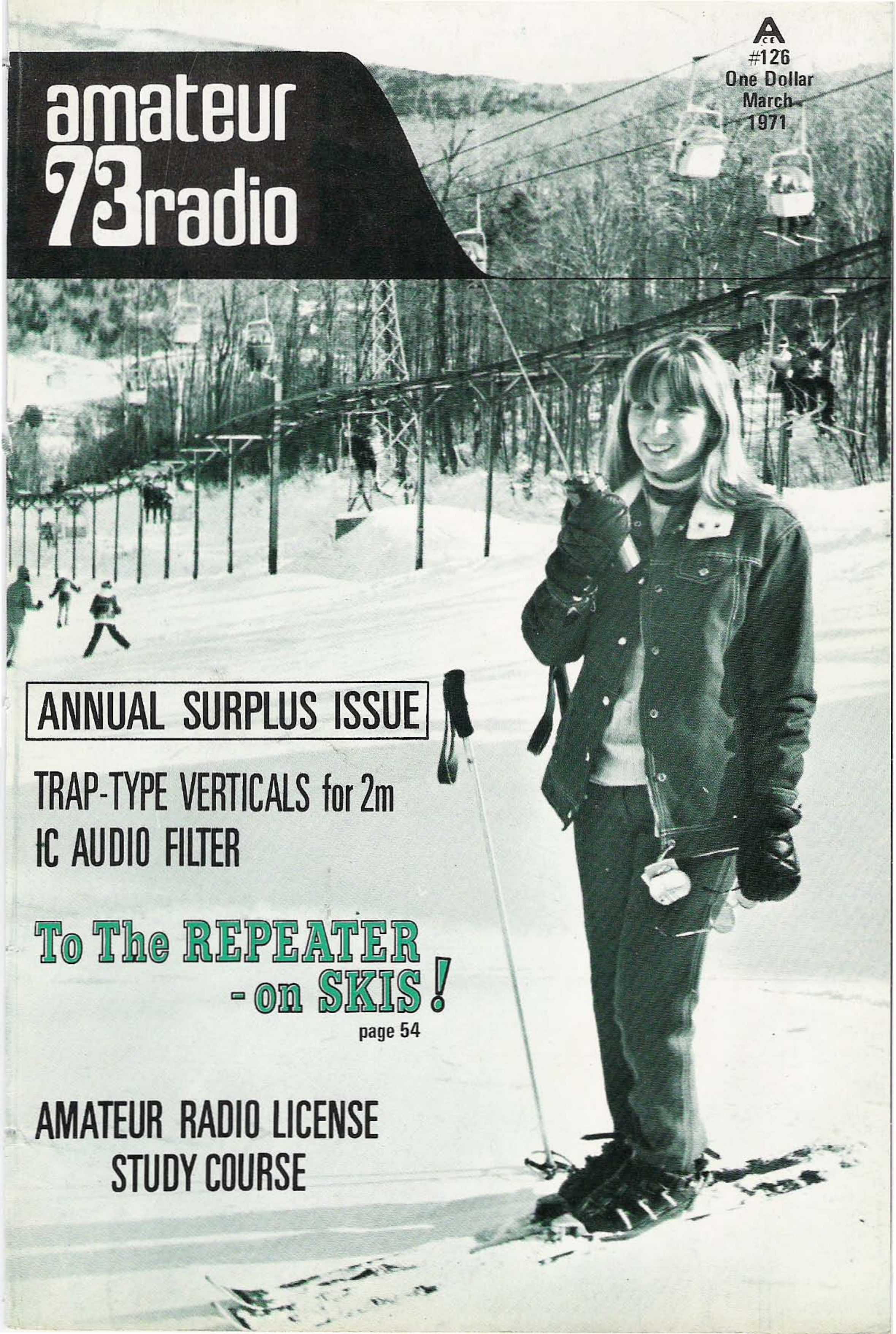
amateur 73 radio

#126
One Dollar
March
1971



ANNUAL SURPLUS ISSUE

TRAP-TYPE VERTICALS for 2m
IC AUDIO FILTER

To The REPEATER - on SKIS!
page 54

AMATEUR RADIO LICENSE STUDY COURSE

Issue 126

Amateur Radio 73

March 1971

CONTENTS

...de W2NSD/1

NEVER SAY DIE

SAROC 1971

These being days of impoverishment, I had not intended to make the scene at Vegas. At the last minute Ken put on the pressure and, with the hopes of perhaps selling a page or two of ads to help balance the books, I hopped on down there.

Just after taking off from Boston I had a short contact with W1TNO through the W1ALE repeater in Concord, N.H. No answers at Schenectady . . . some short contacts in western New York . . . Cleveland was kept busy with long-winded nonlistening talkers . . . ditto Detroit . . . contacts in Chicago . . . no one around in Urbana . . . and so it went. Omaha was not open to breakers. About ten minutes out of Vegas I picked up their repeater and talked with the gang the rest of the way in, while waiting for baggage, and during the limousine ride to the hotel. One mobile pulled up alongside, waved, and then broke in to say hello.

It was colder in Vegas (15°) than in New Hampshire so I grabbed my camera and went across the street (watching out for any possible ARRL-driven cars) and took pictures of the ice-encrusted fountains at Caeser's Palace. Art Housholder W9TRG, arriving on a Frontier Airlines plane, came through the repeater at this time and I talked with him as he flew over Lake Mead and later while he was waiting for his baggage at and every mobile within 100 miles of town. My last contact was from the airport as I went to get on the plane and I said goodbye to Ken, who was just that minute getting out of bed back at the hotel. TWA shut me up from there until I landed in Boston. I have this black curse to put on TWA: May the board of directors eat one meal a week in the tourist section of their planes. That'll hold 'em.

FM/Airborne

Yes, I use my little two meter FM hand transceiver while I'm a passenger on the airlines! It works out beautifully, too. About the only serious problem I have with it is trying to get a word in edgewise on the repeaters I fly over. All too few of the fellows talking over repeaters ever give even one second for a passing-through breaker.

On the way to Saroc I tried to get through a number of repeaters, but just couldn't break the big signals with my hand transceiver. Oh, there were several that I did get into and it was fun to talk for the few minutes I was within range.

How about the plane, you ask? Many of the FM'ers who have hand units have tested them to make sure that no interference is caused to the plane radio or instruments and none has occurred. Considering the use of FM, the frequency and the low power involved, I would not expect to find any interference. Most of the FM'ers

THE WORLD OF FM

Editorial by **Ken Sessions K6MVH**

THE FM SCENE

SAROC was great fun this year. The Flamingo Hotel provided excellent accommodations and Las Vegas provided the atmosphere. I didn't hear a single complaint from so much as even one ham this time.

Times are a'changin', too. A few years ago, gamblers and hotel officials got uptight at the sight of individuals carrying hand-held transceivers through the casinos. But with literally hundreds of 2m FM units protruding from the pockets of so many hams this year, the hotel people apparently grew accustomed to it. No one reported any problems at all – except for the fact that the hotel security people reportedly complained that the hams had newer and better equipment

Dr. Phil Dater, representing the New Mexico repeater chain, gave a slide presentation showing repeater progress in the midwest.

Pretty Linda Mueller, wife of WB6IGZ, tended bar in Room 1031A, a spur-of-the-moment hospitality suite.

The lovely Sharon La Traille, of Varitronics, Incorporated, demonstrated 2m transceivers, amplifiers, and antennas.

FEATURES

On The Cover:

Lin Green talks home via two meters while skiing on Mt. Snow in Vermont, checking on daughter Sage, being minded by Ken. The 110-mile path is via K1ZJH repeater about 60 miles away. (Where's Wayne, you say? Who do you think took the picture?)

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the airport . . . I was just walking around taking pictures all the while.

SAROC was an FM convention this year. The ARRL Forum pulled about a dozen while the FM Forum next door was jammed with hundreds. Ken Sessions organized the FM program and it certainly was the hit of the convention. Most of the exhibitors were FM oriented . . . Regency was there en masse . . . Varitronics displayed their mobile IC2F, their hand unit, and lovely Sharon LaTraille (you saw her in the "Ham's Wide World") . . . Drake had their sideband gear there, but the attention was on their Marker Luxury FM rig and the brand new TR-22 walkie-talkie unit . . . Walt Henry proudly displayed his Tempo FM rig . . . Galaxy was there with their FM-210 . . . Standard displayed a new transceiver and a mini-repeater. Lou Tristao had a tower that he feels FM'ers will like . . . Swan was showing their new FM rig from Japan . . . Ross & White showed their line of tone encoders and decoders . . . Sentry took orders for a lot of crystals from their interesting booth . . . and so it went.

A few non-FM manufacturers were present too . . . Dick Ehrhorn was showing his new all-band linear amplifier . . . Collins was there, but with nothing new for the amateurs and no FM plans whatever in the foreseeable future . . . Carl Mosley was there . . . Robot had a nice demonstration of slow-scan television. Spectronics brought a bunch of FM Motorola hand transceiver modules and the building crowd cleaned him out . . . ComSpec had its new gain vertical 2m antenna on display as well as their new 2 meter 50W amplifier . . . the Pierce-Simpson FM unit made its first appearance at SAROC.

My HT-220 hand unit was with me day and night and I have to admit to having a lot of fun. I kept in constant communication with Ken, the FM hospitality suite, dozens of friends, the convention, the exhibits, the talks, ask the plane captain for permission to use their rig while flying and, though permission can be refused on the basis of a regulation against using receivers in a plane, usually there is no hitch.

Sad to say, TWA has been one of the least cooperative with amateurs. Alas, I've been riding with TWA since they were Transcontinental Western Airlines, over 40 years ago, but I will choose alternative travel in the future where possible since I do enjoy operating while traveling. It wouldn't hurt them any to be nice . . . there is a lot of competition . . . and a growing number of amateurs with hand transceivers. The new little Drake unit (1½ watts) would be ideal for this!

Perhaps I should be in more awe of the complicated electronics in these planes, but my experience as a pilot, my tenure with Airborne Instruments Laboratories, and other background has lessened the mystery. Add to that several trips with no interference reported, even with a 5W unit, and similar reports from a dozen or other amateurs.

So look fellows, when you are talking through a repeater about something of earth-shaking importance, like how many 6SN7s you have left from the old days, won't you be nice enough to at least take one breath between transmissions so I can break in for a minute or so and say hello as I pass over on some other airline than TWA? You can't imagine how frustrating it is to hear you down there talking without being able to ever break you!

