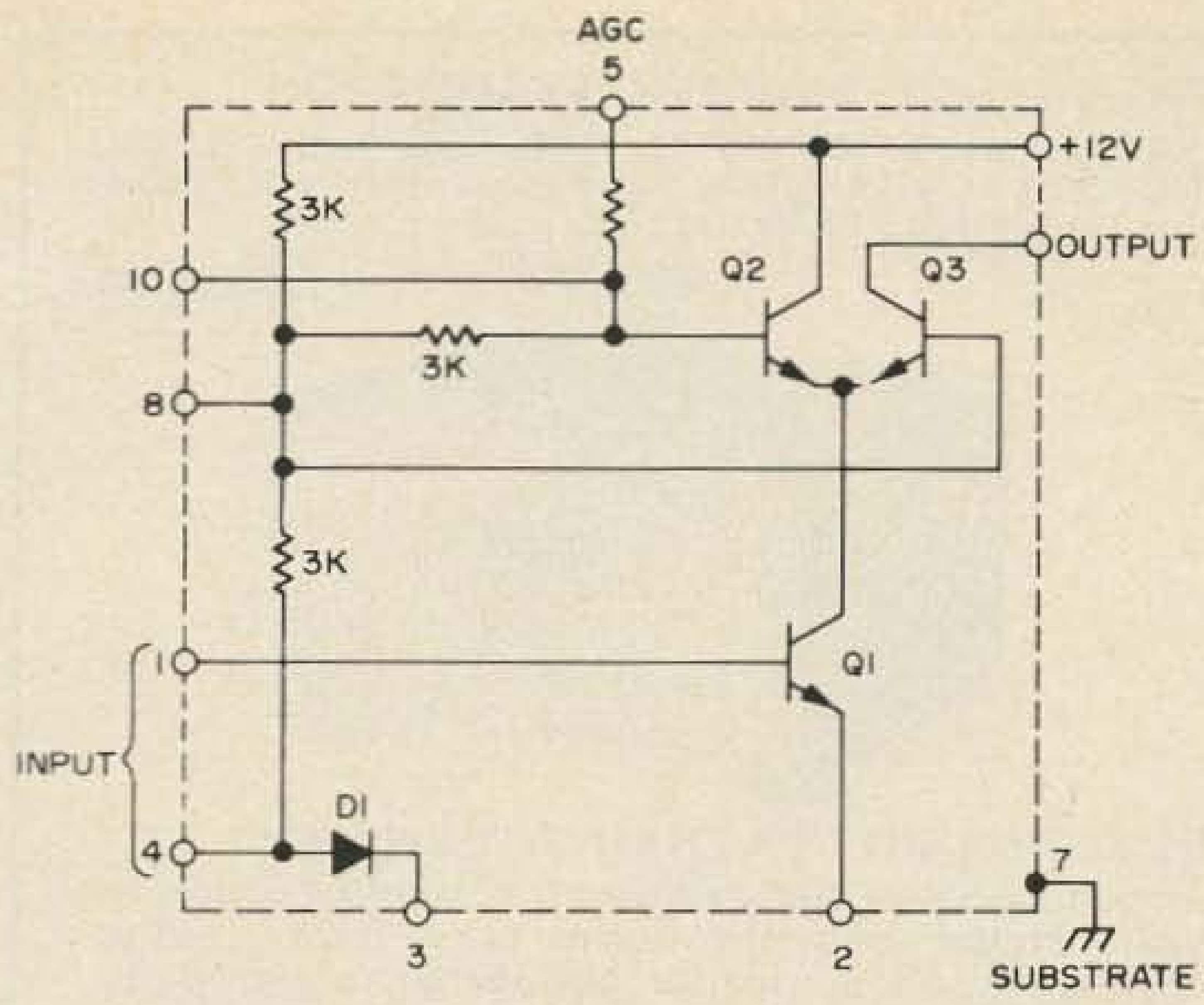

Fig. 3. Internal schematic of the Motorola HEP 590.

claim, and fine avc action is provided without distortion or detuning of the input. Figure 3 shows the internal schematic of the three transistors inside the case, which is only 3/8 in. in diameter, and Fig. 4 shows the external components.

I have been using it for some days now in front of my lab receiver while working and no spurious has shown up so far. The manual control on the avc is perfect, although you don't need it just for rf. This manual control uses the avc input line going to Q2, which is pin 5 in Fig. 2, and it is a nice thing to have in reserve when and if you tack on more i-f stages. It will be used later in its regular automatic form. It operates on Q3, leaving Q1, the input stage, in the low noise condition.

The way this is done, referring to Fig. 3, follows. The current of Q1 goes to both Q2 and Q3. With positive avc voltage on the base of Q2 (going in through pin 5) the current flows only through Q2, and Q3 is turned off with the gain of the amplifier then at a minimum. If the avc voltage on Q2 is *less* than that on the base of Q3 by at least 224 mV, all the collector current in Q1 will flow through Q3, which is the condition of maximum ac gain. Due to Q1 being on all the time, input tuning will remain constant, another advantage of the 590.

The combination of Q1 and Q3 acts as a common-emitter common-base pair and as such reduces feedback by two orders of magnitude compared to a single transistor. This of course is one of the biggest advantages of the 590 IC. All things considered, this unit is an excellent rf amplifier and an intriguing example of things to come in integrated circuits.

The Mixer and Oscillator

These are the only discrete transistors in the receiver, and they're only in it because I haven't yet found an IC substitute for them on VHF and UHF.

The mixer circuitry shown in Fig. 5 has a minimum of components because it uses the tuned collector coil of the rf stage for its input. A capacitor over to the oscillator and an i-f output coil complete the deal.

An interesting thing about this mixer is that, while being extremely sensitive, it has not produced a single spurious so far. No birdies have been heard in several days of operation.

The local oscillator is shown in Fig 6 and is more or less standard with me because it is turning out to be very reliable.

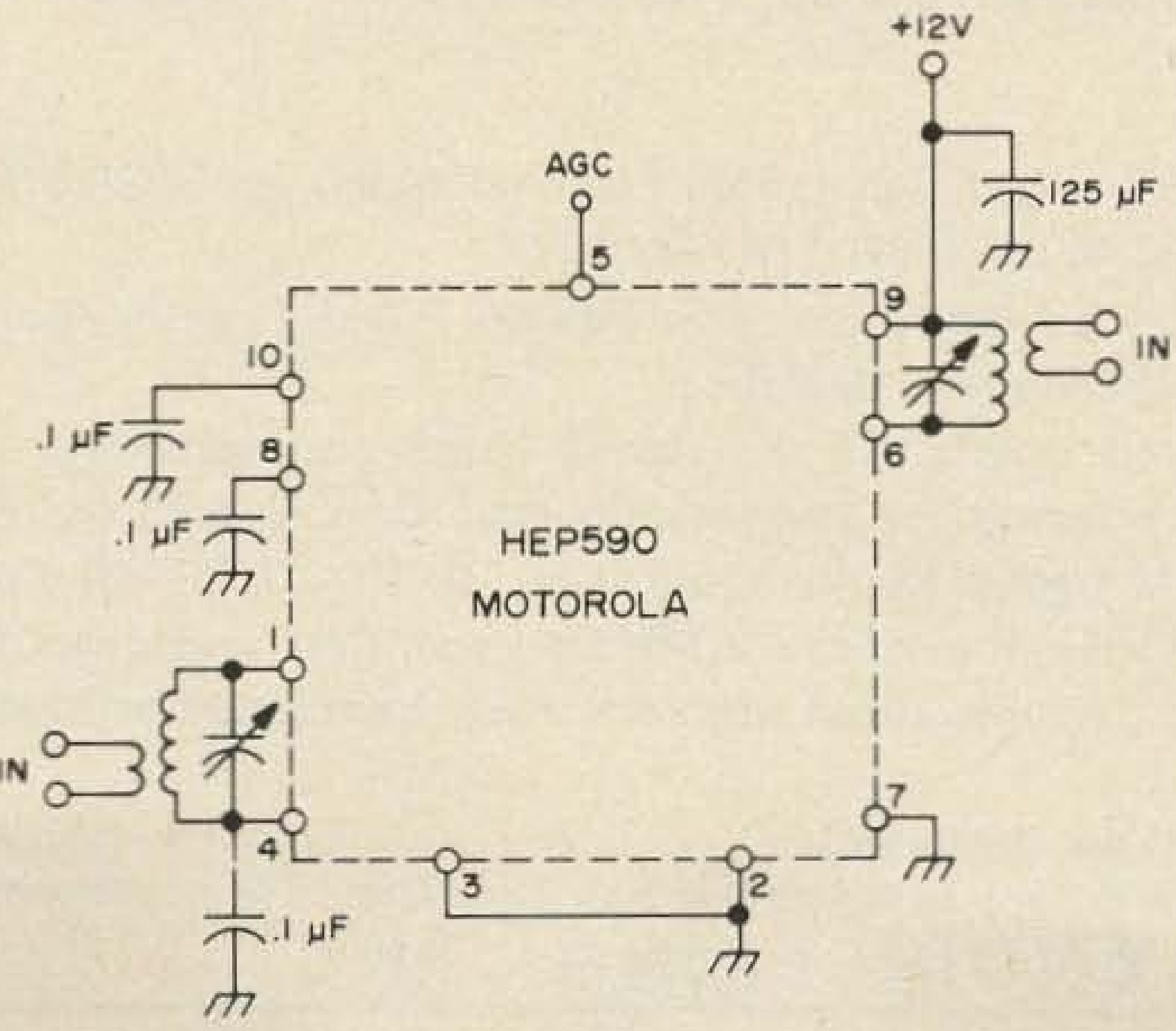

Fig. 4. External schematic for HEP 590.

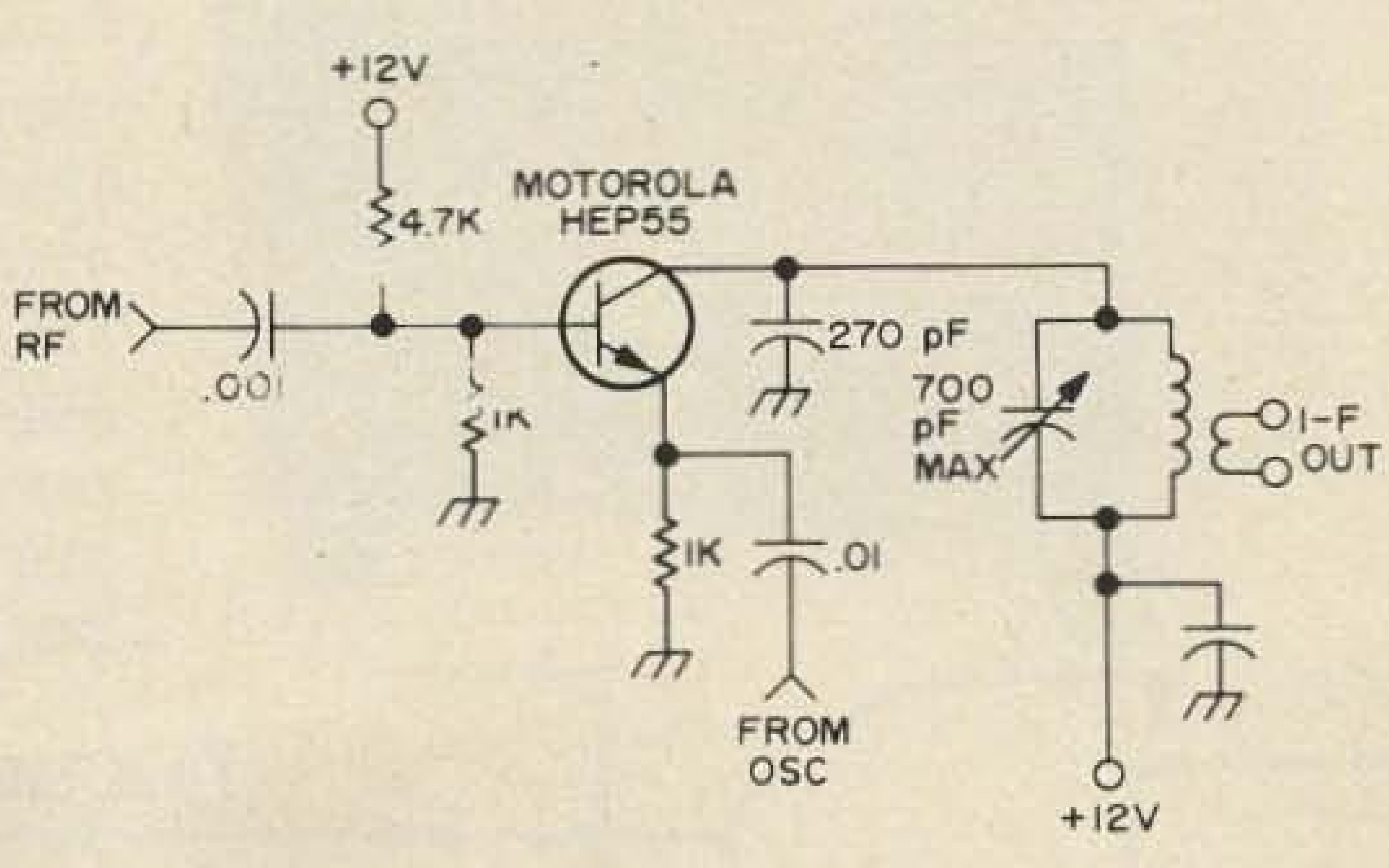

Fig. 5. Mixer schematic.

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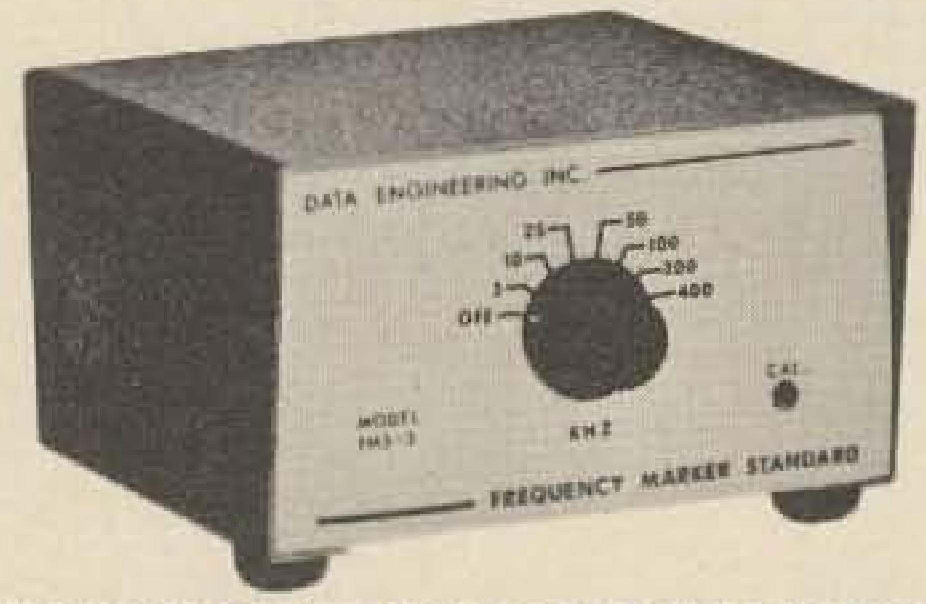

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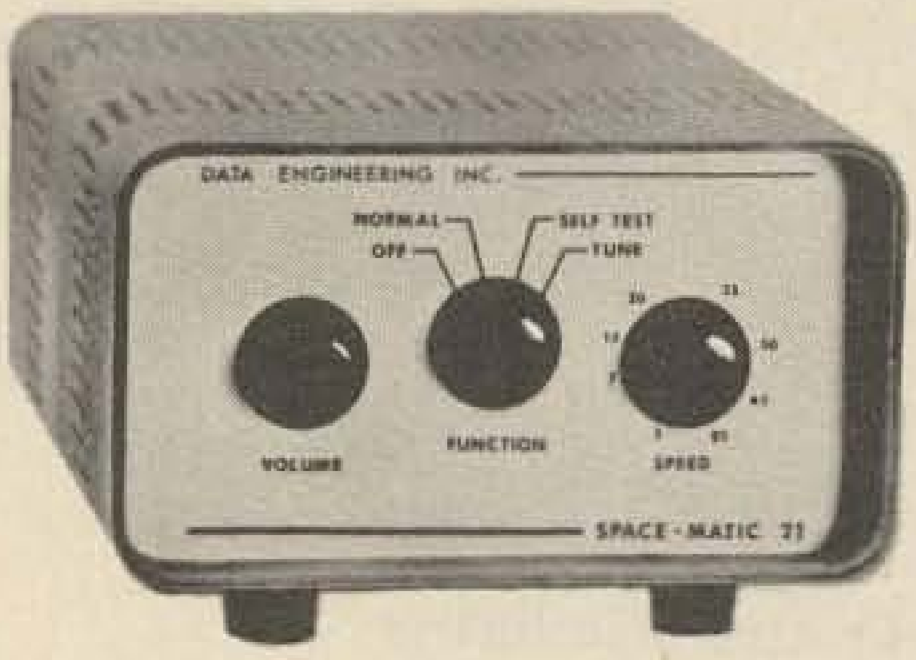

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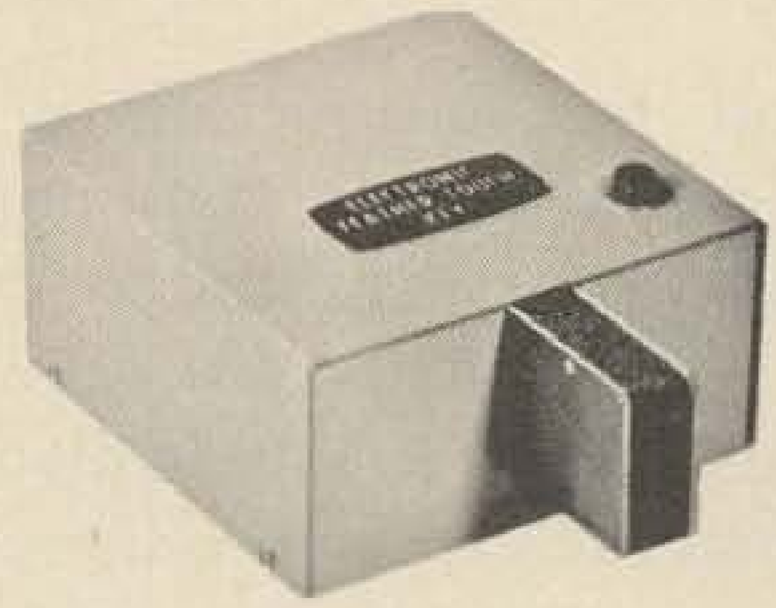

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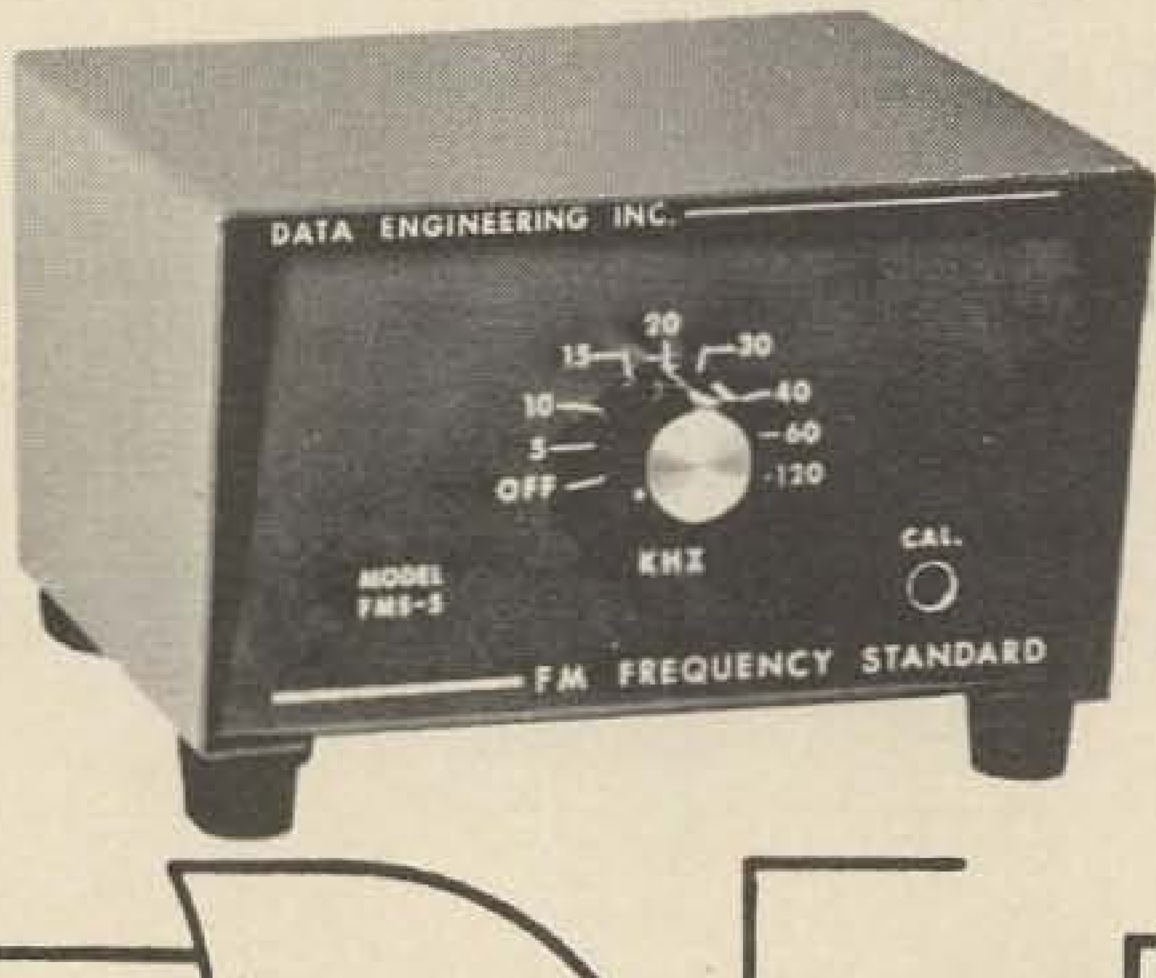

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The whole inductance including the feedback portion is tuned so that considerable reserve power is available. Tap one, the oscillator emitter rf connection to L1, can be varied to suit. Right now it is less than one turn from the ground end of L1. The mixer tap is also at the same place at present, and the results are quite remarkable. I'm getting very excited about the possibilities on Two as well. Maybe it will replace the receiver of my sorely-missed Communicator Three which I *never* should have sold.

The IC I-f and Demodulator

From the way these Motorola HEP 590's worked in the rf stage, I got the idea that maybe only one of them would do for the i-f stage. It turns out that there is *more* than enough gain. You can't stay in the room with everything full on! It's really fascinating. I'm listening to Six as I write, and I can hear everyone within at least 100 miles.

The i-f details are clearly shown in Fig. 2. This i-f portion was installed on a separate copper-clad plank in order to check completely just what it could do, and it sure paid off. At 1.65 MHz there is probably more than 30 dB of gain, and so far it has never oscillated even once. Motorola claims that the "Reverse Transfer Admittance" (that old Devil feedback) is very, very, low. Here are Motorola's words, ". . . is extremely low since in terms of millimicromhos it involves the product of two numbers less than unity, divided by a number greater than one. Hence the fact that it is extremely difficult to measure is understandable." The figure given is less than .001 millimicromhos, therefore it can

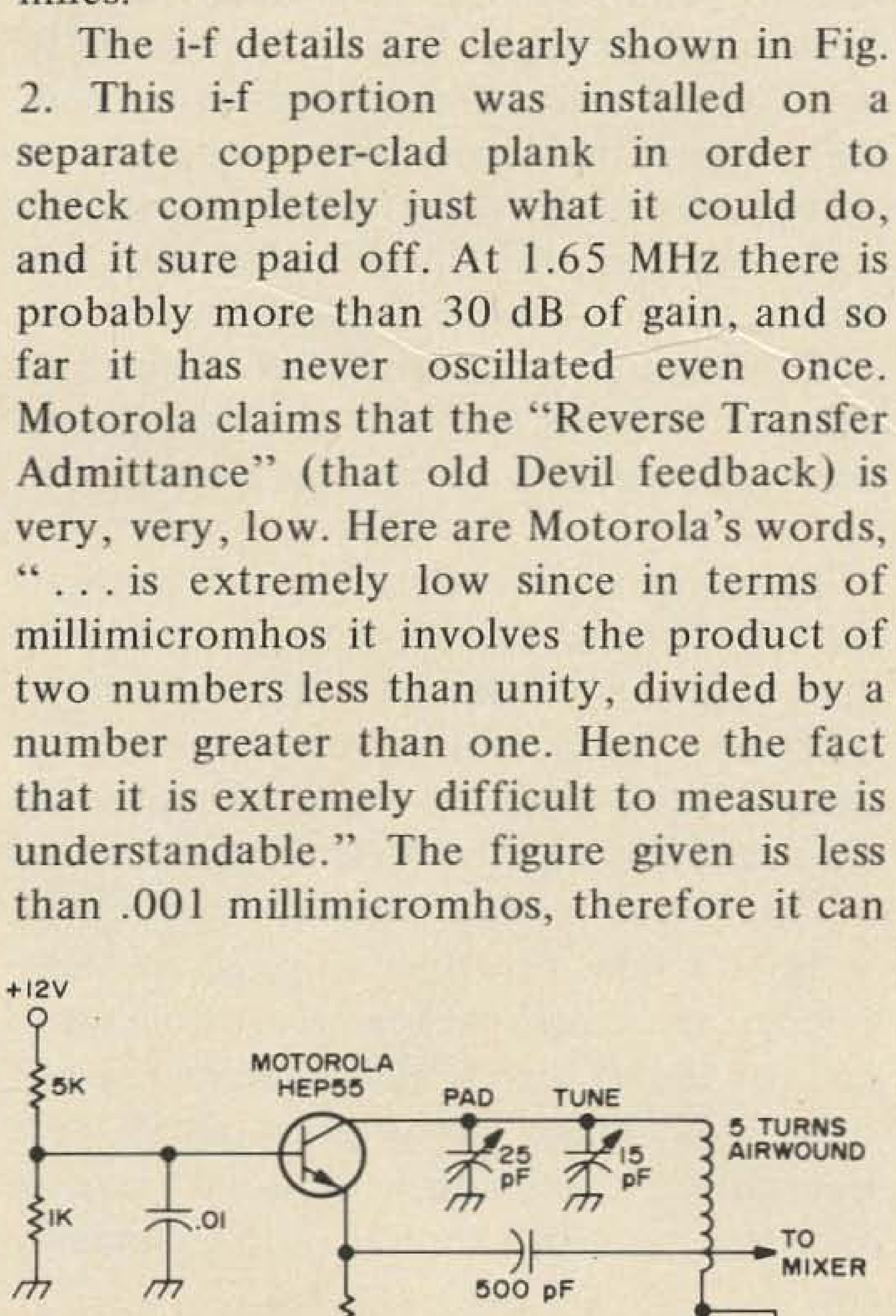
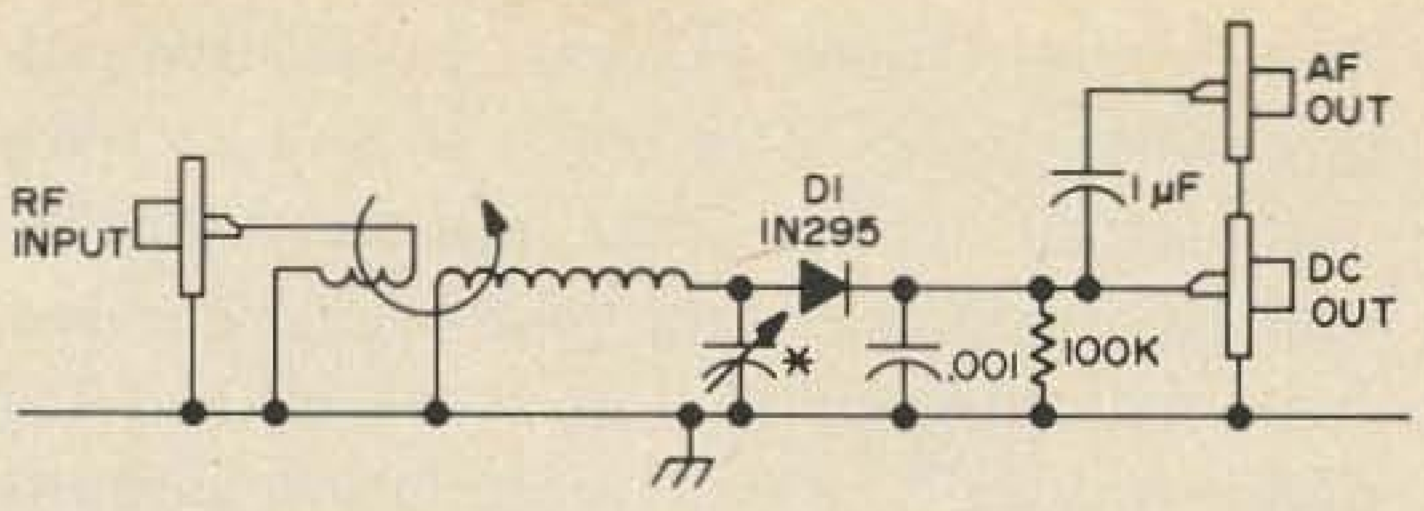


Fig. 6. Tunable local oscillator.



* 1000 pF MAX (3 GANG STANDARD BROADCAST VARIABLE CAPACITOR, ALL THREE SECTIONS TIED IN PARALLEL.

Fig. 7. Diode demodulator, 1.5 to 8 MHz. The coil data is with Fig. 2.

be neglected. So, I neglected it and no oscillation has yet occurred.

The inductors used are detailed in Fig. 2, and will be the subject of considerable experimentation in the near future. The advantages of a single conversion are important, but put a strain on the selectivity question. You need at least 1.65 MHz to avoid excessive image, and selectivity approaching 10 kHz (if you can get it) at 1.65 MHz is not easy. However, as you will see by Fig. 2, we have four tuned circuits, the mixer collector, two in the i-f plank, and the fourth in the tuned diode unit. Cup-cores from Miller 10-C tube-type i-f transformers are used for three of these, and the fourth is an air-wound job, 23 turns per inch, with about 750 pF across it. This is giving separation of some 80 to 90% of the stations on the band, and will do for the moment. There is a question of price also. Coils wound with Litz wire, that is, a number of strands of enamel wire wound into one cable such as "5/41" which is 5 strands of No. 41 enamel each, have a better Q than those wound with a single wire, but the price is a lot higher.

The i-f described here works like a charm except for a slight overlap on close stations. Another HEP 590 on 135 kHz will of course give you selectivity down to 3 or 4 kHz.

Demodulation

As you may have noticed, I like Admirable Modulation. On VHF and UHF, and up into amateur microwaves there is plenty to do, with amateur Space Stations coming up and all, without going into a bunch of up-converters and then a lot of linear amplifiers to get SSB power on those frequencies. These present special difficulties when using solid state, to end up with modulation which does not even enable you to recognize your best friend's voice. Just my opinion, so I'm stuck with it for now. Anyway, AM demodulation circuits can sometimes give you trouble, especially when combined with avc, so let us take a look.

The circuit shown in Fig. 7 is an old-timer, but very valuable for certain types of work such as i-f amplifiers. It has its own "plank" and dial and is calibrated from about 1 MHz up to near 8. It is an excellent reference point for audio quality to start with, allowing a check into the BC band when needed. This is not to say that all those high-end BC stations are Hi-Fi! It adds another tuned circuit to the i-f for increased selectivity, allows you to check for yourself the desirable values of C2, C3, and R1, and has a dc output for metering small improvements in gain. It will be built into the i-f strip later, when the exact inductors, capacitors and resistors are determined.

The Audio IC

Figure 8 shows the internal circuit of the Amperex TAA-300 audio integrated circuit. The external circuitry is clearly shown in Fig. 2. This tiny 3/8 in. diameter can contains no less than eleven transistors and five diodes, and has been engineered to

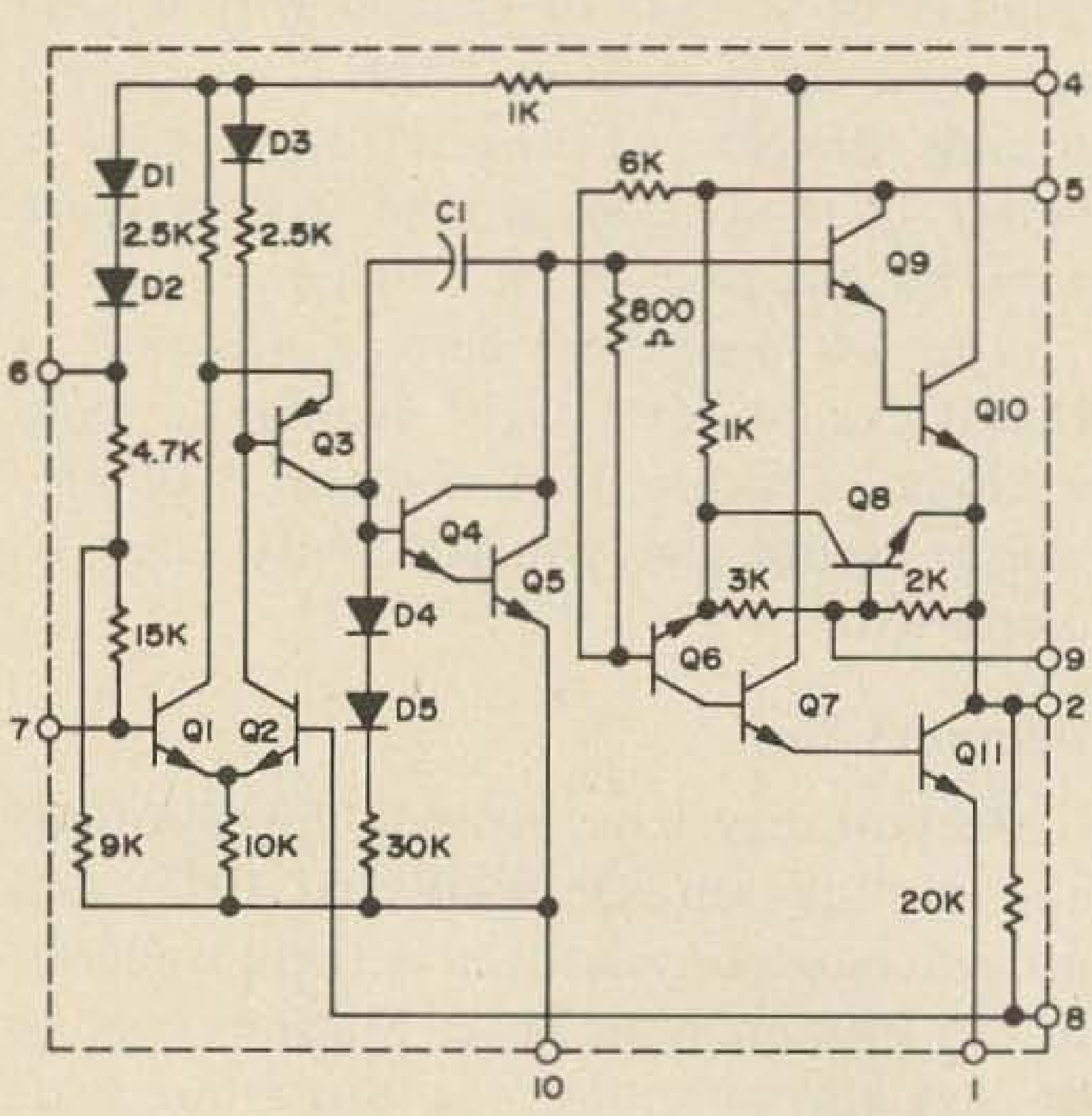


Fig. 8. Internal circuit of the Amperex TAA-300 audio IC one watt amplifier.

put out a clean watt of audio energy from 20 Hz to 25 kHz, which it does, I can assure you. It has negative feedback which can be made variable by the use of the pot attached to pin 8. Checking the internal circuit shown in Fig. 8 you can see that pin 8 is the base of Q2 and the 25 mF capacitor bypass would shunt the feedback to ground if the pot were not in series with it. With this pot at zero ohms the amplifier gain is very high, and with it at maximum there is a lot of feedback, which cuts the gain down but increases the quality of the audio. For a fixed value, Amperex recommends 47Ω.

A high frequency cutoff control is used at the input because for communications work you do not need 25 kHz response. You can also cut down on the lows because for communications you don't need 20 Hz either! Reduce the value of the input capacitor on pin 7.

Shunt pin 4, the dc input, with at least 150 mF, and run a .05 to ground from pin 2 to remove high frequency instability from the lower of the Darlington pair, Q11. Keep the input and output leads apart, preferably using shielding on the input. Use an 8Ω speaker for the best match to the transformerless output circuit. This unit is actually as claimed, a "Miniature Hi-Fi Amplifier," if you're interested in such. I am very impressed with it.

Running this receiver "as is" without the narrowband i-f following, I can repeat that some 80% of the stations will be QRM-free. Also, this figure may be increased later when I really get into the selectivity bit on 1.65 MHz. Further, rotating the beam would help cut down QRM.

If you take the time to gang the three tuning capacitors, package the whole set in one (or more) boxes, add a narrowband i-f strip, and make up a good solid state transmitter to go with it, you will have an excellent portable, mobile, and emergency rig.

If you use it "as is" you will be surprised at what you can hear on Six. It also can give you an instant check on band openings if you leave it hooked up with its own little battery. ...K1CLL

R. F. Dannecker VK4ZFD
52 Pohlman Street
Southport
Queensland 4215
Australia

A Tracking FM-AM Demodulator using an IC

This is the second of two articles, on the use of the phase-lock loop as an FM/AM demodulator.

The circuit to be described uses the Signetics Corp. NE561B IC and is based on Signetics' application notes. Besides providing demodulation of the FM component of a signal and perfect afc tracking of that signal, provision is also made for the synchronous demodulation of the AM component of the signal.

A block diagram of the NE561B is shown in Fig. 1; the portion enclosed in the dotted outline is in addition to the basic phase-lock loop already described. The AM input is taken before any limiter in the main receiver and its phase is shifted 90° with respect to the FM/rf input. This is necessary to have the correct phase relationship between the AM signal and the VCO input to the multiplier.

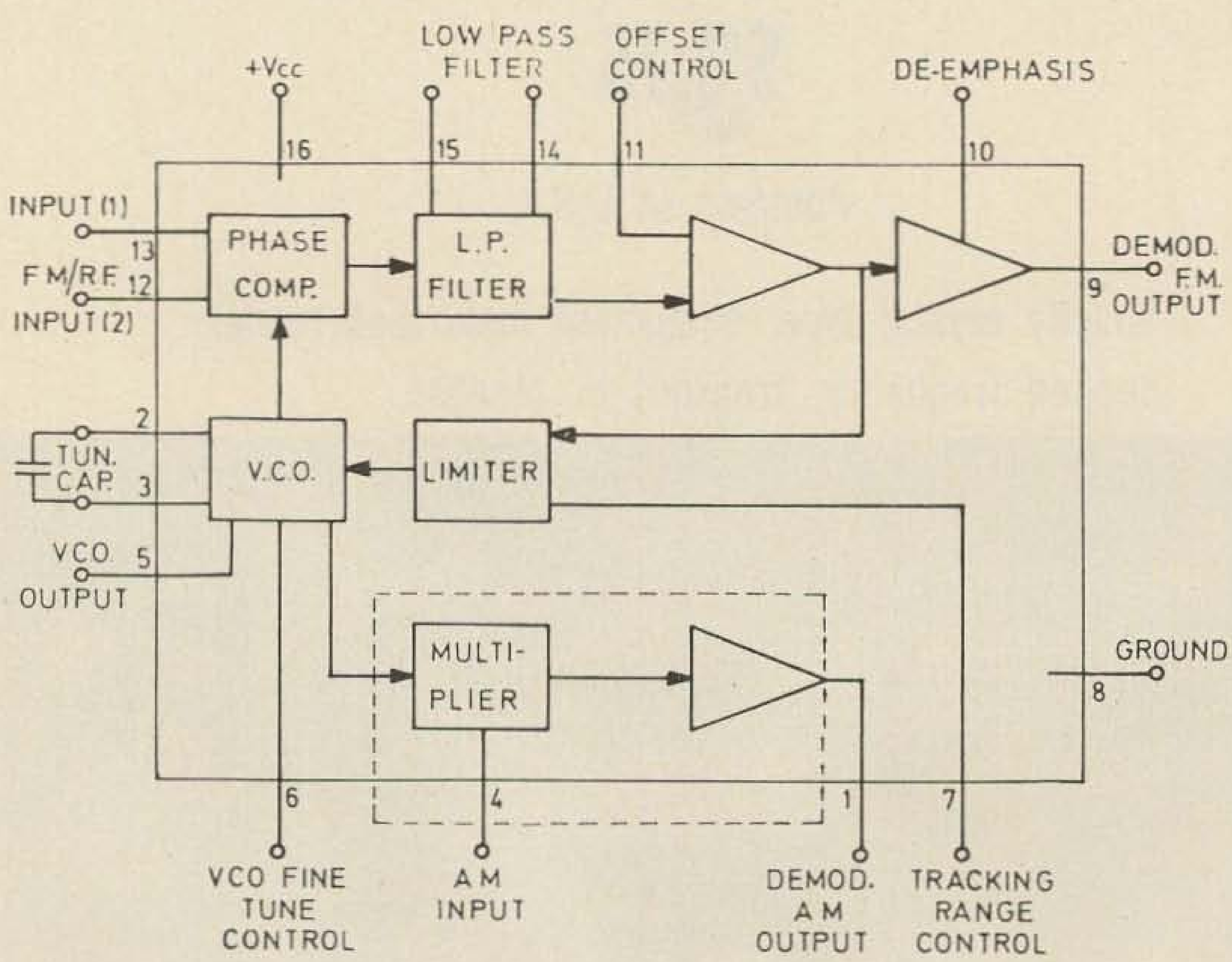


Fig. 1. Block diagram of NE561B.