New Repeater Bulletin

Mike WA8UGT has announced that he is planning on starting a repeater bulletin later this year. I am sure that all of us who remember the fine FM Journal that Mike and Ken Sessions published; will be pulling for him to make it this time. With all but one amateur magazine reported to be in the red this is a particularly difficult than they themselves had been issued. *C'est la vie!*

Some nice surprises were in store for convention-goers. Mr. Everett Henry, FCC officer in charge of amateur and CB policy-making, showed up and agreed to answer questions from FM'ers. He drew a bigger crowd in the FM room than any other speaker on any other subject in any other quarter. He was peppered with questions about repeater rulemaking, unofficial sanctions, and such matters, and managed to sidestep all major issues with the adeptness of a politician.

The whole staff of Regency Electronics showed up. They were kept busy demonstrating the company's growing line of equip.

Walt Henry, of Henry Radio, showed his company's new high-performance, low-cost Tempo FM transceiver, which was itself a smash success at the convention.

Mr. Henry's evasiveness was understandable, in view of the fact that the FCC does not plan to get deeply involved with repeater legislation until after the "phone band expansion" issue is settled. The notorious docket (18803) as well as my own petition (RM-1725) are both stacked neatly on the desk of FCC's Bill Grenfell, who will get going on them some time before midyear.

SAROC's display area looked pretty much "FM," too, with manufacturers proudly showing their latest FM transceivers, rf amplifiers, and other related hardware. Art Housholder showed slides of Spectronics to a packed house. The fact that he did it in the "hospitality suite" contributed to its popularity; the room was stocked with free beverages.

For me, SAROC was a stepping stone to a tropical vacation. When the convention was over, I flew to Los Angeles for a week in the sun and smog. Thanks to the hospitality of my California friends, the week was not as expensive as it could have been.

But I'm glad the week ended when it did. My California friends all know that I flip over Mexican food, and that Mexican food is just not available in New England. So each of my contacts in California went overboard to serve

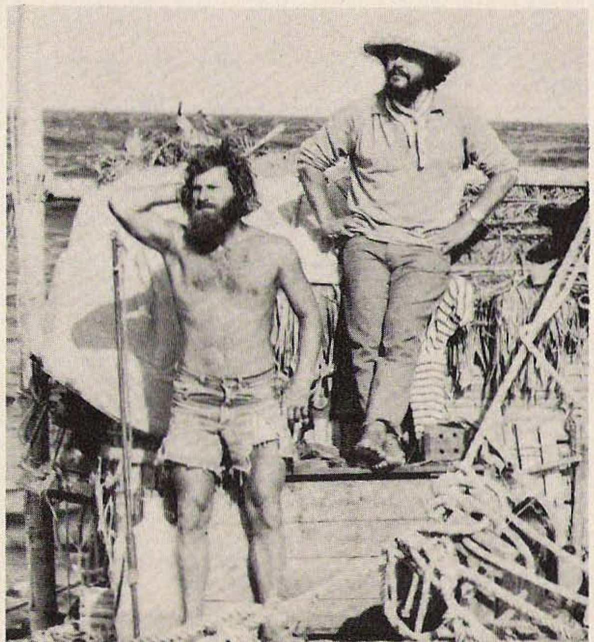
cont. on page 6

VK HAMS HELP "LA BALSA" MAKE LANDFALL

by Alan Shawsmith

In an effort to prove a 1000 year old theory, that the early peoples of South America could have drifted to Australia, by making use of the Equatorial currents and winds, four courageous young men, one of them being a ham, HC9EBP, left Ecuador on May 29 1970, on a 45 ft raft made basically of seven large balsa logs. Appropriately, they named it La Balsa. Filled with the challenge of adventure, they hoisted a square mainsail and with hopeful hearts, turned their primitive ship and faces westward. After a drift of more than 8500 miles across the Pacific, they arrived safely at a small boat harbor named Mooloolaba, 80 miles north of Brisbane.

This incredible sea journey, in a nonpowered craft, must rank as one of the greatest ever by modern man. Others before this have set out from the west coast of South America, but none have come so far or been so long at sea (161 days) in one single hop. They survived the tropical heat, sickness, many severe storms in which all but one were washed overboard at one time or another, including the cat Minette, and by a mixture of skill and good fortune, managed to avoid the numerous coral reefs and shoals along the way.



IARU REGAINS OBSERVER STATUS

The International Amateur Radio Union, an organization of national amateur radio societies run by the ARRL, was removed from the list of organizations permitted to send observers to the International Telecommunications Union meetings by an action of the ITU Administrative Council in 1966.

IARU representatives have never been permitted to participate as other than silent observers at the ITU conferences. Even amateurs sent by their national societies have been unable to be accredited by their own country delegations (except for the U.S.) with the result that radio amateurs have had virtually no say whatever on the frequency allocations set up for them. As a result, amateur frequencies have been constantly eroding at these conferences. The services best represented have been able to hold or gain in frequencies and those least represented have lost the most.

Now the ITU Administrative Council has reconsidered its decision and again will permit the IARU to send observers to the ITU conferences. While this is better than nothing, the real action will come when amateurs are permitted to join their country delegations.

TURKISH HAM NEEDS U.S. SPONSOR

Selim Canbeken TA2SC, 19, would like very much to come to the U.S. and learn about electronics. There just isn't any good education in this field available in Turkey and Selim knows what he wants.

Amateur radio has not been legal in Turkey for citizens since 1937 so the 150 or so active amateurs have operated quietly and in fear. Radio equipment is almost nonexistent and generally has to be built from what can be scrounged. There are no radio stores or manufacturers as in the U.S. Even so Selim was able to build a sideband transceiver, a linear amplifier and even a slow scan televsion flying spot scanner!

On April 28, 1970 the police came and confiscated everything . . . antennas, test equipment, a prewar National 100XA receiver, logs, QSL cards, parts, transceiver, linear . . . everything. This was a cruel turn of events for this avid amateur.

Selim writes, "Now I am a Tone Maister for the famous Turkish singer Zeki Getin. We are working every night at night clubs. This life isn't good for me. Last year I finished my school. I want to go to the U.S.A. for an electronic education. I can work

Approaching Australia, they faced their greatest danger, the treacherous thousand-mile-long Barrier Reef. It was at this point in their voyage that the VK hams began to play a vital part in this Norse-like saga of the sea. Amateur radio operators in Queensland and New South Wales were first alerted by Gus, ZM1RO, in New Zealand, that an unidentified vessel, possibly *La Balsa*, was approaching Barrier Reef. XE1EEI, in Mexico, who had attempted to follow and plot the course of the raft, had passed the message across Oceania that, according to calculations, the raft should soon be within radio range of the east coast of Australia.

During the period the raft was in mid-Pacific, the 100W transmitter it carried became inoperative, due to a faulty microphone – all that *La Balsa* could send was a series of clicks (not Morse). This raised the problem of positive identification and caused many who were listening to proclaim the signals as a hoax. The first ham to pick up these faint clicking signals, on 28 October 1970, was Sid Molan, AX2SG. Others then reported them. The unidentified vessel was asked to send a certain number of clicks, if it was, in fact, the *La Balsa* raft. This it did and regular daily schedules were then maintained at 0400 GMT on 14100 MHz.

Many still refused to believe the signals were genuine. They insisted no raft could remain afloat for this length of time, especially as other ships in the area had reported no sightings. So the mystery deepened as the still unidentified boat approached the East Coast of Australia. At first it appeared to be on a collision course with the Swain reefs, one of the most treacherous areas of the Coral Sea. However, a wind change enabled the raft to bypass this dangerous area. Keith Schleicher, AX4KS, and Les Bell, AX4LZ, were now both receiving the clicking sounds very clearly. With Sid acting as controller, an intense daily vigilance was maintained. A varying code of clicks was devised and in this way much information was exhanged between the raft and the three hams. For example; Sid would request them to send four clicks if all four men were fit and well. A group of two or three clicks would indicate the number of knots drifted during each 24 hours. Their position in Lat. and Long., the state of the weather, the barometric pressure, and much other vital information was transmitted in this manner.

The raft was now in a busy Australian sea lane and all ships alerted but still no report came through. Excitement reached fever pitch. News papers ran headlines, "LA BALSA OR HOAX? – INCREDIBLE JOURNEY" – and so on. On the morning of November 4th the raft indicated it may soon need some assistance. A strong on-shore wind was carrying it close to the coast of Queensland. A plane and boats were dispatched to search in the given area, but by darkness no sighting had been made and the affair remained as mysterious as ever. The skeptics still insisted it was nothing more than an elaborate hoax. Then, at 2300 GMT on the next day a searching plane radioed it had located La Balsa twelve miles off the Australian coast. The frequency came to life as many hams who had been listening quietly for days now briefly broke with congratulations. Air and sea emergency rescue services directed a boat to the scene and the raft was taken in tow to the nearest harbor, some 20 miles away. Capt. Alsar, HC9EBP, and his crew, triumphant and smiling, were taken ashore to a thunderous Australian welcome.

Without the VK hams' timely vigilance and direction – and most of all, their insistence that *La Balsa* was real – it is possible that the raft could have found itself in difficulties, handicapped as it was with no phone or CW transmission, and no one would have known. It might have been wrecked on Great Barrier Reef or struck by a passing ship or crashed in bad weather on some inhospitable part of the coastline.

At the official welcome on Australian soil soon after *La Balsa* crew had landed, Captain Alsar proffered his thanks and gratitude to all the hams who had monitored his transmissions right across Oceania. They were Raphael XE1EEI, Joe HC2OM, Gus ZM1RO, Sid AX2SG, Keith AX4KS, Les AX4LZ, and many others. Well done, chaps!!

RM PRICES STYMIE PROSPECTIVE BUYERS

W5PGG was interested in getting a copy of the RM's on file with the FCC listed on page one of our October issue. He wrote to the FCC and asked for copies of the RM's. No dice. They suggested he get in touch with a company that specializes in that service. Orville wrote to them, giving his list, and got back a quote for the service of $98.46 for the copies of the nine RMs. This cooled him.

for enough money to pay my way while I'm in school. Perhaps I can stay for one year and live with an American family, then I can select a good way for my future. Perhaps I can select to be an American citizen. I have my high school diploma so I can join a school to be an electronic engineer or an electronic technician. This is my ideal for my future."

Are there any ham families near a good school who might have room for this amazing youngster? Write to this fine boy . . . Selim Canbeken, P.O. Box 106, Adapazan, Turkey.

HIS MAJESTY OPERATES PORTABLE IN LONDON!

Uses Ham Radio to Relax While Recuperating from Heart Attack

King Hussein was hospitalized in London for about three weeks, possibly recovering from a mild heart attack brought on by his extended visits to a number of countries during the preceding few weeks. Within a few days he was on the air using a Drake station operating primarily on 15 meters with the call of G5ATM, keeping his schedule with WA3HUP and other friends. While in the U.S. the king visited New York and Washington, staying at Blair House. A number of amateurs that had contacted JY1 visited with him during his stay in Washington. Hallicrafters presented HM with an SR2000 transceiver during his Washington visit. Hopefully we will be hearing this unit from Jordan one of these days.

Many interested amateurs had an opportunity to see the king at length during a one hour interview on the David Frost show. HM acquitted himself well on this show and those that watched it were able to learn a good deal about the Mideast problems.

WESTERNERS ACTIVE IN SLOW-SCAN TV

by W7SAB

The Western SSTV net has grown to quite a few members (principally on the west coast and middle west areas, though check-ins continue over the whole USA and anyone wishing to check in is certainly welcome). Technical information and experience with various equipments are available and more especially availability of hard-to-get parts for those unable to locate them. New stations are always welcome and in fact such stations as KH6BAS in Hawaii have been practically developed with information over the air from W7SAB and K7YZZ, who have spent many hours in getting him set up and operating. Also stations KL7FHN and KL7DRZ in Alaska have received assistance and hard-to-get parts from the group. I1LCF in Bologna, Italy has drawn heavy support and parts in getting his station in operation. ZS6ASR and ZS6PP have also received assistance. Likewise for ZL1DW, ZL1AOY, and ZL1NH (who has actually visited the group). Some contacts have also been made with UW6LC.

Normally the net is conducted by W7SAB with W7FEN, K7YZZ, W7VEW, W7ABW, WA7MOV, K6STI, K6IV, WA7LQO, WB6OMF acting alternate net control For some time the net has been formalized as the Western SSTV Net and on 5 May the 40 meter division of the Western SSTV Net was opened on 7220 at 9:30 local time. Some attempts have been made to interest our Canadian friends in SSTV and in fact a demonstration has been given recently at the University of British Columbia with 55 Canadian amateurs present in which slides, equipment, lecture and actual live demonstration was conducted. Demonstrations and lectures have been given throughout the NW at various radio clubs and K7YZZ has had several articles presented in 73 Magazine, and W7FEN and W7ABW have an article in June 1970 QST.

Early developments in SSTV have been thoroughly covered by our several amateur publications and a complete bibliography is quite comprehensive and of great help in getting started in SSTV. As much of the equipment must be designed and built by interested parties I would consider this activity a great incentive for advancing amateurs in the state of the art and general performance.

The above information about covers the activities and organization of the Western Slow Scan Television Net and I hope this will be of some help to you. I will again list the times and frequencies of the nets for your information.

3845 kHz 9:00 p.m. (PST) nightly
7220 kHz 9:30 p.m. (PST) nightly

HAM POPULATION EROSION

DX NEWS

VE COUNTRIES BANNED

By special edict dated 14 October, 1970, the Department of Communications has requested that all Canadian Amateurs be alerted to new regulations covering communications with various foreign countries. As a result the fifteen countries are now on the banned list under the authority of: ITU, annex 2, to operational bulletin No. 55, dated 13 July, 1970.

A list of the forbidden countries is as follows:

Burundi 9U5
Cambodia XU
Cyprus ZC4
Gabon TR8
Greece SV
Indonisia 8F
Iraq YI
Jordon JY
Laos XW8
Libya 5A
Pakastan AP
S. Yemen 4WI
Syria YK
Turkey TA/TC
Vietnam 3W8

INDIAN NEWS

VU2GV

New Delhi. We are happy to advise you that we have been successful in getting a favourable response from the Government to our proposals for utilising the radio amateur network for handling traffic in emergencies. We are also hopeful that some arrangements can be worked out for establishing an emergency net for simulated emergency tests by the authorities. This will give adequate opportunity for both sides to get acquainted with emergency procedures.

In order to enable this to be properly organised it is proposed to

TOKELAUS

The ZM7-Tokelaud effort looked ready to roll, then it foundered. Initially VE7HE and VE8RA had planned to stay at the home of the Catholic priest on the Tokelaus. However, with Pope Paul VI visiting Pago Pago, the padre locked up and took off to serve on the reception committee. Then the captain of the vessel they were to use began to worry about the typhoon season and the rhinoceros beetle and soon both the housing and the transportation had evaporated.

Apparently there is no docking space at these islands and ships have to lay offshore. The rhinoceros beetle infests the palms and ships have to get beyond three miles at night when the beetle is prowling about in order to avoid becoming a host for the beetle. So with the typhoon season around the corner and the beetle problem, the vessel was not available. It seems that one must have definite accommodations to be allowed on the Tokelaus and the captain of the vessel was not for laying off the island for any length of time.

So this effort did not jell just about the time when everything seemed ready to go. VE7HE and VE8RA spent the week in Western Samoa signing 5W1AG and 5W1AR. They had a good signal and their Tokelaus efforts, which came close to being accomplished, certainly would have gone well.

NIUE

ZK2AG, Trevor, reported as active. Was at 14210kc at 0415Z – with an HW-32 and using a dipole 15 feet up in a palm. Home call said to be ZM3TV. ZM4NH to handle QSLs. Mail service intermittent from the island . . . about once monthly. Said

ANNOUNCEMENTS

Columbus, Georgia Hamfest

The annual Columbus, Georgia hamfest will be held on March 21, 1971 at the Fine Arts Building behind the Municipal Auditorium at the Fairgrounds. For information, write John Laney, K4VGI, 1905 Iris Drive, Columbus, Georgia 31906.

CONNECTICUT QSO PARTY
April 3–5, 1971

The Candlewood Amateur Radio Assn. invites hams throughout the world to take part in The 8th Connecticut QSO Party. Rules: 1) The contest period is from 2300 GMT April 3 to 0400 April 5. Each station may be worked once on each band and mode. The general call is "CQ CONN" on cw and "CQ CONN QSO PARTY" on phone. 2) Conn stations send QSO number, RS(T) and county. All others send QSO number, RS(T) and ARRL section or country. 3) Score one point per QSO. Out-of-state stations multiply total contacts times the number of countries worked (maximum of 8). Conn stations multiply contacts times the number of ARRL sections and countries worked. 4) Certificates will be sent to the high scorer (6 or more contacts) on each ARRL section and country, also the two highest scorers in each Conn. county. Novice certificates will also be awarded. 5) Suggested frequencies are 3540 3925 7040 7275 14040 14300 21050 21300 28040 28880 kHz. Novices try 3740 7175 and 21125 kHz. 6) Logs must show dates, times in GMT, band, mode, QSO numbers, RS(T) and QTH. Send all logs before May 20 to the Conn QSO Party, c/o Tom O'Hara, W1DDJ, 7 West Wooster St., Danbury, Conn. 06810. Include an SASE for results.

OOTC QSO PARTY

The Old Old Timers' Club will hold its 1971 QSO party April 2nd through April 5th starting and ending at 2300 GMT. Suggested frequencies for locating the gang are plus or minus the following: 3520, 3530, 3820, 3830, 7020, 7030, 7240, 7260, 14279, 14290, 21021, 21030, 21270 and 21280. Participants should avoid any possible interference on any of these frequencies which may be used for net operations.

The FCC figures show that the total number of licensed amateurs dropped 683 during 1970. That isn't much of a drop, assuredly, but when compared with the 40,000 gain that we should have had, it is not encouraging.

During the month of December we gained 29 Extra class licensees and 102 Advanced class licensees. All other classes dropped. Somehow 29 Extras out of 264,000 has a message in it somewhere for the incentive licensing enthusiasts who still believe that punishment is better than rewards for getting results.

NO NEWS IS BAD NEWS • MAIL YOUR STORIES, PIX, AND NEWS TO 73 NOW.

ARRL GREAT LAKES DIVISION CONVENTION

MUSKEGON COMMUNITY COLLEGE
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LARGE SWAP & SHOP, MEETINGS FOR ALL MARS PROGRAMS, VHF REPEATER PROGRAM, NET & TRAFFIC MEETINGS, RTTY FORUM, HAM TV, RACES-CD, MIDCARS, QWCA MEETING, AND MANY MORE. COMPLETE LUNCHEON FACILITIES, PARKING FOR OVER ONE THOUSAND CARS, EASY ACCESS VIA INTERSTATE 196 & US-31 TO MUSKEGON, JUNCTION OF US-31 & MICH. 46. COMPLETE NEW AND COMFORTABLE FACILITIES AT THE NEW MODERN COLLEGE. MAIL ADDRESS: *P.O. BOX 691, MUSKEGON MI 49440*

NEW PRODUCTS
Callbook Supplement

The Radio Amateur Callbook Magazine has come up with a new and valuable service . . . a quarterly supplement. Now, instead of having to buy a complete new Callbook every quarter if you want to be sure and have the latest addresses, you can update your most recent book with this supplement.

The supplement even has some advantages over the regular Callbook listings in that it lists all call letter changes when amateurs move from one call area to another and also lists all deceased amateurs as such. This is valuable information that we've missed in the past.

The Spring 1971 Supplement will sell for $3.50. That compares favorably with the $8.95 for the U.S. book and $6.95 for the DX edition. The Supplement covers U.S. listings and U.S. possessions only.

form an All India net at 2030 hrs. IST daily on 14130 kHz. The net will commence operation with VU2KV as the Net Control but we require volunteers to act as alternatives for net control.

We are expecting some teletype machines to be released at reasonable prices. Though these are not in a working condition they can be cannibalised and a few made workable. We would like to know who all would be interested in getting these and get on RTTY. RTTY would greatly facilitate traffic handling in emergencies and would make this easy and fast.

he would be on nightly when possible but on Saturdays especially from 0200–0400Z in the 14220–14240kc area. Wally, SK2AF, presently on leave.

ST. BRANDONS

Alex, 3B8DA, who operated as 3B7DA from St. Brandons, advises that his gear,,,both the transmitter and receiver . . . suffered damage on his return to Mauritius from St. Brandons. This was gear donated by the Southern California DX Club and Alex is looking for some assistance to get the gear operating again. His present plans call for him to go to Rodriguez in 1971, possibly signing 3B9DA. Home address is 39 Brown Sequard Ave, Vacoas, Mauritius. The damage was done by sea water dousing the gear. Alex also interested in stamp collecting.