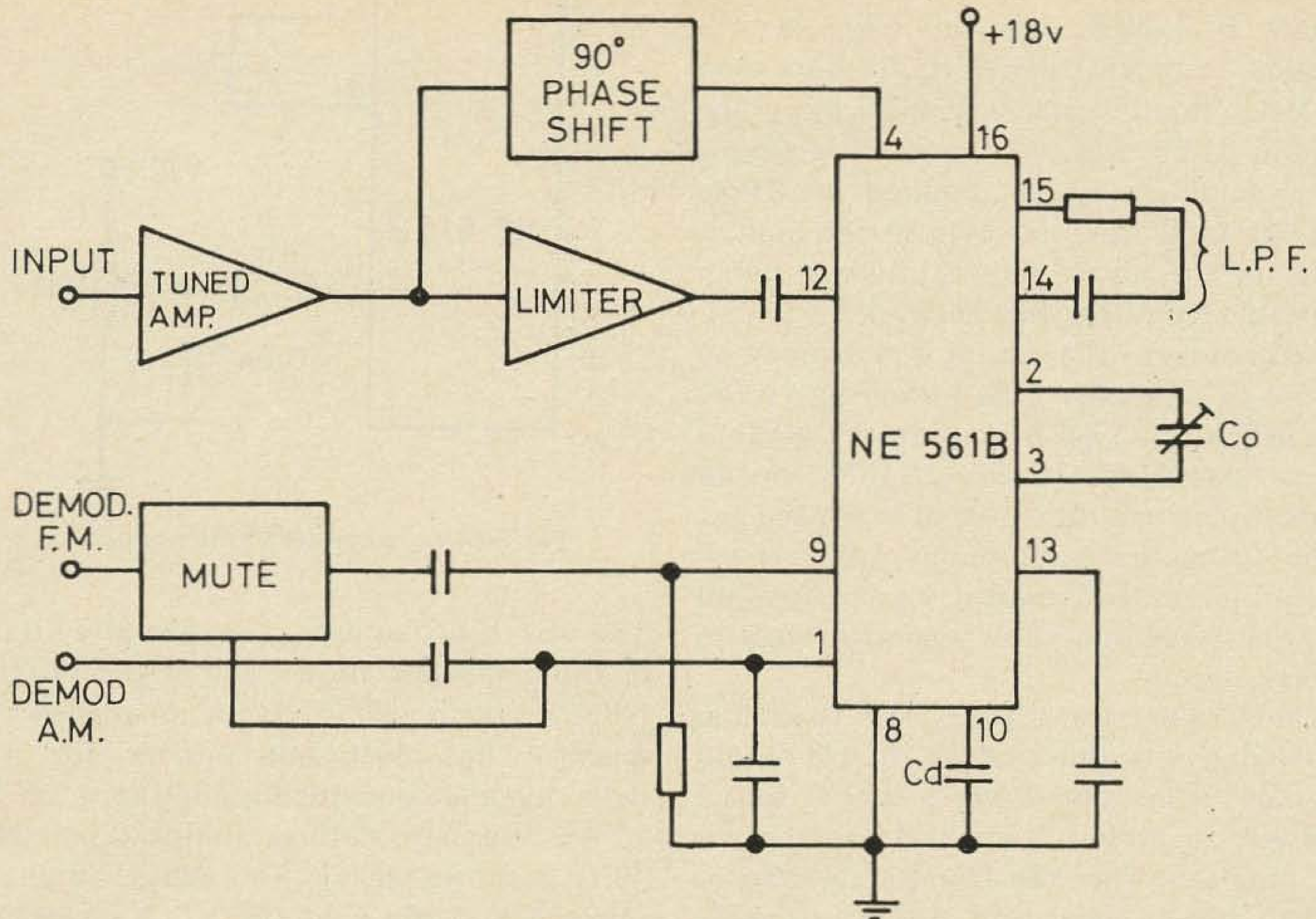


Fig. 2. Basic demodulator.

Shown in Fig. 2 is the basic demodulator. With reference to Fig. 1 we have the limited FM/rf input applied between pins 12 and 13, phase shifted AM input applied at pin 4, the VCO frequency determining capacitor (Co) connected between pins 2 and 3, the external components of the low pass filter between pins 14 and 15, and the FM de-emphasis capacitor (Cd) connected between pin 10 and earth. The muting function is accomplished by use of the output of the AM detector to open an audio gate in the presence of signal input.

The circuit diagram for the complete demodulator is shown in Fig. 3. Circuit functions can be most readily seen with

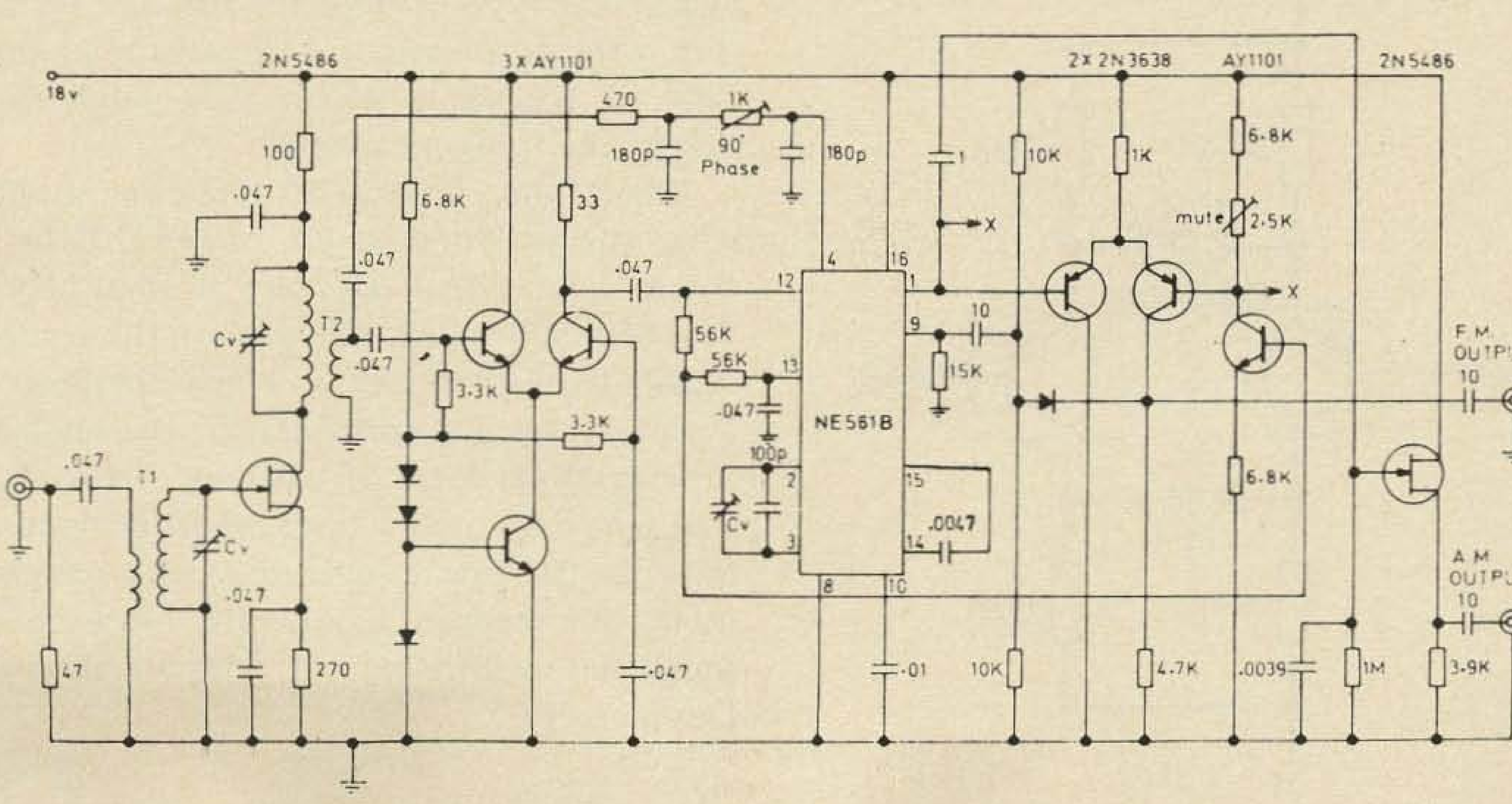


Fig. 3. Phase-lock demodulator.

reference to Fig. 2. The design centre frequency is 2 MHz, but the NE561B will function from less than 1 Hz to more than 15 MHz. Input signal is amplified by the 2N5486 JFET which is wired as a simple tuned amplifier at the required i-f. Three AY1101 transistors are used in the limiter, while the 90° phase shift is provided by an adjustable RC phase shift network.

Muting of the FM output is performed by the use of a suitably biased diode as a series gate. When no signal is present, the diode is reverse biased by the 2 x 2N3638 emitter coupled pair and when signal is applied the output from the synchronous AM detector causes the emitter coupled pair to forward bias the diode and allow signal through to the FM output.

The AY1101 transistor is used to set bias levels relative to those of the IC. AM output is taken from pin 1 via a JFET source follower; an MPF102 would be suitable for this function. The AM detector can also be used to give an indication of signal strength. A suitable circuit is shown in Fig. 4.

If operation at some i-f other than 2 MHz is desired, (e.g. 455 kHz) it would be necessary to change the resonant circuit in the JFET amplifier, change the VCO timing capacitor Co (e.g. 600-800 pF) and the 90° phase shift network (e.g. 2.2K, 5K pot., 2 x 150 pF). If a frequency less than 500 kHz is required, consideration could be given to the NE565 which will function as an FM/PM detector but does not provide for AM detection and consequently muting.

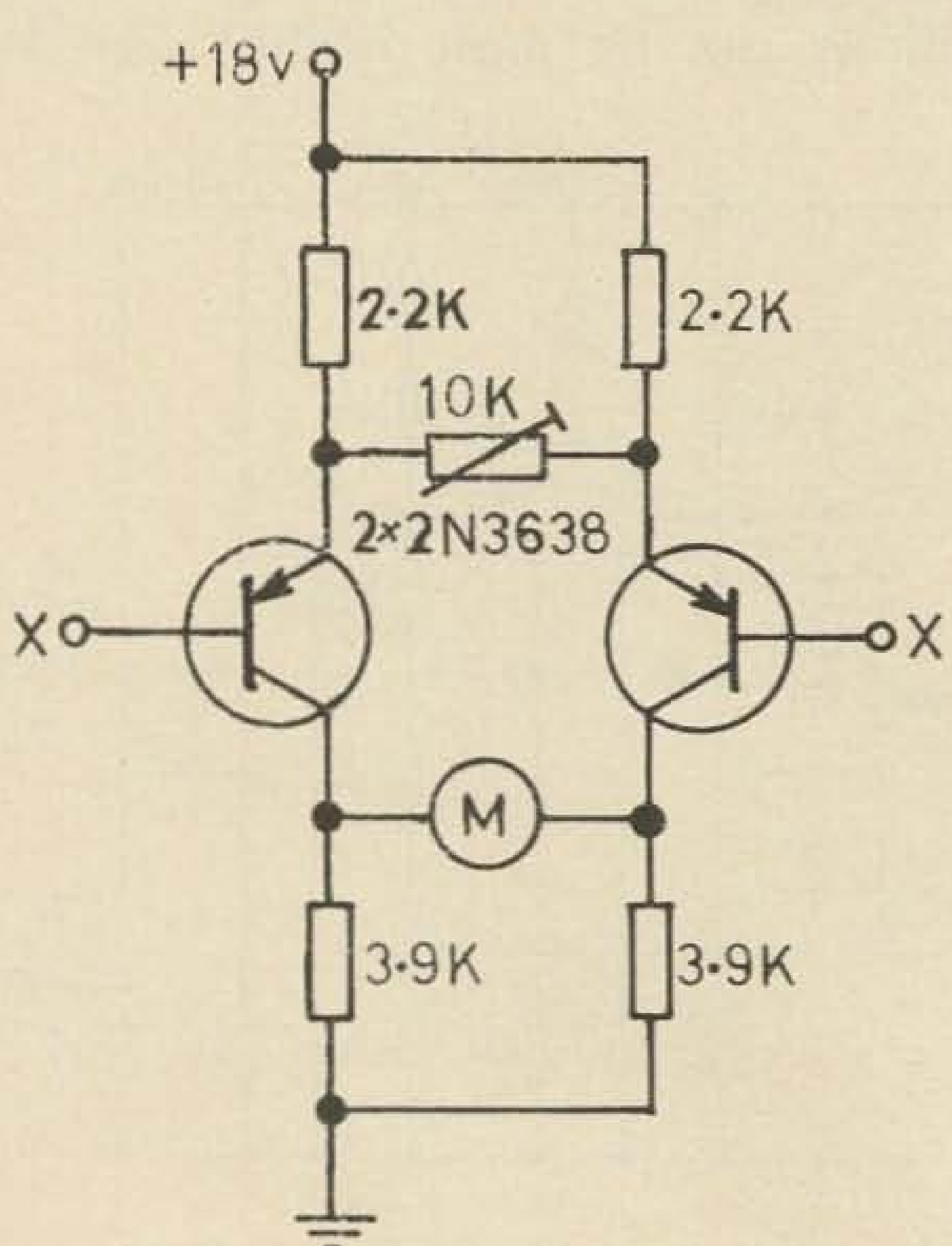


Fig. 4. Signal level indicator.

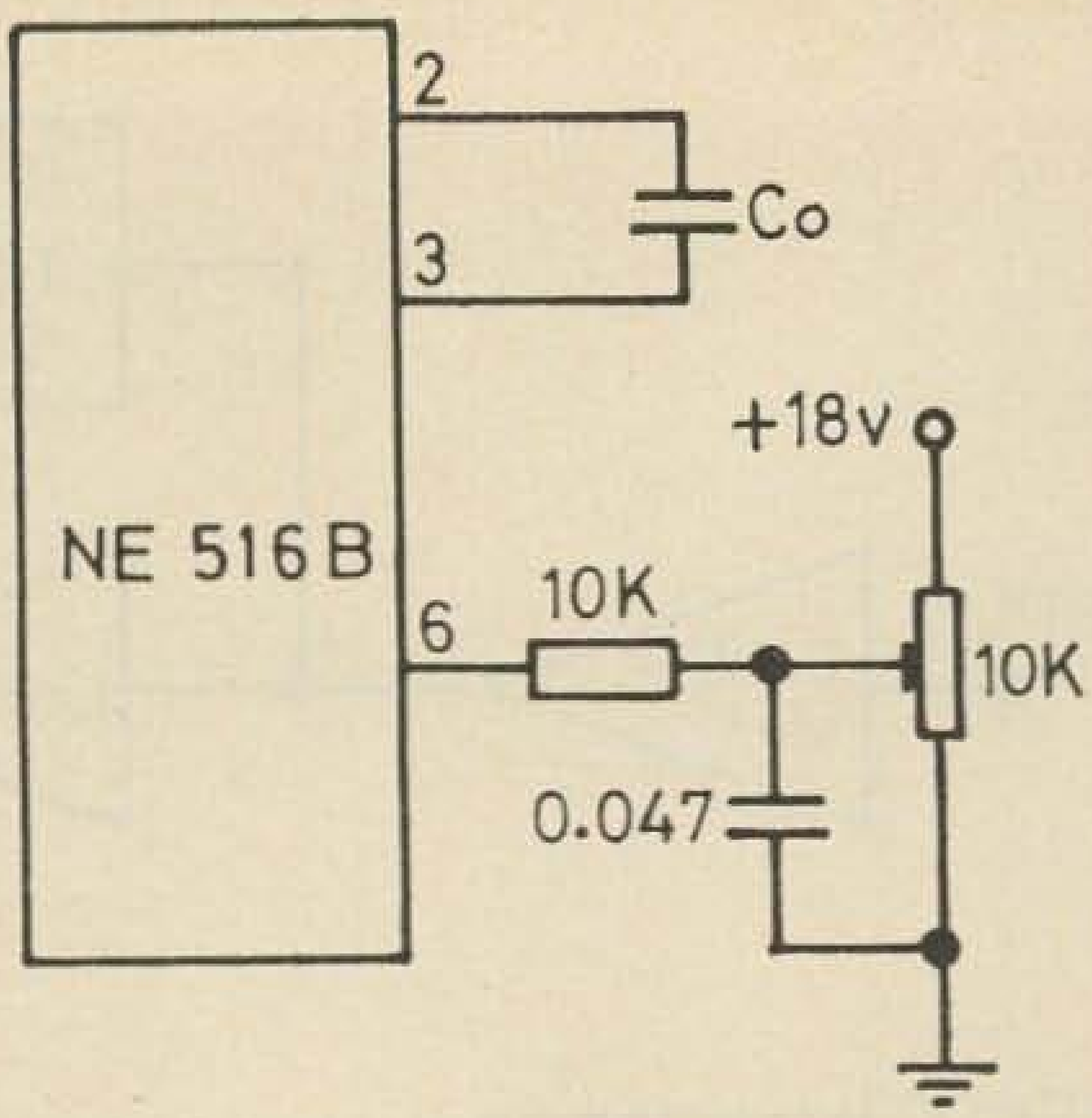


Fig. 5. Alternative VCO fine tuning.

An alternate method of fine tuning the VCO is shown in Fig. 5 in which current is injected into pin 6 of the IC. A change of +12% is possible for an input current of 1 mA. This method of fine tuning will also affect the tracking range of the demodulator.

This completes the description of the phase-lock demodulator.

Such a unit as has been described in this article is in use in a satellite tracking receiver used for monitoring navigational and weather satellites. The principal use of the phase-lock type of detector for this application is the automatic tracking of the Doppler shift of the signal which is as much as ±4 kHz at the frequencies used.

When the proposed amateur satellite with the active repeater on 432 MHz becomes operational, Doppler shift of at least ±10 kHz will be experienced on the received signals from the satellite. It will therefore be necessary for stations receiving the signals to provide some form of tracking of the signal frequency. If such a tracking filter/demodulator as the one described in this article is used, the receiver bandwidth must be the signal bandwidth plus 20 kHz to allow for Doppler shift.

. . .VK4ZFD

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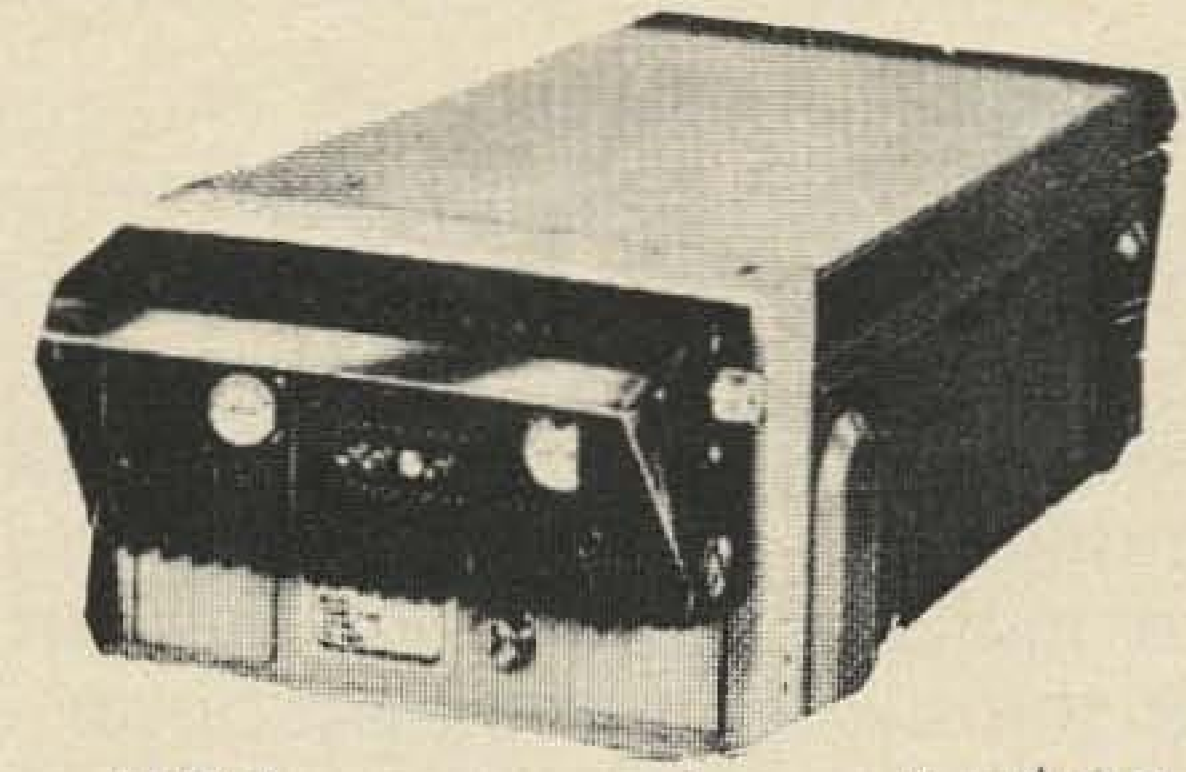

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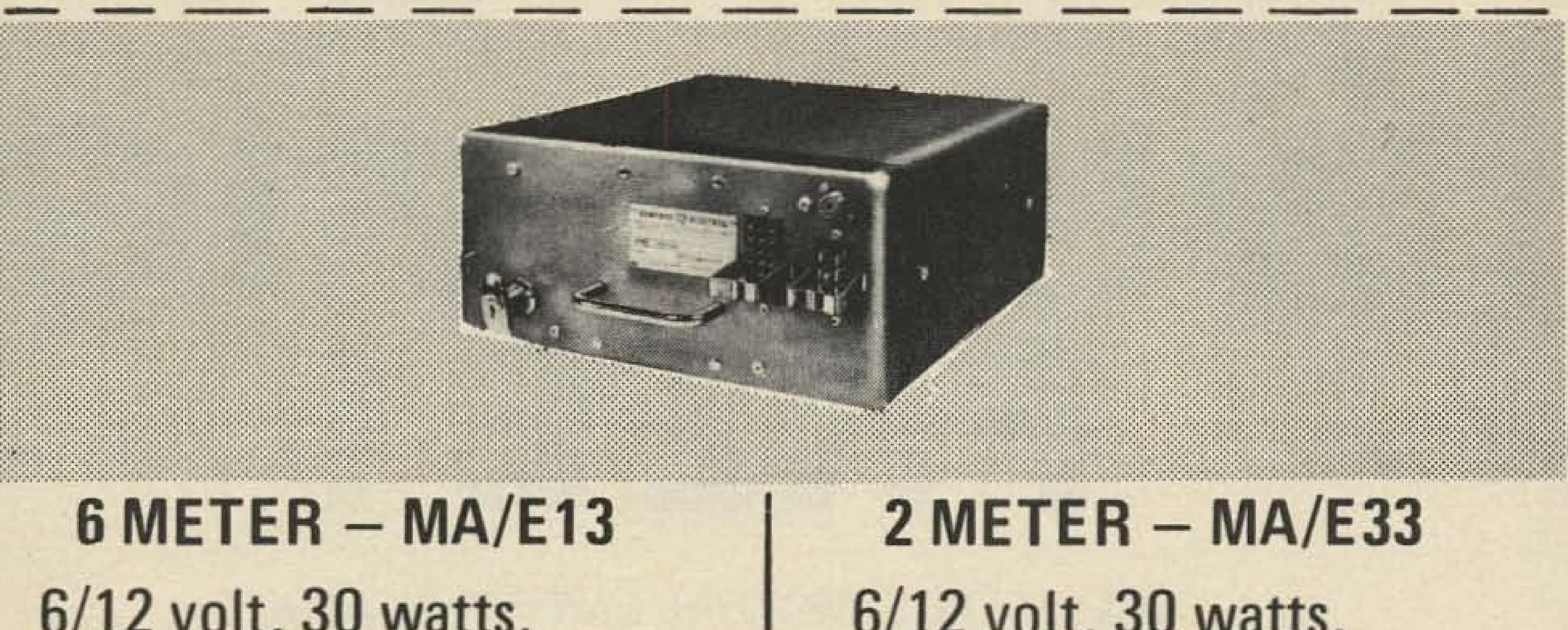

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W7DXX/1 (continued from page 128)

out of band - it's rather difficult for 6 stations to sneak across 10 kHz. The other evening I was tuning across the high end of 20 SSB looking for a clear spot. My sked called for the first clear spot below 14.350. As I tuned between 350 and 340 I was amazed at the lack of activity. "Maybe this is not the QRM capitol of the world after all," I thought. So, I picked a spot just inside 14.350 and gave my friend a call. He came right back. As it happens quite often, after we had been talking about 5 minutes someone broke in and joined us, then someone else, and then still another until there were six of us having a nice roundtable QSO. I pulled out the old trusty 10 minute timer so that identification went like clockwork. (No pun intended.) After a half hour or so, it suddenly hit me. I had been looking at the wrong VFO dial. I was, we were, all six of us were on 14.360. I didn't really know what to do or say. My first reaction was to say, "Well fellas, I'd better get back upstairs and get some work done." They could then worry about themselves. However, since I had started the whole thing it didn't seem quite right. Then too, after more than a half hour of operation at 14.360 I was sure there was a monitoring station using up a heck of a lot of recording tape on us and having a blast writing out all those citations. It occurred to me that perhaps the best way out was to "fess up" to the other guys. After mentioning the fact that we might be "out of the band just a little" we all spent another 5 minutes or so verbally trying to figure out what to do. We came up with several good possibilities. Like using our MARS calls, or just pulling our wall plugs. We finally decided that the best thing to do was to announce the fact that we realized we were in error, identify, apologize and get back into the band. This is what we did. It was sort of a one way transmission to all the FCC monitoring stations. I, as an example, said: "This is W7DXX operating portable one from Peterborough, New Hampshire. If there are any monitoring stations listening we realize we are accidentally out of band and will now QSY . . . sorry." After the whole thing was over and we were back in the band I couldn't help but feel extremely foolish. Not only for being the cause, to a degree, of six stations operating out of band, but for not really knowing what to do after finding myself in the situation. As far as I can recall, this is the first time I have ever found myself out of band. I suppose I could blame it on the new and unfamiliar equipment I was using. However, no citations have been received by any of the five participants so maybe we did the best thing after all. What do you do when you find yourself out of the band . . . Got an answer?

. . .W7DXX/1

PROPAGATION CHART

J.H. Nelson

Good (Open), Fair (□), Poor (O)

SEPTEMBER • 1972

S	M	T	W	T	F	S
					[1]	2
3	[4]	[5]	(6)	[7]	8	9
[10]	11	12	13	(14)	(15)	[16]
17	18	19	20	(21)	[22]	[23]
[24]	(25)	26	27	28	29	30

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	3A	3A	3A	7	7	7A	14	14
ARGENTINA	14	7A	7B	7	7	7	14	14	14A	14A	21	21
AUSTRALIA	14	14	7B	7B	7	7	7	7	7B	7B	14	14A
CANAL ZONE	14	7A	7	7	7	7	14	14	14A	21	21	21
ENGLAND	7	7	7	7	7	7B	14	14	14	14	14	7B
HAWAII	14	14	7B	7	7	7	7	7B	14	14	14	14A
INDIA	7	7B	7B	7B	7B	7B	14	14	14	7	7	7
JAPAN	14	7A	7B	7B	7B	3A	7	7	7	7	7	14
MEXICO	14	7A	7	7	7	3A	7	14	14	14	14A	14A
PHILIPPINES	14	7B	7B	7B	7B	3B	7	7	7A	7A	7	14
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SOUTH AFRICA	7	7	7	7	7B	14	14	14A	21	21	21	14
U. S. S. R.	7	3	3	7	7	7B	14	14	14	14	7B	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	14	14A

CENTRAL UNITED STATES TO:

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ARGENTINA	14	14	7B	7	7	7	14	14	14A	14A	21	21
AUSTRALIA	14A	14	7A	7B	7	7	7	7	7B	7B	14	14A
CANAL ZONE	21	14	7	7	7	7	7A	14	14A	21	21	21
ENGLAND	7	7	7	7	7	7B	7B	14	14	14	14	7B
HAWAII	14A	14	7A	7B	7	7	7	7B	14	14	14	14A
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MEXICO	14	7	7	7	7	3A	7	14	14	14	14	14
PHILIPPINES	14	14	7B	7B	3B	3B	3B	7	7A	7A	7	14
PUERTO RICO	14	7A	7	7	7	7	7A	14	14	14A	14A	14A
SOUTH AFRICA	7	7	7	7	7B	7B	14	14	14	14	14A	14
U. S. S. R.	7	3	3	3	3	3B	7B	14	14	14	7B	7

WESTERN UNITED STATES TO:

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AUSTRALIA	21	21	21	14	7	7	7	7	7	7B	14	21
CANAL ZONE	21	14	7	7	7	7	7	14	14A	21	21	21
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JAPAN	14	14	14	7B	7B	7	3A	7	7	7	14	14
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PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	7	14
PUERTO RICO	14A	7A	7	7	7	7	7	14	14	14	14A	14A
SOUTH AFRICA	7	7	7	7	7B	7B	7B	14	14	14	14	14
U. S. S. R.	7	3B	7	7	3B	3B	3B	7	7	14	7	7
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ACTIVE FILTER DESIGN AND USE PART III

In Parts I and II basic LC filters were developed into active filters utilizing transistor amplifier stages and RC circuits. In this process, we showed that the bulky inductor, or indeed any inductor, was not only unnecessary, but in most cases a hindrance to design and stability. The use of transistor amplifier stages with network selectivity determined by feedback components presents a flexible mechanism adaptable to any filter requirement. One of the main advantages of the active filter is the replacement of high insertion losses normally associated with LC filters with little or no insertion loss and, in many cases, overall gain. At the lower frequencies, inductors become quite lossy and good circuit Q's become more difficult to obtain. Substituting gain stages for these unwieldy components allows the designer to set a value of Q optimum to the desired response.

In spite of the many advantages of transistorized active filters over the passive LC types, there are also some disadvantages. Due to the problems of impedance matching input and output of transistor stages, utilizing a minimum number of components requires that the transistors be incorporated in an emitter follower configuration, thus limiting gain to unity. Naturally, if the number of components, or expense, was not important, design would be somewhat simpler and the resulting response somewhat better. Recent advancements in integrated circuit manufacturing processes have managed to bring the average cost and availability of these components within the reach of the amateur and provide a means of improving the performance of the active

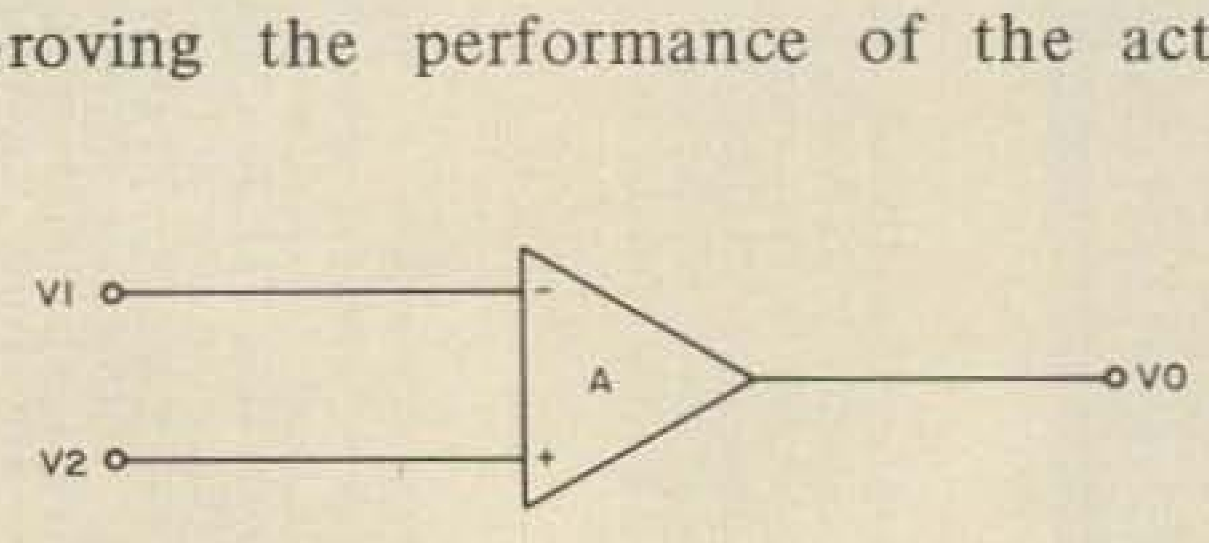


Fig. 1. Operational amplifier.

filter while retaining the low cost of the simple transistor version.

One of the most versatile of the integrated circuit family is the operational amplifier. The ideal operational amplifier is basically a two-input, infinite gain, voltage-controlled voltage source. Figure 1 shows the symbolic representation of the operational amplifier. The output voltage, Vo will always be of the same polarity as the voltage at one of the input terminals and of opposite polarity to that of the other input terminal. Output level is a function of input level and gain of the amplifier:

$$Vo = A(V2 - V1)$$

In considering the use of operational amplifiers as active components in a filter network, there are many advantages to be noted. An increase of reliability is possible due to the closer matching of active and passive components and temperature stability of these components mounted on a single substrate. An additional advantage is evident in reduction of size, weight, power consumption, and cost of a similar passive network.

Unfortunately, the practical operational amplifier is a non-ideal device, the voltage gain of which is highest at dc, decreasing as frequency increases. Naturally, it has a finite input and output impedance and a stability factor which may require negative feedback to preclude oscillation. Stability is normally no problem when utilizing the operational amplifier as an active filter element since the

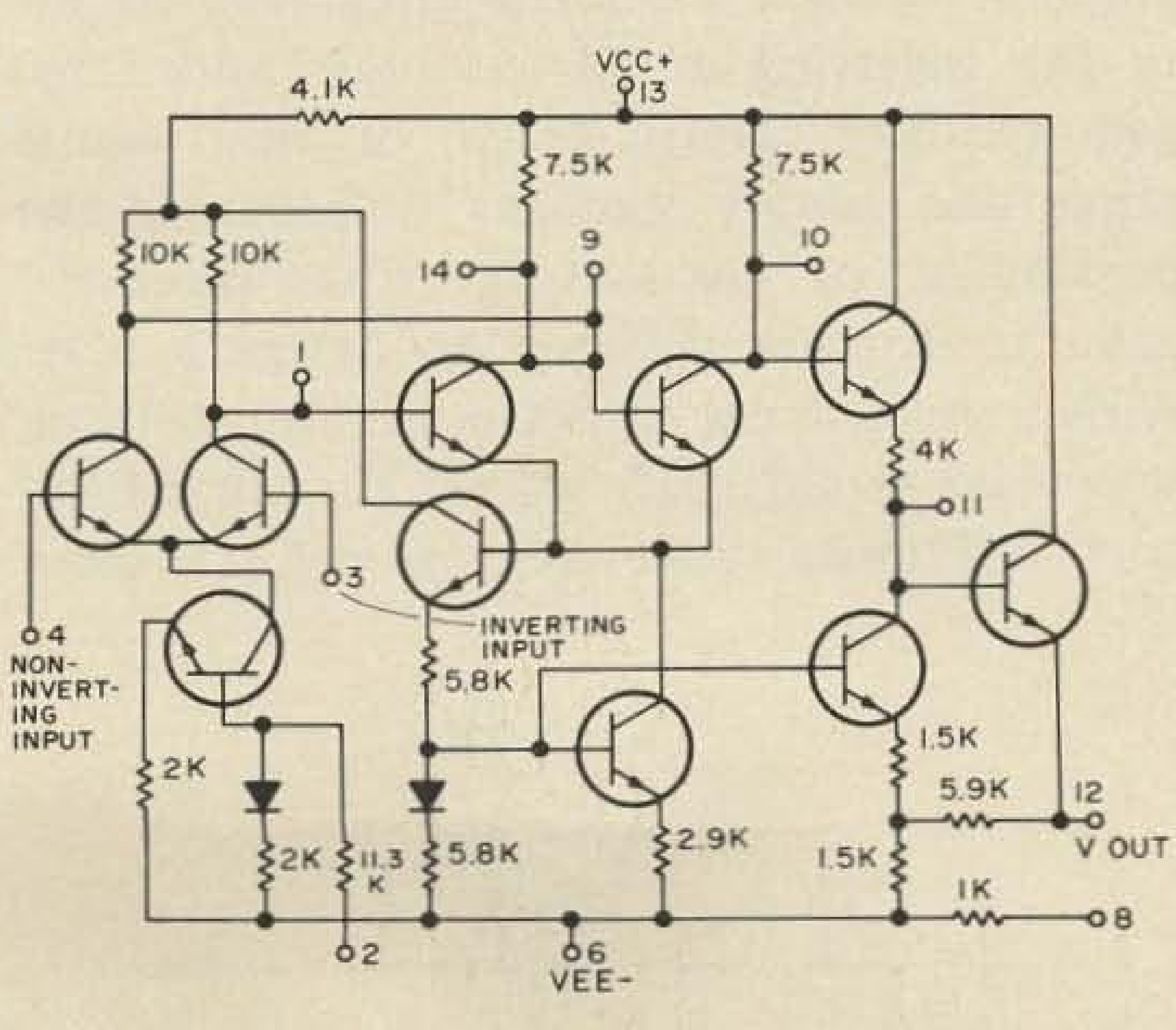


Fig. 2. RCA CA3030 operational amplifier.

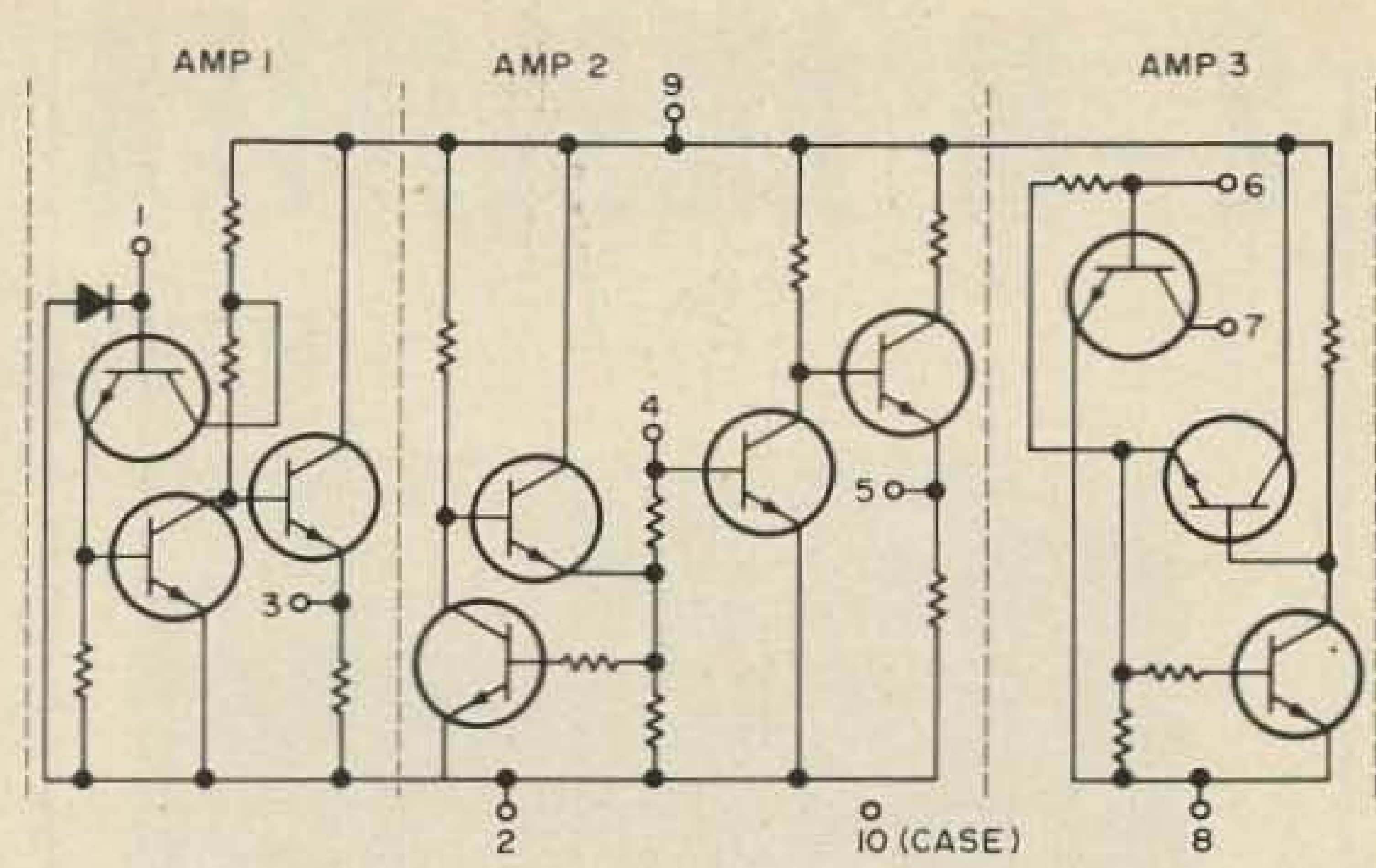


Fig. 3. RCA CA3035 linear amplifier.

outboard frequency compensating components will also serve to make the circuit independent of unstable response, temperature variations, and power supply fluctuations. Referring to Fig. 1, the input labelled V1 is known as the inverting input and any signal inserted here will be 180° out of phase at the output. On the other hand, V2 is a non-inverting input and will not produce a phase shift at the output. The notation "A" indicates open-loop gain of the amplifier without external components. Although either input can be utilized as the signal source, the inverting terminal has the advantage of allowing more gain and attenuation of unwanted frequencies. This is especially true in the low pass filter configuration where the feedback capacitor originates at a low impedance output point.