DX FOOTNOTES

Rio de Oro. Justo EA9EJ is the only active station in this rare spot. Four other amateurs are presently in the country, but no licenses for operation are being issued by the Spanish authorities. Only Justo may operate his rig and no one else. Justo is usually active on Fridays and Saturdays on 14130 from 0600 GMT.

CHAGOS

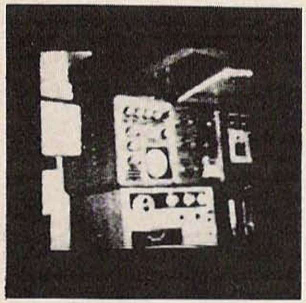
VQ9SM said to be on pretty much of a regular schedule. 14233kc at 0200Z daily; 14030kc at 1400Z. Sometimes this rotation is reversed and he may appear at 14233kc at 1400Z. Reported to be crystal controlled at these frequencies. QSLs go to JAØCUV/1 . . . Tack Kumagai, Post Office Box 22, Mitaka, Tokyo.

East Pakistan ON5DO/AP2, 14206, over there on hurricane relief mission. QSL to ON5KL.
Sikkim AC3PT, Namu, 1230Z, 14292, coming back to looong calls.
Arabic Net, 7Z3AB net control, Fridays 0830Z 21300, 0600Z 14200. You can work nice ones such as YK1AA, SU1MA, ST2SA, MP4BHH, 7X2's, 9K2's, etc.
Caribbean Net, 3804 @ 1000–1100Z.
Canton Island K6AZB/KB6 Norm 0200–0500Z 14325.
Marcus Island, 2200Z 28550, Dick, QSL JA1BA.
Oman MP4MBB 1230Z 14235, John, QSL G3LQP.
Trucian Oman MP4TDK 1530Z 14078, Dave, QSL RSGB.
Sudan ST5AD 0730Z 14247, Alban.
Pitcairn Island VR6TC 0600–0700 14185 Sunday, 0500Z 14230 Wednesday, Tom.
Rodrigues Island 3B9BZ Bert 1400Z 14200, QSL 3B8AD.
Laccadives VU5KV, QSL Box 3031, New Delhi with 5 IRC's.
Vietnam XV5HH 1230Z 14169, QSL W9JT.

LETTERS

Gray Matter

These photographs refute a statement which Wayne made in the January issue in the discussion of the EKY Video SSTV gear. Wayne stated that the SSTV pictures are composed of blacks and whites with no grade shades. The SSTV standards presently in use provide for a continuous gray scale between black and white as the photographs certainly show. To be frank, the lack of gray values in the gear that Wayne was observing was



probably a function of improper construction or adjustment in that particular piece of gear. Improper setup of the video discriminator will decrease the dynamic range of the monitor and result in an overly contrasty picture. SSTV pictures of normal well-lit scenes, whether televised with a vidicon camera or flying spot scanner, have excellent gray-scale rendition and I am sorry that EKY's gear gave the impression that this wasn't so. There are enough constraints required with the SSTV system that I tend to be perhaps overly sensitive to comments that impart still more patches worth? Is a human life expensive enough?

At about 0330 EST on Christmas Day, 1970, I was driving home from a party at a friend's house in Miami. As I pulled up at a light on a deserted street, I saw that the car on my right was smashed in in the front, the door was open, and a person was sitting on the seat with a smashed face, losing blood, and in shock. At this time of the morning, when very few persons are awake to answer a radio call, the Miami autopatch enabled me to have the police and an ambulance on the scene within three minutes.

The ability to contact the police, while not necessarily instrumental in saving this person's life, has undoubtedly been so in the past, and will undoubtedly be so again in the future.

To the opponents of FM and the repeaters, I would like to ask another question. How would you feel if you became involved in an accident on a deserted road late one night? Would you still be so opposed to that conglomeration of black boxes, antennas, and telephone lines if the ham who happened along procured an ambulance for you? You know, it's happened in the past, and it could happen again.

Amateur radio is very much h a hobby of public service. If a repeater and an autopatch provide this particular service only once in five years, what is the price of a human life?

Jeffrey R. Harrow WA4RLG

FM Correction

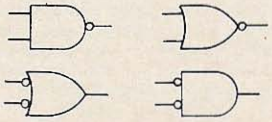
We have read your article regarding the Regency HR-2 2 meter FM transceiver in the December issue with great interest. We were disappointed to see that the chart contained in the article had one significant error and one significant omission with regard to our unit.

First, our SR-C806MA sells for \$335.00 not \$349.00. It also comes complete with 4 channels, not just 146.94 as indicated. I am sure these clarified to avoid misleading your readers.

Virtually *all* DTL IC's available from any source are in the so-called "930" family which requires a supply of +5V ±10% rather than the +4V mentioned in the article.

Your definition of an inverter talks about "+ and - logic." In fact, an inverter has nothing to do with positive and negative logic or positive and negative voltage. An inverter merely inverts the logic signal put into it: a *0* becomes a *1* and a *1* becomes a *0*.

Figure 4 has two logic symbols called 2-input *nand* gates. The one labeled "most common form" is correct, but the other is one representation of a 2-input *nor* gate. The correct symbology is shown below:



NAND NOR

The "typical buffer with gated input" in Fig. 5 is simply two *and* gates with their inputs and outputs in parallel to increase the drive capability. This is possible with RTL, but is more complicated with DTL and TTL.

The "flip-flop" in Fig. 5 is not a flip-flop unless *nand* gates are substituted for the *and* gates shown.

The paragraph which says that you can make a 3-input gate from a 4-input gate by grounding one of the inputs is true for the *nor* gates used in RTL but not for the *nand* gates used in DTL and TTL.

The existence of a clock input has nothing whatosever to do with a flip-flop being RS or JK. An RS flip-flop is defined by its response to the R and S inputs, as shown below:

R	S	Q
0	*0*	no change
0	*1*	*0*
1	*0*	*1*
1	*1*	unknown

that I ask my friends to write a short letter indicating what we ham experimenters have accomplished and how my activity has influenced or helped their progress. I'm sure anything that could be truthfully said will aid the city officials in understanding more about ham radio and its benefits.

If your local newspapers have written up ham activities or accomplishments, include the clippings with your letter. Be sure to include any specific association and activity with me.

Please address your letter to:

San Jose City Council
801 N. First Street
San Jose CA

Letters should be mailed as soon as possible.

Mike Staal K6MYC

HELP!

I recently came into some good fortune by being handed three wide band amplifiers, Instruments for Industry Model 500A, without tech data. Since I am a Novice and very limited in my electronic background I would like to know how and where I might use these beautiful pieces of electronic gear. And if it's not asking too much, how about where I might pick up a schematic and some additional tech data, as the corporation is now defunct.

Ted Onyshczak WN3OIP
302 Red River Ave.
W.S.M.R., NM 88002

Thumbs Down

I am not renewing my subscription for the following reasons:

1. I don't like FM, much less repeaters which monopolize frequencies. (Maybe 10 years of Uncle Sam with FM & repeaters gave me this negative attitude.)

2. The condoning of amateur radio to support alien causes.

3. Lack of articles etc. for an old brasspounder like myself.

4. The constant lambasting of I thought you were exceptionally kind to the ARRL in your writeup of the Boston Convention. Personally, I thought it (except for 73's room, of course) a waste of time. I left after three hours of the first day and enjoyed some flying out of Hanscom AFB.

Bob Lauzon WB2NSD
Drawer G
Pittsford NY 14534

CW/Phone Split

The continuous battle between the phone and CW boys (I am of the latter group) could be solved (hopefully) by exactly splitting all ham bands – half for phone, half for CW. Those who can't hack the code could flap their lips all day at a mike, and those of us who can't talk could wear out our fingers to our hearts' content.

Of course, on the CW half, code proficiency would remain the criterion as determining just how much of a band a feller could use. But what would the phone boys do? See who could talk the fastest?

William S. Cronan III WA6NPB
9056 Willowgrove Ave.
Santee CA 92071

50/50 split seems a little unfair considering phone users outnumber CW men by more than 20 to 1.

. . .Ken

More FM

Just a note to let you know I appreciate your magazine very much. I don't always agree but we're not all perfect. Too bad the "boys" in Connecticut don't know when to leave well enough alone, e.g. Incentive Licensing, Repeater Rules. How about some more FM articles. I'm new in the FM game. Already have Ken's great book.

Larry Godek W6KQL

Larrt :
Larry Godek W6KQL

Watch our smoke in April!

. . .Ken

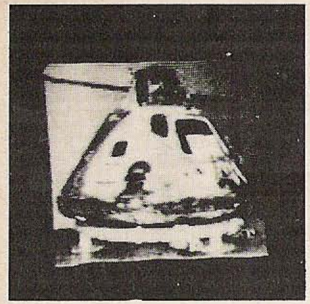
Pro IL

The monkeys who pack your Gunsmoke evidently have been opening the mail for you. Almost a year ago I wrote with my comments supporting incentive licensing, but I noticed it was not included in the "sum total" of supporting statements that you allegedly received.

Paul Schuett WA6CPP

We printed only those letters received after the ACTION coupon was published (which trailed your alleged letter by 9 months). Since last issue we have received additional letters, both pro and con – but those published last issue are still representative, and the mail runs heavy against incentive licensing.

. . .Ken



shortcomings to the pictures. We have to put up with a 120-line picture, but these pictures are certainly crisp and well-rendered within these limitations.

Ralph E. Taggart

Ever since I have gotten my first 73 Magazine I have thought of it to be the greatest publication for the hams. If you don't think I am an old stinker I would like to make one suggestion – *don't print articles "side-ways"* in the 73; such as, the news page, editorial, Caveat Emptor and others. This is not only awkward but detracts from the good image 73 has . . .

Charles D. Stoffel
78 Havenwood Drive
Rochester NY 14622

Is that better?

Score 1 for Autopatch

During the past several years, there has been some rather strong protest from various sides against repeaters and autopatches. I am a commercial pilot and carry my HT with me whenever I fly. I'v worked into repeaters across the entire United States and I can't say I can agree with very many of the objections for these two technological devices.

However, I have a question for the opponents of this form of progress. What price are the repeaters and autopatches things were simple oversights or errors as our ad in the same issue calls these things out correctly.

STANDARD COMMUNICATIONS CORP.
Thomas L. Fischer
Vice-President - Engineering

We understand the SR-C826MA is now available, which supersedes the 806 and surpasses it in performance as well. An operational repeater at SAROC using 826 components was impressive indeed.

. . .Ken

On page 96 of the December issue of 73 Magazine, you list specifications for several FM transceivers. Some of the information on the Standard SR-C806MA is in error.

We are a dealer for Standard products and would like to see the errors corrected if possible.