The input stage of the operational amplifier consists of two transistors connected to form a differential amplifier. The RCA CA3030 operational amplifier in Fig. 2, shows the two input transistors connected back-to-back. This configuration provides a high input impedance and allows the offset (signal level above dc base) to be adjusted via the "no-signal" input terminal. The input

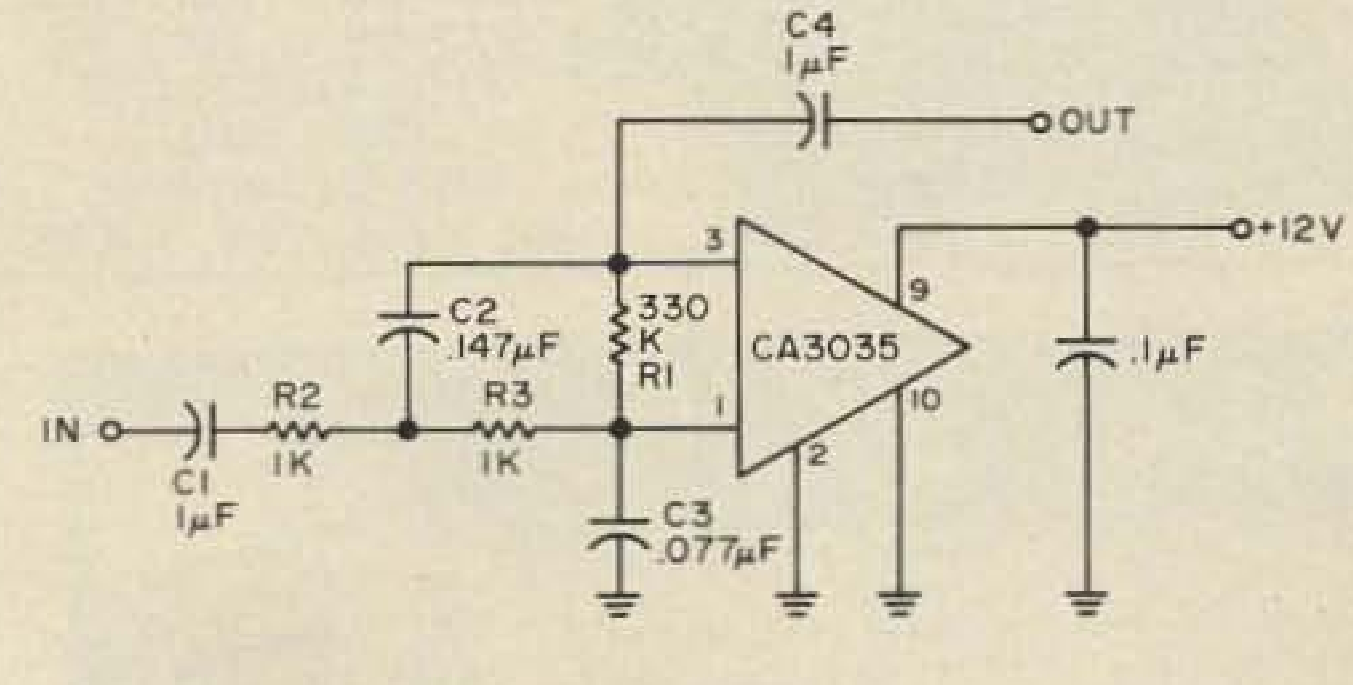


Fig. 4. 2-pole low pass with linear IC.

differential amplifier is followed by voltage gain stages which raise the signal to a high level. Various terminals are brought out of these voltage gain stages to allow frequency compensation. The final stage of the amplifier is a low impedance output in the form of a push-pull emitter follower which provides freedom from loading which might affect the desired frequency response. Since the operational amplifier is a bipolar device, it will amplify both positive and negative voltage swings. Although some integrated circuits may be used with single polarity power supplies, by additional circuit modifications, it is wise to use positive and negative supplies with a common ground, as recommended by the manufacturer.

In utilizing integrated circuits for active filter design, there are a number of new problems which are not so apparent in transistorized filters. First of all, with integrated circuits we have a number of transistor stages, with their associated components in very close proximity to each other on the same physical base. Consequently, freedom from internal feedback becomes an important factor. Similarly, external frequency determining components must have short leads and, in some cases, be physically oriented to prohibit stray pick-up. Secondly, circuit stability is dependent on gain and loading among other parameters. As an example, failure to match the low output impedance of the integrated circuit will tend to change the frequency response of the filter, increase current drain, and decrease applied voltage. Using the integrated circuit in the inverting mode to obtain additional gain requires careful design of input signal range and supply voltages to preclude the possibility of oscillation. With increased gain, it is more difficult to design a filter with a sharp 3 dB cutoff point. In addition, where we could easily expect a passband flat to ±1 dB limits when working with transistor

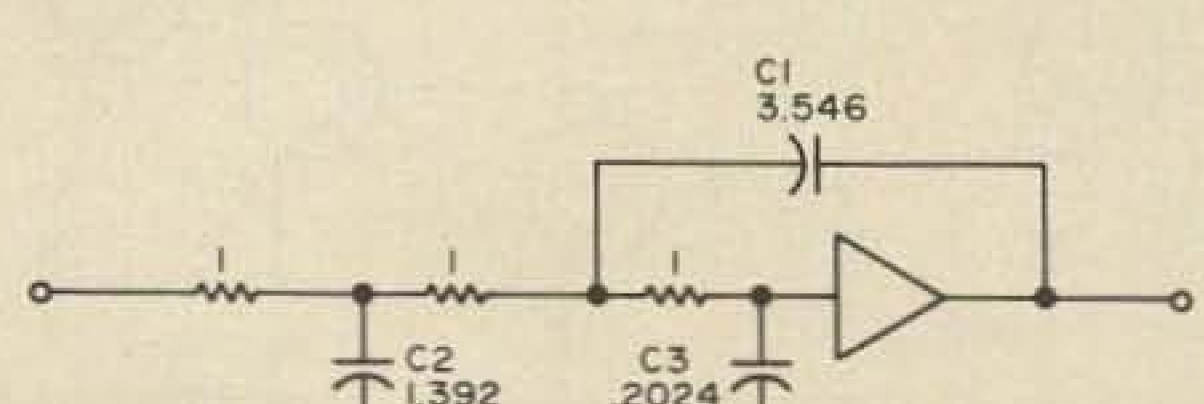


Fig. 5. Normalized low pass.

filters, we now must employ extra sections to create a flat response.

In order to estimate the passive component values for active filters, we use a network normalized for a frequency cutoff of 1 radian per second. The network shown in Fig. 4, gives the normalized component values for a three-pole filter to produce a Butterworth response. Recomputing the capacitor values, by frequency scaling for a 3 dB cutoff at 1500 Hz gives:

$$C_1 = \frac{3.546}{2\pi(1500)} = 370\ \mu F$$

$$C_2 = \frac{1.392}{2\pi(1500)} = 147\ \mu F$$

$$C_3 = \frac{.2024}{2\pi(1500)} = 21\ \mu F$$

More practical values for the capacitors are obtained by impedance scaling. In this operation, the normalized resistance values are multiplied by the desired filter impedance value while the capacitors are divided by the same figure. Utilizing a new figure of 1 KΩ provides the values shown in the network of Fig. 5. The non-inverting input of the integrated circuit should be terminated with a value of resistance equal to the impedance seen by the inverting input transistors of the operational amplifier, the value of this resistance may be much lower than the input impedance, and can best be found by substitution after the designed value frequency selective components are in place. To increase stability of the network, the inverting input is biased with a resistance determined by the level of the input signal and the gain of the operational amplifier. The RCA CA3030 operational amplifier is

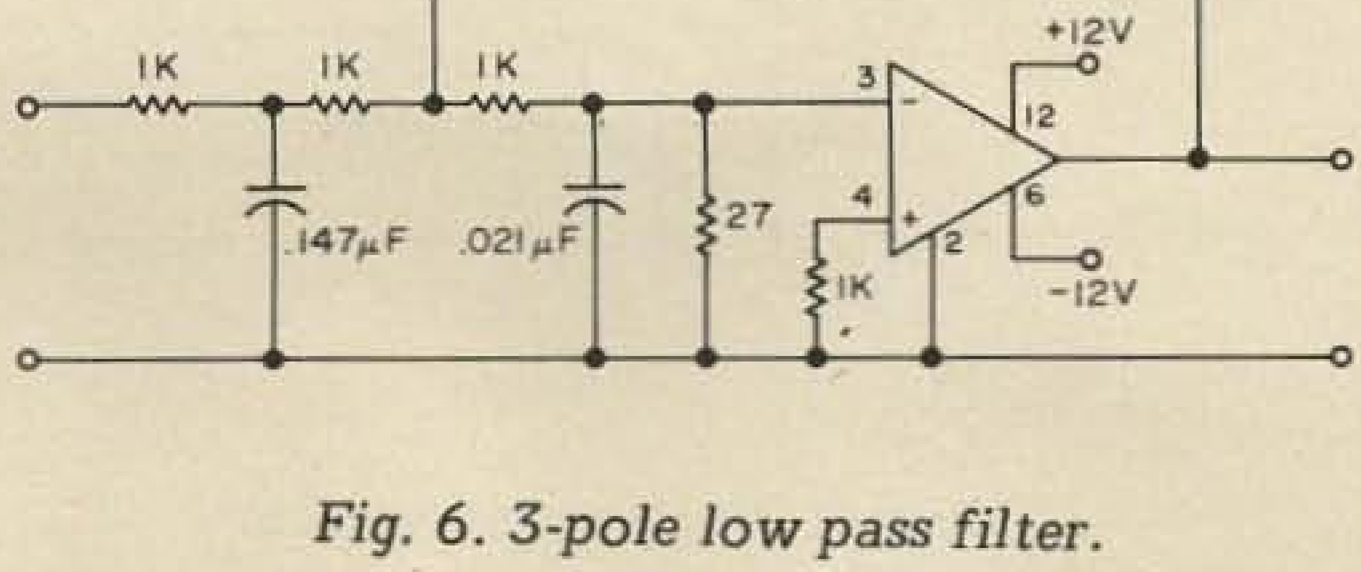


Fig. 6. 3-pole low pass filter.

used in this low pass network as an example of a low-cost integrated circuit for active filter work. The response of this network is shown in Fig. 7a. The tolerance of the components used in this circuit was 10%. Closer tolerance components, or trial and error replacement, will bring the cutoff frequency down to the desired 1500 Hz point. The circuit exhibits gain of 7 dB indicating that higher values of network resistors might be used if it is desired to obtain more common electrolytic capacitor values. The attenuation curve is not as steep as it might be. This is mainly a problem of Q and lack of component isolation in the integrated circuit.

Normally, we would expect a noticeable increase in attenuation slope when adding filter sections. Figure 8 shows the normalized values for a two-pole filter with Butterworth response. Utilizing the same cutoff frequency, computations for the component values appear as follows:

$$C_1 = \frac{1.414}{2\pi(1500)} = 150\ \mu F$$

$$C_2 = \frac{.707}{2\pi(1500)} = 75\ \mu F$$

With 1 KΩ resistors:

$$C_1 = \frac{150}{1000} = 150\ \mu F$$

$$C_2 = \frac{75}{1000} = .075\ \mu F$$

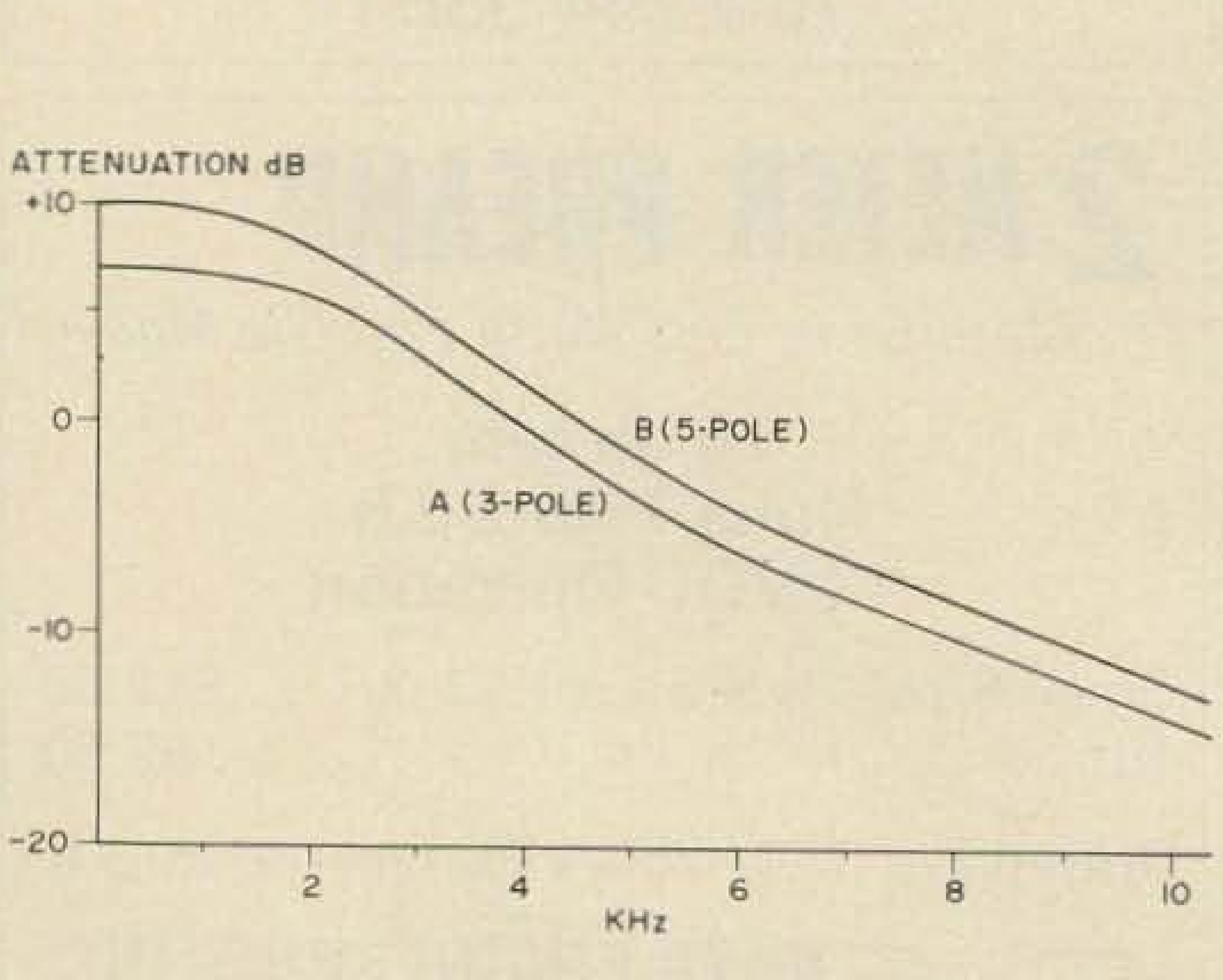


Fig. 7. CA3030 low pass response.

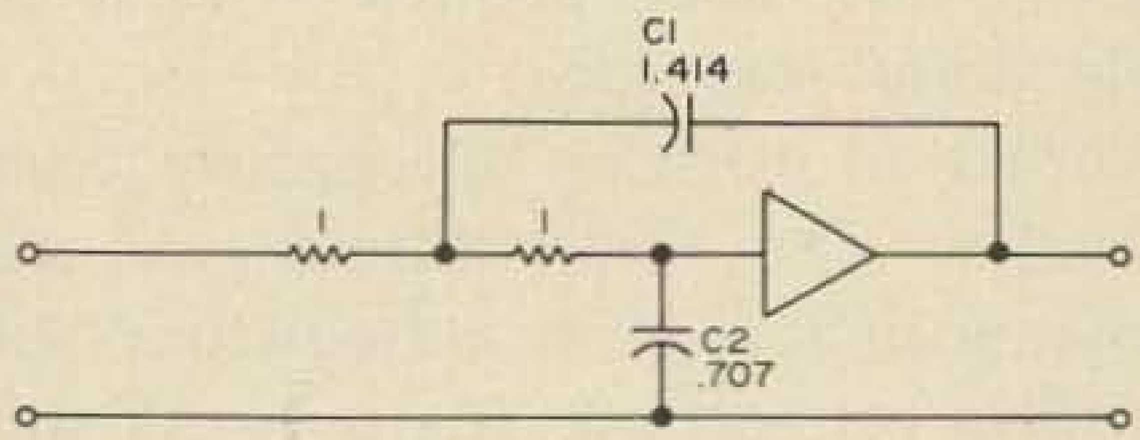


Fig. 8. Normalized 2-pole low pass.

The new two-pole configuration is shown in Fig. 9. With this section added to the previous three-pole network, the five-pole filter provides us with 10 dB gain, but, as can be seen in Fig. 7b, no additional attenuation. Thus it is not possible to vary the response curve by adding additional poles without recomputing the pole values for the entire filter. In other words, to change a three-pole network to a five-pole configuration, calculations from normalized values for a five-pole design must be made rather than adding a two-pole section. An exception to this rule exists when an RC network is added to the output to flatten the response; however, these components are not normally considered an active pole of the filter.

Although the versatility of operational amplifiers is hard to match, integrated circuit linear amplifiers are easier to adapt to filter design. The RCA CA3035 integrated circuit linear amplifier, shown in Fig. 3, is an economical, high-gain, wide-band amplifier which can be operated from a single power supply. Three separate amplifiers are housed in this TO-5 case, and they may be operated individually or cascaded for a voltage gain approaching 129 dB. Power supply voltages may vary as much as 5 to 18 volts, and each amplifier is internally temperature compensated in the range -55° to +125°

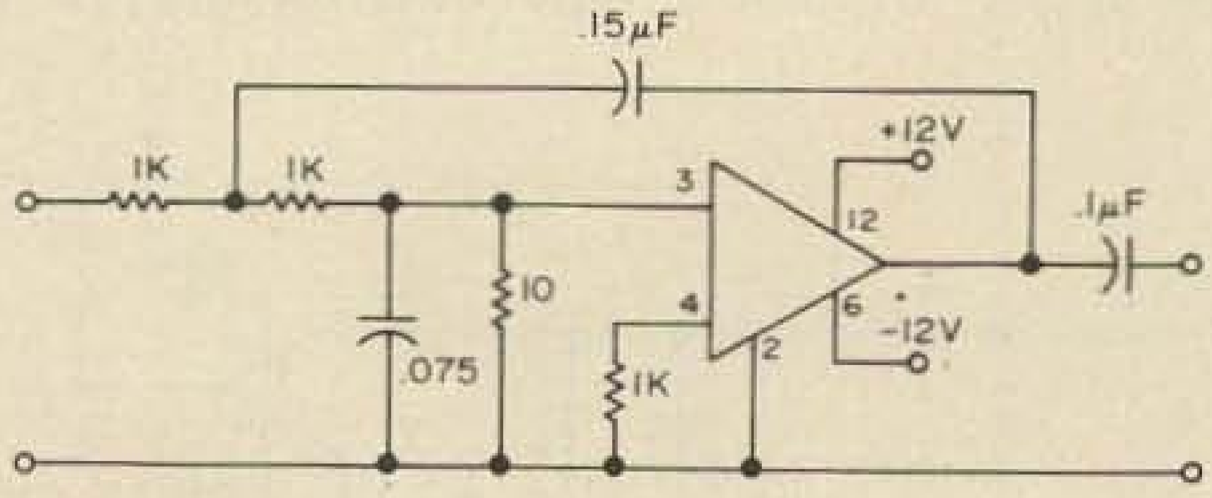


Fig. 9. 2-pole low pass filter.

Amplifier number one offers high input impedance (50 KΩ), low output impedance (270Ω), low noise, and a response flat within 3 dB from dc to 500 kHz. A diode protects the amplifier from possible damage by overloading signals.

Amplifier number two has an input impedance of 2000Ω and an output resistance dependent upon the output load resistor. This amplifier may be externally powered by a separate power supply through pin 7.

Design of a low pass filter with the RCA CA3035 IC linear amplifier is shown in Fig. 4. Resistor R1 provides a bias for amplifier number one. The second and third amplifiers are not used in this circuit. Capacitor C1 couples the signal to the active network while C4 provides output coupling. R2, C2, and R3, C3 make up the two poles of the low pass filter. The frequency response curve for this active filter is shown in Fig. 11a. Frequencies below the 3 dB rolloff are flat within ±1 dB, the attenuation curve is smooth and easily varied by changing the values of the components making up the two poles.

In many cases, a sharper rate of attenuation is desirable than that shown in curve A of Fig. 11. With a few additional components and making use of amplifier number two of the CA 3035 integrated circuit linear amplifier, the slope is easily steepened. Referring to Fig. 10, we now have a three-pole low pass active filter which lends itself well to experimental design on the workbench. The output coupling capacitor, C4 of Fig. 4, has been replaced by a 0.22 μF capacitor which, besides coupling the output

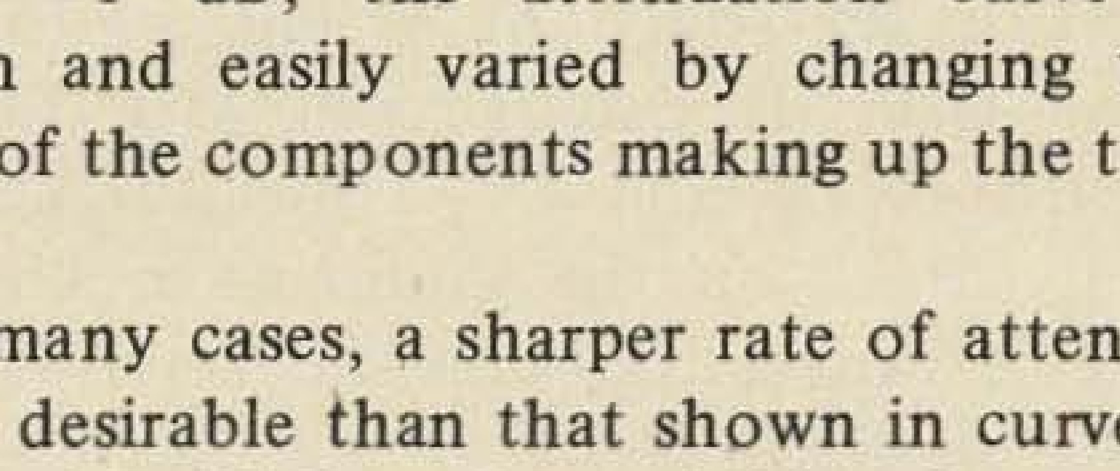


Fig. 10. 3-pole low pass with linear IC.

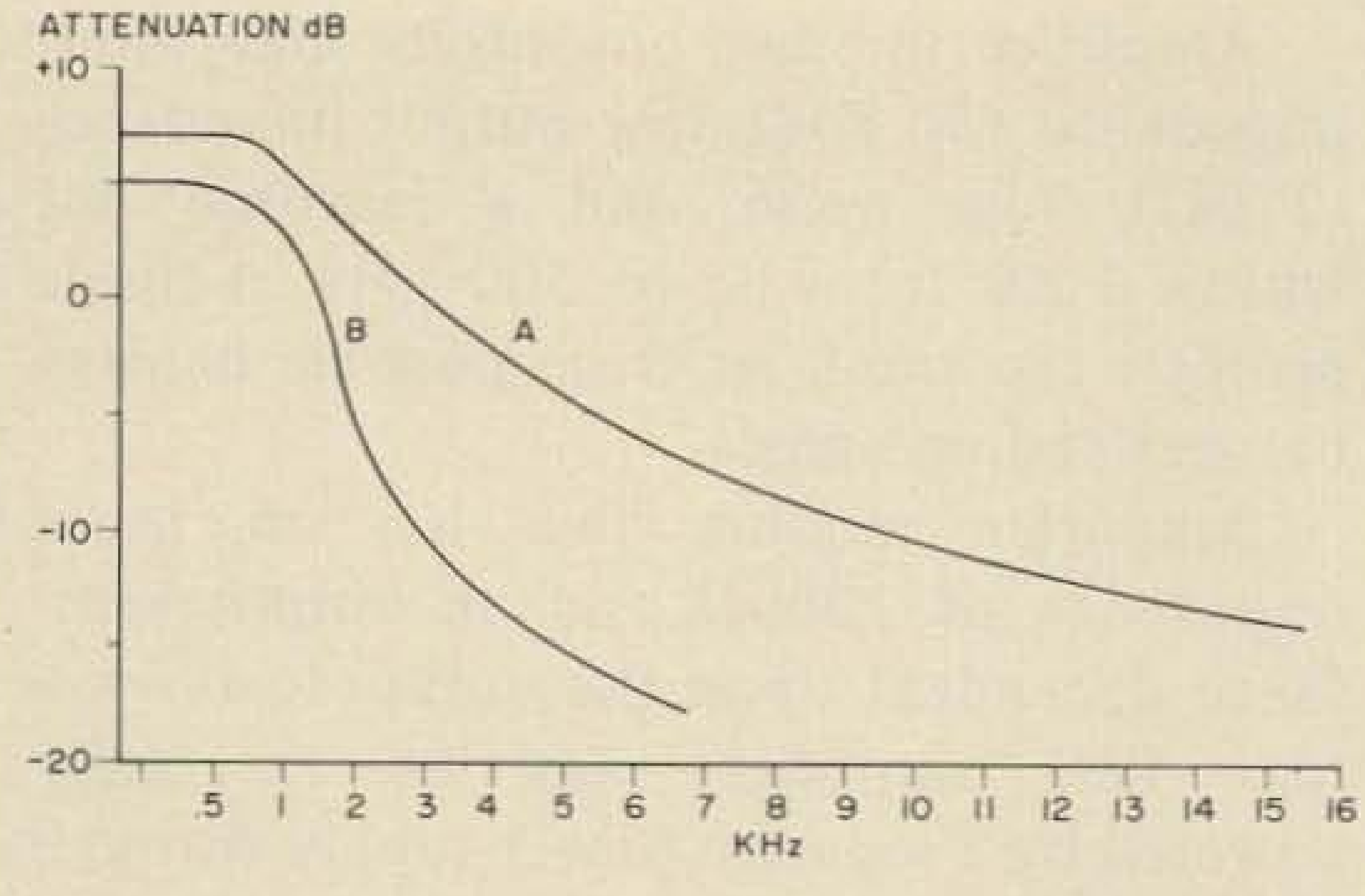


Fig. 11. Low pass response RCA CA3035.

of amplifier number one to the input of the second amplifier, also acts in conjunction with C5 and R4 as an impedance matching component. This procedure is necessary to preclude distortion and loss otherwise encountered when the output impedance is much less than the following input impedance. These components must be selected to assure faithful coupling of the signal over the entire frequency range of interest. Resistor R5 functions as part of the third filter pole in conjunction with feedback capacitors C6 and C7. Capacitor C7 has a great affect on the attenuation slope and may be varied to obtain the exact degree of slope desired. Resistor R6 also helps to match the output/input impedance of the two amplifiers and compensates for the impedance change caused by the feedback network. Curve B in Fig. 11 shows the effective increase in slope attenuation by addition of the third pole and amplifier number two. Note that the three-pole filter still exhibits a nominal gain of 5 dB. The circuit was not designed with obtaining a signal gain in mind, although the CA3035 is capable of a much greater increase in signal level. We would normally be satisfied with a

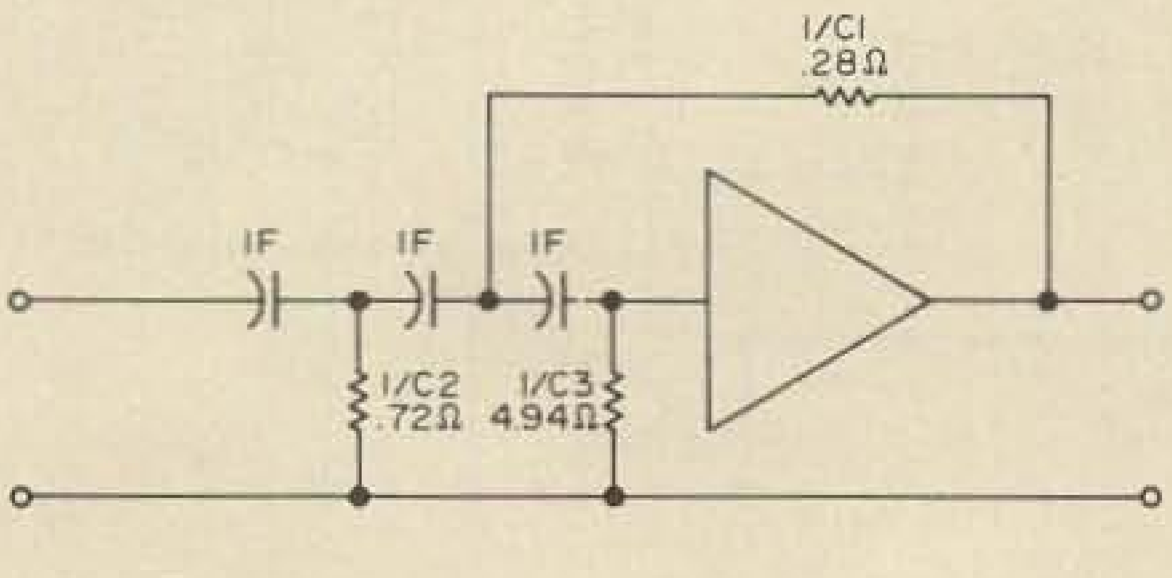


Fig. 12. Normalized high pass filter.

signal gain of unity for a filter in order to preclude possible problems with extraneous coupling and amplifier oscillation.

Figure 12 shows normalized values for a three-pole high pass filter. The values are obtained by finding the reciprocals of the normalized low pass configuration shown in Fig. 5. To achieve frequency scaling, all capacitor values are divided by 2πFC. For a cutoff frequency of 500 Hz:

$$C_{1,2,3} = \frac{1}{2(3.14)500} = 310\,\mu F$$

Impedance scaling is then obtained by multiplying each resistor value and dividing each capacitor value by a constant chosen for convenience in component selection. Using 1000 as an impedance constant, the circuit values of Fig. 13 are obtained.

From the response curve of Fig. 14a it can be seen that the active high pass filter configuration of Fig. 13 exhibits 7 dB of loss. Most of this loss could be regained by utilizing a larger value constant when carrying out the impedance scaling procedure. Utilizing the closest common value when constructing the ideal circuit of Fig. 13 accounts for the -3 dB cutoff point being about 500 Hz off of the design specification. Overall response and attenuation slope of the high pass filter is good.

The RCA CA3035 integrated circuit linear amplifier does not lend itself as well to high pass filter design as it does to low pass design. This is due, first of all, to the biasing requirements. Base bias is obtained from the B+ line at pin 3, which is the output terminal for amplifier number one. Utilizing the bias resistor in the normal fashion tends to upset the feedback network, thus altering

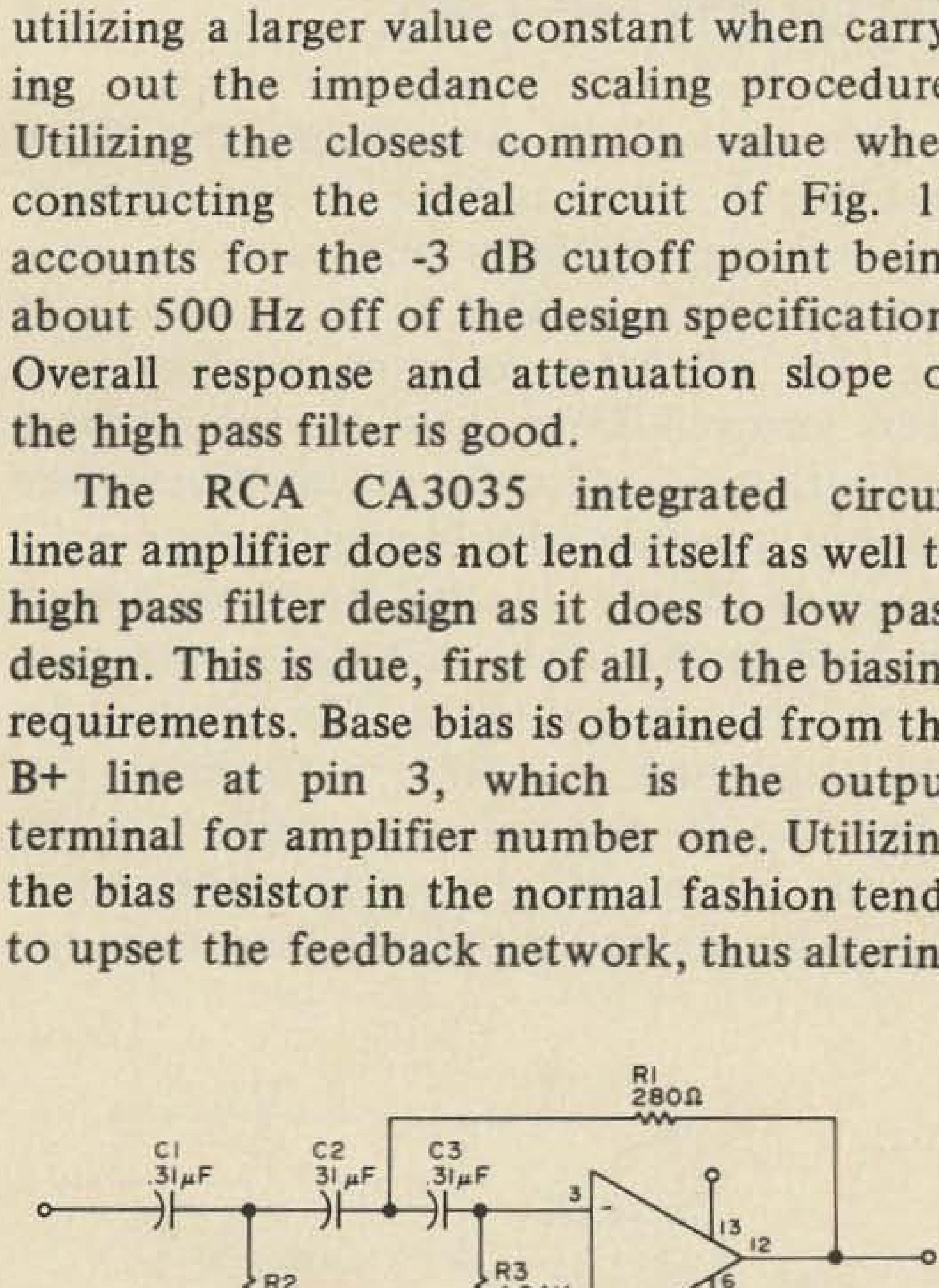


Fig. 13. RCA CA3030 high pass filter.

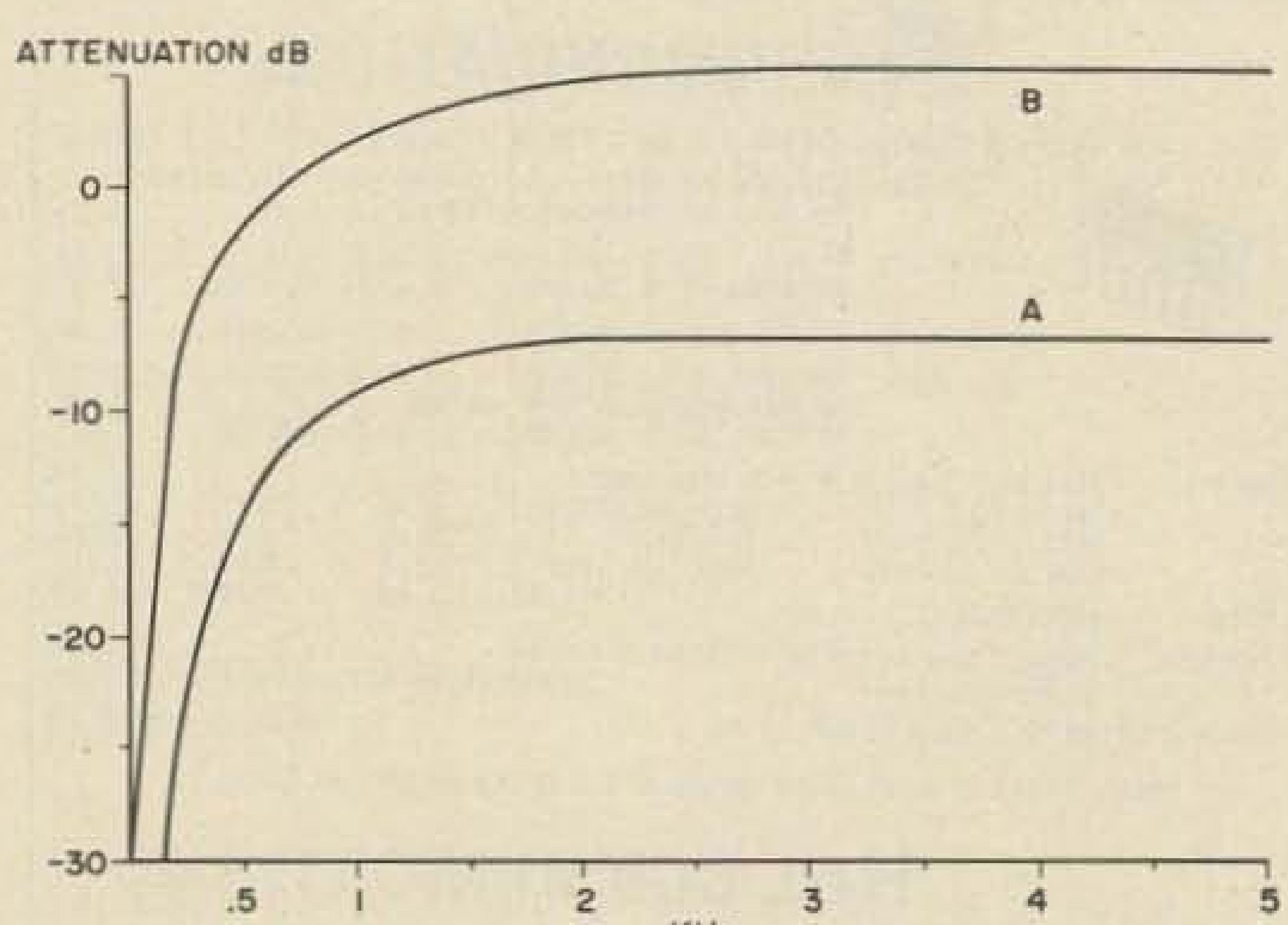


Fig. 14. High pass filter response.

the response. Placing the 5.1 KΩ resistor of the filter network from terminal number one to ground, and not adding the normal 330 KΩ bias resistor, will not permit satisfactory operation due to the diode across the input of the integrated circuit which sets the base at a certain level above ground at all times. Therefore, bias must come from the B+ line and be of a value to preclude clipping of the incoming signal by the diode incorporated into the first stage of amplifier number one.