The price of the SR-C806MA is $335 not $349 as listed in the chart. The SR-C806MA comes with crystals for three channels in addition to 146.94 not just crystals for 146.94 as indicated in the chart.

I wish to thank you in advance for your cooperation.

Very truly yours,
ELKO Electronics Specialties
Thomas E. Doyle

The Standard is now being supplied with crystals for .94 direct, .76 direct, .34/.94, and .34/.76. Sorry about the errors!

. . .Ken

Hooray!

You really started off the New Year right with the FB January 1971 issue. I enjoyed *every* article in the magazine, including the front cover! Hope to see more articles on the humorous side, and the same type of cover in issues to come!!

Gordon Bello WA1JWQ
16 Beals St.
Brookline MA 02146

Get HEP!

Your article *Getting HEP to IC's* in the January '71 issue contains several errors. I, suspect that these may be primarily the result of trying to simplify and condense a lot of material into a short article, but they should be corrected.

If the RS flip-flop has a clock or trigger input, it may be called a clocked RS flip-flop, or an RST flip-flop. It behaves exactly the same as an unclocked RS flip-flop except that the inputs are ignored until a clock pulse occures. A JK flip-flop is just like an RS flip-flop except that the output (Q) inverts when both J and K inputs are *1*'s. a JK flip-flop may or may not have a clock, but usually does.

Again, the ÷2 and ÷4 circuits assume RTL flip-flops since grounding the S and C unputs will not work with DTL and TTL flip-flops.

Let me close by saying that 73 remains my favorite ham magazine, both technically and editorially. Right on! (Write on!?)

E. Douglas Jensen W5OGJ/K4DAD
Senior Digital Systems Engineer
RECOGNITION EQUIPMENT Inc.
Dallas TX 75222

Ham in Trouble

For several months now my ham radio activity has been jeopardized by a local ordinance in San Jose limiting antenna height to 35 ft above the ground.

I have applied to the city for variances to allow for my TH6-DX at 70 ft and my 2-meter collinear array to stay up at 40 ft. The variances have been denied. But at the last appeal the city indicated that I might be right about the fact that sometimes ham antennas should be higher than 35 ft. The city officials suggested I attempt to change the local ordinance limiting tower height. This is what I am working toward now and that is why I need your help.

City officials have stated what my best course of action should be to influence the city council. Of course, the modification of the 35 ft local ordinance will benefit all of the San Jose hams, so I am enlisting their support.

Since I have so many outstanding friends all over the world whom I've experimented with, it was suggested ARRL without any constructive and active solutions.

Joe W6RPX

Stars 'n' Stripes

73 and CQ are the only ham magazines carried by the Stars and Stripes newsstands; all other magazines are only available by subscription.

Under separate cover I am sending you a picture of the new repeater location here in Stuttgart, Germany. Wayne Green once spent an evening in the restaurant above the site.

Hanne Knorr 552-56-1321
Boeblingen AYA SAC-N-21
APO New York 09046

Death of a Rig

I knew very little about the Swan 1011 before reading Ken's editorial in the November issue. It is shocking to hear that a group of "worried" amateurs could talk Swan out of the production of the 1011. Maybe if enough of us who use 20 meters write back to Swan in favor of their rig they will consider putting it back into production. Swan puts out some very fine rigs, and I think that we should encourage them to bring up new ideas instead of tearing apart whatever new that comes out. I'd like to commend "73" and Ken for taking a stand on this issue. Thanks for keeping us informed.

Warren Watson WA0POL
3456 Perry Ave. N.
Minneapolis MN 55422

Optometrist's Conspiracy?

73 has been the only radio ham magazine allowed in this rumpus room of W6VVF for a long time.

It now appears that you are in league with the optometrists to foster sales of eyeglasses to read 73.

To top it off, you have included a comprehensive index to 1970 articles that my trifocal glasses just can't read without the use of an additional magnifying glass!

Having once been a printer's devil, I don't understand why such an important index has to be set up in such fine print when a couple more pages would have made the index easy to use.

I'll continue to read that portion of 73 in the future that I can see but be assured, I am not going to dig through these microscopic ads for goodies. I can read the telephone directory without my glasses so don't prescribe stronger lenses. Try the next size font – larger, not smaller!

W. E. Nichols A/W6VVF

We get a lot more articles in an issue when we reduce the size of indexes and directories. Some advertisers feel they need to use up every square inch of space, too. It must pay off for them, though, or they wouldn't keep advertising in 73. We'll see what we can do for you about increasing the type size of the news pages. Fair enough?

Lobbying

QST has a December editorial saying that a lobbyist is not necessary because – look what has been accomplished by Barry Goldwater as a senator.

Now it strikes me that QST, by pointing to the accomplishments of Barry, has actually defeated its own contention that a lobby is not needed.

If we had a lobbyist, he would attempt to get Congress to do just what Barry has done and more for ham radio. On the other hand, if there is no lobby and no Barry Goldwater in Congress, what would the ARRL have been able to point to in support of their opposition to a lobbyist.

What I am trying to say is that the QST editorial argument supports a lobby.

On the subject of licensing of hams, I go back to the late thirties and later where I argued at RCB meetings that I do not favor more than one type license for amateurs other than Novice because of divisions it would cause among hams. It was bad enough then. I feel very sad at the bickering going on today about who is a lid, who can use what part of what band, etc.

Dave Korpus W2BKP
773 East 46 St.
Brooklyn NY

QST's editorial was indeed contradictory. We have Barry Goldwater, they say, so who needs a lobby? They don't seem to realize that Barry's actions on behalf of ham radio are the actions of a lobbyist. Curious, no?

. . .Ken

WWV via R-4

Keep up the good work with 73. I've been reading it since the first issue. I thought that other hams with Drake R-4 rcvrs might profit from this discovery. To receive WWV without extra crystals:

1. Set rcvr to tune 7.133 AM
2. Rotate preselector to 2.4 on the inner scale.

That's all there is to it! WWV clear as a bell.

Laird Simpson W7AWB/0
8120 Bloomington Ave. S.
Minneapolis MN 55420

Unhappy New Year!

All those who have worked AS3B on CW and have sent their cards to his manager, K2PJG, please take note: You have been taken. No such call as AS3B and K2PJG is not his manager. He cannot possibly write to all those who have sent him a QSL because he is crippled severely by cerebral palsy, and writing is a task for him. And to the person who claims the call AS3B and has caused PJG some trouble, I along with Bob's other friends wish him a miserable New Year.

Dr. G. Schwartzbard WB2IWH
213 Dayton Ave.
Clifton NJ 07011

con't on page 5

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business venture. 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 exmaple: 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. . .

TRADE, SELL: used receivers. Trade for new amateur equipment. Available HQ-180C, R-4A, HQ-200, NC-190, SX-110, 2B, HW-16, GPR-90, SX-130, Eimac 4-1000A, PL 8160/4-1000A, S-Line, Nems-Clarke 1456A, S-36. Send for current list. Steven Kullmer, Evergreen Hatchery, Dysart, Iowa 52224.

"1971 TESTS-ANSWERS" for FCC First and Second Class License. -plus- "Self-Study Ability Test." Proven! $9.95. Satisfaction guaranteed. Command, Box 26348-S, San Francisco CA 94126.

2 PORTABLE TRANSCEIVERS for two meters F.M. One on 146.34–146.76. WABCO 24H82C, 2 Channels. Input 10–18 VDC, 7W RF Output at 18 VDC. 0.5 W audio output, 14 diodes, 30 transistors, triple conversion receiver, like new with manual – $135.00 each. Please send for Brochure. B. Dickerson, 1200 Johnston St., Philadelphia PA 19148.

MANUALS--R-390/URR, R-390A/URR, USM-24C, BC-639A, SP-600JX, BC-348JNQ, URM-25D, UPM-45, UPN-12, OS-8C/U, CV-591A/URR, BC-779B, TS-186D/UP, FR-5/U, USM-26, $6.50 each. S. Consalvo, 4905 Roanne Drive, Washington DC 20021.

HELP WANTED: Experienced ham, background in military electronics, to run surplus house in Northern New Jersey. Warehouses full of surplus gear waiting for the right man. Salary and commission basis or participation with small capital investment. Send resume to P.O. Box 2129, South Station, Newark, NJ 07114.

SELLING OR SEEKING HAM, CB, or H.F. EQUIPMENT? Get "Electronic Peddler," 2810 Caledon, Cincinnati OH 45244. $1.75 yearly. Your ad .08 per word per insertion.

VOICE COMMANDER I 1 watt G.E. FM transceiver. 34–94 crystals, manual. Works FB. Needs batteries. $45. Brad Rehm, W9LYK, 858 W. Chalmers Pl., Chicago IL 60614.

WANTED: Name and address of Sec./Treas. of "Ten-Ten Net of Southern California". John D. Brannon, GMAT, Box 20, APO, S.F. 96263.

HEATH HW-100 xcvr, HP-23A supply, SB-600 spkr, mike, key, good condition. $280. Bert O'Connor, 16 Smithshire, Andover MA 01810.

73 MAGAZINES 13 issues from Oct. 1960 thru Dec. 61 including January 1961. Sell or swap. Make offer. K8UHX, 4212 Fulton Pkwy, Cleveland OH 44144.

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

COLOR ORGAN KITS $7.50. IC Power Supplies $2.75 to $8.50. Computer Grade Electrolytic Capacitors $.35. XMTR Transistor TRW PT3690 $2. Used Variacs. Nuvistors. Catalog. Murphy, 204 Roslyn Ave., Carle Place, New York NY 11514.

150 WATT SALA MODEL 20-13-115 type CV constant voltage transformer, output 118V at 1%, New $18.00. Taut band 1% lab, multimeter D.C.

Leaky Lines

by Dave Mann K2AGZ

I got a brainstorm recently and wrote a letter to the office of U Thant, Secretary General of the United Nations. The thought had occurred that since ham radio is an international activity which promotes amity and good will, that perhaps it might be possible to establish a working station at UN Headquarters in New York, with operational privileges for visitors with current licenses. Since the UN constitutes a legitimate international enclave within New York City, as does the ITU within the city of Geneva, I reasoned that perhaps this station might achieve separate country status in the same manner as 4U1ITU, and might be acceptable for DXCC credit. The latter part was an afterthought, to be discussed at some subsequent date. My main target was to get permission from the UN authorities to establish the station.

I pointed out that since this year marks the 25th anniversary of the signing of the Charter in San Francisco, it would be an auspicious occasion for the initiation of such a station. And I asked the Secretary General if we might not be favored with a prompt reply.

The answer came in less than a week, not from Mr. U Thant, but from Josef Nichols, First Deputy Chief of the Communications Section of the Secretariat. He relayed cordial greetings from the Secretary General, and stated that Mr. Thant had expressed warm enthusiasm for the many contributions of the world's amateurs toward world peace and friendship. He en-

Then, of course, the idea hit me, square in the middle of my dumb skull. I have about as much chance of getting any League Committee to agree to a proposal of mine, as Spiro T. Agnew has of being elected Honorary Chairman of the S.D.S.

But I still think the thought has merit, and I still intend to try to get the station established . . . with or without separate country status. It would be a marvelous accomplishment to have a ham station operating at the UN, where the face of amateur radio could be observed by visitors from all over the globe, doing what it does best; establishing and maintaining international cameraderie, good will and peaceful co-operation among all the peoples of the planet. That's more than all the so-called statesmen and all the political geniuses have been able to do.

* * *

Over the last six months or so, ever since one of my close friends popped off that the code requirements ought to be scrapped because they are obsolete, I have conducted a private survey among about 1500 amateurs, selected at random, more or less. My poll consisted of a short series of simple questions, unlike some well-known political polls, not loaded nor designed to result in a predetermined conclusion. I wanted to learn the true facts concerning CW, let the chips fall where they might. And without wishing to appear immodest, I am happy to say that I anticipated the result. By an overwhelming majority

There has been a good deal of discussion pro and con concerning these list-type operations and frankly, I have mixed feelings about them myself, even though I go along with them as a sort of half-a-loaf.

To a great extent these are like the little girl with the little curl in the middle of her forehead. When the net control station succeeds in maintaining his chairmanship effectively, reducing the confusion to a modicum, the hubbub is neutralized, and a surprisingly large number of QSO's is the happy result. But in a number of instances, where the control station has been incapable, either through ignorance or inexperience, of handling the job properly, the ensuing chaos has been horrific. I am sure that these nets, while they may be unpalatable to many, have certainly served a useful purpose to those DX chasers who are not blessed with strong signals by virtue of extravagant antenna systems and ideal locations. From their standpoint the lists have made the difference between a contact and total failure. They could never hope to compete on an equal basis with the big guns on our DX bands.

Perhaps the next time you are tempted to belittle these lists, you might give a charitable thought to all of those who, but for this method, would have precious little chance to realize their hopes of working rare DX. And then, you may enjoy the knowledge that more people are experiencing the satisfaction which ordinarily would come only to those few who are fortunate enough to be able to compete fairly with each other. View it as you would view your golf handicap, and it begins to make more sense.

SWAN 270B with SS-16 filter (shape factor 1.28:1!) factory installed, with Electrovoice 600E mike. $450. Curtis electronic keyer factory wired with relay $50. All absolutely mint, with manuals, in factory packaging. Marty Barrack WA7PUE, 505D East Country Club Drive, Yuma AZ 85364.

FACSIMILE machines Transmitting and receiving model. 110vac units in operating condition wt. 30 lbs. $16.95 ea. Facsimile paper 500 for $4.25. Send check or M.O. with sufficient postage, excess refunded to R. C. Anderson, 1733 W. Ellen St., Chicago IL 60622.

ELECTRONIC ORGAN, basic spinet kit, transistorized, known make, limited supply, send SASE for particulars. W9YCB, L. G. Hanson, RR 2, Box 52A, Angola IN 46703.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607. 451-7755 area code 415.

DERRICK ELECTRONICS HAS ANTENNAS. We'll give the best deals on Hy-Gain, Mosley, Cushcraft, Rohn, Tri-Ex, Easy-Way, Tristao. Box 457, Broken Arrow OK 74012.

MOTOROLA FM – 2 meters; U43GGT, 40 watts output, transistor supply, very clean, with cables and control head, less crystals – $145.00. 80D Transmitter strip – $15.00. Sensicon A Receiver – $20.00. Complete 80D, Dynamotor supply with cables and head – $40.00. WA1INO, P.O. Box 587, Manchester CT 06040.

MILITARY SURPLUS. All new. Electronics, devices, components. Compare and save. Catalog 10¢ (stamps or coin). Electronic Systems, P.O. Box 206, New Egypt NJ 08533.

MODEL 19 TELETYPE, good operating condition, for sale or trade. (202)-234-4678, P. S. Richter, K1SDX/3, 2727 29th St. N.W., Washington DC 20008.

ranges: 3, 15, 30, 150 volts and .06, .6, 3.30 Amperes, Gulton model VAR-101. $24.50. 100 Megacycle vacuum type crystal $5.00. 6 ampere 200 volt Motorola silicon rectifiers 75 cents each. 1 ampere 400 volt, 10 cents each. 100 M.A. 2 inch panel meter D.C. to 50 Megacycles $7.50. 240 volt primary, 24 volt secondary at 10 amps, Barber Colman $6.00. SASE for more items. RHC, 2425 Bradley Road, Rockford IL 61107.

HAM-M ROTOR: Used 1 season, like new. First $59 takes it. D. Steele VE7BCX, 1732 Brookshire, Tustin CA 92680. 714/878-3495.

HT-2 VARITRONICS HANDIE-TALKIE: Unused, perfect, complete. First $159 takes it. D. Steel, VE7BCX, 1732 Brookshire, Tustin CA 92680. 714/878-3495.

FACSIMILE TRANSCEIVERS Mod. TXC w/110 V.A.C. – P.S. Good cond. $175. each. Facsimile Rec. Mod RD-92/UX w/110 V.A.C. – P.S. Good Cond. $100. each. News Clark Telemetry Rec. Type 14-12 New & Unused. Timefax electrostatic rec. paper $5./roll. Charles Moss, Rt 1, Box 411, Mt. Shasta CA 96067.

THE SPRING AUCTION of the **ROCKAWAY** Amateur Radio Club will be held Friday evening April 23rd at 8 P.M. at the American Irish Hall, Beach Channel Drive at Beach 81st Street, Rockaway Beach, N. Y. Come to the best Auction in the New York area. For further information write to Al Smith, WA2 TAQ, P.O. Box 341, Lynbrook NY 11563.

WANTED, MAN WITH 2nd CLASS PHONE TICKET or better to work in 2 Way radio sales & service with option to buy business. Am Distributor for E. F. Johnson F.M. & Motorola Service Station. No smoking habit preferred. Walt Fairbrother, 29 Alden St., Greenfield MA 01301. Ph. 413-773-5063.

dorsed the spirit of international cordiality which has always been so marked a part of amateur radio. Unfortunately, the letter went on, they could not consider establishing such an operation at this time, since the expected visits of many heads of state would tax their security facilities to the limit. My proposal was highly acceptable at some time in the near future, but, regrettably, it must be declined for the period of the celebration. Hence, the door to such an operation has been flung open, to be acted upon when the time is more propitious.

In mentioning the matter to other hams, I discovered a great deal of skepticism concerning ARRL DXCC Committee's willingness to consider granting any separate country status to such an operation. This puzzles me, for several precedents have been established which leave the way clear. United Nations Headquarters is certainly no different than ITU, Geneva, or even HV, the Vatican, both enclaves within larger political entitites. If there were a refusal to grant status, it would be highly inconsistent. In what possible way does New York differ from Geneva or Rome?

the continued use of code is endorsed wholeheartedly. Even confirmed phone men who rarely, if ever, use telegraphy, expressed what I like to think was a sentiment, rather than merely an opinion. They would not care to see CW fade into limbo like the horse and buggy or the old fashioned waltz.

One thing I noticed almost universally among those who had to 'fess up that they hadn't been on CW for years. They all vowed solemnly that "One of these days I'm gonna get out the old bug and get back on CW, because the phone frequencies are starting to become a real rat race." It seems that even those who suggest that less emphasis on CW is now in order, invariably add, somewhat wistfully, "There was a time I could copy forty per minute without any trouble at all." Somehow all hams seem to find a source of real pride in that accomplishment, and are a bit ashamed to admit that they have allowed their skill on CW to atrophy.

Yes, my little survey clearly shows, despite all arguments to the contrary, that far from being ready for the boneyard, CW is a lusty, healthy, living part of our hobby, still very much utilized both for its usefulness, and in a way even more importantly, for the sheer fun and pleasure of it.

* * *

I am an enrolled, card carrying member (what am I saying?) of three or four of those recently organized nets which have been formed for the purpose of facilitating DX contacts, so that those foreign operators who are intimidated or otherwise frustrated by horrendous pile-ups will be able to minimize their difficulties and work a few QSO's.

HOBBYISTS – Electronic components at huge savings. Transistors, 2N3566 and 2N3567, 6 for 25¢ 2N3638, 4 for 25¢ capacitors 10¢ carbon resistors 5¢. Thousands of components. Catalogue free. SASCO Electronics, 1009 King St., Alexandria VA 22314.

TRANSCEIVER,SR-150 and power supply P-150 AC, complete with crystals for five bands and calibrator, excellent condition. Turner SSB mike, new. $300 plus shipping. McFolin, WA4WRU, 710 Dellwood Rd., Huntsville, AL 35802.

Letters con't from page 4

A comment on the formulas on page 28 of your November issue for calculating electrical lengths.

The formula used in both cases by W6AJZ is one which has already been corrected from the free space calculation by some 5%, for length/diameter, and end effect. It is the one commonly used for wire antenna dimensions. To apply velocity factors, which are a ratio to the free space dimension, is therefore incorrect, in this case.

Correct formulas are 369/f (MHz) x V for the 3/8 wavelength, and 492/f (MHz) x V for the 1/2 wavelength.

Owen Jackson OA4MS.

I confirm that the formulas should read: for the 3/8 wave stub = 369/f (MHz) x V; and for the coupling line = 492/f (MHz) x V x m, where "m" equals the multiples of half-waves required to reach from antenna to operating position. The "m" was typographically misplaced in the first formula in the printed article.

I think the fact that some local W6s successfully applied the erroneous formulas is accounted for by the short line length they used . . . only ½ wavelength, which minimized the affect of error. Longer line multiples of "m" would undoubtedly lead to grief.

Ring up one shameful boo-boo to W6AJZ; and my thanks to OA4MS for showing me the error of my ways.

W6AJZ

What do you suppose they're up to now?

EDITORIALS CONT.

W2NSD/1 cont. from News Page 1

time to start a new publishing effort so Mike will need all the help and cooperation he can get.

When you consider that Mike is undertaking this all on his own with no support beyond good wishes from any of the amateur magazines you can see that he has his work cut out for him.