One method of surmounting the above problems is shown in Fig. 15. For comparison, the same number and value of components has been used as in the circuit of Fig. 13. All filter network resistors have been removed from their normal shunting positions to form parallel circuits where they will not interfere with biasing. Capacitor C1 has been moved to the feedback branch where it functions as a dc blocking capacitor as well as a filter element. The response for this active high pass filter is shown in Fig. 14b. Due to the different design of this circuit, some of the component values should be changed in order to flatten the top

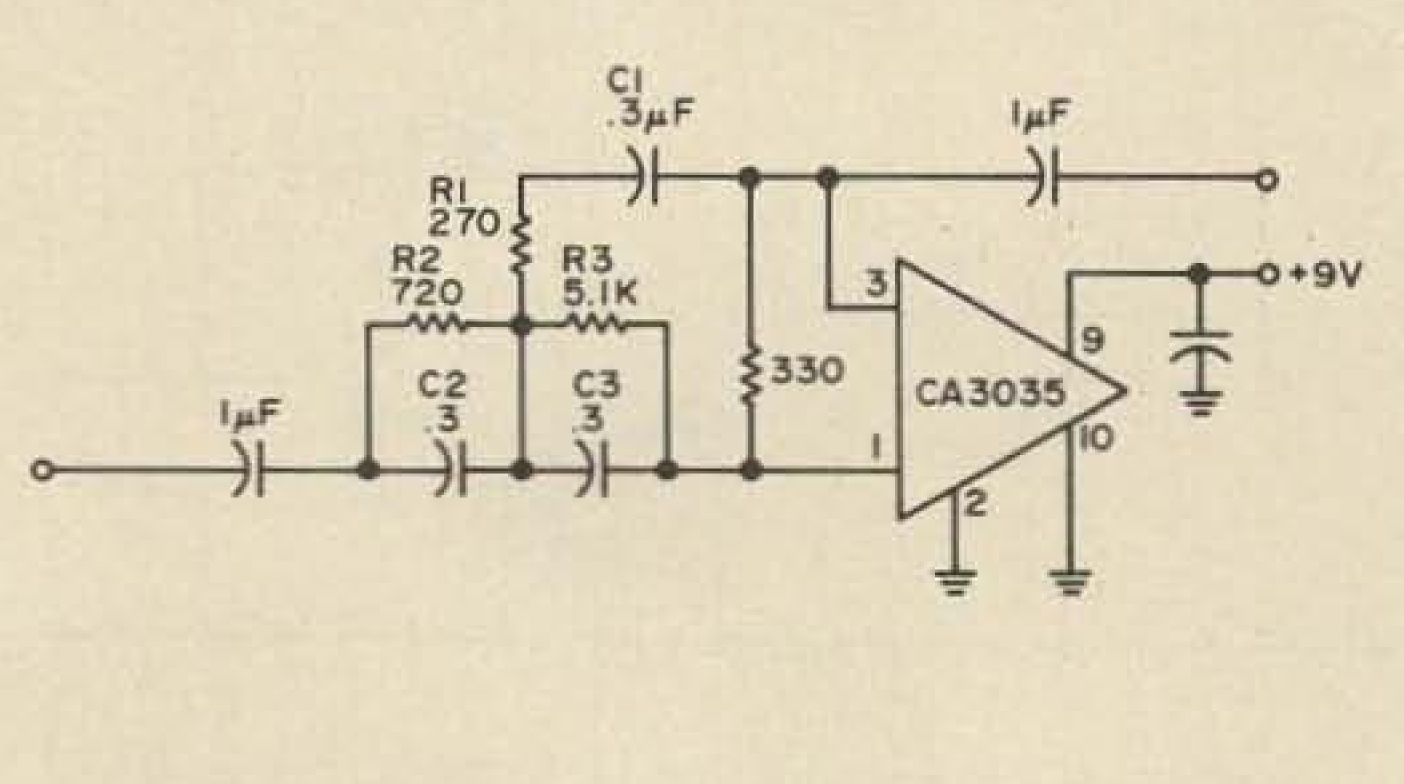


Fig. 15. 3-pole high pass filter with linear IC.

of the curve and place the -3 dB cutoff point where desired. Increasing the value of C2 and decreasing the value of C1 will make the curve more symmetrical without affecting the 5 dB gain.

Figure 16 shows a simple bandpass configuration which is capable of providing good response symmetry when utilized in a circuit with enough gain to allow small signal application. Similar to design of twin-T circuits, the component values for the bandpass may be of almost any value as long as the RC ratio is maintained. However, better results are obtained if the value of R_A is no lower than 1 KΩ. Design values may be obtained by the following formulas where BW is bandwidth at -3 dB, G is nominal voltage gain, and F is the center frequency. By way of an example, we will work out a possible design for a bandwidth of 500 Hz, center frequency of 1200 Hz, with a gain of 10 dB. As a matter of convenience, we will use 0.1 μF capacitors. Where:

$$R_A = \frac{1}{2\pi BW\, G\, C}$$

$$= \frac{1}{2(3.14)(500)(10)(.1x10^{-6})}$$

$$= 31.8\Omega$$

$$R_B = \frac{1}{\pi BW\, C}$$

$$= \frac{1}{3.14(500)(.1x10^{-6})}$$

$$= 6.3\Omega$$

$$R_C = \sqrt{\frac{1}{2\pi C \frac{2F}{BW} - BW\, G}}$$

$$= \sqrt{\frac{1}{2(3.14((.1x10^{-6})\ \frac{(2(1200)2)}{500} - 500(10)}}$$

$$= 45.2\Omega$$

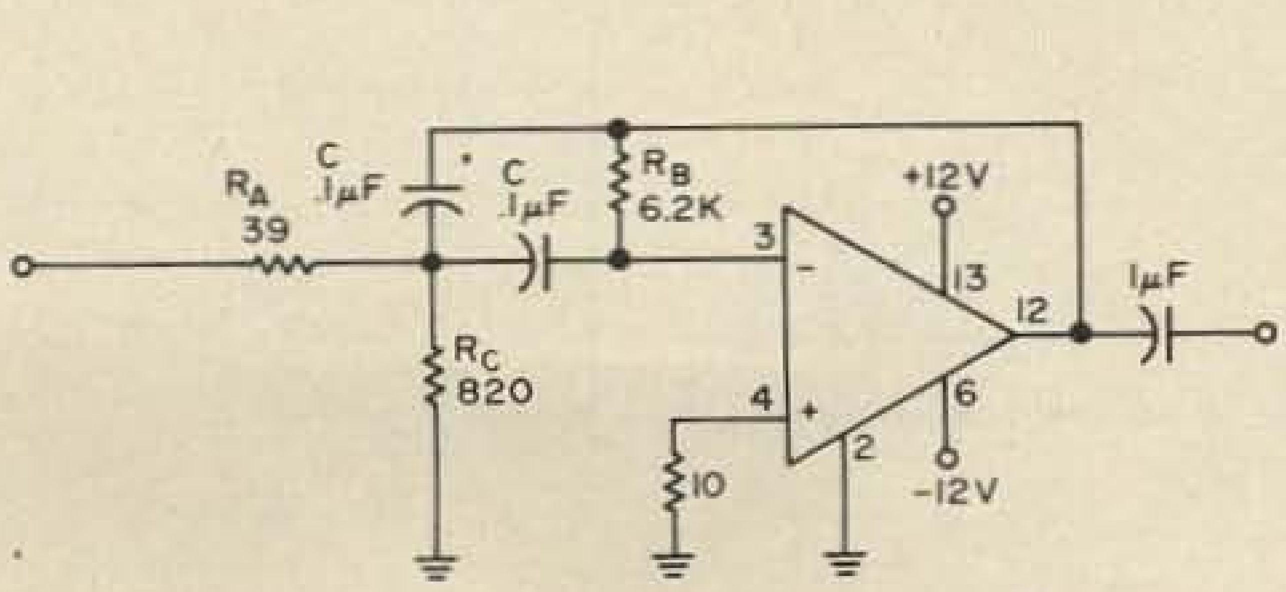


Fig. 16. Active bandpass filter.

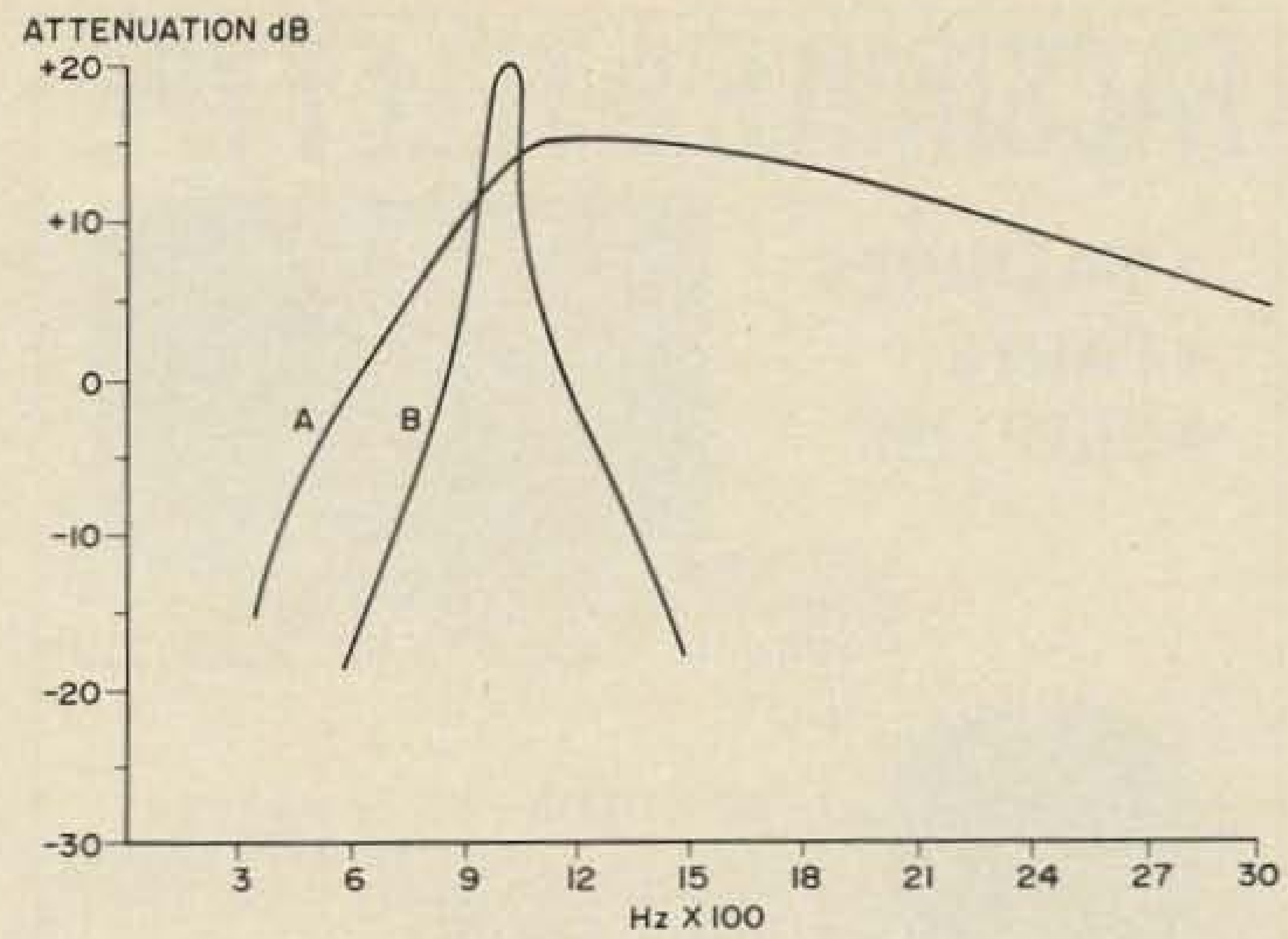


Fig. 17. Bandpass response.

The component values of Fig. 16, derived from these formulas, produce an unsymmetrical waveform as shown in Fig. 17a. Resistor R_c sets the center frequency within ±600 Hz. The change in the value finally needed over the design value indicates an asymmetrical response, as indeed we have. Changing the value of C to .01 μF will increase the value of R_A to 3.3 KΩ and R_B to 62 KΩ. A more symmetrical response will be obtained with these values.

Linear integrated circuit amplifiers are well suited to bandpass use. In Fig. 18, the RCA CA3035 linear amplifier is used in a narrow bandpass version of the twin-T configuration. Component values are determined by allowing R2 = R3 = 2 x R4. Since R2 and R3 are also used as bias resistors, their value should not be less than 150 KΩ. In addition, gain for this circuit is so high that a lower value of R2, R3 will cause a distorted response at the center frequency. The capacitors should be maintained in a ratio

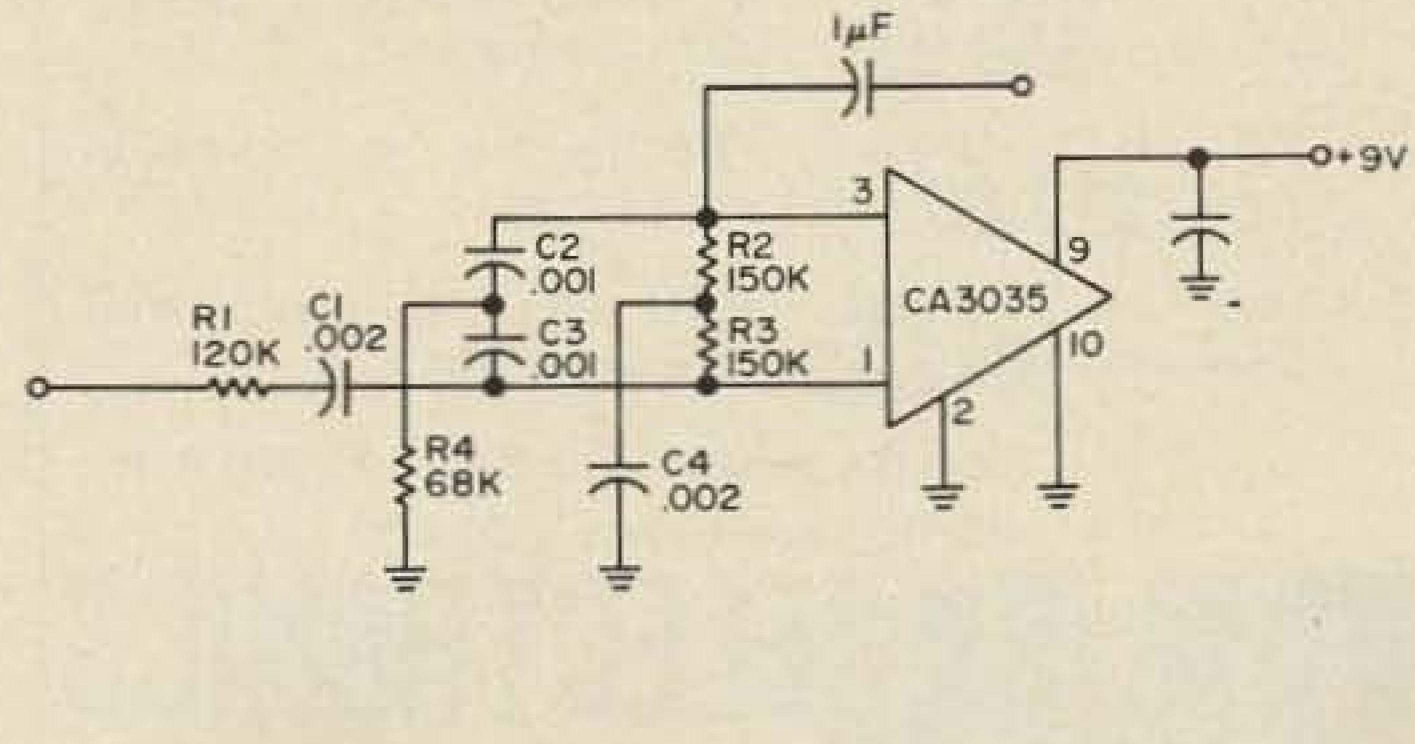


Fig. 18. Narrow bandpass with linear IC.

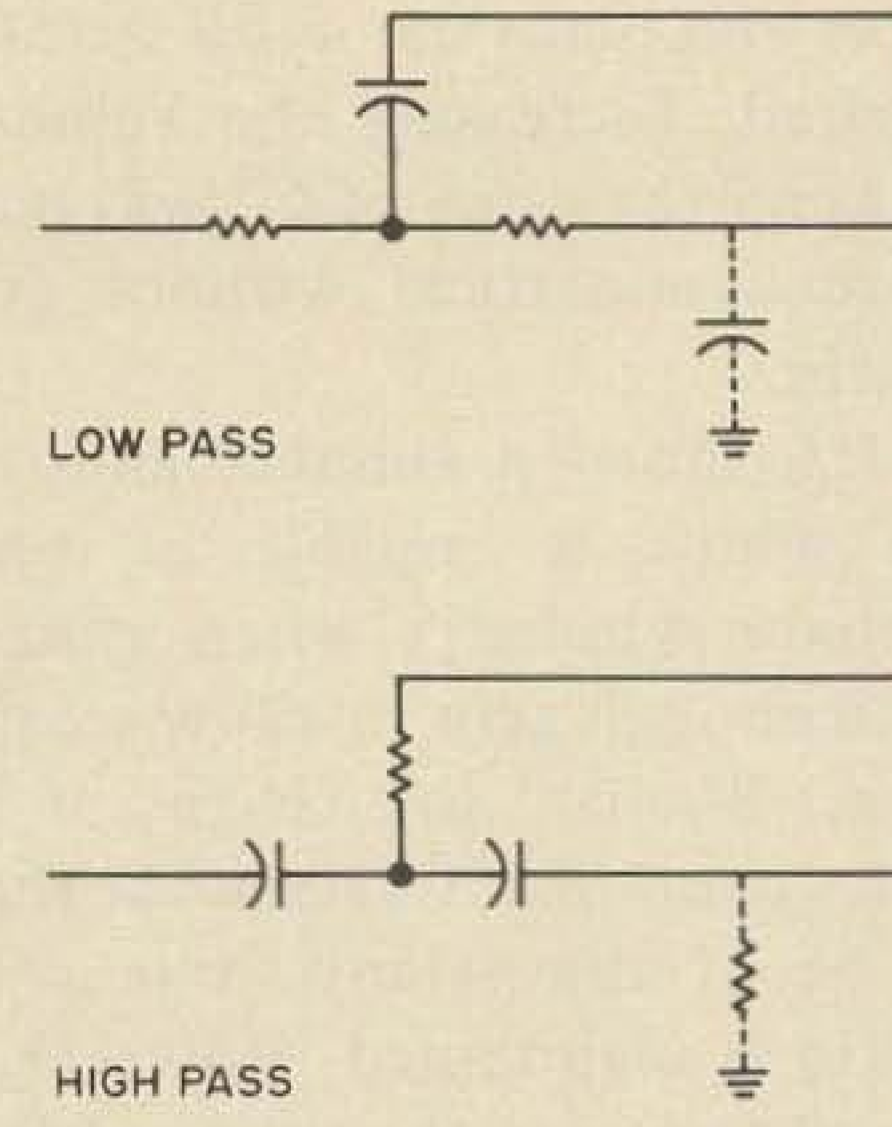


Fig. 19. Basic forms for combining.

where C2 = C3 = C4/2. Center frequency of the narrow bandpass may be found by utilizing the formula:

$$F_{RC} = \frac{1}{2\pi R_2 C_2}$$

This active filter circuit offers a high Q, which can be lowered for greater bandwidth, by decreasing the value of R1. An increase in gain is also obtained when R1's value is lowered. The symmetrical response of the filter, tuned to 1 kHz, is shown in Fig. 17b. An even greater increase in Q may be obtained by increasing the value of R1. This is done at the expense of lower gain.

Depicted in Fig. 19 are the basic RC two-pole high and low pass filter configurations. Using these basic forms in a series configuration will produce a bandpass design while a parallel configuration gives a bandstop response. Increased Q may be obtained by designing individual filters with an increased number of poles, or adapting the design to the specific requirement.

If we parallel the simple configurations of Fig. 19, disregarding components shown by

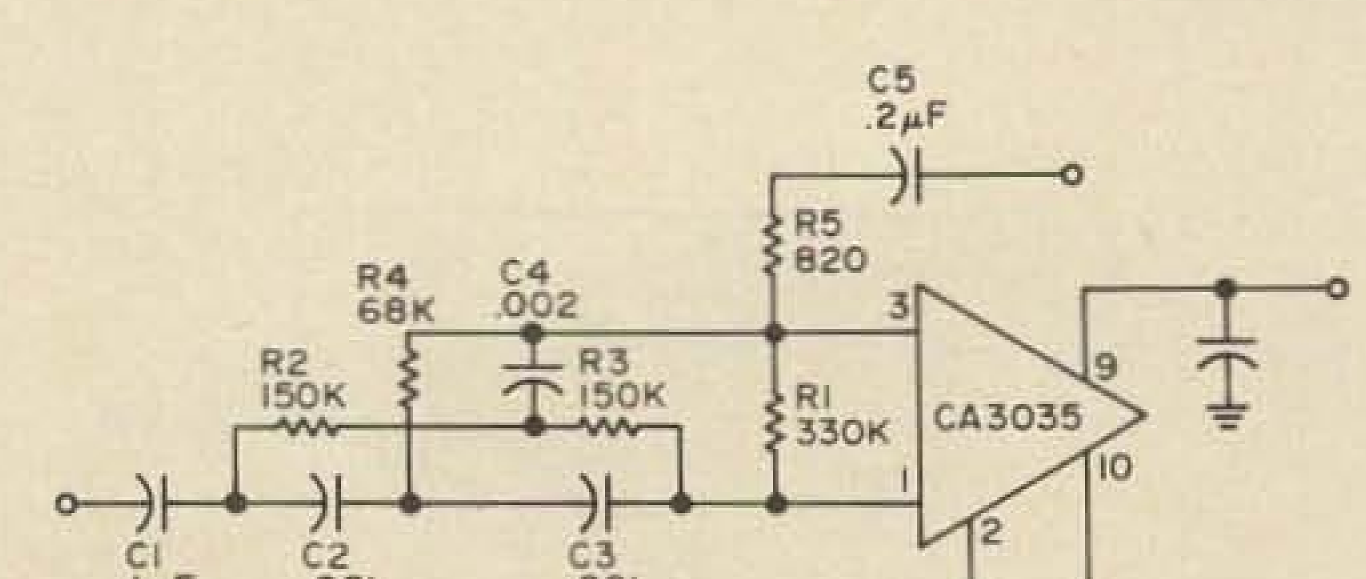


Fig. 20. Narrow bandstop with linear IC.

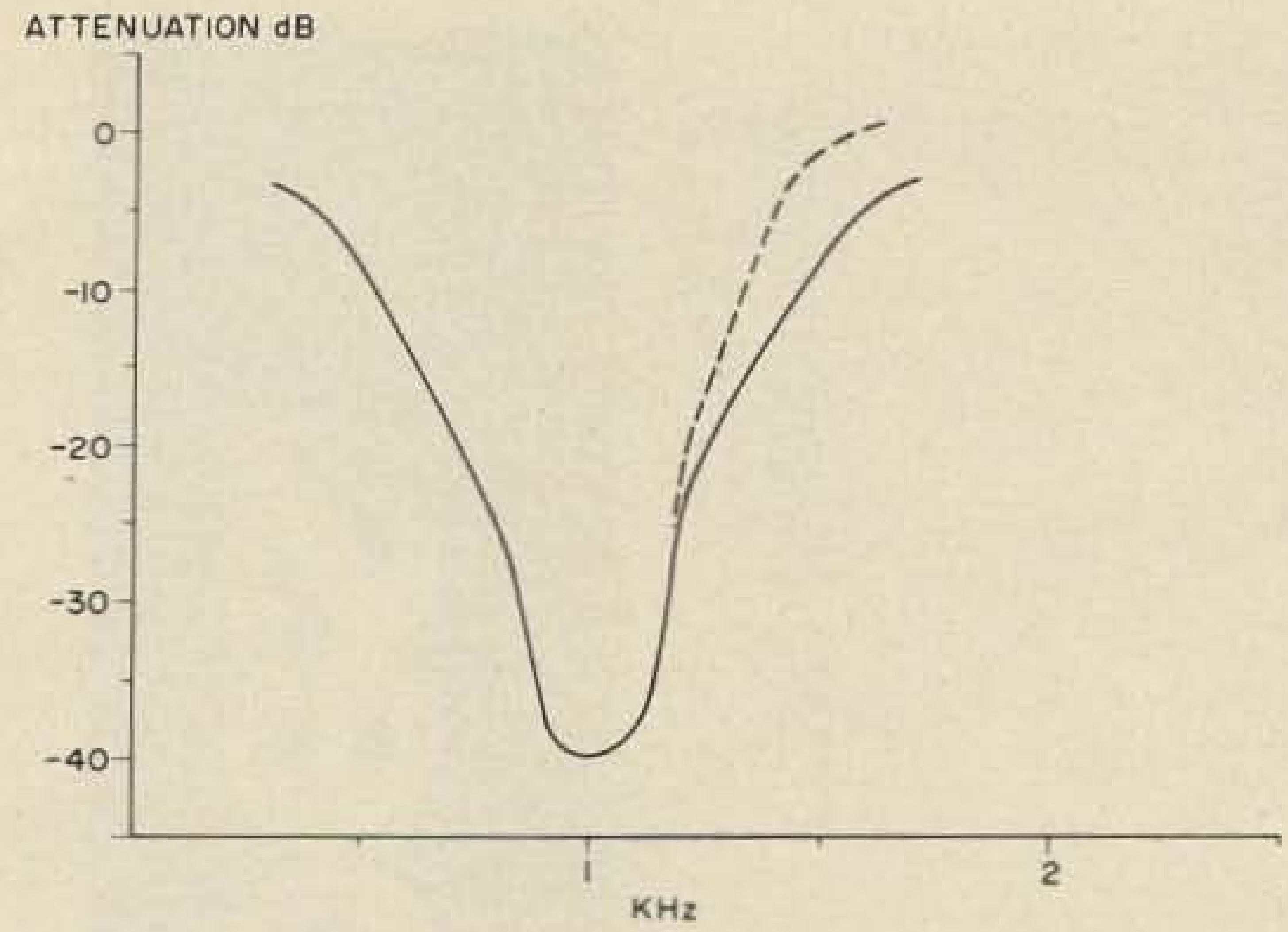


Fig. 21. Bandstop response.

dashed lines, the design takes on the appearance of a twin-T. Thus, the bandpass circuit of Fig. 18 now becomes a bandstop filter. The completed design for the narrow bandstop filter is shown in Fig. 20. Output components R5 and C5 tend to make the response of the filter more symmetrical. The response of the active bandstop filter is shown in Fig. 21. The dashed line indicates the response when a 1 μF capacitor replaces R5 and C5. Using lower values of R2 and R3 in twin-T design will tend to lower the overall Q of the filter.

From the days of the trial and error procedure of winding inductors we have now progressed to the point where a complete filter can be designed and constructed in a space no larger than the size of a quarter, and, in most cases, with better results.

. . .K3PUR

References

Active Filters: Part 12 Shortcuts to network design, Robert R. Shepard, *Electronics*, August 18, 1969.

Active Bandpass Filter, Leslie Robinson, *EEE*, February 1968.

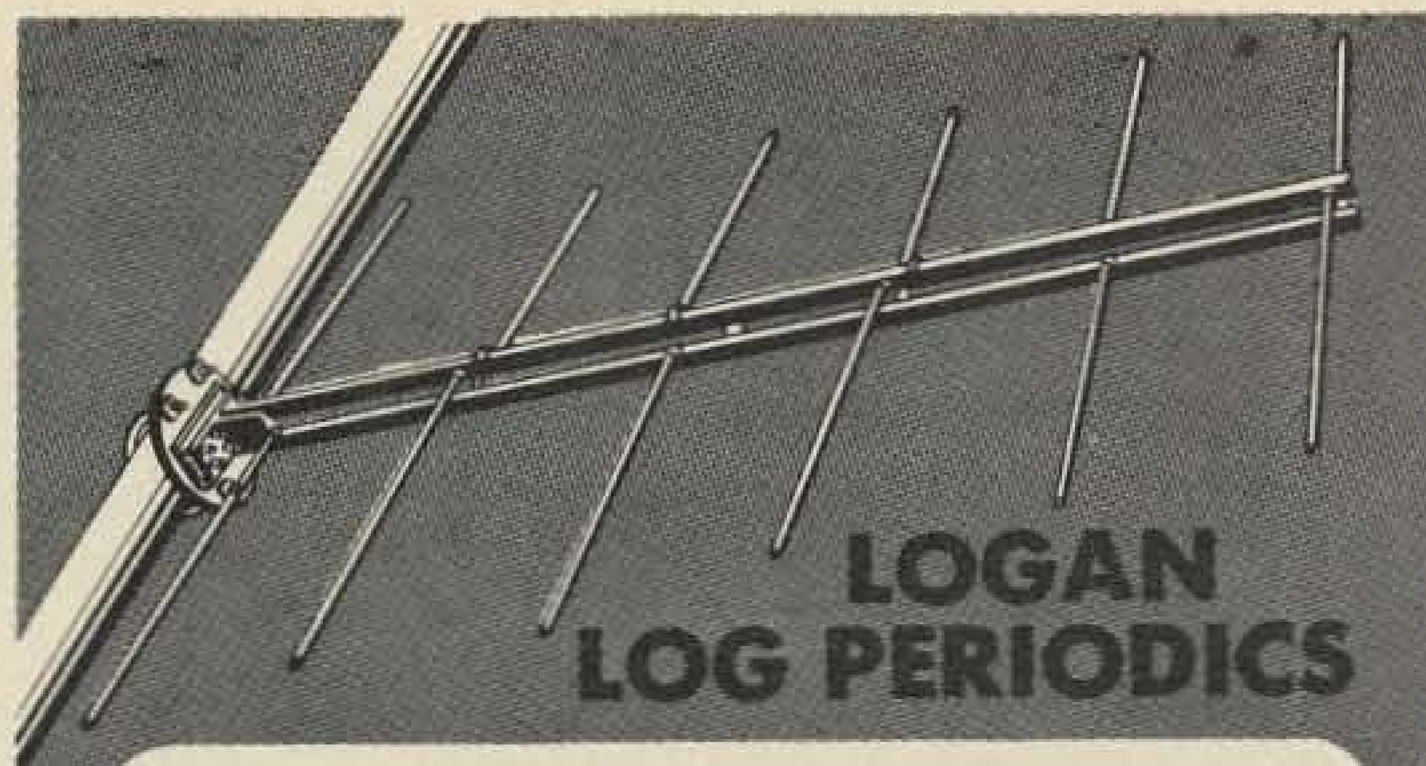
RCA CA 3035 Integrated Circuits, R&R Electronics, 311 E. South St., Indianapolis, IN.

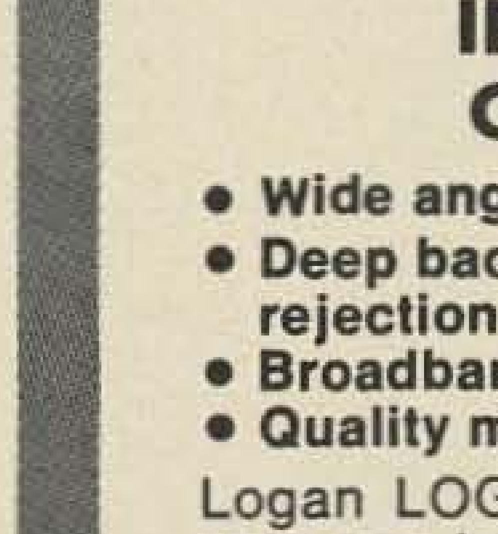
The Operational Amplifier, Donald E. Lancaster, *Electronics World*, August 1967.

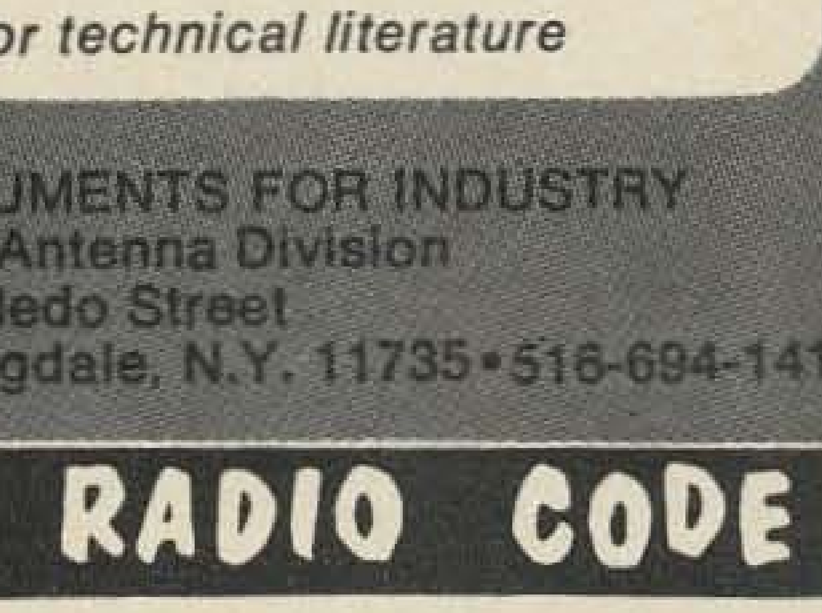
Third Order Filters Using One Operational Amplifier, James L. Harrison, *EDN*, January 1966.

RCA Linear Integrated Circuits: File No. 316, RCA Electronic Components, Harrison, NJ.

RCA Linear Integrated Circuits: File No. 310, RCA Electronic Components, Harrison, NJ.







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A MODERN VHF FREQUENCY COUNTER

In the last part of our VHF frequency counter series, this month we will cover the actual construction of the unit. Most of the fine details are pretty well covered by the layout drawings, and so we will keep the text itself short. When looking at the drawings, make sure to read the fine print in the notes which may explain quite a few questions.

(If you want to reduce the overall size of the counter, you can cut the board in two with a fine toothed saw, about 4 inches back from the front edge, between the two heavy copper lines running the length of the board. If you stack the rear part of the board upside down above the front part, you can connect the two without too much trouble with short wire jumpers. But make sure to use heavy wire or braid to connect the grounds of the two boards together at the ends of the two boards.)

Construction of the counter is quite straightforward, since almost all components are mounted on the main p.c. board shown in Fig. 19. This board is 7" x 10" in size, with the readouts and the two input circuits along the front (long edge) of the card so they are convenient to the front panel of your cabinet. In order to explain where all the parts go and which part of the main board has which circuit, we've broken up the main board layout into smaller sections, Figs. 20 through 26. Each of these takes one or two of the circuits shown in Figs. 3 through 10 and shows the actual layout of the parts on the board. In each drawing, a small sketch in the corner shows where to find that circuit on the main board, shown in Fig. 19.

Looking at Fig. 19, the front of the board is shown at the top, and the view is at the copper side of the board. A good way to recognize the front edge is by the five 9-pin

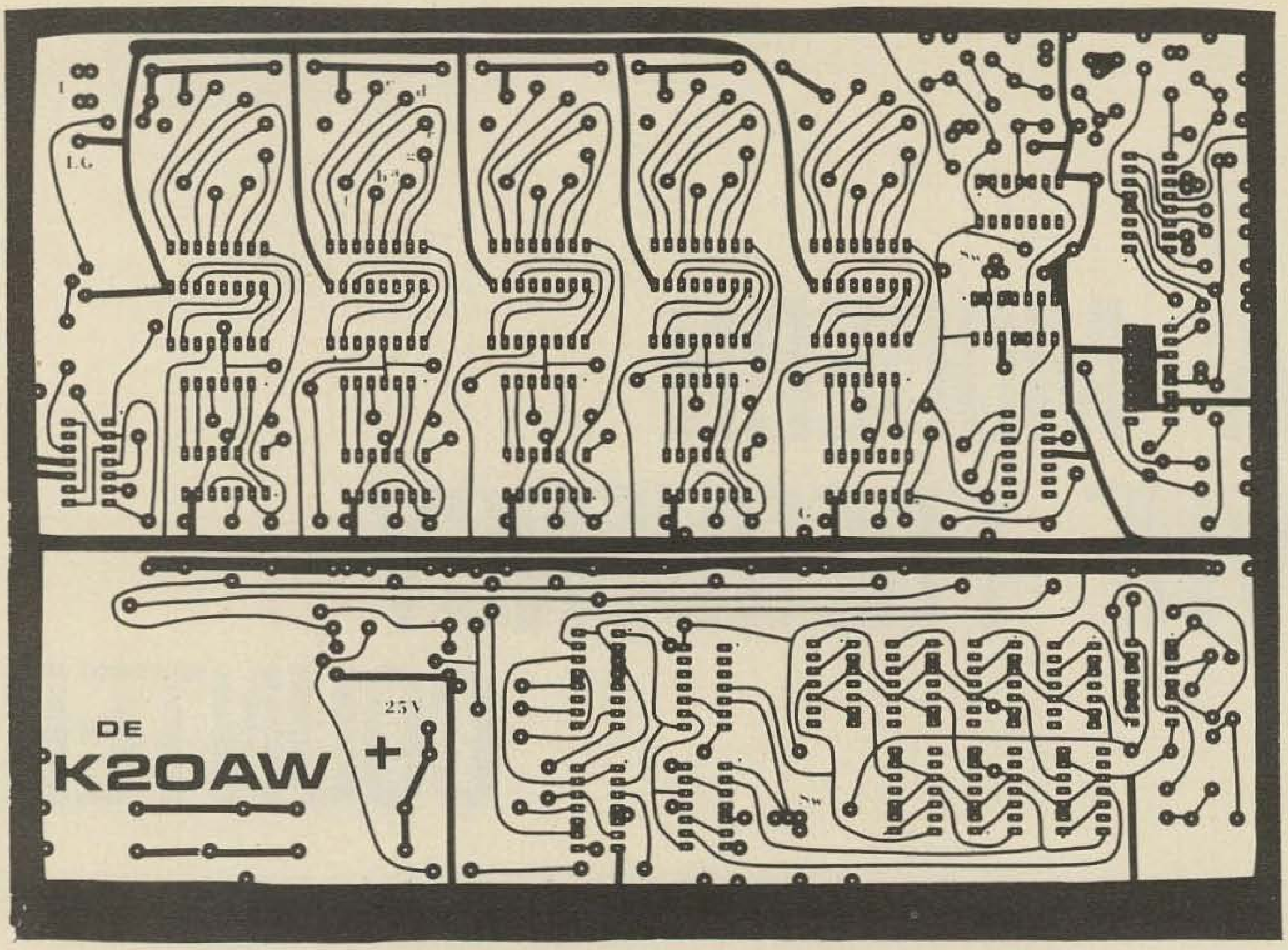


Fig. 19. Printed circuit board layout for main board (copper side, 50% actual size).

Numitron tube sockets along the edge. In each of these figures, we are looking at the copper side of the board. The components actually mount on the other side, so we are actually looking at the bottom of the board. This is important when mounting transistors and IC's.

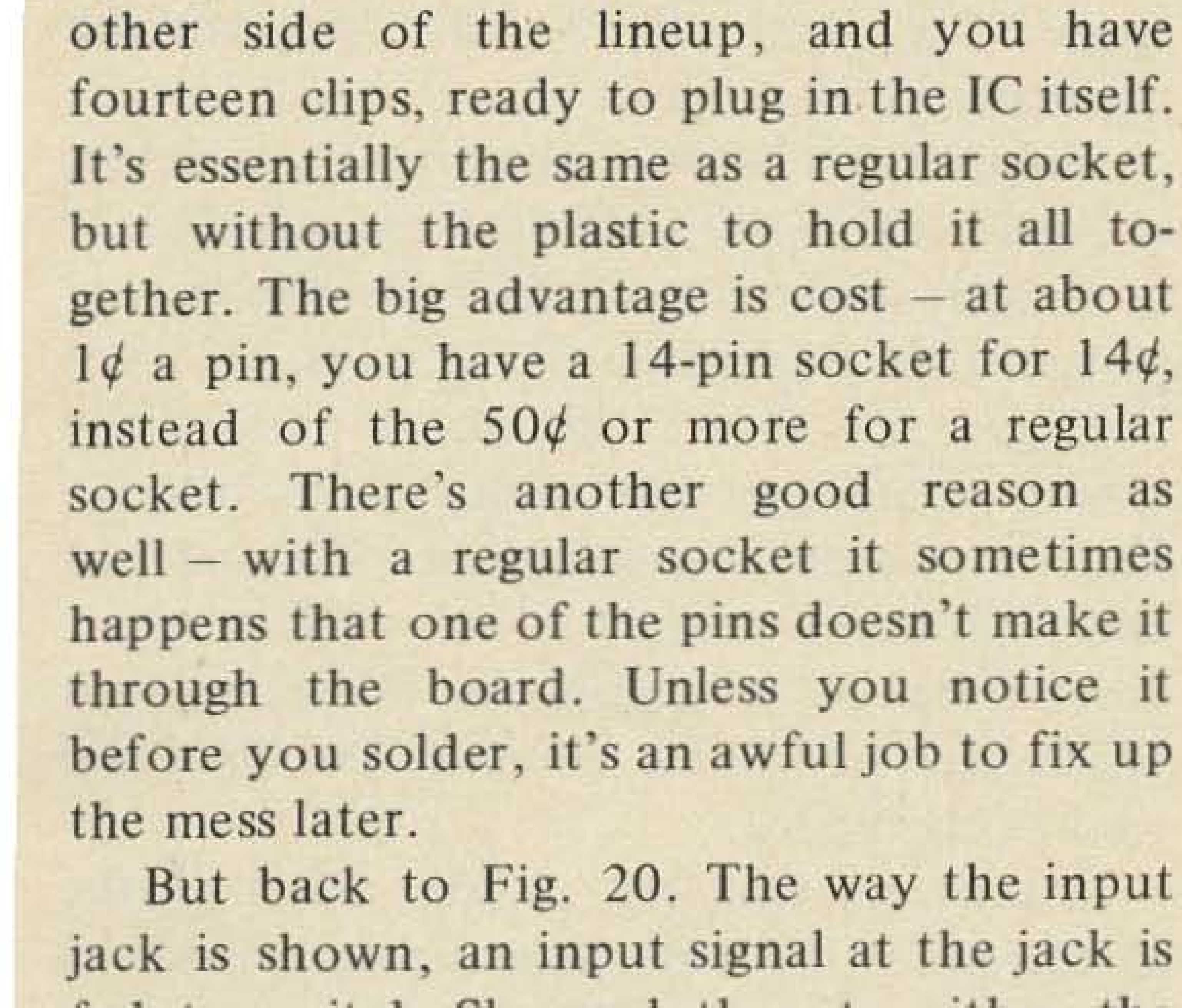
Figure 20 shows the 0–20 MHz input circuit. Transistor Q1 is shown as a bottom view at the side; the important thing to notice is the orientation of the little tab on the transistor case. Notice also that the IC's have to be inserted in a certain way – there is usually a little notch or depression at one end of the IC body, on the side that has pin 1. We have marked the position of this notched side on the drawings with a small half-moon. Furthermore, the drawings and the board have a small dot next to pin 1. Starting at pin 1, the pins are numbered consecutively down that side, and then back along the other side. IC1 is a seven-pin IC, and so it has pins 1 to 7 along one side (starting from the terminal near the dot), and pins 8 through 14 back along the other side. Pin 8 is on the same end as pin 7, and pin 14 is on the same end as pin 1. Some of the IC's have 16 pins, with pins 1 to 8 along one side, and 9 through 16 returning back along the other.

Incidentally, IC sockets of one kind or another are a must for a project like this. We don't want to scare you, but occasionally an IC is defective, or for some reason you have to troubleshoot the board, and removing an IC that has been soldered on the board is a pain in a place pills can't reach. There is also another reason for sockets, and that is that some of the IC's on the board do not have all their pins connected. In order to leave more room for connections at the bottom, these pins aren't brought through the board. That means you have to remove these pins on the IC socket – it's not a good idea to start cutting pins on the IC's themselves.

Since IC sockets can be quite expensive (even more expensive than some of the IC's themselves), we suggest a product called Molex Soldercon IC terminals, or just

MOLEX pins. These are individual little clips, one for each IC pin, which come in long strips joined by a connecting strip. You break off as many as you need (such as a strip of 7 for one side of a 14-pin IC), insert the whole strip into the board and solder, and then snap off the connecting strip. This leaves seven independent little clips, standing up from the board. Put another seven on the other side of the lineup, and you have fourteen clips, ready to plug in the IC itself. It's essentially the same as a regular socket, but without the plastic to hold it all together. The big advantage is cost – at about 1¢ a pin, you have a 14-pin socket for 14¢, instead of the 50¢ or more for a regular socket. There's another good reason as well – with a regular socket it sometimes happens that one of the pins doesn't make it through the board. Unless you notice it before you solder, it's an awful job to fix up the mess later.

But back to Fig. 20. The way the input jack is shown, an input signal at the jack is fed to switch S1a, and then to either the low-frequency circuit or the VHF scaler, depending on the position of the switch. S1



Above sketch shows location of circuit on main circuit board.

*Fig. 20. 0–20 MHz (low frequency) input circuit. Notes: 1. See Fig. 3 for diagram; 2. Capacitors marked * are bypass capacitors not shown on diagram. 3. Omit S1 if no VHF scaler installed.*

is actually a DPDT switch, with the other pole shown in Fig. 22. If you want to simplify the switching, you might eliminate the part of S1 shown in Fig. 20 and use two separate input jacks instead. This might have

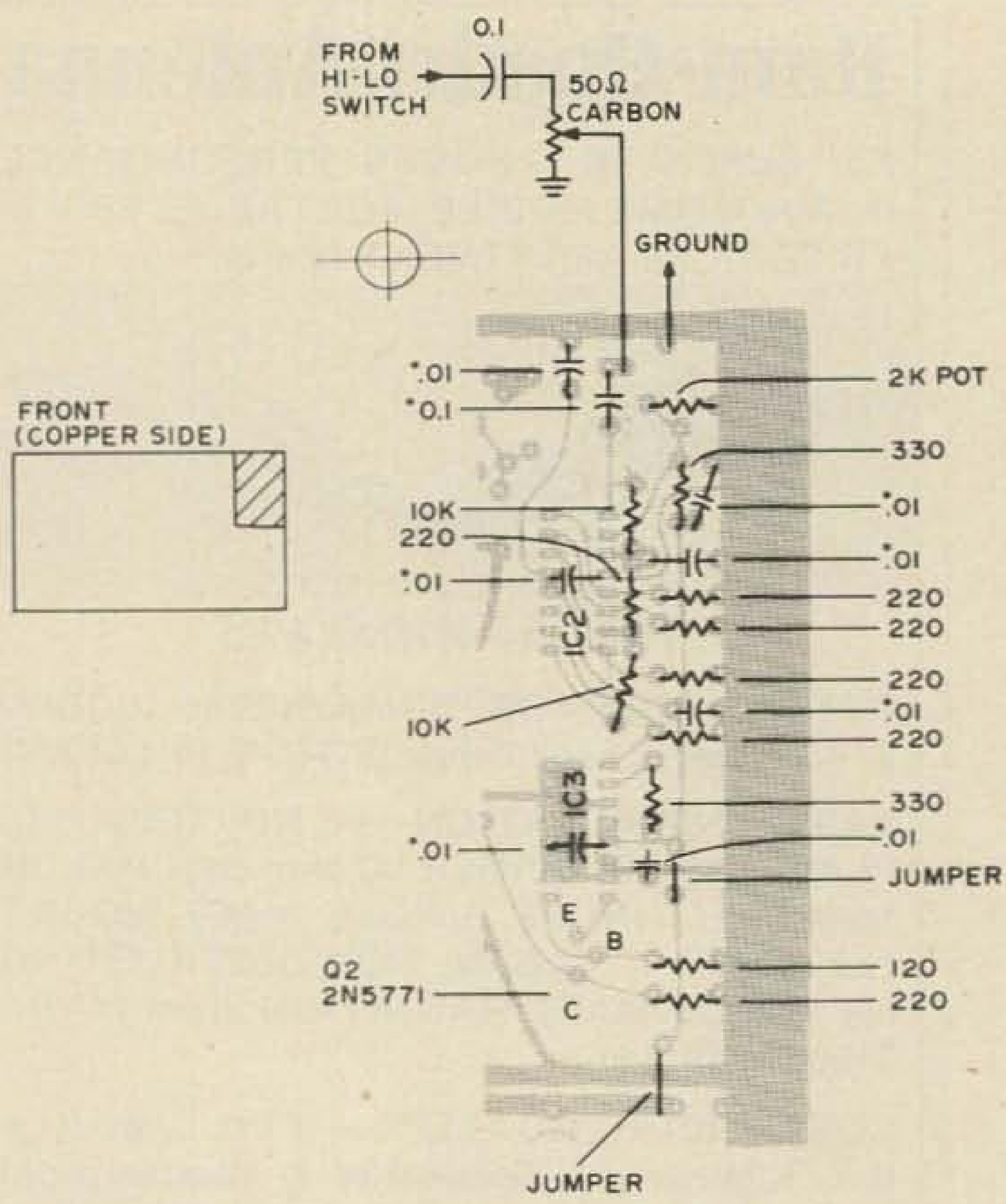


*Fig. 21. VHF prescaler circuit. Notes: See Fig. 4 for diagram; 2. Note the two 0.1 disk capacitors between pins 5 and 12 of IC; 3. Capacitors marked * are bypass capacitors not shown on schematics.*

the advantage of allowing you to hook up the counter to two different places, and measure the frequency at either by just flipping S1.

Figure 21 shows the VHF scaler circuit. If you are not including the scaler in your counter, then simply omit all parts in this figure, and omit S1 as well, wiring up the input jack directly to the low-frequency input circuit instead. Otherwise, the VHF scaler is pretty much standard. Make sure, here as elsewhere, to place all parts right down against the board with the shortest leads possible. Notice also the two small 0.01 μF capacitors mounted underneath the two IC's. After you solder in the IC sockets (they go on top of the board), solder the two capacitors on the bottom of the board to the two pins shown (pins 5 and 12), using the shortest leads you can. The capacitors should be bent down tight against the underside of the board.

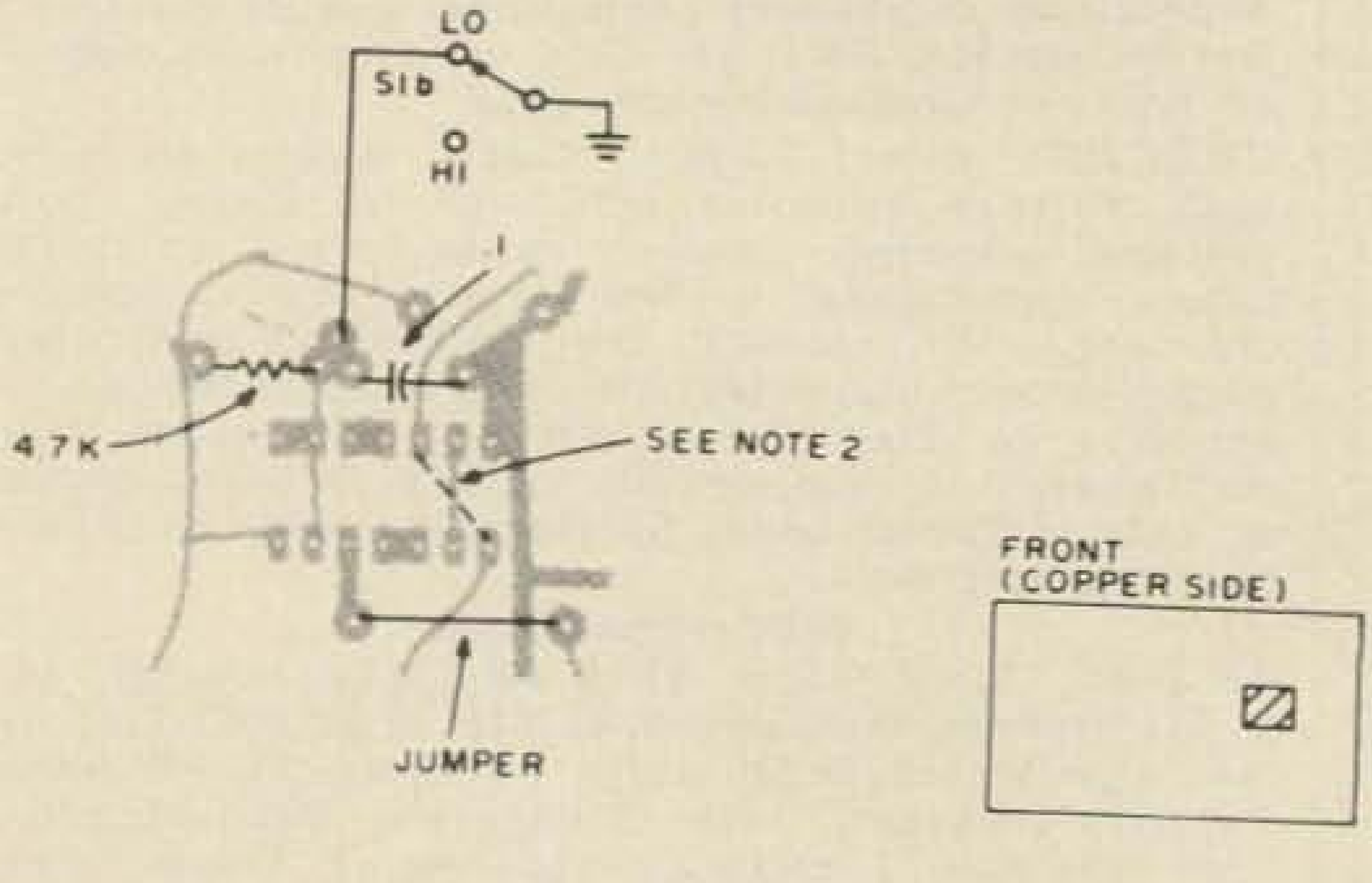


Fig. 22. Input selector circuit. Notes: 1. See Fig. 5 for diagram; 2. If no VHF scaler is used, this circuit is not needed. Omit all parts shown and jumper pins 5 and 8 as shown by dashed line.

Figure 22 shows the input selector, needed only if the VHF scaler is installed. If not used, just omit all the parts shown and jumper pins 5 and 8 on the IC pads.

Figure 23 shows the major part of the board, containing the counters, latches, decoders, and over-range circuits. This part of the board will keep you busy for a while, since it has 37 wire jumpers. Make sure that these jumpers are as short as possible, flat against the board.

Shown at the left of Fig. 23 is all the circuitry for the over-range indicator and the power supply for the Numitron or Minitron readouts. As pointed out last month, we need a separate supply for these incandescent readouts, but not for LED readouts. Hence if you decide to use LEDs, you can omit the transformer and the two diodes. You can also omit Q3 and 10K resistor, since the LED over-range indicator can be driven directly off the output of IC21, pin 13, as shown in Fig. 28. Incidentally, if you are using LEDs, you can also omit the four jumpers at the very front of the board, connecting pin 2 of all the Numitron sockets, but don't forget the ground to terminal LG, which connects to the system ground all the way back at the +5V power supply.

Figure 24 shows the 10 MHz crystal oscillator and the time base dividers. Only two comments here. Note the short jumper runnning under IC24 and IC28. Put this jumper in before putting in the IC sockets, to make the work easier for yourself. Second, when putting in the 10 MHz crystal, leave the leads on it about 1/2" long. As pointed out in the first part of the article, someday you may want to place the crystal in an oven, and at that time you'll appreciate this.

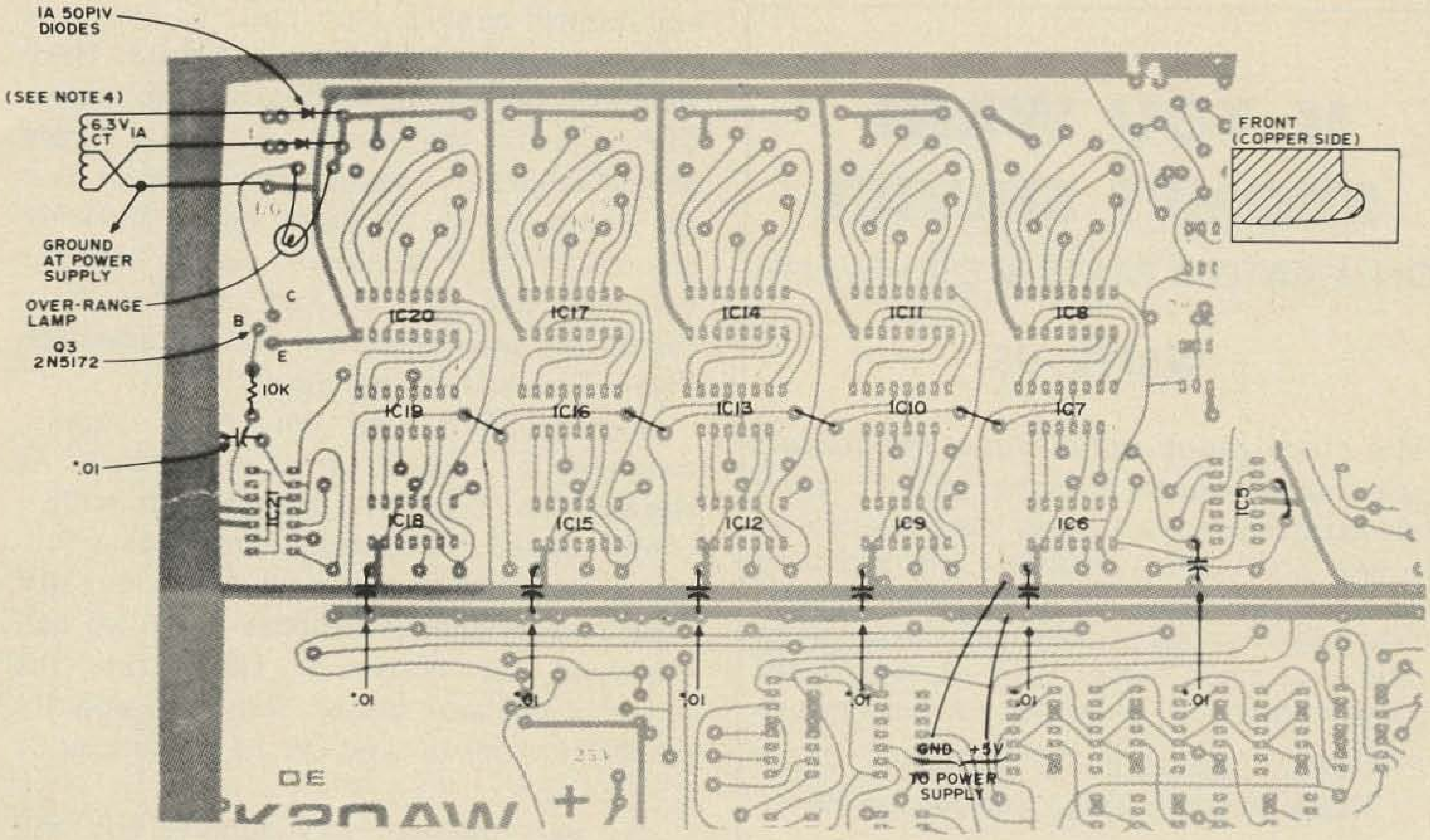


*Fig. 23. Counters, latches, decoders and over-range circuitry. Notes: 1. See Fig. 6 for diagram; 2. There are 37 jumpers shown – don't miss any; 3. Capacitors marked * are bypass capacitors not shown on diagrams; 4. Q3, transformer, diodes and associated parts not needed for LED readout.*

Figure 25 shows the time base selector and control circuits. Note again two jumpers running under IC sockets, as before. Make sure that the switch is connected as shown. The lead to the switch can be a single unshielded lead, running either under or over the board, up to the front panel. Virtually any silicon NPN transistors can be used for Q3, Q4, and Q5 as long as they have reasonably good gain, but we suggested the 2N5172 since it is very cheap.

Figure 26 shows the +25V supply, mounted in a corner of the main board. As shown, the circuit is designed for a 38V center-tapped transformer, and uses a full-wave rectifier. If you have a 16- to 20V transformer, add two diodes as shown and eliminate the centertap. This makes the circuit a full-wave bridge. Watch the polarity on the electrolytic, and use a 50V unit, not a 25V unit!

As part of the +25V supply, you will need a long jumper from the 25V terminal over to the 4.7K resistor near Q1, shown at the left of Fig. 20.

As mentioned earlier, the easiest readout to use is the Numitron; just install 9-pin miniature tube sockets on the board and plug in the readouts. In one of our prototypes, however, we used LEDs because of their good looks. Figure 27 shows the LED readout board for mounting them. In addition to MOLEX pins or 14-pin IC sockets, you will need 35 150Ω resistors for current limiting. The over-range indicator also

*Fig. 24. 10 MHz crystal oscillator and time chain divider circuits. Notes: 1. See Figures 7 and 8 for diagram; 2. Capacitors marked * are bypass capacitors not shown on diagram; 3. Note the jumper running under IC24 and IC 28.*

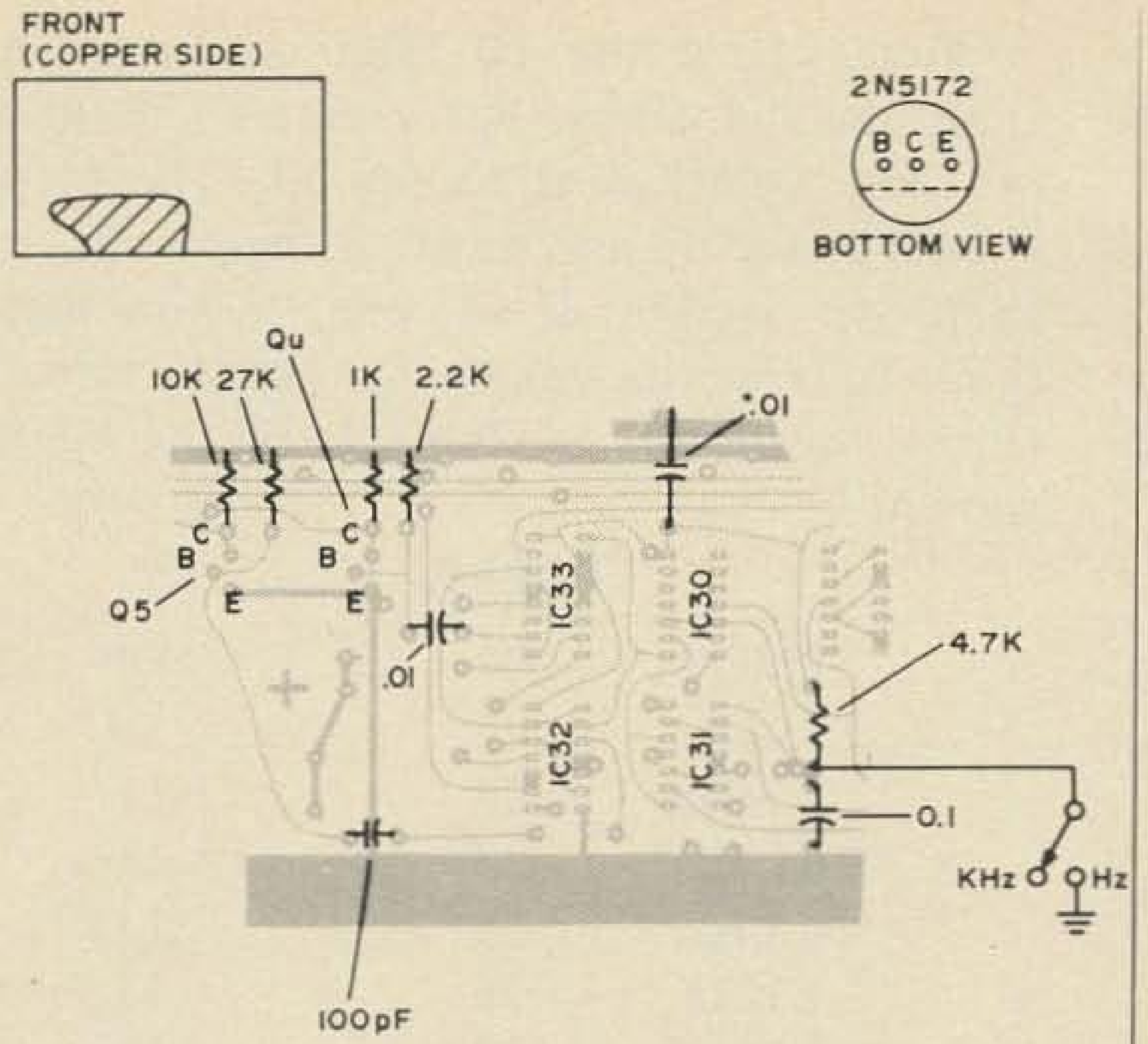


*Fig. 25. Time base selector and control circuits. Notes: 1. See figures 9 and 10 for diagram; 2. There are 11 jumpers shown – note especially the jumper running under IC32 and IC33; 3. Capacitor marked * is a bypass capacitor and is not shown on diagrams.*

mounts on this board; the board has room for two over-range indicators, one above the other, to make a sort of : (colon) arrangement, but only one is really needed. For LED over-range indicators you will also need 220Ω current limiting resistors. If you decide to use incandescent over-range bulbs, then follow the hookup as shown in Fig. 23, but you will need a spearate source of lamp voltage. It seems to be the hard way.

To connect the LED board to the main board, note the letters cgdaebf on the LED board, on one of the 9-pin sockets on the main board, and in Fig. 15. The actual connections are shown, for one LED indicator, on Fig. 28. The cgdaebf terminals for each LED connect to the like terminals on the main board, to the corresponding 9-pin socket. The over-range LED connects to pin 13 of IC21, through the 220Ω resistor, the 5V terminal on the LED board goes to +5V at the power supply, and the LG terminal goes to the ground terminal, also at the power supply. If you use two LEDs for over-range we suggest using Q3 and the 10K resistor, and connecting the 120Ω resistors to Q3 at point X, as shown.

After wiring up the main board, but before installing the IC's in their sockets, we suggest that you examine the board carefully for good solder joints and no shorts. Hopefully you used a small pencil iron, such as a 30-watt Ungar, and good solder. We like 60% tin, 40% lead (not the other way around!) solder of the thin variety. If you scrub the board with Brillo soap pads just before starting construction, to clean off the copper, you should have no trouble soldering to it with a minimum of heat and solder.

Once construction is done, check for shorts. Use an ohm-meter to check between ground and the +5V connection point shown in Fig. 23. With all the IC's out, you should get a high reading – at least several hundred ohms.

Now is also the time to build the power supply. After you finish it, make sure to test it and, if needed, adjust the output voltage to +5V before connecting to the main board. An over-voltage can ruin a lot of expensive IC's

Once everything is hooked up, take the big step and turn on the main power. If all the indicators read 00000 you will probably breathe a sigh of relief, but all is not done yet. With luck, your counter should now be working. Except for two bad connections, our second prototype worked right away. Just in case that your counter doesn't work and you need to do some troubleshooting, here is a suggested way of going about it. You will probably need a scope, though.

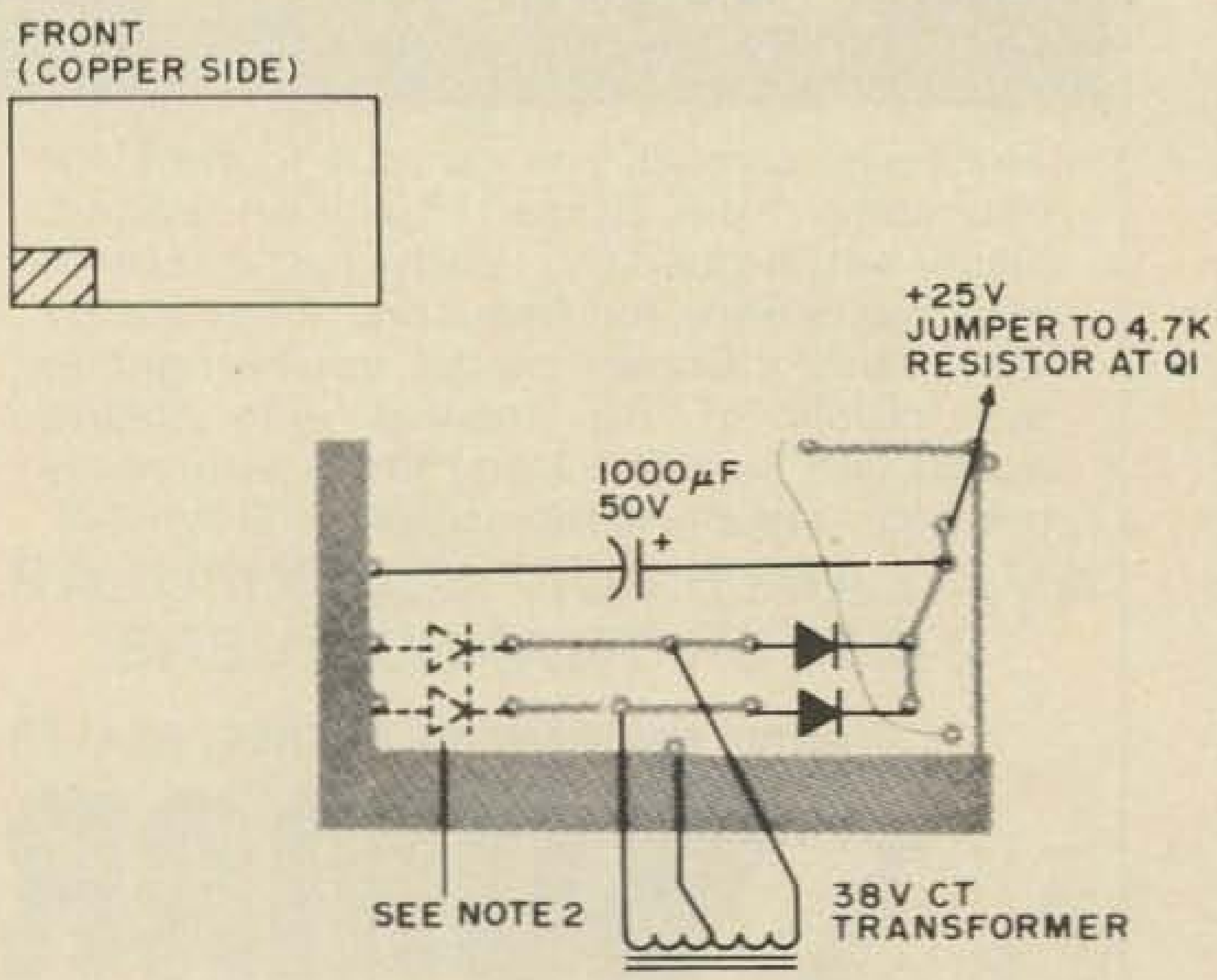


Fig. 26. +25 volt power supply. Notes: 1. Circuit shown in diagram in Fig. 17; 2. Supply is designed for a 38V CT transformer – if a 16–20 v transformer is used, disconnect centertap and add two diodes as shown dotted, thus converting the rectifier into a bridge.

First, check the 10 MHz oscillator and time chain dividers. Put a meter (20,000Ω per volt VOM) at IC23 pin 11. The meter should swing up and down at the rate of one cycle per second. If so, fine. If not, use a scope to trace the signals through the circuit. Check the points in Table I for the signals shown.

TABLE I

Signal	IC	Pin
10 MHz	22	8
1 MHz	23	11
100 kHz	24	11
10 kHz	25	11
1 kHz	26	11
100 Hz	27	11
10 Hz	28	11
1 Hz	29	11

If no 10 MHz signal appears at IC22, interchange the SN7400N IC with one of the others in the counter. If the signal seems to go down the line but stops at some point in the divider chain, interchange the affected SN7490N with another. In this way, you should be able to get the oscillator and divider chain working.

Next step, if everything is OK so far, is to check whether the indicators light. If not, check the power connections to the indicators, and the ground and +5V connections to the SN7447N decoder/drivers. If some indicators light and others don't, interchange IC's and indicators (with the power off!) to try to narrow down the cause. If interchanging the IC's doesn't do it, check your connections.

Once the indicators light, they will probably read all zeroes. Place the Hz–kHz switch in the Hz position and turn off the power for about five seconds. When you turn the power back on, the indicators should come back with some really crazy readings, or perhaps even totally dark. It should take about two seconds for them to reset back to zero. This is because the flip-flops in the counters and latches come back in random states, and it normally takes two seconds to get everything reset back to zero. If this occurs as described, fine. Otherwise check the control circuits for wave-

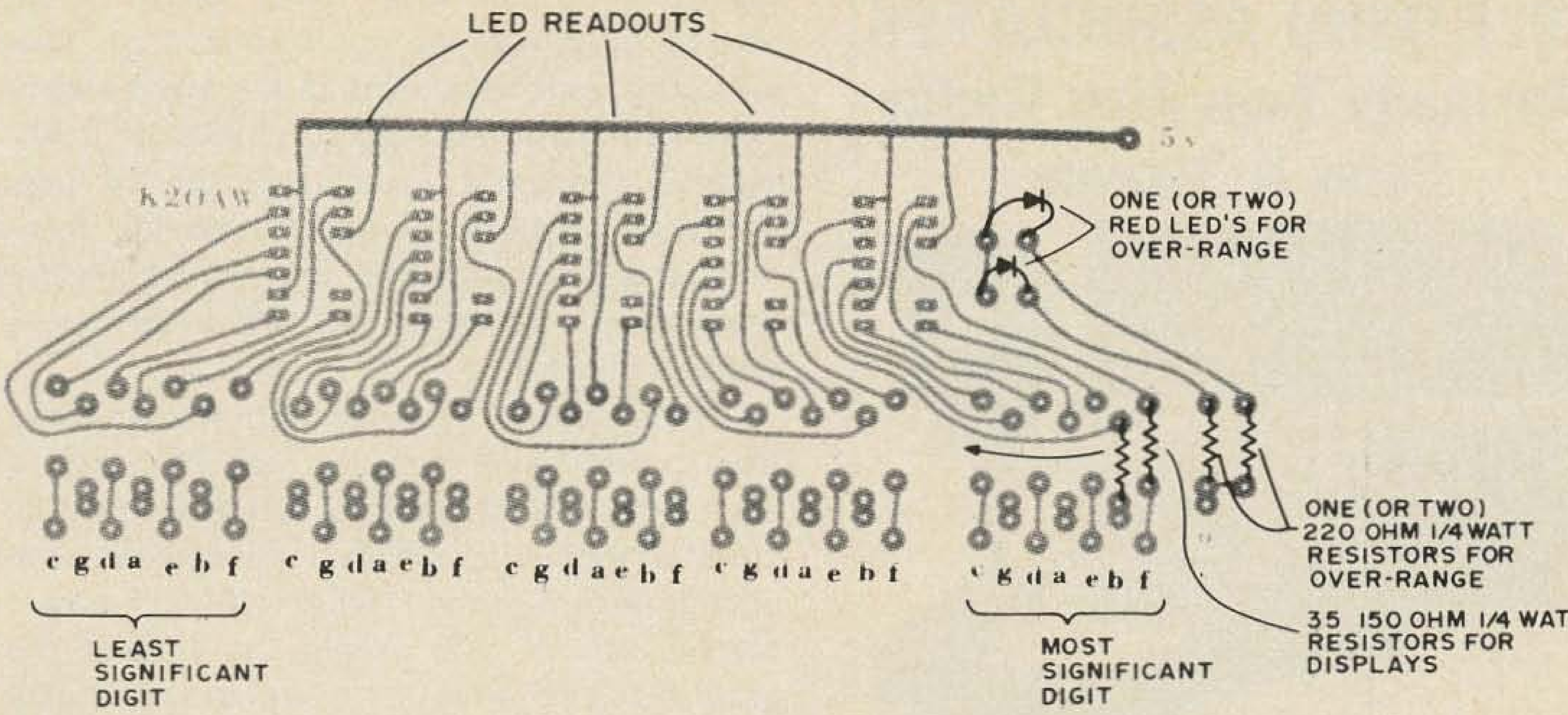


Fig. 27. Rear view (copper side) of board for mounting MAN-1, 10A, or LED-700 readouts.

forms similar to those in Figs. 11 and 12, depending on the position of the Hz–kHz switch. Unless you have a really good scope, you may not be able to see the thin pulses on the reset and strobe lines.

Once everything seems to work OK, remove IC4, and connect a short wire to pin 8 of the socket. Place the Hz–kHz switch in the kHz position, and use the wire to trace the signals listed in Table I, starting at 1 kHz and going up in frequency. The 1 kHz signal should result in a reading of 00001 on the displays, the 10 kHz should result in 00010, and so on. Go through all five counters like this, checking for a 1 in each place. If everything works fine at lower frequencies, but not at the higher frequencies, check the SN7490N counter at the right most position that doesn't work by interchanging it with another to its right – don't go back and swap IC's in the time chain dividers, though – leave well enough alone. If most of the readings here are OK but one of the digits in the center does not seem to work, check the counter, latch, and decoder as well. If you use any readout other than the Numitron, and get some strange readings, check the wiring between the readouts and the main board for a mixup.

Once you have gone this far, you are pretty close to being home. Try both input circuits. If one input works and the other doesn't, that should narrow down the trouble. If neither works, check the circuitry around IC4. Check also the wiring to S1 – you may have the wiring mixed up so that the input of one of the two input circuits is connected at the same time as the output of the other. You won't get too many signals through that way.

Once everything is working, readjust the 2K and 5K pots for best sensitivity. Don't be

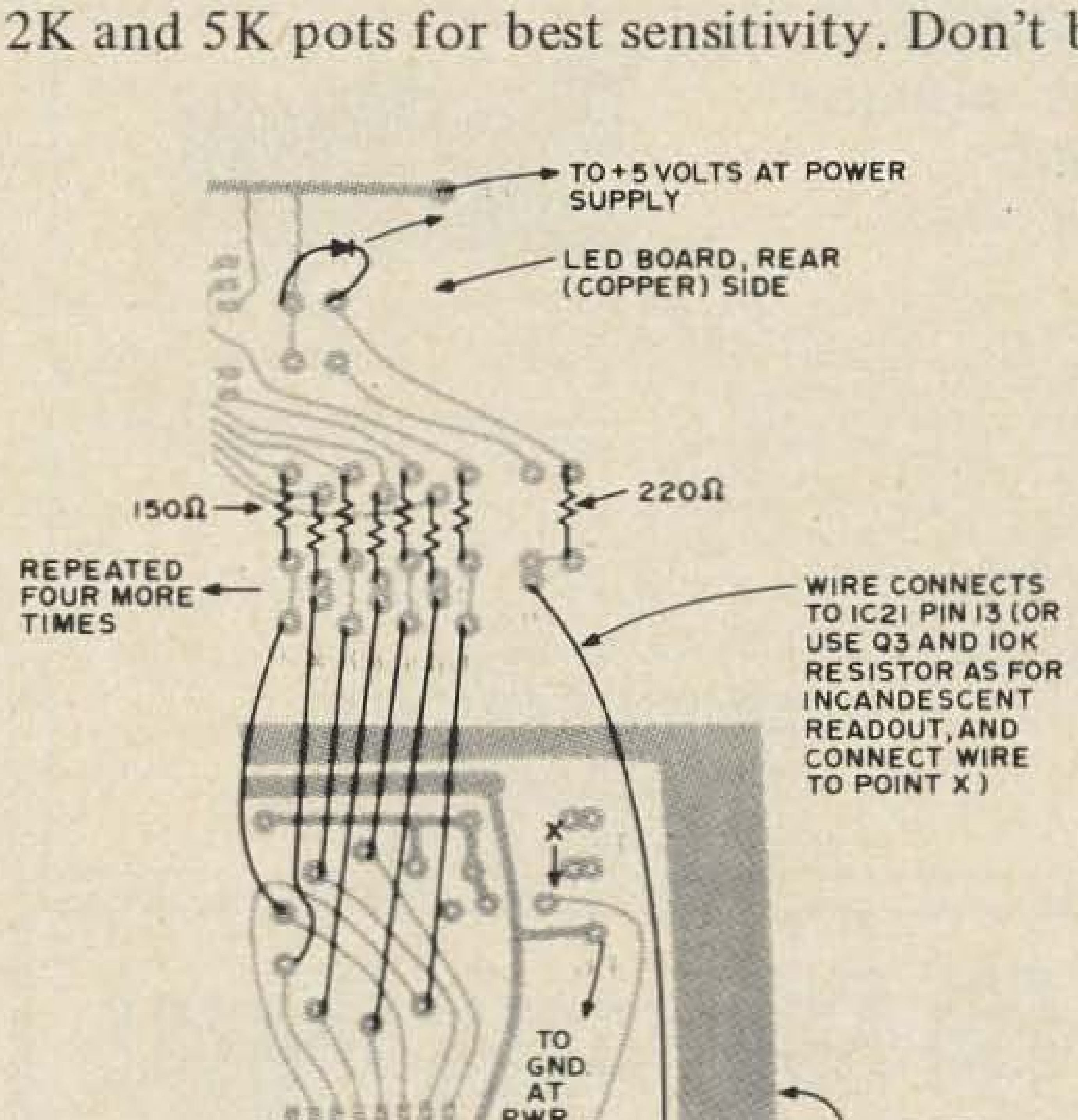


Fig. 28. Connections between LED board and main p.c. board.

surprised if the VHF input shows some reading even with no input connected. This indicates some oscillation in the input amplifier, and you can easily eliminate it by slightly moving the setting of the 2K pot. We've seen even some fairly expensive commercial counters do this, and the oscillation usually gets swamped out when an actual signal is connected.

The inputs are actually quite sensitive. We have a local radio station on 1310 kHz a mile or so away, and we often notice the counter with a 01310 indication when connected into a circuit which has its power turned off. If you forget to connect the ground to the input of the counter, you may often see a 00060 reading in the Hz position – that's just plain hum. It's nice to know that your local electric company keeps its frequency on the nose.

Speaking of frequency, there is one more adjustment to be done, and that is zeroing of the 10 MHz oscillator against WWV. This is quite simple, as the counter puts out a nice 10 MHz signal with the case off. If you find that the crystal won't quite go to 10 MHz, you can change the value of the 33 pF capacitor in parallel with the trimmer capacitor as needed. If you can't receive WWV, then you might connect another (calibrated!) counter to the 10 MHz signal and adjust that for the right frequency. Heathkit has another trick in their instruction manual for their counter, and that is that you place an ordinary transistor AM radio near the counter, and tune to a broadcast station. Since the counter puts out strong signals at 10 and 20 kHz as well, the harmonics of these will beat with the station. Since the FCC requires commercial stations to be close to their assigned frequency, which is always on a multiple of 10 kHz, you can zero beat the counter against the station. But pick a station which you know to have a good engineering staff, not your local college run station run by sleepy-eyed undergraduates.