THAT QST EDITORIAL

In December the unsigned QST editorial defended the ARRL position that amateur radio needs no lobby in Washington to protect the hobby. They attributed my concern about this to an effort to build up the circulation of 73. That allegation ill befits them.

Amateurs who took the time to read the QST editorial carefully and thoughtfully may have recognized the illogic of their argument. Actually they made an extremely strong case in favor of a Washington lobby for amateur radio. In essense, they said that since we have Goldwater in Congress, a lobby is not needed. It was Goldwater who broke the ice with the reciprocal licensing bill. . .Goldwater who was responsible for the effort to license aliens. . .etc.

Senator Goldwater is providing some of the functions of a Washington lobby for amateur radio. . .true. But Senator Goldwater has been sent to Congress by the people of Arizona and it is to them that he owes his primary efforts, not to us. If he has time left over, we are benefited. . .if not, well, too bad.

We have but to remember back to the years that amateurs worked toward getting that reciprocal licensing bill into Congress . . .to no avail. Without Senator Goldwater I doubt seriously if we would be any further along in getting reciprocal licensing today than we were ten or fifteen years would irritate congressmen shows a profound misunderstanding of the lobby function. Their insistence that Congress has little power to help amateur radio is downright appalling.

The fact is that the FCC recently jammed through a 125% increase in the amateur radio license fee and the ARRL was completely powerless to stop it. They demonstrated that they have no clout where it counts. The increase was unreasonable and should never have happened. You can bet that the AOPA would never let anything like this happen to the pilots or the NRA permit such a catastrophe to hit their members.

Read that editorial again when you get a chance and see what you think of it now. Maybe you will join the "Drumbeaters."

Is 1971 the year when ARRL members will start taking an interest in amateur radio and will vote in some new directors? That is where you have to start if you are going to make a dent in the conservative core at HQ.

NEW FCC FORM 610

The FCC has announced that effective July 1, 1971 they will no longer accept 610 forms which are dated July 1970 or later. The form 610 is for applying for an individual amateur radio station and/or operator license.

NEW THREAT TO 220

The Electronics Industries Association is petitioning the FCC to take the 222–224 MHz amateur band and turn it over to CB, removing it entirely from amateur use. They further are asking that the amateur frequency allocation be changed so that one class can use 220–222 and another class use 224–225 MHz!

The following companies are financially supporting the EIA program:

K6MVH cont. from News Page 1

me tacos or enchiladas. It was tacos for supper with WB6AOF, tacos for lunch with W6NOS; enchiladas for lunch with WB6IGZ, then an enchilada dinner with WA6BOF and K6VBT. When I visited my mother in Boulder City, I was going to tell her about my "forced" Mexican food diet, but I didn't have the heart. When I walked into her house, a surprise party was under way for me. In case you haven't already guessed, the "party" was in the form of a taco feed.

The fellows at Standard Communications (both hams) showed their new superselective transceiver and demonstrated a repeater made from Standard transceiver parts.

It's a real pleasure to be home again, here in Peterborough. And clam chowder never looked better!

A Big One in Texas

It looks like it's getting to be convention season; particularly with respect to VHF operation. The hottest thing on the calendar right now is the First Annual Southwest Regional VHF Conference, slated for March 21 and 22 at the Sands Motel on West Hwy 80, in Midland Texas.

Tickets are modestly priced at $2 for the conference, $1 for the Saturday evening dance, and $2 for the Sunday swapfest. I don't know exactly what's on tap for the conference program, but I will be there as either speaker or "open-forum" participant.

According to Paul Storm (WA5RAG), president of the Midland club, door prizes will be awarded at the dance and the swapfest. In addition, prizes will be awarded for CW, frequency guessing, homebrew equipment (no kits), etc. Talk-in frequencies will be 7270 SSB and 146.94 FM. (The local repeater is .34/.94.)

Advance registrations may be sent to MARC, Box 967, Midland TX 79701.

Speaking of Conventions

Wayne and I are occasionally invited to speak at conventions or hamfests, and we nearly always accept. But invariably, we attach a string to it so that 73 doesn't go broke paying air fares. What we require is sufficient guaranteed subscription sales to cover expenses for the trip. That way 73 picks up the tab, but the money comes from the area we visit. The whole thing generally works out quite satisfactorily for everyone.

NEW PREFIXES IN GERMANY

In addition to the existing call sign prefixes the German postal authorities now issue the prefixes *DA*, *DB*, and *DF*. There are now the following call signs:

ago. Someday I hope that John Barrows, (W6ECS) the chap who spent more time than anyone else in the world trying to get reciprocal licensing enacted, will write a history of that effort. His major opponent in this was none other than ARRL HQ which was, at the time, vigorously fighting anything that they did not originate. I will leave it to your objectiveness as to whether they have changed in this attitude.

I have talked with Senator Goldwater about the importance of our lobbying for amateur radio and he has been most helpful in suggestions to this end. We do need to make sure that all congressmen know what amateur radio is and how it differs from the citizens band and other services. Amateurs are making enough news for us to get congressmen to enter items in the Congressional Record frequently. This is one paper that every congressman reads every day. Mail and handouts seldom get through the assistants, but the Record does.

The CBers have begun to find out how important congressmen can be to their efforts to get the FCC to listen. At the November 20th confrontation between the FCC and representative CB groups in Washington I doubt if the FCC representatives would have done more than politely listen to the CB pitch for more frequencies, more power, higher antennas, and legal hamming. But there were a number of congressional representatives there and the FCC *did* listen. I was there to watch that important meeting. Amateurs have never held such a meeting with the FCC, have they?

As of mid-January the powerful Electronics Industry Association still intends to petition the FCC to follow the CQ Magazine plan and turn 146–148 MHz over to CB. This is in addition to their 222–224 MHz petition for CB channels. Can we hold our frequencies against this formidable combination of a well funded and experienced Washington lobby plus a large number of cooperating CB groups who have the ear of their congressman? Senator Goldwater has his work cut out for him and I hope Arizona doesn't need anything serious soon.

The QST editorial is slanted. The use of such emotional terms as major clinker . . .pointless idea. . . expensive . . .dangerous. . .with reference to the proposed Washington lobbyist is scarcely honest rhetoric. Their inference that a lobbyist

Amphenol
Antenna Specialists Company
B & K Division of Dynascan
Browning Laboratories, Inc.
CTS Knights, Inc.
Courier Communications
Demco Electronics
Echo
E. F. Johnson Company
Hallett Manufacturing Company
Hallicrafters Company
Heath Company
Hy-Gain Electronics Corp.
Kaar Electronic Corp.
Lafayette Radio Electronics
Midland International Corp.
Mosely Electronics
Olson Electronics
PACE Communications Corp.
Raytel Division of Raytheon
Regency Electronics
Rohn Electronics
Squire Sanders, Inc.
Texas Crystals
Turner Microphone Company
World Radio Lab

The above companies are CB manufacturers, though a few are also in the amateur field. In all it is a formidable group backing this proposal.

Keep in mind that the EIA is centered in Washington and knows its way around when it comes to lobbying. Keep in mind that amateur radio has no lobby whatsoever and thus has no way to effectively oppose any pressures that can be brought to bear. What will the outcome of this one-sided pressure to completely take away this amateur band? Since you have nowhere to turn for help, if this is of any importance to you, you are forced to do something about this yourself. But what can you do?

First of all you must understand the issue and what is at stake. The complete text of both the EIA proposal and RM-1633, the only alternative so far filed with the FCC, will be published at the end of this editorial so you can judge for yourself the factors involved. 1633 asks for the establishment of a new class of amateur license, requiring only a knowledge of rules and regulations, which would use the middle 4 MHz of the 220 band. This was proposed as a plan for bringing more new amateurs into our hobby via the VHF FM route. The band would still remain open to all amateurs and no frequencies would be taken away from amateur radio.

While many amateurs may not agree 100% with the proposals of 1633, some feeling that the new class of license should demonstrate at least 5 wpm code ability, others feeling that a Novice level of theory should be required, the entry of the EIA proposal would appear to virtually eliminate the possibility of such options, and reduce the problem facing the amateur to chosing one or the other of the two alternatives. There is a good possibility that even if amateurs are in 100% agreement (which would be historic) that they still would not be able to stop the EIA juggernaut.

Practically speaking, your choice would seem to be either a support of the EIA proposal through your silent submission, or an active fight to put through RM-1633.

VERON

25th ANNIVERSARY

The Dutch national society, VERON, celebrated 25 years of service to the radio amateur at a "Day of the Amateur" held on 15 November 1970 at Philips Ontspanningscentrum (recreation center) at Eindhoven.

After opening speeches by the president of VERON, A. H. J. Claessen, PAØCLA, and the president of the Eindhoven district club, members heard a lecture by Dr. J. A. Saxton, president of the RSGB, entitled *Amateur Radio and Propagation Research*. Dr. Saxton, who is director of the UK Radio and Space Research Station, spoke of the past achievements of amateurs in the field of propagation research and emphasized the need for continuing vigorous work in the future.

Nearly 300 members attended during the day and the success of the meeting was assisted by the excellent facilities of the Philips center.