And don't let your friendly envious hams talk you into calibrating your counter with a borrowed BC-221 frequency meter! Try a little one-upmanship and offer to them first.

I'd like to thank Mike, WB2AAQ, for his help in building one of our prototypes.

. . .K2OAW

Peter A. Stark K2OAW
196 Forest Drive
Mt. Kisco NY 10549

FREQUENCY SYNTHESIZER FOR 2M FM: Part I

One of the major expenses in going on 2-meter FM is the price of crystals. Even so, it seems you never quite have the right ones. Well, here's the device to eliminate all that – a frequency synthesizer which lets you hop all over the band.

The complete information to enable you to build your own will be presented in three parts. This month we will give a complete description of what the synthesizer is and what it can do, along with a block diagram and simple description of how it works. If you decide to go ahead with building it, there's a complete parts list at the end of this installment. Next month we give the diagrams and the detailed theory of operation. The month after that we will have the printed circuit board layout, parts layout drawings, and construction and operating information.

And now a little information about the unit:

1. The complete price should be under $100, depending on where you get your parts. We will have some information on parts sources in the parts list later.

2. The unit covers from 145 to 148 MHz in steps of 5 kHz. With a few modifications the range could be extended down to 144 MHz, but that complicates the switching and so we decided against it.

3. It is inherently quite stable. It has only one crystal, at 10 MHz. Once you beat this crystal against WWV all other frequencies automatically fall in line.

4. The synthesizer can be used for both transmitting and receiving, with a choice of two-frequency operation. That's a necessary feature for working through repeaters, since you can transmit on one frequency and receive on another.

5. It is designed as a crystal substitute. You merely plug the synthesizer output cables into the crystal sockets of your rig. It is not a complete transceiver by itself.

6. It is designed to operate with most common amateur two-meter transceivers. The unit could also be used with most commercial transmitters of the GE/Motorola class, but you'd have to make some changes to use it for reception as well. The synthesizer is designed for receivers having either 10.7 or 11.7 MHz i-f frequencies with low-side first oscillator injection, which pretty well limits it to use with the more popular amateur-only transceivers.

7. Since the synthesizer is only a crystal substitute, your regular transceiver is used for all other functions (such as modulation). But in case you have an AM rig, it is possible to FM modulate the synthesizer itself. That will give you an FM signal. In our prototype

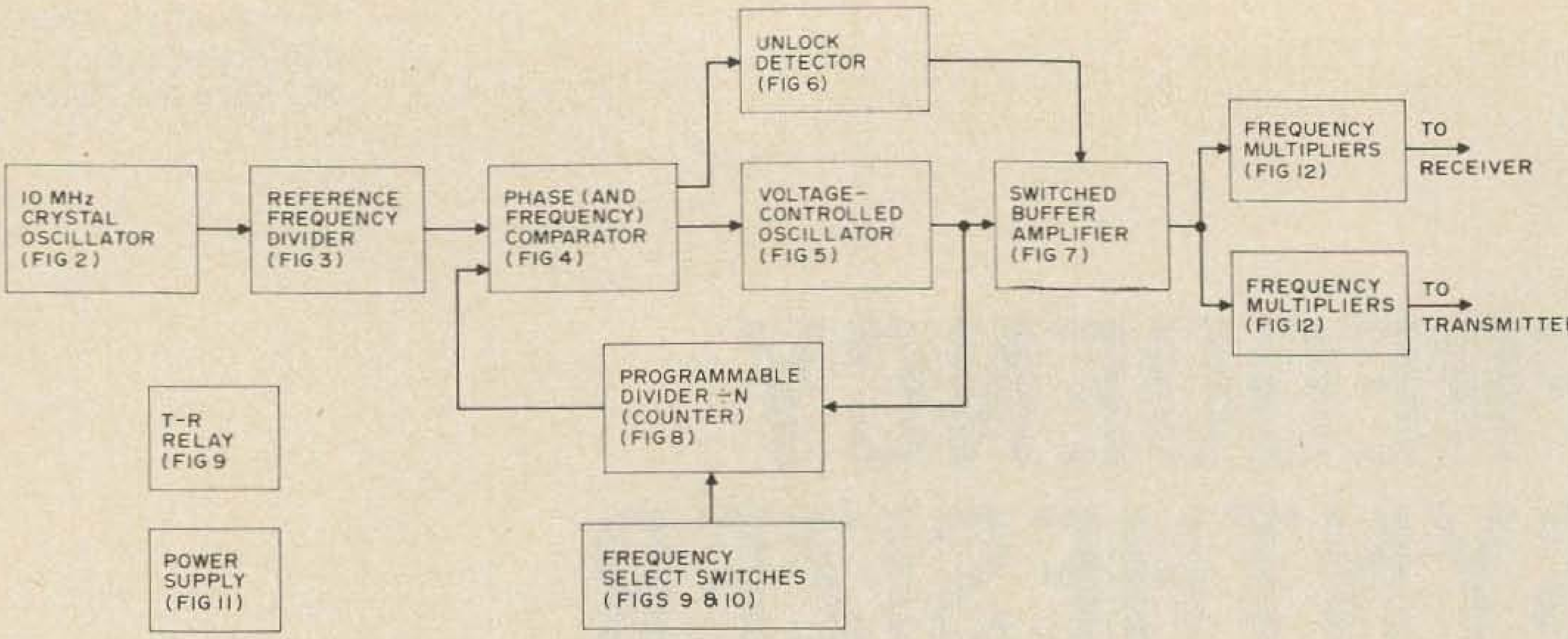


Fig. 1. Frequency Synthesizer

we had a little extra room in the case, and so we decided to install a touch-tone pad, which modulates the synthesizer. We plan to put in a tone-burst encoder and PL (snythesized?) at a later time.

8. We went out of our way to make the project easy to build. Except for the power supply, switching, and output buffers and multipliers, everything else fits onto a 7" x 9" printed circuit board. The p.c. board layout and etched boards are available to make your job even easier.

The requirement that the synthesizer work with a variety of transceivers makes the design a bit awkward, since different transceivers use different crystal frequencies. You can ignore the circuit capacity that your unit is designed for, since that has no effect on the output frequency with the synthesizer, but the crystal frequency itself (and the equation used to calculate it) is an important factor. Table I lists the requirements for several common amateur transceivers. As you can see, the actual crystal frequencies range from 6 MHz to 45 MHz. Most of the rigs use a 10.7 MHz receive offset, except that the Standard uses 11.7 MHz; this requires a small change to the synthesizer. (The new Swan FM 1210-A uses 16.9 MHz offset. You'd have to make a number of changes to adapt the synthesizer to that rig.)

As you can see in Table I, most of the transmit crystals are 8, 12, or 18 MHz (the older Regency HR-2 uses 6 MHz rocks). We decided to build our unit to output at 6 MHz, which can easily be doubled to 12 or tripled to 18 MHz. If you need 8 MHz, then you will have to change the design a little to output at 8 MHz directly. It is also possible to modify the synthesizer to output directly at 12 MHz, but it's easier to take the 6 MHz output and double it.

As for receiving, most rigs use 45 MHz rocks. You can start with 6 MHz and multiply by 8, start with 8 MHz and multiply by 6, or start with 12 MHz and multiply by 4. The 15 MHz signal needed by the Standard can be obtained from 8 MHz by doubling. But keep in mind that if you plan to use the synthesizer for both receive and transmit you have to pick a common frequency output. You can't pick 6 MHz output if you need 15 MHz for the receiver, since you can't double or triple 6 to get 15. Since 6 MHz seems to be the most useful with the widest variety of units (including our Varitronics IC-2F and an old Pre-Prog transmitter) we decided to design for that.

TABLE I

Crystal Frequencies for Common Transceivers

Unit	Transmit Formula	Transmit Freq.	Receive Formula	Receive Freq.	Synthesizer Output
Varitronics IC-2F	$\frac{f}{8}$	18 MHz	$\frac{f-10.7}{3}$	45 MHz	6 or 12 MHz
Varitronics IC-2F	$\frac{f}{8}$	18 MHz	$\frac{f-10.7}{3}$	45 MHz	6 or 12 MHz
Drake	$\frac{f}{12}$	12	$\frac{f-10.7}{3}$	45	6 or 12
Standard SRC-826M SRC-146	$\frac{f}{18}$	8	$\frac{f-11.7}{9}$	15	8
Swan FM-2X	$\frac{f}{12}$	12	$\frac{f-10.7}{3}$	45	6 or 12

The rest of this article describes the 6 MHz version, but wherever applicable we will tell you the applicable information for the 8 or 12 MHz versions. If so, the additional information will always be in parentheses, following the 6 MHz information.

And now on to details. Figure 1 shows the block diagram of the overall unit. The individual diagrams for each block will be shown next month, and the block diagram gives the figure numbers for each detailed diagram.

The heart of the unit is the voltage-controlled-oscillator which we will simply call the VCO from now on. The VCO actually generates the 6 MHz (or 8 or 12 MHz) output frequency. This signal is fed into a switched buffer amplifier and then into the frequency multipliers needed to generate the correct crystal frequencies for your rig. Two sets of multipliers are usually needed, one set for the transmit frequencies and one for the receive frequencies.

All the rest of the synthesizer is used as an automatic frequency control to keep the VCO on frequency. The correct terminology is actually to call it a phase-locked-loop (PLL). This is done by a feedback loop which compares the VCO output frequency with a crystal-generated reference frequency in the phase (and frequency) comparator. It is used here as a frequency comparator, but since it works by actually comparing phases it is called a phase comparator.

Since the crystal frequency and the VCO output frequency are not the same, we can't really compare them directly. Instead, we take the 10 MHz crystal frequency and divide it by a factor of exactly 48,000 in the reference frequency divider to get 208-1/3 Hz (in the 8 MHz version we divide by 36,000 to get 277-7/9 Hz, and in the 12 MHz version we divide it by 24,000 to get 416-2/3 Hz).

At the same time, we take the VCO output frequency and divide it by another number, N. But this division is done in a programmable divider, and the exact number by which we can divide is changed by the frequency Select Switches. Suppose we want an output on 145.000 MHz. Then the switches are wired in such a way that the progrmmable divider divides by exactly 29,000. Then the divider takes the VCO output frequency, divides it by 29,000, and sends the result to the phase comparator.

The phase comparator looks at the two frequencies it gets. If they are exactly the same, nothing happens. But if the frequency coming out of the programmable divider is too low, the phase comparator decides that the VCO frequency is too low also, and sends a control signal to the VCO to increase its output frequency. In the same way, if the frequency fed back from the programmable divider is too high, the phase comparator forces the VCO frequency down. In this way the phase comparator controls the VCO in such a way to make the output from the programmable divider the same frequency as the output from the reference frequency divider. This is the automatic frequency control action.

Now, if the output of the VCO, divided by the number N, is equal to the reference frequency, another way to look at it is that the output of the VCO is the reference frequency times N.

Using the 6 MHz synthesizer as an example, if we set the switches for 145.000 MHz output (so that N is 29,000), then the output from the synthesizer is the reference frequency (208-1/3) times N (29,000). If you multiply this out, you get exactly 6.041667 MHz. This is the exact 6 MHz crystal you would need to multiply up to 145.000 MHz. (If you want to do a little work, you can multiply 29,000 by the reference frequencies used in the 8 or 12 MHz synthesizer, to check that you get the right output frequency.)

Since the phase-locked-loop forces the VCO output frequency to equal the reference frequency times N, the way we get various output frequencies to cover the range from 145 to 148 MHz is to change N. This is done with eight front panel frequency selection switches. Just as an example, at several typical frequencies we have the following:

PARTS LIST

4 SN7400N
3 SN7490N
1 SN7492N
1 SN7492N
1 SN7493N
4 SN74192N
1 SN7473N
1 SN7474N
2 SN7404N
1 SN7430N
2 SN7410N
1 LM309
1 LM309K
1 MC1648P
1 40673
1 MFE3002
6 2N706
1 2N5771
1 HEP52
1 2N3055
1
7 1N4001
23 1N914
1
1
2
2
4
2
1
1
1
2 33 pF
1 .001
1 0.1
18 0.01
2 100 pF
1 2000 μF
1 1 μF
3 250 μF
2 100 μF
3 30 μF
1 10 μF
1 47Ω
1 60Ω
4 220Ω
1 1800
1 560
4 1K
1 1 meg
1 12K
1 27K
3 10K
1 1.5K
2 4.7K
2 2.2K
1 15K
1 470
2 100K
14 330
1 7"x9"
300
1-4 PAX-1
1-4 33K

TTL Quad two-input *nand* gates
TTL decade counters
TTL Divide by 12 counter
TTL Divide by 12 (8 MHz output only)
TTL programmable up-down decade counters
TTL dual J-K flip-flop
TTL Type D flip-flop
TTL hex inverters
TTL eight-input *nand* gate
TTL triple 3-input *nand* gate
5V regulator, 250 mA. (may be replaced by an LM309K if you mount it off the board)
5V regulator, 1 amp., plus finned heatsink
MECL oscillator
RCA dual-gate-protected FET transistor
Motorola enhancemnt N-channel FET transistor (caution – don't remove clip on wires.)
NPN fast switching transistors, or equiv. (sil.)
PNP fast switching transistor, or equiv. (sil.)
PNP transistor or equiv. (sil.)
(or TIP3055) NPN silicon power transistor (or equiv.)
12-volt 10-watt zener diode
silicon diodes (1 amp, 50 PIV) (Do not substitute for the two paralleled ones in the VCO unless you know what you are doing.)
silicon switching diodes (or equiv.)
LED indicator diode – red (LOCK light) (optional)
12VDC 10 mA SPDT relay (Sigma 65F1A-12dc or Calectro D1-967)
SPDT toggle switches (CHANNEL SELECT)
SP3T rotary switches (MHz SELECT)
3P10T rotary switches (100 kHz and 10 kHz)
SPDT rotary switches (0-5 kHz)
AT-cut 10 MHz series-resonant HC-18/U crystal coil form, 7/32" dia., 15/32" long, ferrite slug (Calectro D1-893 or equiv) (Coil is 3-6 μHy, adj.)
1.7-14.1 pF air variable capacitor (Johnson 189-505-5)
NPO disk capacitors
disk capacitor
disk capacitor
disk capacitor
disk capacitor
15Vdc electrolytic
15 Vdc electrolytic
15 Vdc electrolytic
15 Vdc electrolytic
15 Vdc electrolytic
15 Vdc electrolytic
1W resistor 10%
1/2W resistor 10%
1/4W resistor
"
"
"
"
"
"
"
"
"
"
"
"
"
"
p.c. board
MOLEX Soldercon pins, used for IC sockets
International Crystal power amplifiers, one for each doubler or tripler
1/2 resistors, one for each PAX-1 used

Miscellaneous

Chassis, case, power switch, connectors, coax, #32 enamel wire for coil, knobs, power supply providing 12V at 750 mA (or auto or motorcycle battery) – must be well filtered.

Notes

Printed circuit board layouts are available from the author (send SASE); etched boards and parts kits are available from Circuit Specialists, Box 3047, Scottsdale, Arizona, 85257. Contact them directly for information.

at 145.000 MHz, N is 29,000
at 145.005 MHz, N is 29,001
at 145.010 MHz, N is 29,002
at 146.940 MHz, N is 29,388
at 147.995 MHz, N is 29,599.

As you can see, changing N by 1 changes the output frequency by exactly 5 KHz, thus giving us the 5 KHz channel spacing. If we make the programmable divider adjustable so N goes from 29,000 to 29,599, that will cover the entire 3 MHz of the band.

Since each count in the programmable divider changes the output by 5 KHz, if we subtract 2140 from N during receiving we will automatically drop the output by 10.7 MHz. (To use an 11.7 MHz receive i-f offset, we subtract 2340.) This subtraction is done automatically by a T R relay. In fact, the switches can be wired to indicate the actual channel frequency. It is not necessary to figure out the value of N corresponding to the operating frequency – if you want to transmit on 146.340, just set the four transmit switches to the digits 6340. To receive on 147.015, just set the four receive switches to 7015. It's that simple.

When you use the synthesizer for transceiving, the VCO has to switch back and forth between two frequencies every time you push or release the mike button. As with any feedback system, this takes a little time. In the synthesizer, it takes the VCO about ¼ to ½ second to reach and settle on the new frequency. To make sure that you don't transmit on the wrong frequency during this interval, an unlock detector monitors the phase detector output, and turns off the switched buffer amplifier while the VCO is moving to the new frequency. This makes it a little rough to break into conversations, but we've researched the problem and, short of having separate synthesizers for receive and transmit, there seems to be no way of getting around the problem. We could reduce this time below ¼ second, but only by greatly complicating the unit and upping the cost.

Next month we will continue with more info.

. . .K2OAW

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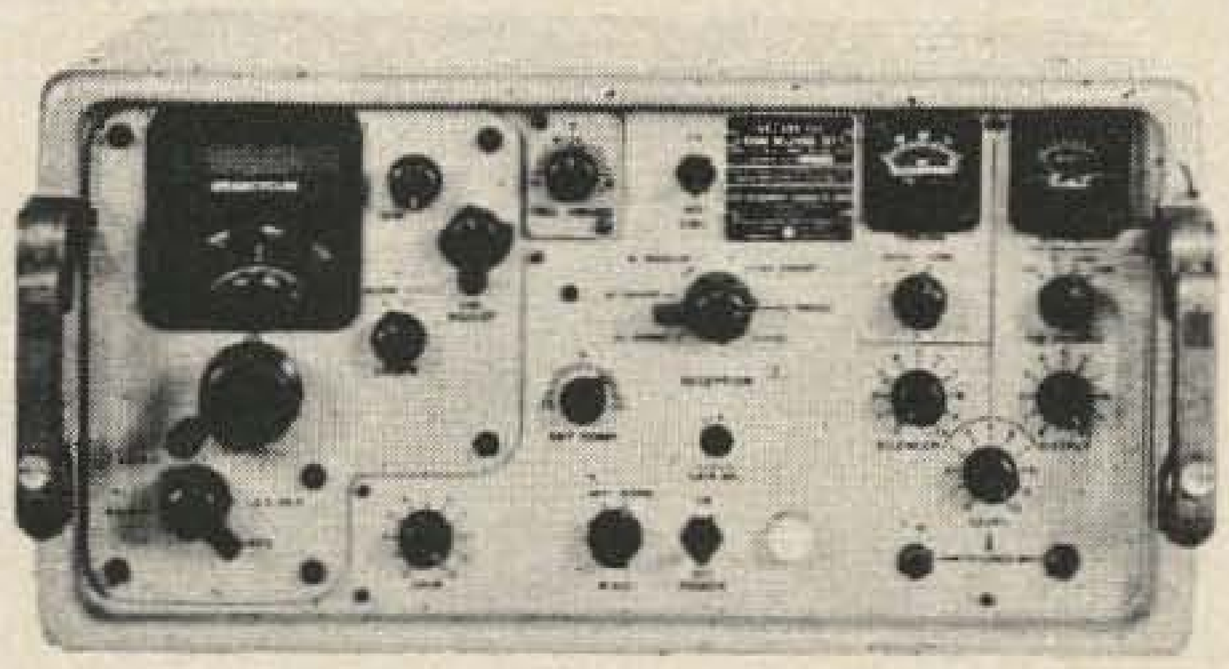

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The Rolls-Royce of currently available surplus VHF receivers. AM, FM and CW over the range of 30-60 and 60 to 260 mHz. Separate front ends provide optimum performance on each band. Three separate I.F. strips provide 20, 40 and 300 kHz selectivity. The 40 kHz I.F. utilizes nuvistors yielding a remarkable system noise-figure. I.F. and video outputs allow spectrum display and analysis. After all this, the engineers found a few extra square inches on the chassis and added a carrier operated relay to activate a tape deck or other external device.

If you will drop us a line, we will send two pages of detailed specs. and a photo of the guts of this beast.

Price, complete. **$400.00**

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SP-600

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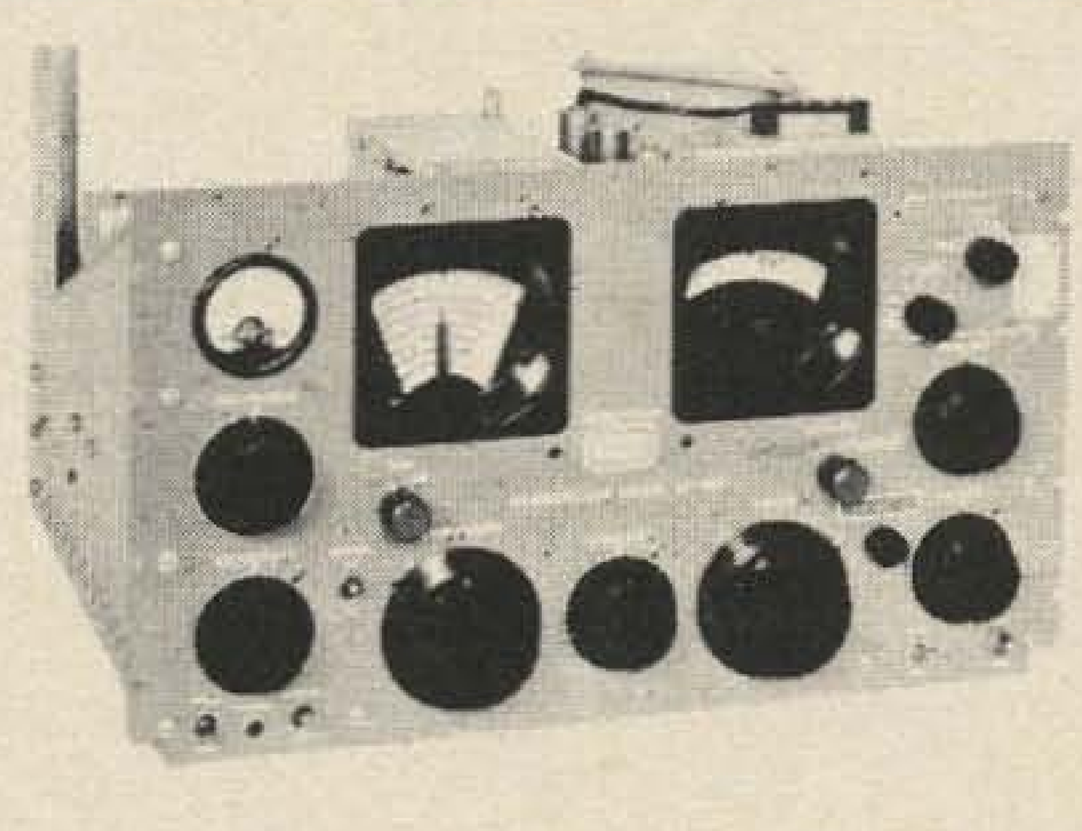


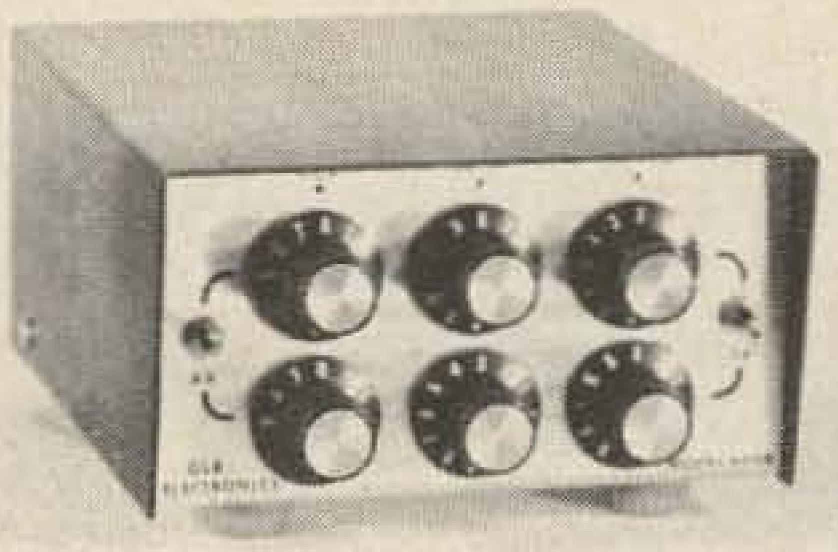
An/Com maintains an extensive inventory of military and commercial equipment and publications. We continuously research methods of utilizing surplus military equipment. Write or call stating your requirements.

(Continued from page 9)
a hold and the speaker wires are right there ready.

The power cord comes with a jack built into it – handy for taking the rig out for changing crystals or using it in the house. You can use one crystal for two or more channels if you are a cheapskate too, with a simple cross wire which you can install in seconds – or take out. This is nice for things like 34–94 and 94–94 pairs.

With all the features one might expect this unit to sell for well over $300 – so it will probably boggle a lot of minds to find that this power house sells for only $249.95. It's the most powerful rig you can buy today unless you get an outboard amplifier. *General Avaiation Electronics, Inc., 4141 Kingman Dr., Indianapolis IN 46226.*

GLB SYNTHESIZER



The GLB Electronics model 400B synthesizer is now beginning to become available to dedicated FMers. This synthesizer is designed to work with most of the popular ham FM transceivers and make them so they can hit any 10 kHz frequency on transmit and receive in the entire two meter band, from 144–148 MHz.

There are two sets of dials for setting the frequencies. One set is used for transmitting channels and the other for receive . . . plus there are switches to reverse this order if you happen to feel like it. Or you can use one set to transceive, if that turns you on.

Once you have plugged the 400B into your transceiver and programmed its output to match your rig's crystal requirements, all you have to do is switch from any channel to any other at will. If you want to use a 31–91 repeater you switch the transmitter dials to 6–3–1 and the receiver dials to 6–9–1. It is that simple! Perhaps you want to check the reverse pair? One flip of the two toggle switches and you are listening on 31 and transmitting on 91. That's handy at times.

The specifications that come with the unit have a lot of details that might interest you, though they have little to do with the use of the unit. Like it uses 350 mA at 10–15V dc . . . takes about 10 milliseconds to lock up between receive and transmit . . . uses the push-to-talk from the transceiver . . . has a frequency stability of .005% . . . size 3" high, 5¾" wide, 6½" deep . . . has enough power to feed even fairly long cables, etc.

The model 400B sells for $130 in kit form and $190 assembled. More info can be had from *GLB Electronics, 404 Cayuga Creek Rd., South Cheektowaga NY 14227.*

The GLB part of the company name comes from Gil Boelke W2EUP and the project is an outgrowth of a group effort by the Buffalo repeater association. Gil has sneakily removed the IC numbers and substituted color codes on the eleven ICs in the unit, so don't expect that you can borrow a unit and make one up for yourself. I don't see much in the way of identification of the 14 or so transistors either.

While it is not quite as fast to work the two sets of switches as it is one channel switch, the total flexibility of the arrangement certainly makes up for the slight additional work. Every repeater is immediately within your reach – every simplex channel – every invert pair – no matter where you go. If you get into a new area you know you can still match anything they can dream up in weird pairs. . .even in Chicago and Los Angeles! – and that's saying a lot.

STANDARD SRC-826M UPDATED

Standard doesn't seem to even try to take advantage of their changes in design. Pity, for they have been making substantial improvements in the unit and the changes should be brought to the attention of the prospective customers.

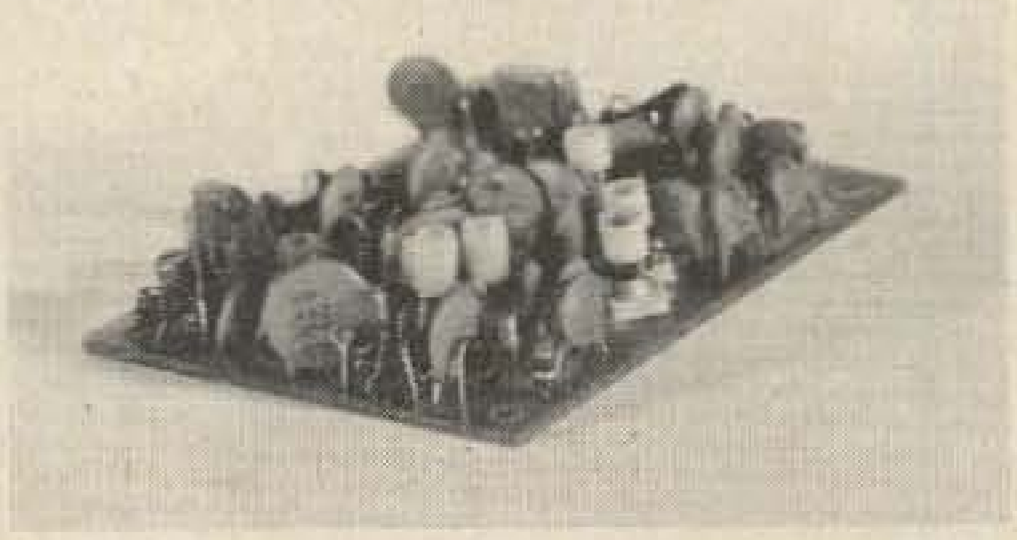
The recent review of the 826 in *CQ* was particularly unfair, with a good deal of space being taken up airing complaints over problems that have been surmounted for quite a long time. The fact is that the Standard equipment that has been sold for the last couple of years has been of excellent quality.

The current model 826 has been changed so that the crystals are right out there in the open when you open a little door in the cabinet. You don't even have to take the rig out of the case to change or tweak crystals now.

Sometime in the last year the 826 crystal deck was changed from its previous vertical position to horizontal. This was a major improvement since it made it infinitely simpler to get in there and tweak those trimmer capacitors. The older model required the services of a malformed dwarf to get into the trimmers – the horizontal board cured all that, putting the capacitors where anyone could reach them. The new door just makes it even easier.

Standard is a bit evasive about the i-f filters they are using, but there is good reason to believe that they have been sending their units along with ever narrower filters. The 826 may have the narrowest i-f on the market today. This makes a big difference when the set is to be used in a major city where the rf pollution is high and where there may even be a 146 MHz repeater output within 30 kHz of the desired channel. Many sets fall apart under these conditions. In situations such as this the reason for paying a bit extra for a transceiver becomes very apparent. *Standard Communications, 639 N. Marine Ave., Wilmington CA 90744.*

2mFM FOR $35.00



As impossible as it seems, there is now a neat little two meter FM transmitter on the market for only $35 – and that is complete with crystal and microphone. We found it difficult to believe at 73 when we received the first announcement of this rig, so we sent for a few of the transmitters, just to see. Sure enough, they arrived, complete with crystals and microphones, ready to go for the frequencies we had specified.

The rig has ten transistors and is built on a pc board only 2½" x 3" – the whole thing is about 3/4"' thick, so it could easily be squeezed into a hand unit . . . or into just about any 2m receiver to make it into a transceiver. It uses an 8 MHz crystal (the crystals for the Standard transceivers will work just fine in it if you want to use more than the crystal that comes with it) and has three triplers, a buffer and power amplifier. The final runs about 0.1 watts with 8 volts on the unit and will go up to a full watt if you run the voltage up to 12 volts – and add some heat sinking to that output transistor. But why run high power when low will do the job, right? The 100 mW seems adequate for most line-of-sight applications.

It took about five minutes to solder some wire leads to the board for the 8 volt power (transistor 9V battery), a 19" "antenna" to the output terminal, and hook in the mike. The rig took off immediately and put out a beautiful signal. Tests were made through nearby repeaters – good reports. A couple of days later, Bill, W1PFA, had one of the little rigs working through the K1MNS repeater.

One of the first "conversions" on my units was to remove the soldered-

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NATIONAL DEVICES

LM370	AGC/Squelch amp	$4.85
LM373	AM/FM/SSB strip	$4.85

LM309K 5V 1A regulator. If you are using TTL you need this one. $3.00

POPULAR IC's

MC1550	Motorola RF amp	$1.80
CA3020	RCA ½ W audio	$3.07
CA3020A	RCA 1 audio	$3.92
CA3028A	RCA RF amp	$1.77
CA3001	RCA	$6.66
MC1306P	Motorola ½ W audio	$1.10
MC1350P	High gain RF amp/IF amp	$1.15
MC1357P	FM IF amp Quadrature det	$2.25
MC1496	Hard to find Bal. Mod.	$3.25
MFC9020	Motorola 2-Watt audio	$2.50
MFC4010	Multi-purpose wide band amp	$1.25
MFC8040	Low noise preamp	$1.50
MC1303P	Dual Stereo preamp	$2.75
MC1304P	FM multiplexer stereo demod	$4.95

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MPF102	JFET	$.60
MPF105/2N5459	JFET	$.96
MPF107/2N5486	JFET VHF/UHF	$1.26
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40673	Dual-gate	$1.75
3N140	Dual-gate	$1.95
3N141	Dual-gate	$1.85

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T50-2 3 cores	$1.00
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in crystal and put in pin sockets so regular FM crystals could be plugged in to change the frequency. That took about five minutes. Next I wired in a little transformer to step down the audio input impedance so I could feed the rig from a receiver and make a midget repeater out of it. For a few days I drove every passing amateur crazy with my tiny 34–94 repeater. It covered Peterborough nicely, which was what I had in mind. That little rig could do a fine job as a low powered repeater if I put it up on the mountain. I note that the German repeater on the Zugspitz has only been running about two watts, and has been used over 200 mile paths.

Perhaps, with the era of these extremely low cost rigs, we may find one-town repeaters becoming popular – perhaps even mobile repeaters may be next.

The amateur interested in simple construction could take this little rig and build it into a hand unit quite simply. He might add a little transistor radio and converter – or perhaps he might work on International Signal to release the receiver boards they make.

These boards are made in the U.S.A. by the same company that puts out the Clegg equipment. They were originally designed for being built into fire hats to provide communications for firemen. When that project was cancelled, International Signal found themselves sitting there with a few hundred midgit transmitters and receivers. Hmmm, they said, would the amateurs be interested in cleaning out these leftovers? They sent out a trial letter to a few hundred known FMers and the answer was a resounding YES! The rigs disappeared instantly. Hmmm,. they then thought – let's see what happens if we advertise them in 73.

At $35 this has to be one of the best bargains ever to hit for the FM amateur.

There has been some talk of using these inexpensive transmitters as another weapon in repeater wars. Imagine the consternation of the repeater mogul who has been crushing co-channel repeaters with high power when he finds that his repeater is being keyed up by short random pulses from well hidden things like this. It could take forever to find them. Such talk is irresponsible and such an approach to repeater problems should not even be considered. There is no King of Repeaters so arrogant that you cannot sit down face to face with him and work out your problems. Well, there may be one that arrogant – but only one, and he isn't *your* problem. No, let's be sure to use these almost throw-away priced transmitters for the benefit of amateur radio, not to further battles.

73 will welcome application ideas for these rigs – conversions – whatever. *International Signal, 3050 Hempland Road, Lancaster PA 17601.*

SOLID STATE REPEATER

Not a few repeater groups are fed up with the miseries of keeping tubes in their converted surplus type repeaters. And how many repeaters sit there and work, month in and month out without requiring almost constant attention? The availability at a very reasonable price of a trouble-free solid state repeater should be welcomed.

Standard Communications has put together a repeater package using the best commercial Standard boards which should be very popular. The unit operates from 12 volts, which means that in most installations there will be a power supply with a good sized storage battery across it – so in case of ac power loss the unit will be able to operate from the battery. The drain is low – about 400 mA on receive and 3 Amps on transmit.

The fellows at Standard have tried to put everything in the repeater that you will need . . . input for the identifier . . . adjustable time out timer . . . external speaker jack for testing . . . carrier delay timer for the squelch tail (or tale, if you like that better) . . . and a remote control jack. The repeater is designed for 19" rack mounting and is only 5¼" high and 9" deep. The output is ten watts – about right for the average repeater. Higher power is rarely needed except to meet the needs of the repeater owners ego and almost invariably leads to the alligator syndrome. If the temptation is just too much and you must have more power, the ten watt output will drive one of the amplifiers available from Tempo and others quite adequately. Tempo has an amplifier in the works designed for repeaters, built on a 19" panel.

There are local controls on the repeater to turn the receive on, the transmitter on, the squelch on, a volume control for the speaker, a repeat-duplex switch, monitor switch and a tone squelch switch.

The price? Under $600. Just barely. *Standard Communications, Box 325, Wilmington CA 90744.*

REPEATER UPDATE

LISTENING 94 76 88 73 70 64 82 . .

AL	WB4QCL	Montgomery	34 – 94
AL	W4MWF	Montgomery	16 – 76
AL	W4QEE	Mobile	22 – 82
CA	WA6ILA	Mt. Oso	28 – 88
CA	WA6RTM	San Miguel	518 – 670
CA	KØPHF	Pueblo	DELETE
GA	WB4WST	Atlanta	34 – 76
HI	KH6FOX	Waikiki	16 – 76
HI	KH6EOL	Waialva	20 – 80
IN	K9HDH	Elkhart	16 – 76
IA	WAØBBQ	Ottuma	34 – 94
KS	WØDKU	Wichita	46 – 94
KY	W4YWH	Covington	19 – 79
MO	WØOKB	Savannah	25 – 85
MO	WAØZIK	Eldon	28 – 88
NJ	K2GCL	Waldwick	25 – 85
OR	K7KGV	Grants Pass	34 – 94
CT	WA1KGK	Bridgeport	DELETE
CT	W1FPT	Trumbull	34 – 94
CT	WA1KHA	Manchester	04 – 64
CT	WA1OXW	Fall River	28 88
	(Change from W1RGG)		

HOT GEAR

Saul A. Cohen, K4ACJ, reports the theft of a Swan Cygnet Model 270 transceiver S/N 313022 and a Collins MIC Model MMs S/N 4294. The equipment was stolen from his car in San Francisco on June 4.

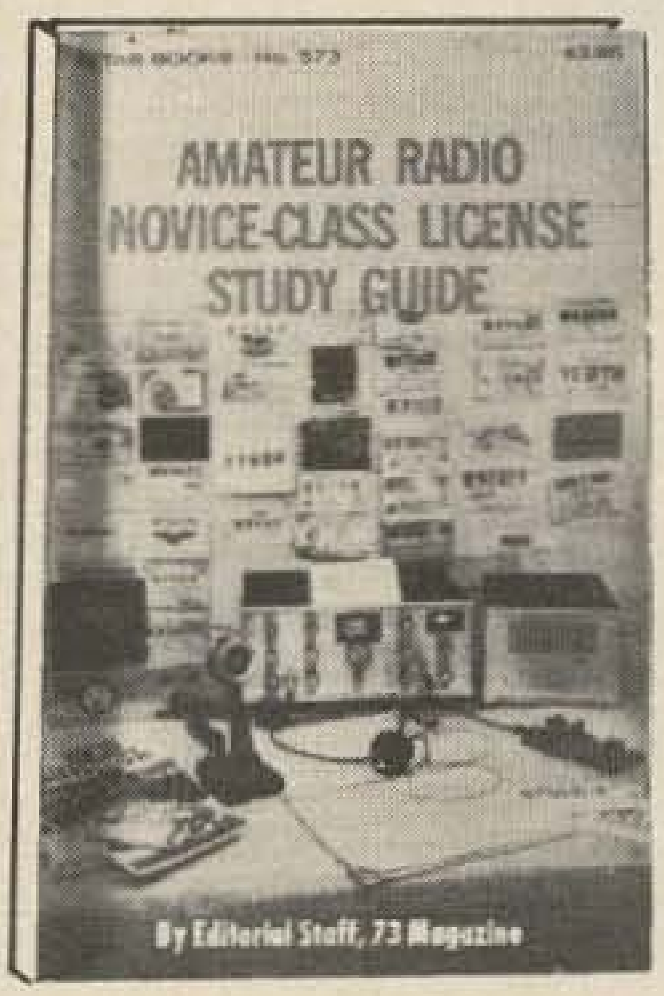
Contact Saul A. Cohen, K4ACJ, 4524 Michigan Ave., Miami Beach FL 33140. (305) 531-9782.

Roger W. Coulson, WA1NVC, 31 Rosedale Road, Watertown MA 02172 reports the theft of his 11 channel HR2A, No. 04-07152.

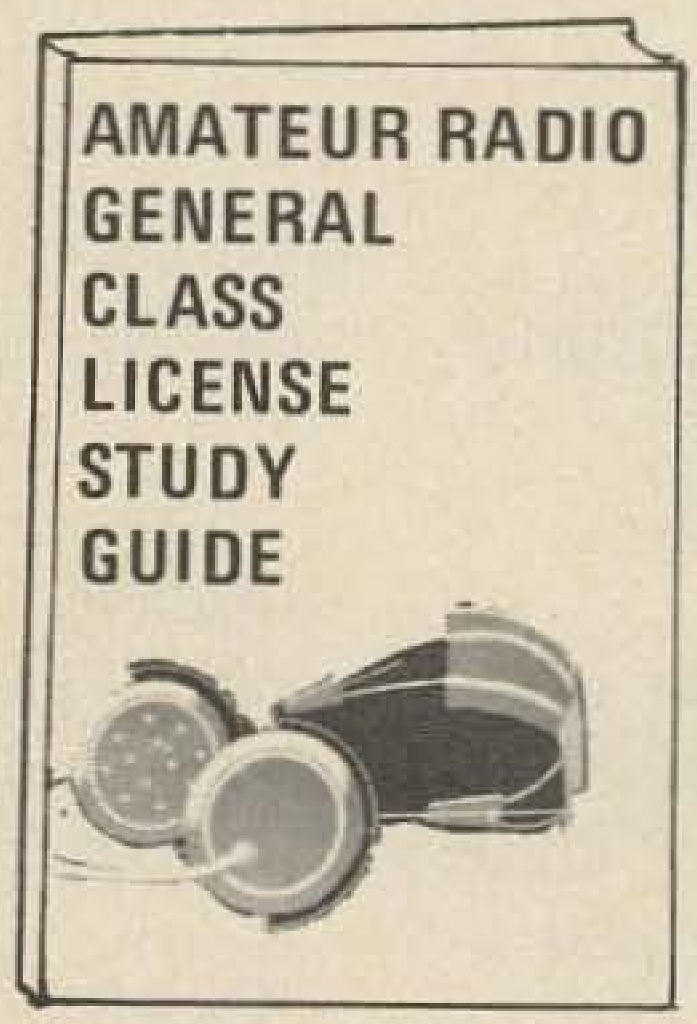
List from Past Issues:

Mfr., Model, Ser. No.	Owner	Issue
Halli, SR46A, No.446100	WA1EMU	9/71
Reg., HR-2, No.04-03505	WA5BNM	11/71
Sonar, FM3601, No.1003	WB2ARM	11/71
Coll., 75A4, No.804	WØMGI	12/71
GE, Portable, No.1041218	K2AOQ	1/72
Coll., 75SE-B, No.15640	Col.St.U.	1/72
Coll, 21S3, No.12000	Col.St.U.	1/72
Coll., 516F1,No.1649	Col.St.U.	1/72
Simp. Mod-A, No.35457	W2PWG	1/72
SBE SB-33 No.103906	WA5JGU	2/72
Heath HW22A No.907-1835	W1BDX	2/72
Nat'l HR050 No.280019	WA5DQF	2/72
Halli., SR160 No.416000-108039	K9YVA	2/72
Drake TR3 No.3858	WA9EYL	2/72
Coll., KWM2A No 13815	ARRL HQ M. Godwin	2/72
Coll., 312B4 No.59920		
Coll., 30L1 No. 40084		
Coll. MPL No. 44507		
Coll. MM1 (mob. mike)		
Misco minispkr.	Sgt. Hopkins Wilm. DE Police	2/72
Swan SW174 No. 416-5	WØAXT	2/72
Reg. HR2A No.04-05896	K4GBL	2/72
Heath SB102,No.132-128107	W.Singer Woodbridge VA 703,491-2257	3/72
Yaesu FT-101 No. 107036	WA2YSW	4/72
Standard 2m FM No. 102703	W6NPV	4/72
Drake ML2 No. 20189	WB2LLR	4/72
Standard SRC-806M No. 009210	K1TLP	5/72
Aerotone 6M 355LT, No. 685064	RR Police Grd.Ctrl.Trml. NYC	5/72
Standard SRC-806M, No. 102703	C. Mathias 3234 Coronado Ave Imperial Beach CA	5/72
Lafayette HA-410 No. 009210	WA2KDG	5/72
Coll., 62S1 No. 10728	MSU ARC E.Lansing MI	6/72
WRL Duo-Bndr 6010AT302	WA6FCY	6/72

Free Free Free Free Fr

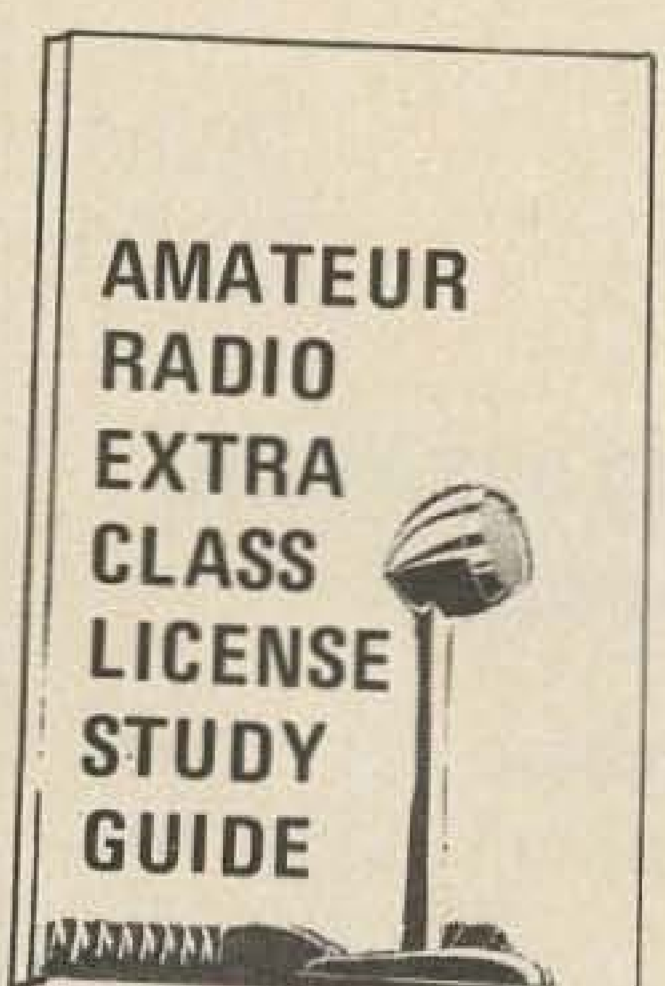


A The Novice Class License Study Guide has not yet been published in 73 or in any other magazine. This book contains all the basic technical information need to pass the Novice License with flying colors. . .and is invaluable as a basic text for understanding the General Class Study Guide. Profusely illustrated and so clearly written that just reading it is enough to permit most applicants to pass their exam. $3.95 value.



B The 73 General Class Study Guide has helped thousands to easily pass their General License the first time through. At $9 a whack, isn't it foolish not to hedge your bet with this comprehensive and simple book? No other study guide is as complete or as easy to read. None. A $4.95 value.

C The Advanced Class Study Guide has proven to be the only complete text for preparing to pass the Advanced Class license exam. Never before has radio theory been made so simple. After just reading this book it is almost impossible to fail that exam. And remember that in addition to the trouble of going to the FCC to take that exam, there is a little matter of $9 you have to ante up. Why take a chance on failing? $5.95 value.



D The Extra Class License Study Guide makes all that complicated electronic theory seem simple. A little study with this book and you will be ready to face the FCC examiner with confidence. A $4.95 value!

E The 73 DX handbook has every DX aid you could hope for. . .QSL Bureaus, postage rates worldwide, DXCC and WTW country lists and record pages, maps of many areas of the world with prefixes, plus a complete wall-sized world map with each book! It is profusely illustrated with pictures of many of the top DXers, plus articles on working DX on the different bands. There are great circle bearing maps and charts, and more. . .more . . .more.

F The FM Anthology has reprints of all the articles and technical data from the early issues of the FM Journal. No FM library is complete without this data, much of it just not available elsewhere. $5.95 value.

G The BEST of FM is a compilation of the best articles that appeared in the FM Journal from March 1968 through June 1969, the last of the magazine. Read the extremely controversial Chronicles of 76. Plus dozens of technical and circuit articles available nowhere else. $4.95 value.

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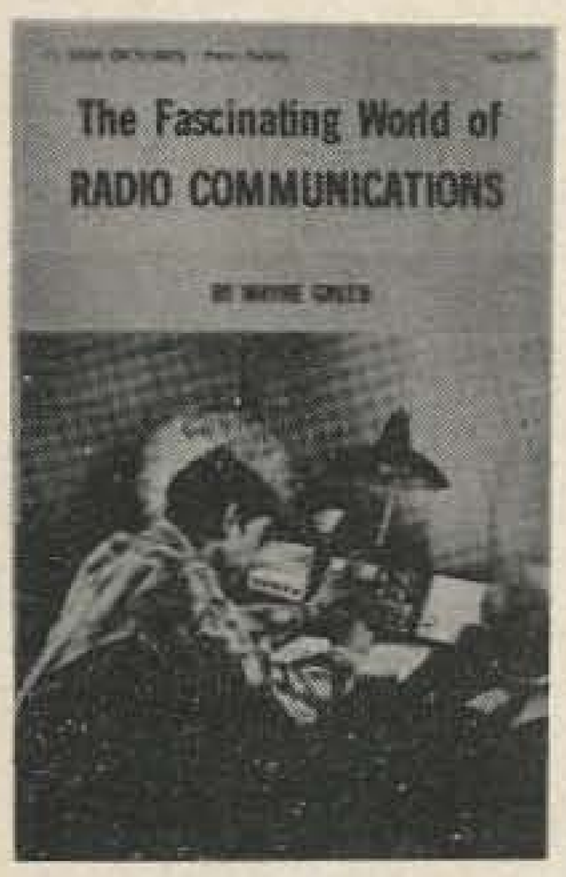
J Solid-State Projects for the Experimenter contains over 60 projects taken from the pages of 73 Magazine. Build a Six-Meter Fet Converter. Or, maybe a ham TV receiver. It's all here. $3.95 value.



K The Fascinating World of Radio Communications is an introduction to radio communication. This book gives you some of the history of radio communication and an idea of what you can expect from your new hobby. $3.95 value.

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Over 3000 great articles have appeared in our back issues and most of them are just as good today as the day they were printed. You will have the time of your life reading all those wonderful issues you missed. We have separated the back issues into three packages, issues from 1960–1964 (I), 1965–1967 (II), and 1968–1970 (III). These back issue bundles are put together by illiterate apple pickers borrowed from other ham magazine staffs and thus there is no possibility of our guaranteeing any particular issue in your bundles . . . you take pot luck. Due to the $12 value that we are making available in these back issues packages (12 different back issues in each package), we must ask that you foot the shipping charges.

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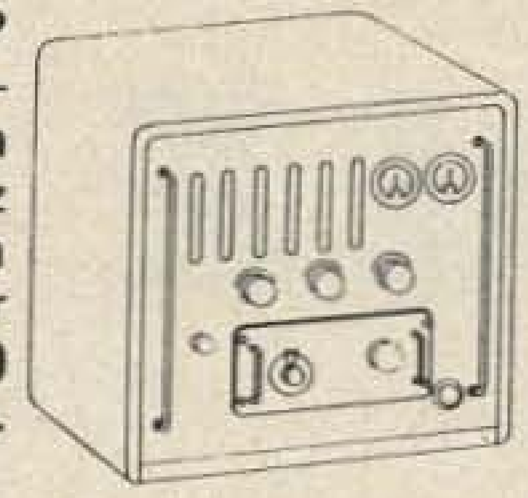

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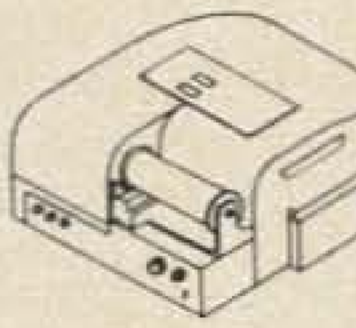

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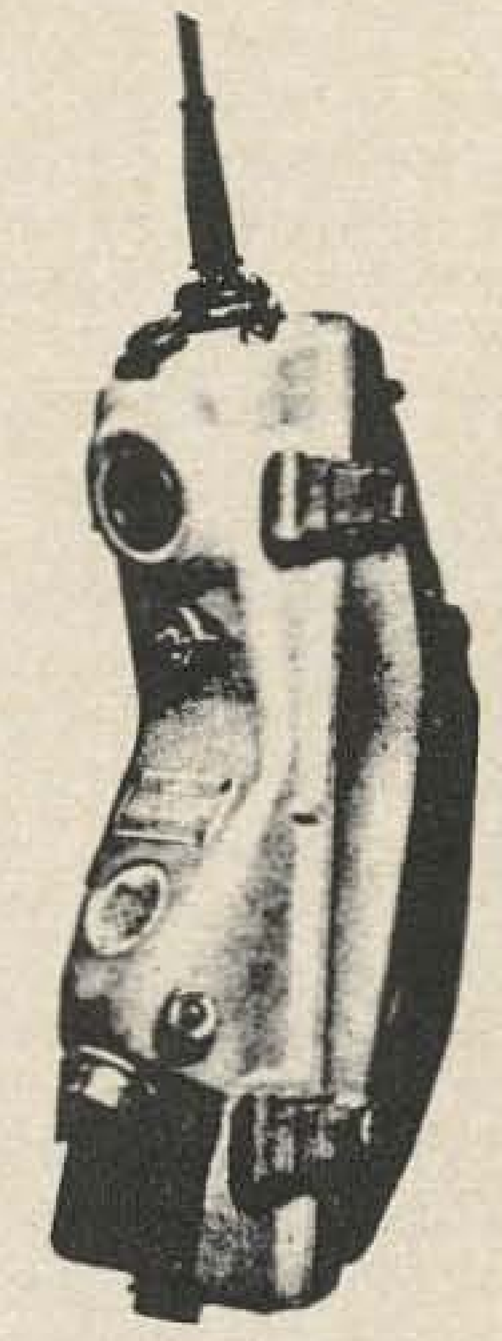
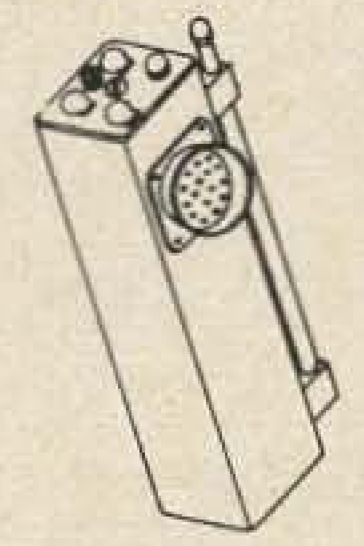


Walkie talkie solid state HT1E manf. by Hallicrafter used in Viet Nam 30 to 50 kHz AM. Can be put on citizen band or converts to 6 meters powered by flashlight batteries. Size 12" x 3" x 3" with schematic. $35.00 ea.



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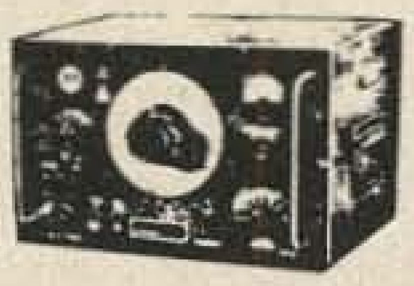

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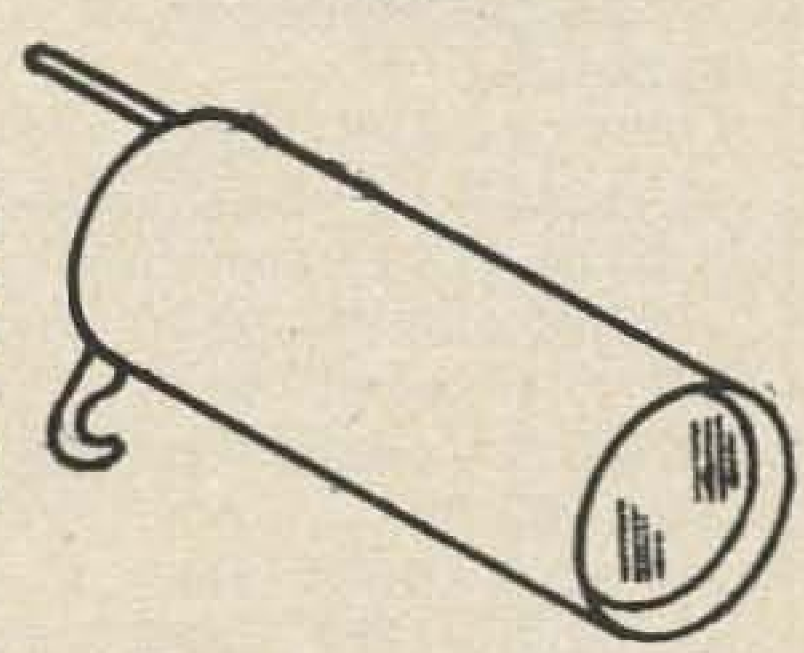
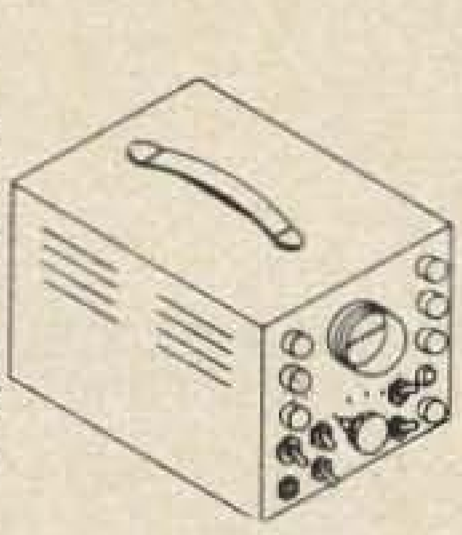


Stereo Scope Indicator. Compact 3" scope unit with 110 VAC supply; many used for teletype distortion. Ind. converts to panadapter or stereo output indicator. (Sit back and watch changes in pattern on the scope.) With conversion $24.50



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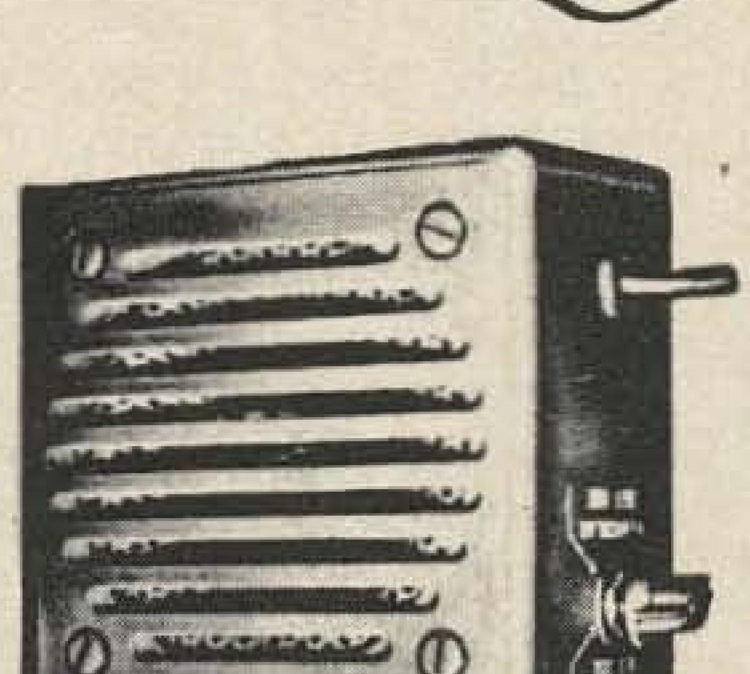

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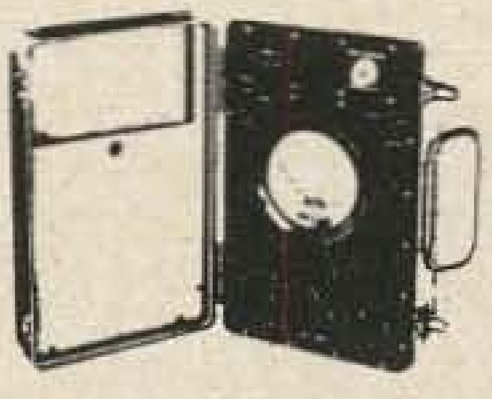

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LETTERS

For the past 3 or 4 years, I have been reading, off-and-on, every ham radio magazine I could find. Last year, a good friend introduced me to 73. Having seen them all, and read them all, I feel that 73 is just about the best there is. I therefore respect your opinions.

For some time, I have been studying for the license, but personal problems always restricted my time. Now I am finally catching up on my code.

Here's my question: If I can achieve 13 wpm (I think I can) would you suggest I try for a General rather than Novice? I have sufficient electronic background to pass the theory. I have heard various arguments for and against; some say that something is missed if one doesn't go through at least a few months as a Novice. What's your opinion?

Dan Case
Erie PA

It sure would be a shame to miss having to buy a bunch of equipment for the Novice bands that you won't need later as a General – and to miss out on the frustration of operating with crystal control (unless you get the Microcomm). . . and all the other miseries that turn Novices away from amateur radio so they never even get a chance to find out how much fun can be had. Don't miss this educational approach to amateur radio.

I disagree with what was said by W7AR in his letter of July 1972. SSB is the most efficient way to transmit information. It takes up exactly the same amount of space in the spectrum as does the original information. The reason that we need so much spectrum space to carry voice (about 3 kHz) is the tremendous redundancy of speech. The redundancy has its advantage. As in all information transmission systems, redundancy helps eliminate errors. If we have a clear frequency and want to send the most information in the least time, using the minimum bandwidth, we are forced to go to a language with less redundancy. Such is the language of RTTY. With RTTY, you can send more information per unit time per unit bandwidth than you can with voice.

As we increase the bandwidth required by our signal, we increase either the speed of information or the redundancy of the signal. Therefore, I believe that the new breakthrough in communications will not be a new type of modulation, but rather a new language to apply to our old type of modulation.

The reason we don't divide down our voice frequencies for transmission, then multiply them back up upon reception can be explained in several ways. One is that it is not possible to send the same amount of information in the same amount of time on a narrower bandwidth. Another explanation is that all rf multiplication and division is done assuming that the signal is digital, either on or off. This is fine for FM, where there are no amplitude variations, but it will only cause tremendous distortion to AM where amplitude varies.

One way to make voices on SSB sound better is to slow down the transmission speed. Before a QSO, record everything you want to say on tape at 15 IPS. Play it back on the air at 7½ IPS. Have the fellow at the other end record at 7½, then play back at 15. He will find the frequency response to be almost twice as good. We used the same bandwidth at a lower speed.

There seems to be quite a bit of confusion about amplitude modulation (which SSB is). A couple of months ago, Wayne wrote, "How come if you vary the level of the carrier, the carrier doesn't change level," or some such thing about AM. I have almost completed an article that explains all this with a little trig and algebra. Also, I explain the phasing method of generating SSB and the advantages of AM. Yes, AM does have some advantages (redundancy strikes again), but we must use a different detector to take advantage of them. Is 73 interested?

Harold Hallikainen WA6FDN/6
San Luis CA

I don't work 220 yet, but it burns me up that anyone would ever think of giving more privileges to the CBers. Amateurs have to work to get a license, take a test, and keep a log. Why does the FCC push us around?

All a person has to do to be a CBer is fill out a paper. When he signs his name, he can use the band for anything he wants. Excessive power, foul language and illegal antennas – he can violate any rule he wants and the FCC doesn't say much. But, if an amateur violates a small rule, his license is revoked or he is fined.

I think the FCC should crack down on CBers and stay off our backs!

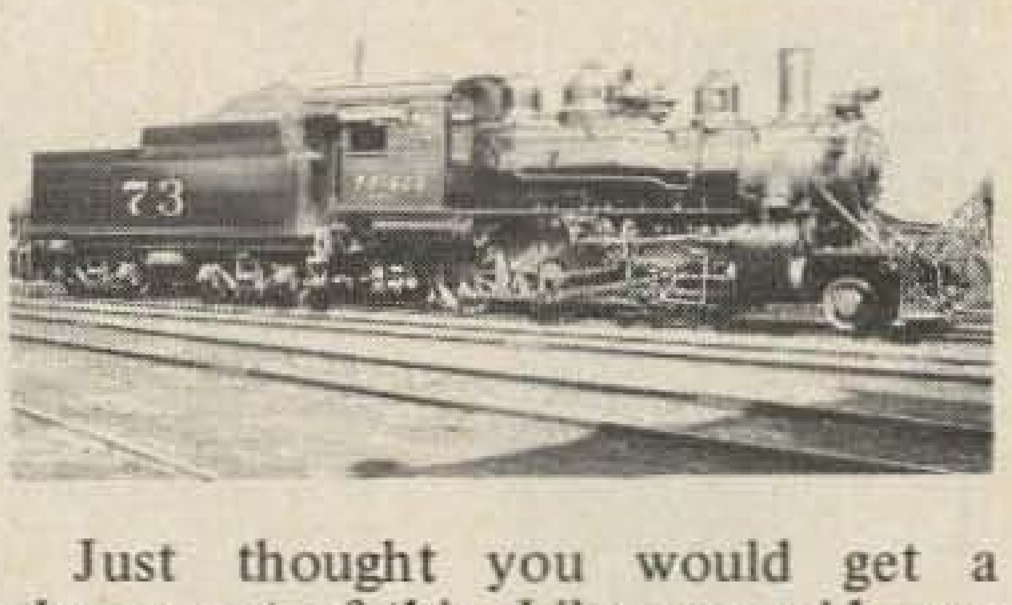
By the way, I think 73 magazine is the best magazine for me! I really enjoyed "Step on the Klutz" by Bob Manning.

Al Wilson WN8LUD
Riverview MI

What really pushed me over the hump to subscribe to 73 was Bob Manning's article in the June issue. Perhaps mine, as well as other ham's subscription, will replace the one that Carl Emerson cancelled.

Thank you and keep up the good articles that are of a general nature and of assistance to the Novice as well as the 2 meter fans.

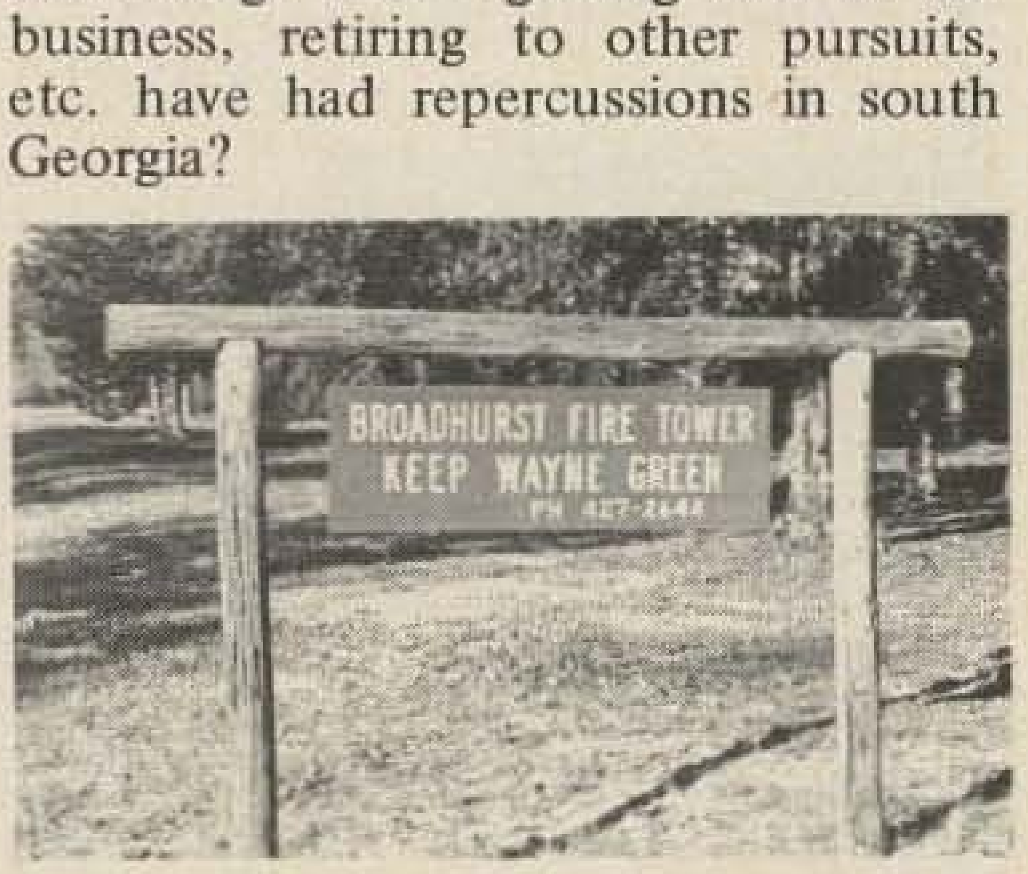
M. June Zenge WL7HKA
Ketchikan AL



Just thought you would get a charge out of this. Like you said, you never know where 73 will pop up next. This shot was taken in 7-46 at the Frisco Roundhouse in Memphis TN. The engine was built in 1912 and scrapped about 1950. So I hope you're around that long.

Don Wirth WB0ECM
Maplewood MO

Could it be that your periodic mumblings about getting out of the business, retiring to other pursuits, etc. have had repercussions in south Georgia?



This photo is of the sign erected at the base of a fire lookout tower located on busy US 301 in Wayne County, Georgia, about 50 miles north of the Florida border.

Read and heed!

M. Wayne Street, Jr. K4QEX
Savannah GA

Great cover on June issue. Let's see more.

Richard Rosenbaum WA2AOI
Jamaica NY

I'm very interested in ham radio and enjoy your magazine.

I m writing concerning the article "OSCAR MARINER on MARS" published in the May issue, in which I understood that there was a manned spaceflight to Mars. Has there really been such a flight? Or, was this article some idiot's idea of fiction?

OPEN FRAMEPLATE TRANSFORMERS
INPUT: 105, 110, 115, 120, 125 VOLTS – 60 cys.
SECONDARY: 3200 VCT @ 1 amp.
SIZE: 9¾" x 10½" x 10½" NEW
SHIP. WT. 100# PRICE: $49.95

TOROID TRANSFORMERS
MOST VERSATILE WE EVER HAD
3½" RD. 3" H
WT. 3#
4-14 V INPUT WINDINGS
4-5V FEED BACK WINDINGS
2-333V – 1/2 amp. WINDINGS
2-167V – 1/2 amp. WINDINGS
WILL SUPPLY 1000V @ 1/2 amp.
CAN USE ANY COMBINATIONS OF ABOVE.
SHIP. WT. 5# PRICE: $5.95 or 2/10.00

UTC–DOT–7
200K–PRI.
1K–SEC. PRICE: $1.50 ea. or 4/$5.00

UTC–DOT 9 600 OHMS C.T. SECONDARY
10K PRI. PRICE: $1.00 ea. or 3/$2.50

TRANSFORMERS
115V INPUT
10 or 20 V.C.T. OUTPUT @ 1/2 amp.
SHIP. WT. 1¼# PRICE $1.50 ea. or 3/$5.00

SOLA CONSTANT VOLTAGE HARMONIC NEUTRALIZED TRANSFORMERS
INPUT: 110 or 220
OUTPUT: 118
RATING: 250 VA 2.12 amps
ELIMINATE BROWN OUTS
PRICE: $19.95

TRANSFORMERS STANCOR
F 610 6.3 VCT @10 amp. 115V INPUT 60 cy.
SHIP. WT. 5# PRICE: $2.95

DIODES
1 amp. BULLET TYPE w/ SILVER LEADS 600 P.I.V.
PRICE: 10/$1.00 or 110/$10.00

VARIACS
5 AMP. GENERAL RADIO TYPE V5 NEW
PRICE: $6.95 or 2/$12.00

TRANSISTORIZED POWER SUPPLY
ADJUSTABLE, REGULATED & METERED
0–20 V @ 5 amp. SHIP. WT. 28# PRICE $14.95
0–15 V @ 1.5 amp. SHIP. WT. 11# PRICE $9.95
0–12 V @ 10 amp. SHIP. WT. 28# PRICE $19.95
EXCELLENT CONDITION

ROTRON FANS
SAUCER FANS
280 CFM 7" DIA. x 2½" DEEP 115V–50–60 cy.
PRICE: $9.95 EA.

FEATHER FANS
270 CFM 7" DIA. 2-7/16" DEEP
PRICE: $6.95 EA.

SPECIAL
T.S. 323/UR
PRICE REDUCED . . . .$49.95 w/ CAL. BOOK
Excellent Condition

MINOR REPAIRS NEEDED
T.S. 323/UR
ALL HAVE CAL. BOOKS BARGAIN NOT JUNK
PRICE: $24.95

UTC TYPE TGR
TELEGRAPH TONE FILTERS. WE START AT 765 & GO TO 2805. HAVING THEM IN 170 CYCLES STEP.
LIMITED QUANTITY PRICE: $11.95 ea. 2/$20.00

ALL PRICES ARE F.O.B. OUR WAREHOUSE, PHILADELPHIA, PA. ALL MERCHANDISE DESCRIBED ACCURATELY TO THE BEST OF OUR KNOWLEDGE. YOUR PURCHASE MONEY REFUNDED IF NOT SATISFIED. TERMS ARE CASH. MIN. ORDER $5.00. ALL MERCHANDISE SUBJECT TO PRIOR SALE. RFE – REMOVED FROM EQUIPMENT.

WINTRONIX MODEL 850 INDUCED WAVE FORM ANALYZER. This unit, in conjunction with your present oscilloscope, permits you to view wave forms in the range from audio thru MHz without any direct connection. The probe is simply placed over the tube in question and the wave form is displayed on the oscilloscope. It may also be used as a high gain amplifier to increase 'scope sensitivity. Excellent for T.V., radio, amplifier, and transmitter repair and maintenance. Brand new, with probe.
SHIP. WT. 13# PRICE: $19.95 ea.

AMPEX RF-3
COMPLETE MEMORY – RACK MOUNTED IN CABINET. INCLUDES POWER SUPPLY – SENSE AMPS – READ & WRITE CIRCUITS. ALL I.C. LIKE NEW.
SHIP. WT. 200# PRICE: $1000.00

MEMORY CORE STACKS
32K
42K
SHIP. WT. 100# PRICE: $99.50

IC BOARDS
962 936
946 933
948 951
EACH BOARD HAS 3 OF ONE TYPE OF ABOVE
PRICE: $2.00 ea. or 3/$5.00

IC BOARDS
15 IC ON BOARD TYPE 900 – 914 & 923
PRICE: $2.00 ea. or 3/$5.00

14 PIN DUAL INLINE
IC SOCKETS GOLD PLATED CONTACTS.
PRICE: 50¢ ea. or 5/$2.00

METERS
0–150V AC 3½" NEW PRICE: $3.50 or 2/$6.00
0–500V DC 3½" NEW PRICE: $1.95 or 3/$5.00
0–1.5 MA DC 3½" NEW PRICE: $1.95 or 3/$5.00
0–10V DC 3½" NEW PRICE: $1.95 or 3/$5.00
0–300 amp. DC 50 MV FSWD/SHUNT
PRICE: $2.50 or 3/$6.00
0–50 UA 2½" RFE PRICE: $2.50

METERS PANEL TYPE WESTON MODEL 1238
0–500 microamps full scale calibrated .005 to 500 roentgens/hours. 270 degree scale, approx. 3" dia. excellent for wavemeter etc. New and in original boxes.
PRICE: $1.95 ea. or 3/$5.00

#360 TEKTRONIX WAVE FORM INDICATOR
bandwidth DC to 500 KC. Sensitivity .05/DIV. 50V/DIV. waveforms required for hor. deflection.
Size: 4" x 12" x 14"
#160A regulated power supply for above indicator.
Size: 4" x 12" x 14"
#162 wave form generator for above indicator.
Size: 4" x 12" x 6"
SPECIAL PRICE FOR ALL 3 UNITS
SHIP. WT. 35# PRICE: $99.95

CAPACITORS
65,000 MFD 5V
25,000 MFD 25V
20,000 MFD 30V
40,000 MFD 10V PRICE: 3/$1.00 or 10/$3.00

MODIFICATION KIT 110896 TO PROVIDE OPERATION OF MODEL 14 TD @ 100 wpm FOR GOVERNED MOTORS. NEW. PRICE: $6.95

R 11A LOW FREQ. RECEIVER 190–550 KC
modern Q 5'er.
SHIP. WT. 8# PRICE: $7.95 or2/$14.00
#R 48 REC. freq. 230–250 mc.
SHIP. WT. 45# PRICE: $24.95
#T282 D/GR trans. freq. 225–400 mc.
SHIP. WT. 150# PRICE: $39.90

400–550 MC RECEIVER Xtal controlled, 4 section through line – Front end w/crystal mixer. 5 stage I.F., 28V. input, D.C. to D.C. toroid inverter P/S. Subminiature tubes – 1-5636, 1-5896, 2-6111, 3-5718, 4-6205. 4 miniature Babcock relays, and toroid bandpass filter. Heavy alum. watertight case. 6" x 8" x 10"
SHIP. WT. 18# PRICE: $9.95

1206 South Napa Street
215-468-7891
SELECTRONICS
Philadelphia PA 19146
215-468-4645

MORE LETTERS

I am interested in factual information on all phases of radio communication and if this was the author's idea of a joke, then 73 has no place on my bookshelf; it will be 73 to 73 with no 88.

Hilda Dip Chan
New York NY

I have tried all the ham magazines and 73 is still the best all-round publication. Some are all news, some are for geniuses, and some are UGH! half CB. Almost all of the articles in 73 are within my meager knowledge. I am a hard core appliance operator.

My favorite series was the General Class Study Guide. I really enjoy the articles written by fellow hams and I hope they will continue.

Thomas Grabowski K3SPY
APO San Francisco

In answer to your card asking for a renewal on my subscription, I would like to state that I am not renewing this year. I have nothing but complimentary things to say about the magazine and I am sure that it fills a need for many amateurs. However, since I am not in the least interested in RTTY, SSTV or the higher frequencies, I am left with little of interest other than the editor's tiffs with CQ.

Roger W. DeBusk M.D.
K8LSG

I enjoyed solid state construction and Bob Manning's articles are very very good – really enjoy them.

Keep plugging away for us as your efforts are greatly appreciated.

Jack L. Zimmerle WB4QXI
Huntsville AL

You might want to mention in your excellent publication that copies of a U.S. Air Force Medical Service Digest article on Navassa Island activity in February, 1971 are available free of charge by writing to: Richard J. Brown WØEXD/KC4, Pathology, Bld. 626A, NAMRL, Pensacola FL 32512.

Would you like to know why I decided to subscribe to 73? Well, in addition to the articles and ads, both interesting enough, it was the letter by P.T. Atkins, WB2OZW in the March issue. It was the hope that ham radio can have that quality and lead to those kinds of contacts that got me into the business in the first place, which has been confirmed by some great moments within the limited opportunities of the Novice privileges, and which makes me determined to get that General! So, I concluded that 73 would also be of some help to that end.

David A Fee WNØEWE
Brookings SD

I think your magazine is the best. Since you reach a lot of people, maybe one of them can help solve my problem. I've exhausted all the amateurs in this area.

I have a 1969 Chevrolet custom camper with a 396 engine; 18,000 miles on it. In 16,000 miles, I have burned up 6 sets of points and 3 sets of plugs. Even that isn't so bad. The real problem is how to get rid of the S7 level engine noise.

Hope someone can help me.

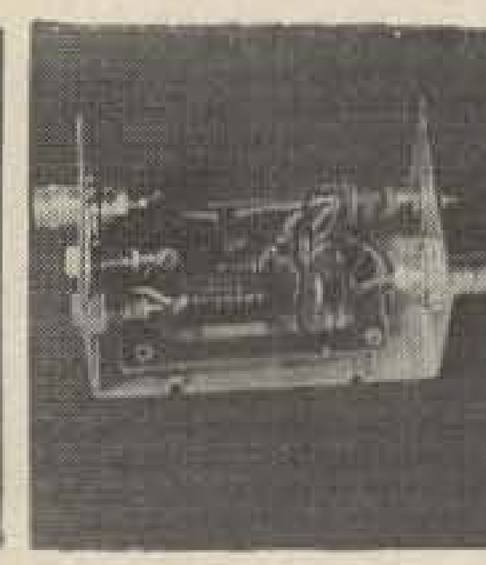
Keep up the good work.

Roy R. Edmiston WA7LUX
Henderson NV

I read about Al Smith (W1GAA) and his problem concerning pirates in the ham business in the June Letters column. I have had a couple of similar experiences and the Post Office handled them with excellent success. In fact, it surprised me. All you have to do is go to your local Post Office claim office with bona fide evidence (cancelled check) and a copy of the order or any correspondence. Tell them all about it and I'm sure action will be forthcoming. No attorney fee either. Hope this is some help in getting your hundred bucks back.

Guy C. Long K9DOF
Elkhart IN

I built the VHF Scaler described in the June 1972, 73 and thought you might be interested in the final construction.



The two photos show the layout in detail. I eliminated the divide-by-100 IC. The unit is powered by a lantern battery. I have already pointed out an error on the bias resistor that was shown as .18k (properly 180 ohms). Incidentally, I have yet to hear from the author on the subject. It would seem that the author should be required to answer and answer promptly; who else can the constructor turn to for answers. If there is any further interest, please feel free to contact me.

Joseph F. Dineen W1JSS
Westwood MA

The idea that you brought out in your recent editorial "Going Through Channels" is really worth a lot of thought and a trial.

A similar idea that may also be worth study and a trial would be to use specific frequencies or channels in each of the high frequency bands for tune-ups. This could decrease the QRM throughout the band by concentrating that form of interference at specific spots. These could be, for instance, in the 7 MHz at 7050, 7225, and 7275. The idea would be to use a standard frequency for this purpose and have enough of them through the band so that the transmitters would still be in tune when the operator goes over to his operating frequency.

This would be similar to the procedure that's used on some nets of having everyone tune-up on net frequency at a specific time just before roll call. This net tune-up, of course, would not apply to an all day net like ECARS. That net operates much more effectively if people tune-up on another frequency; yet, when they do so they are likely to tune-up on someone else.

One idea that fascinates me is operating cross band between two meters and ECARS on 40 meters. It seems to me that it would be fascinating to check in and monitor ECARS on 2 meter mobile.

I enjoy your editorials and your magazine. I think it is the best of the bunch. The other magazines are good, but you are to be commended for being more progressive and innovative. In these times of change we need a magazine such as yours with an editorial staff that is adaptable to the new circumstances of the day.

Keep up the good work.

C. W. Tazewell W4NGU/3
Baltimore MD

On page 34 in the May issue is a mistake which has appeared in your magazine at least 100 times. (This is not much of an exaggeration.) Examine Fig. 5. When you use half of a center-tapped transformer you do NOT obtain one-half of the impedance! For gosh sakes, folks, I cannot understand how a magazine sophisticated enough to include many complicated IC projects can constantly fail to catch this silly, stupid error. It's usually in at least every other issue! Stop it! By perpetuation of this you are doing the industry harm.

Clyde Wade
Little Rock AR

Look here Clyde, you know and we know that halving the winding does not halve the impedance, but since it stands to reason that it should why make waves? Don't be a trouble maker all your life. Besides, this is the only thing that one hundred different 73 authors ever agreed on, so why try to spoil it?

BETTER THAN POT!

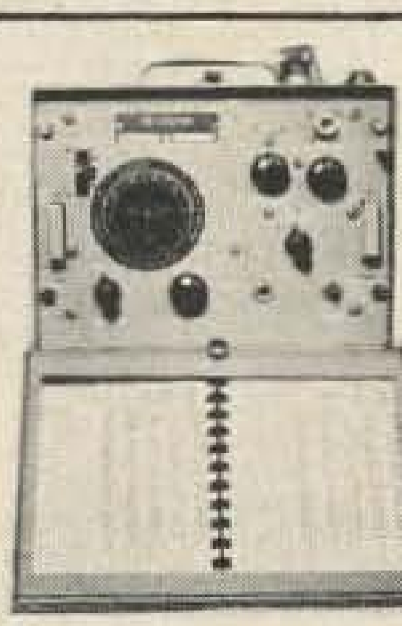
Being a college student means I have to give up many things (like sleeping at night, which I probably wouldn't do anyway). However, at the risk of not eating for the next week or two, I have to renew my subscription to 73 (besides I wouldn't want the staff to starve). At any rate, I would completely lose my mind if I couldn't read 73 every month. I have to have at

COMPUTER KEYBOARD W/ENCODER $35

Another shipment just received. Alpha-numerics keyboard excellent condition. Once again we expect an early sellout. Price of $35 includes prepaid shipment in the US and shipment made within 24 hours of receipt of order.

COMPUTER KEYSWITCHES

Another fantastic bargain for the builder. We have brand new bounce-less micro switch keys, spares from the above units, less key-tops. Make up your own keyboards. Made for PC mount. Package of 48 brand new key-switches only $12.00 postpaid.



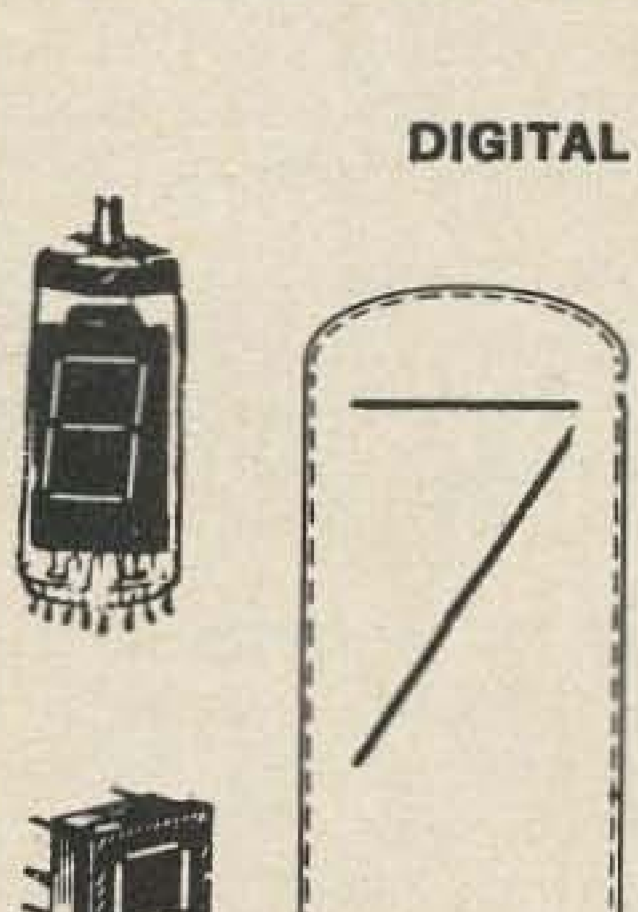
TS 323 FREQ. METER

Similar to the familiar BC 221 except this one covers range of 20—450 mc. Accuracy .005% Used, guaranteed OK, less batteries, with schematic. TS-323 ship sgt 35 lbs. $50.00

POWER TUNEABLE VARACTOR $5.00

Similar to MA-4060, used in doublers, triplers, amplifiers, etc. Fully guaranteed, with specs and some circuits. $5 each or 6 for $25 pp.

DIGITAL READOUTS



GE Y 4075 25V Miniature $1.75

GE Y 1938 24V Standard $1.75

RAY CK 1905 Standard $1.75

MAN-3 1.7V Miniature $3.50 ea. 10/$30

GIANT ALPHA NUMERIC B7971 $1.75

MAGNO-NONRESTRICTIVE MEMORY

Good for 7116.5 bits storage. Like new. $10.00

LASER DIODE 3 WATT

RCA TA-2628 w/specs. $5

ROPE MEMORY MODULE

From APOLLO project $10

1,000μF 450V CAPS

For photo flash or linear power supplies $1.50 each. 10/$12

LASER DISCHARGE CAPS

Brand new Laser Storage high speed discharge caps. 40μF at 3KV. each $10

GOV'T SURPLUS OPTICS

6" f/6.3 METROGON wide-angle lens (73° angle of view). In cone with shutter; fabric shipping trunk included. **$15.00.** Filters, red or yellow, **$3.00 each.**

6" f/6.3 METROGON wide-angle lens (73° angle of view). In cone with electric Rapidyne shutter. **$25.00.** Filters, red or yellow, **$3.00 each.** Fiberglass shipping trunk, 21" by 18" by 13", **$20.00.**

24" f/6 lens assembly in K-17 cone with shutter and iris. **$30.00 each.** Filters, red or yellow, **$5.00 each.** With electric Rapidyne shutter, **$40.00.** Fiberglass trunk, 26" by 30", **$25.00.**

36" f/8 lens with cone, iris, and shutter, With electric high-speed Rapidyne shutter, **$49.00.** Filters, red or yellow, **$5.00 each.** Fiberglass trunk, 26" by 20" by 13", **$25.00.**

12" f/4 Perkin-Elmer lens with electric high-speed shutter, **$40.00 each.** Filters, red or yellow, **$5.00 each.** Aluminum trunk, 21" by 18" by 13", **$20.00.**

24" f/4 (write for particulars), **$100.00.**

12" f/2.5 Aero-Ektar K-37 camera. 41° angle of view. With light-sensitive shutter trip control. Choice of A5A or LA-21 magazine. **$125.00.** Fiberglass trunk, 24" by 24" by 21", **$25.00.**

On items above, we can remove and ship lens assembly if the cone is not wanted.

FIBERGLASS shipping trunks. Lightweight and rugged for protection of equipment on field trips.
21" by 18" by 13", **$20.00.**
26" by 20" by 13", **$25.00.**
3 trunks for the price of 2

All material f.o.b. Lynn, Mass. Send self-addressed envelope for complete list.

JOHN MESHNA JR. ELECTRONICS
P.O. Box 62 E. Lynn, Mass. 01904

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.

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

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

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

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

...AND MORE!

least one vice or addiction (it's the IN thing).

I really enjoy your magazine if you haven't guessed that yet. Please keep up the good articles and circuits, especially the circuits since as a physics major I can appropriate the needed parts from the electronic's lab. (They pay me once in a while for working there; not enough – but, there are advantages like good test equipment.)

You're doing a fine job. Keep up the good work.

Kent Croynn

Here is my payment for a subscription. I recently picked up one of your magazines and was surprised at the improvements that you have made. The articles are very up-to-date with FM and state-of-the-art techniques. You stay with the current trends and I'll stay with 73.

David Parker WB4GLO
Grand Farks AFB

All I can say about seeing the K1YSD article in the June issue is that, whenever I open that issue, my eyes are mysteriously drawn to his article where I'm then transformed into a crazed maniac suffering from laughing convulsions. When my friend reads the article, the same thing happens to him. It must be a disease.

Bob Davidson WB8IPB
Chagrin Falls OH

1972 SUMMER SALE

CALCULATOR CHIP – 40 DIP "Calculator on a chip" the manufacturer will not let us advertise the number of this item but we provide full data and instructions for building a 12 digit calculator ADD, SUBTRACT, MULTIPLY, AND DIVIDE . . . . $14.95 ea.

COUNTER IC SPECIAL

FAIRCHILD Dual Inline 958 Decade Counter and FAIRCHILD 960 "NIXI" Driver combination. These are new and fully guaranteed but are unmarked. Combination (2 ICs) $1.75. 10 sets (20 ICs) $15.00.

DIGITAL SPECIAL

Ten brand new (on carriers) dual-in-line JK flip-flops–LU321 with data sheet and two pages of application notes describing hookups for–divide by three through ten, and twelve. Also self correcting ring counter hookups, etc.

10 LU321 W/data $4.00

TTL dual-in-line

7400, 7401, 7402, 7404, 7405, 7410,
7420, 7430, 7440,
7450, 7451, 7453 . . . . ea.$. .25
7441 BCD decoder driver 1.15
7442 BCD decoder 1.15
7473 dual JK flip-flop .65
7474 dual type D FF 50
7475 quad latch 1.15
7476 dual JK FF 65
7480 gated full adder 80
7483 4 bit full adder 1.60
7486 quad exclusive or gate 65
7489 64 bit RAM 4.00
7490 decade counter 1.15
7491 8 bit shift register 1.15
7492 divide by 12 counter 1.15
7493 4 bit binary counter 1.15
74154 one of 16 decoder 3.00
74192 up/down decade counter 2.25
74193 up/down binary counter 2.00
74195 unv. 4 bit SR 1.15
8220 parity gen/checker 1.00
8200 4 bit magnitude comparator. 1.60
8280 preset decade counter 1.15
8281 preset binary counter 1.15
8520 25 MC divide by "N"
2 to 15 . . . . 2.00
7495 4 bit SHIFT REGISTER 1.15
8590 8 bit shift register 2.00
8270 4 bit shift register 2.00

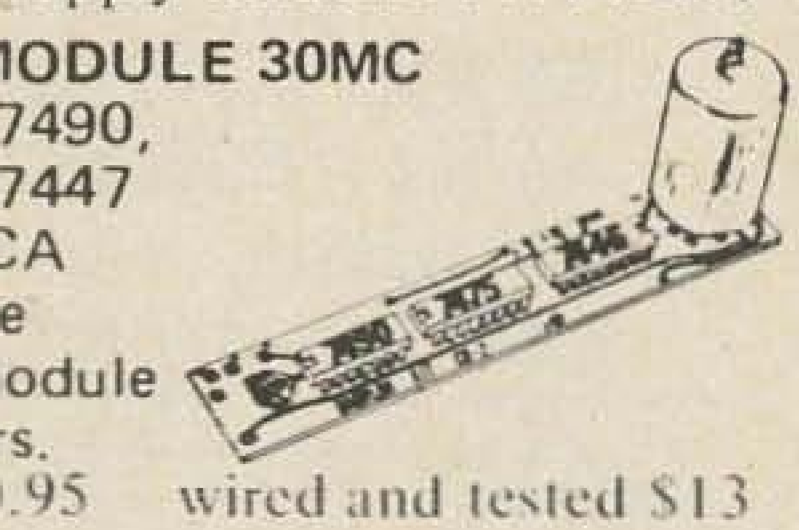
LINEAR SPECIAL

Ten (10) Teledyne TO-5 741 operational amplifiers with a two-page sheet of application notes covering the basic circuits using op-amps . . . . $.65 each
Op-amp package 10-741's, data sheet and application notes . . . . only $6.00

LINEAR IC's (dual-in-line)

LM100 positive voltage reg. 80
747 dual 741 op amp DIP 1.10
LM302 voltage follower op-amp 1.25
709 operational amplifier 40
710 voltage comparator 75
LM309K 5V-1A power supply module 2.50

DIGITAL COUNTER MODULE 30MC



unit includes board, SN7490, SN7475 quad latch, SN7447 7-segment driver and RCA "numitron" display tube W/decimal. 1" x 4.5" module will mount on 1" centers.
kit $10.95 wired and tested $13

LAST MINUTE ADDITIONS

NE565 Phase lock loop, TO-5 . . . . $4.25 ea.
NE566 Function Generator, DIP (8 pin) $4.25 ea.
NE567 Tone decoder, DIP (8 pin). . . . . . $4.25 ea.
7447 7 segment decoder driver $1.60
74181 Arithmetic Logic Unit, 24 pin, DIP. . .$5.00
8261 fasy carry for above $2.00
8223 256 bit bipolar field programmable,
read-only memory $10.00
8570 8 bit SI, PO, shift register $2.50
LED Red Emitting Lamp 60

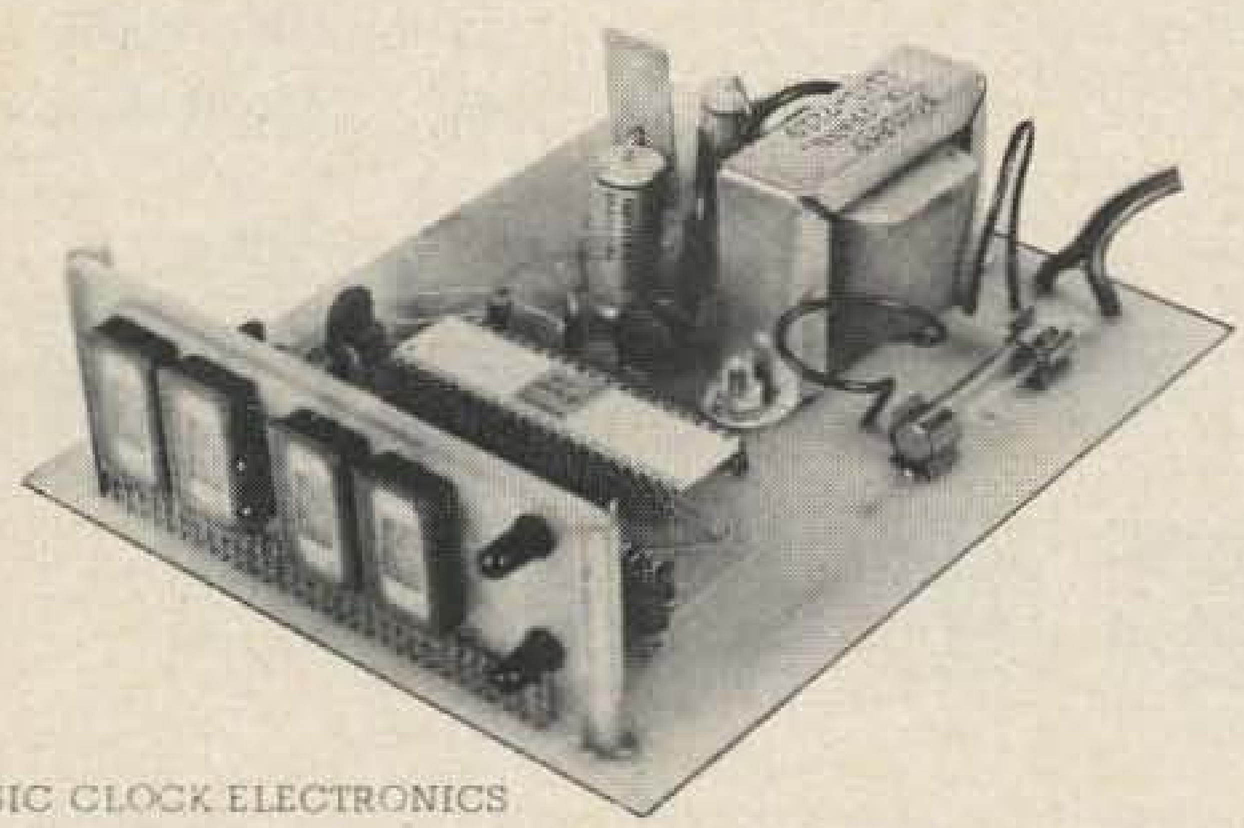
All IC's are new and fully tested – leads are plated with gold or solder. Orders for $5 or more will be shipped prepaid. Add 35¢ handling and postage for smaller orders. California residents add sales tax. IC orders are shipped within two workdays of receipt of order – kits are shipped within ten days of receipt of order. Money back guarantee on all goods sold.

BABYLON ELECTRONICS

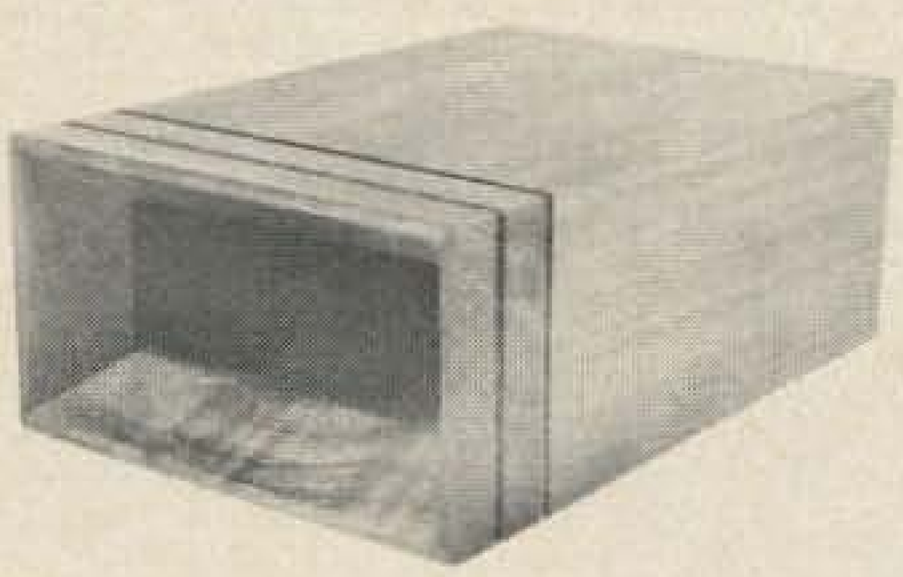
SEND FOR FREE FLYER

P.O. Box J
CARMICHAEL, CA 95608
(916) 966-2111

NEW and SURPLUS ELECTRONICS FOR THE HAM and EXPERIMENTER

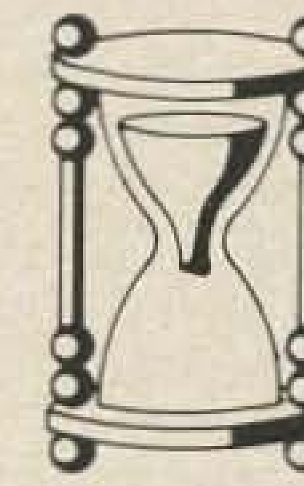


BASIC CLOCK ELECTRONICS



SOLID WALNUT CASE

The Time Machine



ELECTRONIC CLOCK KIT

THE TIME MACHINE utilizes the latest electronic techniques and advances to provide time information like no clock has before. A Large Scale Integration (LSI) circuit provides the logic to convert the 60 hertz line frequency into a displayable time. Internal options include a presettable alarm circuit, five minute snooze, seconds display, and 24 hour time.

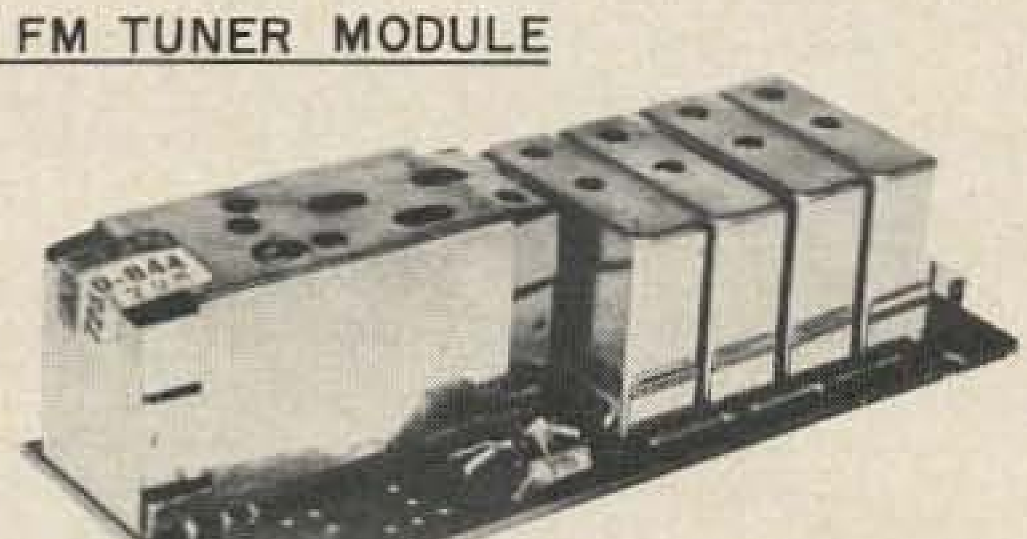
Because of the new technology involved, this kit is not recommended for the beginner. The circuit board connections are small and require specific soldering techniques using small solder (included in kit) and a small low wattage iron.

Average time to assemble the kit is around two hours. Full instructions and theory of operation are included with each kit.

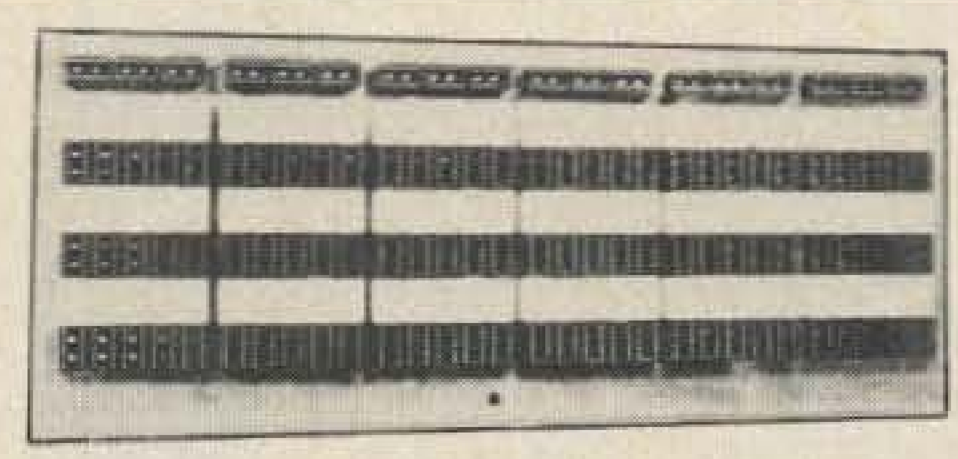
1.	Basic Clock Electronics (kit)	$ 52.50
2.	Solid Walnut Case (completed)	10.00
3.	Alarm option	7.95
4.	Snooze option (requires alarm option)	2.00
5.	Manual Reset option (SPST Pushbutton)	.50
6.	Auto-Power Reset option (1uf/25V Cap)	.95
7.	Seconds Display option (SPST toggle sw)	1.00

VARICAP TUNED FM TUNER MODULE

17$\underline{50}$



WE MADE A FANTASTIC BUY ON VARICAP FM TUNERS. THIS LITTLE GEM IS BUILT LIKE A ROCK AND HAS OUTSTANDING SENSITIVITY. IT TUNES THE ENTIRE FM BROADCAST BAND USING VOLTAGE. THERE IS NO LIMIT TO THE DIFFERENT WAYS TO TUNE IT ...PUSHBUTTON, REMOTE, SCANNED, ETC. INCLUDES COMPLETE RF, IF, & PREAMP



IC SOCKET PANEL

INTERDYNE Wire-wrap Panels (Wired) ....$ 19.80
Has 198 Wire-wrap 14 Pin IC sockets. Has pin 7 connected to ground and pin 14 to power plane. May be used as-is or sockets removed for breadboarding. THAT'S 10¢ a SOCKET....

KEYBOARDS

1. Micro Switch 16SW3-8 Hall Effect Solid State Keyboard. Has 16 individual dual outputs 12.50
2. Controls Research 11 Key Reed Switch Keyboard 6.00
3. Controls Research 15 Key Reed Switch Keyboard 7.00
4. NEW Touch-Tone Pad Keysets 24.95

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MILITARY ELECTRONICS

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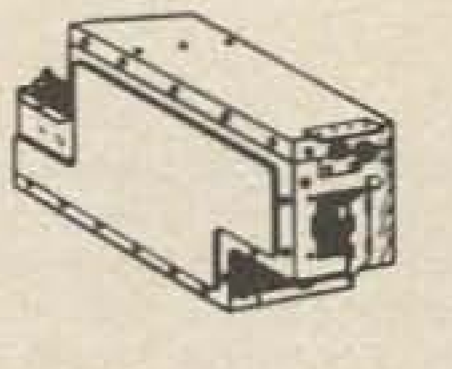
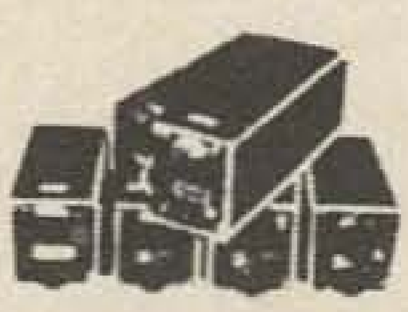
ARC-5 VHF RECEIVER, TRANSMITTER, MODULATOR 100–156 MHz



R-28 RECEIVER with tubes and crystal,
Excellent Used $19.50
T-23 TRANSMITTER with tubes and crystals, Brand New in Original Carton $23.50
MD-7 MODULATOR with tubes, Excellent Used $10.50
Set of Plugs for MD-7 .... $8.50

AN/APR - 4Y FM & AM RECEIVER

"FB" for Satellite Tracking!



High precision lab instrument, for monitoring and measuring frequency and relative signal strength, 38 to 4000 Mc. In 5 tuning ranges. For 110 v 60 cycle AC. Built-in power supply. Original circuit diagram included. Checked out, Perfect.
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All tuning units available for above. Price upon request.

BC-603 FM RECEIVER

Converted for 35–50 Mhz. 10 preset pushbutton channels or manual tuning. Complete with 10 tubes, checked out, like new $39.50
AC Power Supply, New $14.95
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Set of 10 tubes for BC-603 Receiver $5.95

BC-604 FM TRANSMITTER 20 to 27.9 Mc.

Output approx 30 watts. 10 crystal controlled channels. Complete with tubes.
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SCR-274-N, ARC-5 COMMAND SET HQ!

Freq. Range	Type	Exc. Used	Like New	BRAND NEW
RECEIVERS.	**Complete with Tubes**			
190 - 550 Kc	BC-453	$16.95	$23.50	$27.50
6 - 9.1 Mc	BC-455	—	18.50	$22.50
1.5 - 3 Mc	R-25	—	$19.50	$21.50
TRANSMITTERS.	**Complete with Tubes**			
4 - 5.3 Mc	BC-457	$8.95	—	$11.95
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Code practice tapes for above P.U.R.

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Complete with tubes, NEW............. **$12.50**

APN-1 FM TRANSCEIVER 400–450 Mc. Freq. modulated by moving coil transducer. Easily converted for radio control or 70 cms. Complete with 14 tubes, dyn.
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Fine general purpose Navy unit 125 to 20,000 Hz. Operates on 12 or 14V dc. Complete with tubes, crystal calibration book. Checked out.
Excellent Used $59.50
As above, less book $22.50

BRAND NEW

BC-645 TRANSCEIVER

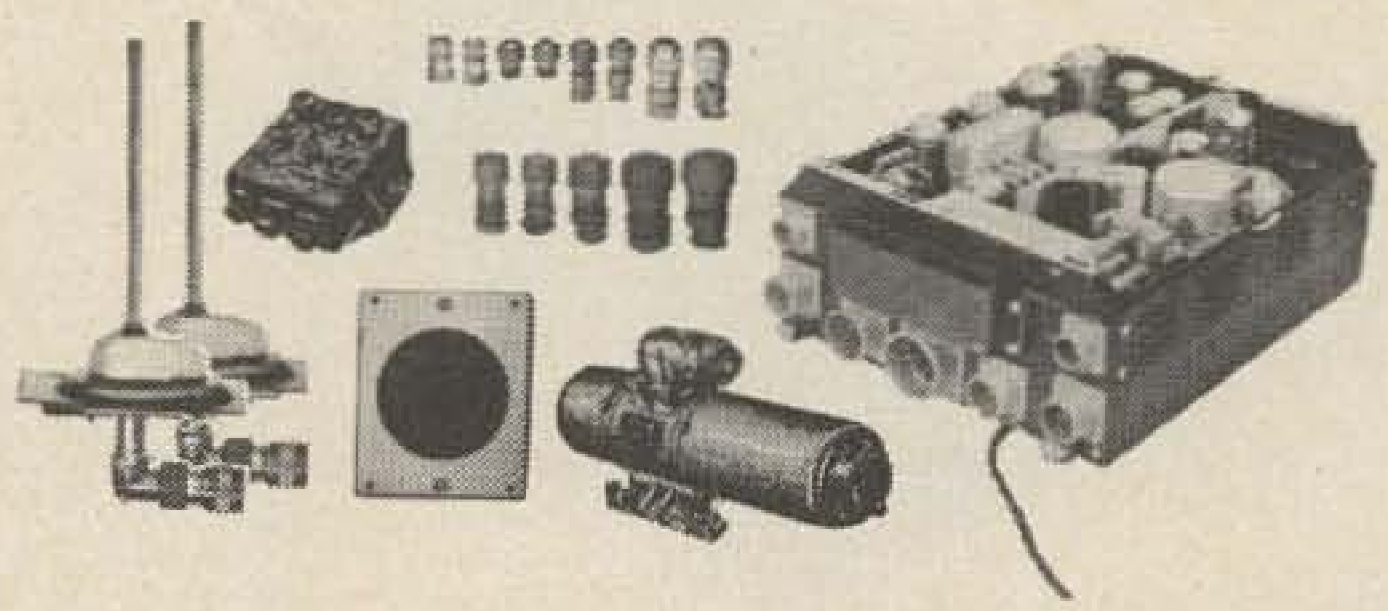
EASILY CONVERTED FOR 420 MC. OPERATION

BRAND NEW, complete with 15 tubes, less dynamotor and accessories, in original factory carton

For FIXED or MOBILE use

$16.95

DEPENDABLE TWO WAY COMMUNICATION MORE THAN 15 MILES!



Superb quality components and circuitry, ideal for the technican experimenter. Many fabulous experiments, for example: you can construct a Yagi antenna for the 420 Mc band that will produce a gain of 10 db and yet fit on your operating desk!

FREQUENCY RANGE: About 435 to 500 Mc.
TRANSMITTER has 4 tubes: WE-316A, 2-6F6, 7F7
RECEIVER has 11 tubes: 2-955, 4-7H7, 2-7E6, 3-7F7
RECEIVER I.F.: 40 Mc.
SIZE: 10½" x 13 ½" x 4½". Shpg Wt 25 lbs.

ACCESSORIES FOR BC-645

MOUNTING for BC-645 Transceiver $1.50
PE-101C DYNAMOTOR, 12–24 Volts, (easily converted to 6 volts) 7.95
MOUNTING for PE-101C Dynamotor 1.00
UHF ANTENNA ASSEMBLIES (set of 2), per set 2.95
COMPLETE SET OF 11 CONNECTORS 5.95
CONTROL BOX BC-646 .... 2.95
MOUNTING for BC-646 Control Box 1.00

SPECIAL "PACKAGE" OFFER:

BC-645 Transceiver, Dynamotor and all accessories above, COMPLETE, BRAND NEW, While Stocks Last **$26.95**

SCR–625 MINE DETECTOR
locates any metal buried approx. 2-ft in ground or water. Easy to operate.
Our Special Price, less batteries **$44.50**

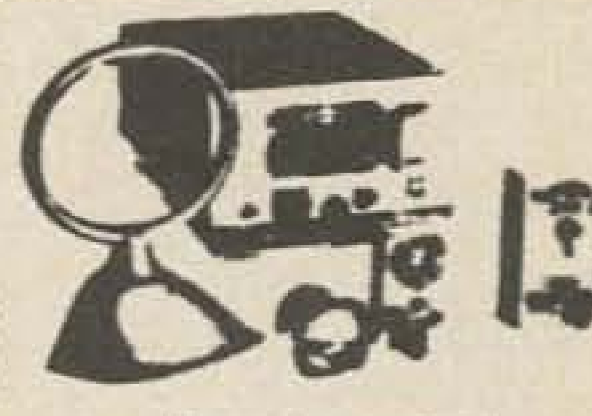
CATHODE RAY TUBES — STANDARD MAKE
All New in Original Carton

3AP1* . . . 1.95 ea. 5AP1 . . . 3.75 ea.
3FP7* . . . .98 ea. 5MP1 . . . 2.75 ea.
9GP7 . . . . . . 3.95 ea.
*Sold in Lots of 3 only

HEADSET Low impedance. With large chamois ear cushions. 4-ft cord and plug. Reg. $12.50. Our Special Price **$2.95**
Less ear cushions.................. $1.95
High impedance adaptor for above... $ .69

MN–26Y RECEIVER

Like New $13.50
New $15.25



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ACCESSORIES FOR ABOVE AVAILABLE FROM STOCK.

Remote control commercial type navigational receiver.

WILLARD 2V STORAGE BTRY

Rated at 20 Amp.-Hours. Model 20-2. Rechargeable. Compact non-spill construction. Lightweight polystyrene container, 3x4x5½". Shipped dry, uses standard electrolyte. Shipping Weight 3 lbs. NEW, each

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A few weeks ago while we were in Chicago for Expo-72 Wayne and I had a chance to work through a very fine repeater. The Chicago 16–76, WA9ORC. The repeater features several satellite receivers with a "voting system." I must say, I was impressed with WA9ORC. At the Expo-72 site the ORC gang had a control point set up for talk in and message handling. They had several of their people walking around the vast area with walkie-talkies on a "secret frequency." These people were acting as security for the area. As will unfortunately happen with all the gear on display at a convention, a couple of units were "ripped off." It didn't take long for the ORC cops to get into action. As an example, Wayne and I thought one of our Standard walkies had been stolen. While Wayne reported the possible theft I went out to the car to check on the possibility that we had already packed the unit (which we had). On my way back to the Exhibit I was stopped several times by ORC cops asking to see my Standard. In all, the Expo-72 show was a lot of fun. I understand it was much better than last year. The exhibits were interesting, as were the talks and the Flea Markets. The Flea Markets were my favorite. For a couple of acres all you could see were hams selling their wares. No matter what small part or large piece of gear you were looking for, it could be found. I'd like to say to the Expo-72 group, Well Done.

A small problem has developed with the Bajo Nuevo DXpedition. Instead of going to Bajo Nuevo we may go to Serrana Bank, unless some problems with the Colombian Government can be ironed out. I had written to the official amateur organization of Colombia, the LCRA. They sent back their new criteria for a DXpedition to Bajo Nuevo. They are: 1) The expedition leader or Director must be a Colombian citizen; 2) The Director must have a Colombian license; 3) 50% of the expedition members must be Colombian citizens; 4) The expedition must be sponsored by the LCRA. I am told by a member of the last DXpedition to Bajo Nuevo that this action is the result of one Colombian gentleman and it was done for personal reasons. The new criteria virtually makes a DXpedition to Bajo Nuevo impossible. However, there is one more avenue of attack I am taking. We are still planning on Bajo Nuevo but if the problems can not be resolved we will go to Serrana Bank which is not far from Bajo. Serrana Bank will be just as good a DXpedition. I have already received the call KS4BS for Serrana Bank. Either place, the DXpedition will take place. I still need written confirmation from some of you who want to go on the DXpedition. If we do indeed go to Serrana Bank we will have room for a couple more operators. Today, those of you who want to go on the 73 DXpedition who have not written, please do it. If you wish, give me a collect telephone call. We need to start getting the equipment checked out and ready to go. There are a million details to be worked on if we are to have a good DXpedition so please write or call today.

What do you do when you find yourself operating out of band? I would think the normal procedure would be to quietly sneak back in without saying anything. Perhaps no one will notice. This might work if you are a few cycles out of the band. But, what do you do if you are engaged in a roundtable with 5 other stations and you find yourself 10 kHz

(continued on page 72)

Yaesu presents the great two-meter leap forward

Since Yaesu makes and sells more factory-assembled amateur rigs than any other company in the world, it follows that we'll only place dependable, fully-perfected products on the market.

So now, after more than two thoughtful years of development, here are our entries in the two-meter FM field:

YAESU FT-2 AUTO

Great new features — like Auto-Scan and a special Priority-channel — place the FT-2 AUTO in a class by itself. These unique capabilities are achieved with advanced digital-logic circuits. Here's how they work:

With Auto-Scan on, the receiver scans all 8 channels at 20 channels per second, indicator lights provide a visual channel display, stopping on receipt of a signal. At the end of each transmission, the receiver continues to scan. (Just push a channel button to skip over any channels you wish eliminated from the scanning cycle.) To lock on any frequency being received, simply depress the mike button momentarily. The lock light then glows indicating that transmitter and receiver are working together. To unlock, you again hit the mike button and the receiver continues to scan.

Only Yaesu offers this type of remote, one-handed control of the scanning function.

The Priority-channel feature allows automatic monitoring of a pre-selected frequency. When the receiver stops on a frequency other than the Priority-channel, Auto-Scan will check every two seconds to determine if the Priority-channel is busy. If it is, the receiver reverts instantly to the Priority-channel. Manual or Auto-Scan mode of operation is instantly selectable on front panel. In manual mode, the push buttons function as channel selectors.

The FT-2 AUTO will operate from either 117 V AC or 12 V DC power sources.

Receiver/transmitter specifications include: selectable 10 Watt or 1 Watt power-output levels: a frequency-adjustable tone-burst generator for repeater activation: 0.3 uV sensitivity for 20 db quieting; 10.7 MHz crystal filter, in addition to a 455 kHz ceramic filter, for superb adjacent channel rejection; adjustable deviation and mike gain controls; Hi-Q slot-coupled resonators used in receiver front end; all solid-state construction, with diode-protected MOSFET input stage.

This exciting new rig is available now. Just send your check for $329.95 — or use Master Charge or BankAmericard. We'll even include a free anti-theft mounting bracket that locks up your rig when its going mobile.

YAESU FT-2FB

This new unit features the same receiver/transmitter specifications listed above for the FT-2 AUTO (without the scan feature), but in a compact 6⅝ x 2½ x 10-inch package that weighs only 4 lbs. The FT-2FB has 12-channel capability, with illuminated frequency readout. It operates directly from a 12 V DC source. This rugged, handsomely-styled transceiver is yours for only $229.95. (A matching AC power supply with rechargeable batteries for emergency operation is available for $79.95.)

Both units come with a one-year warranty and are backed by Spectronics' fast, dependable service system. Act today, and be glad you waited for the finest in two-meter FM.

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SPECTRONICS EAST

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☐ Send FT-2 AUTO. Enclosed find $329.95*
☐ Send FT-2FB. Enclosed find $229.95.*
☐ Send more data.

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*California residents add 5% sales tax.

NOTE: Both units are supplied with crystals for simplex operation on 146.76 MHz, 146.82 MHz, and 146.94 MHz. Additional crystals are $5.00 ea.

4

Chew the rag all day or win the contests...

the CX7A makes them both easier.

There are a couple of different ways to look at signal/one's CX7A. You might compare it to a car.

For the rag-chewer's convenience and ease of operation, it's strictly in the Rolls-Royce category.

For the competitive-minded amateur, it's like driving a Ferrari.

That's because the CX7A was designed with uncompromising quality. With more features than you can imagine. The rig equals a room full of gear, all neatly enclosed in a compact, desk-top unit.

It lets you do things no other rig lets you do. And do all of them better. Sitting at the console of the CX7A you're in command of the amateur radio universe.

Whether you're a Rolls-Royce type or a Ferrari-minded guy.

See the remarkable CX7A at your signal/one dealer's. Or write for a detailed brochure.

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