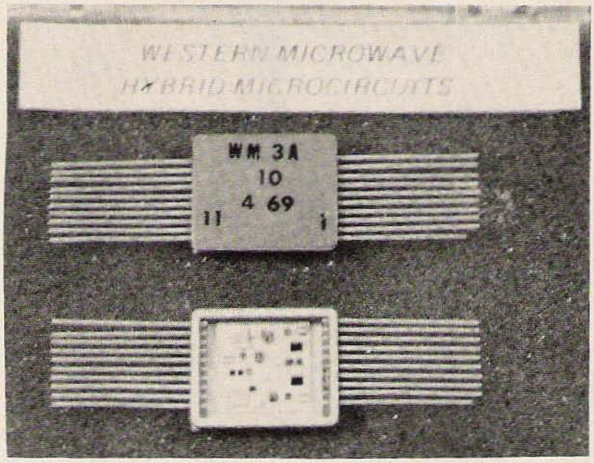
		License Class
DA 1 AA – DA 2 ZZ	Amateurs of Foreign Armed Forces	A + B
DA 4 AA – DA 4 ZZ	Amateurs of Foreign Armed Forces	C
DB 1 AA – DB 9 ZZ	German amateurs	C
DC Ø AA – DC Ø EZ	German amateurs	C
DC Ø=FA – DC Ø JZ	Foreign civilians	C
DC Ø KA – DC Ø ZZ	German amateurs	C
DC 1 AA – DC 6 ZZ	German amateurs	C
DC 7 AA – DC 7 ZZ	German amateurs in West Berlin	C
DC 8 AA – DC 9 ZZ	German amateurs	C
DF 1 AA – DF 9 ZZ	German amateurs	A + B
DJ 1 AA – DJ Ø ZZ	Foreign civilians	A + B
DJ 1 AA – DJ 9 ZZ	German amateurs	A + B
DK Ø AA – DK Ø ZZ	German club stations, special call signs	B
DK 1 AA – DK 9 ZZ	German amateurs	A + B
DL Ø AA – DL Ø ZZ	German club stations, special call signs	B
DL 1 AA – DL 6 ZZ	German amateurs	A + B
DL 7 AA – DL 7 ZZ	German amateurs in West Berlin	A + B
DL 8 AA – DL 9 ZZ	German amateurs	A + B

USSR PREFIXES

Prefix Club Stations	Prefix Individual Stations	Prefix Individual vhf Stations	
UK1	UA1	RA1	European USSR
UK2	UA2	RA2	Kaliningrad
UK2	UC2	RC2	Byelorussia SSR
UK2	UQ2	RQ2	Latvian SSR
UK2	UP2	RP2	Lithuanian SSR
UK2	UR2	RR2	Estonian SSR
UK3	UA3	RA3	European USSR
UK4	UA4	RA4	European USSR
UK5	UO5	RO5	Moldavian SSR
UK5	UB5	RB5	Ukrainian SSR
UK6	UG6	RG6	Armenian SSR
UK6	UD6	RD6	Azerbaijan SSR
UK6	UK6	RF6	Georgian SSR
UK6	UA6	RA6	European USSR
UK7	UL7	RL7	Kazakh SSR
UK8	UH8	RH8	Turkomen SSR
UK8	UJ8	RJ8	Tadzhik SSR
UK8	UM8	RM8	Kirgisk SSR
UK8	UI8	RI8	Uzbek SSR
UK9	UA9	RA9	Asiatic USSR
UKØ	UAØ	RAØ	Asiatic USSR

John Schultz W2EEY/DL
40 Rossie St.
Mystic CT 06355

A view of an encased WM3A filter and one with part of the casing removed to show the internal hybrid integrated circuitry. The encased filter measures only 8/10" x 7/10" and is about 3/16" thick. Photo courtesy Western Microwave, Los Gatos CA 95030.



INTEGRATED CIRCUIT AUDIO FILTER

The development of complicated multi-inductor filters and multi-transistor rc filters is culminated in a new type of integrated curcuit audio filter. The filter should have many applications in amateur radio equipment designs.

One item that has been used in innumerable pieces of amateur equipment and accessories over the years is an audio filter. Such filters, particularly if they were used for audio selectivity purposes, could get to be very elaborate and large with multiple section designs. It was probably only inevitable that the current stream of progress toward the micro-miniaturization of electronic components would also reach audio filters. However, the miniaturization of audio filters that has been achieved is not just simply a miniaturization of inductors and transformers. None of these components are used in the audio filters to be described, and these integrated circuit filters offer adjustment versitility that could never be achieved with inductors. Such filters open up the possibility for the construction of numerous compact pieces of accessory equipment that can be used to improve the operation of receivers and transceivers.

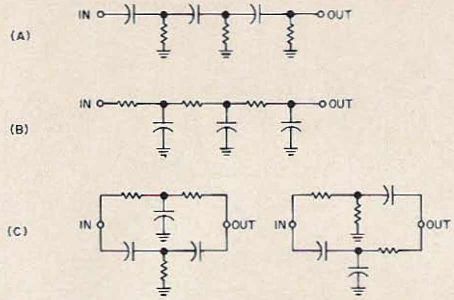


Fig. 1. Basic rc networks allow filter circuits to be built without the use of inductors. High-pass circuit (A), low-pass circuit (B), and notching and peaking circuits (C).

Background

Many attempts have been made to do away with the use of inductors in filters both because of size and cost factors. Some of these attempts date back quite a few years and all revolve about the use of rc networks in place of inductors. For instance **Fig. 1(A)** shows an rc high-pass filter. As the frequency of the input signal increases, the reactance of the capacitors decrease and more voltage appears across the output. **Fig. 1(B)** shows a low-pass filter that works in a similar manner. If you combined the filters, using an amplifier for each, you could form a bandpass filter. You could also combine various forms of rc networks to form notching or peaking filters, as shown in **Fig. 1(C)**. Such filters by themselves, of course, are crude and provide poor selectivity. Usually such filters are used together with amplifier stages to compensate for the filter attenuation and also in feedback arrangements so the filter

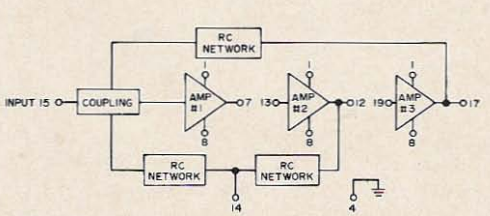


Fig. 2. Block diagram of the Western Microwave WM3 filter. ALL of the blocks shown are contained in the single filter unit shown in the photograph. Each amplifier is, in fact, a separate integrated circuit amplifier. The numbers refer to the terminal connections.

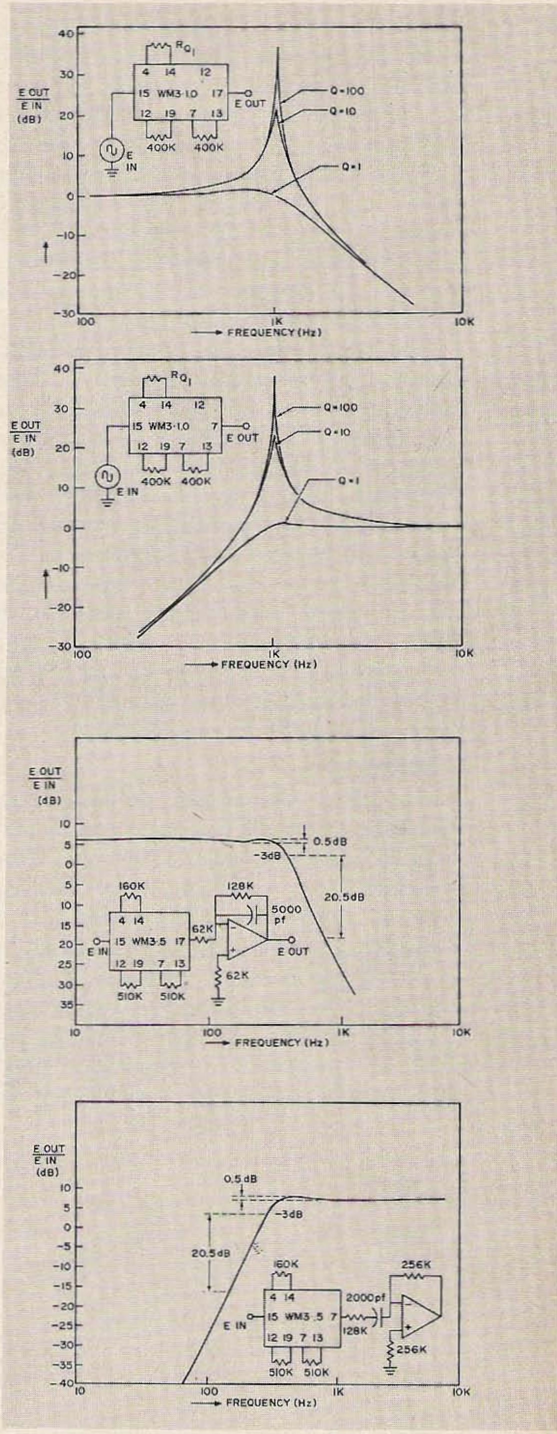


Fig. 3. The WM3 filter can be used alone [(A) and (B)] to function as a low-pass or hugh-pass filter or in conjunction with a postamplifier [(C) and (D)] to produce a steeper slope at the cutoff frequency.

circuits are not loaded down. Unfortunately, by the time you combine sufficient discrete component rc networks and transistor amplifier stages to have the rc filter duplicate the performance of an inductor network, the rc filter can be as large and as costly as the latter. The advent of integrated circuits has changed all that, however. High gain amplifier circuits and multiple rc networks can be incorporated in one physically compact unit.

The block diagram of the integrated circuit filter is shown in **Fig. 2**. Three multi-transistor operational amplifiers and the necessary rc networks in a feedback arrangement are combined in the hybrid filter unit. Three external resistors are used and can be manipulated to change the operational characteristics of the filter. One can see some of the filter components in the unencased view of the filter in the photograph. The encased filter measures 0.8 inches x 0.65 inches x .15 inches thick. The surface area is about that of a 25 cent piece, and it is hardly any thicker.

Performance

The filter really begins to shine when one investigates its performance possibilities. It can be used as a high-pass filter, low-pass filter, peaking filter, notching filter, etc. The center frequency can be adjusted as desired by an external potentiometer as well as the Q if desired. The unit can also be set up so you can switch select a variety of different filter effect outputs.

Graphs portray the performance of this type of filter best. **Fig. 3** illustrates the output versus frequency characteristic of the filter in several low-pass and high-pass circuits. The filter can be used alone for these functions, or its output used to drive another ic operational amplifier power stage to further increase the slope of the frequency response at the cut-off frequencies.

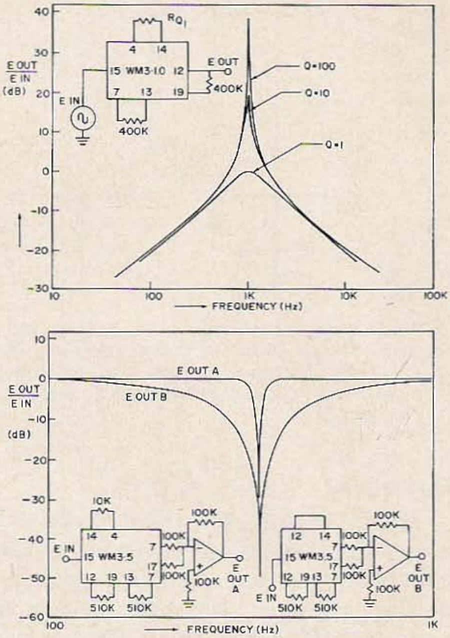


Fig. 4. The extremely sharp peaking and notching characteristics of the filter make it ideal for use as an cw selectivity device. The peaking and notching frequencies can be tuned from 500 to 1500 cycles.

Fig. 4 shows the filter used as a peaking or notching filter. Note the extreme

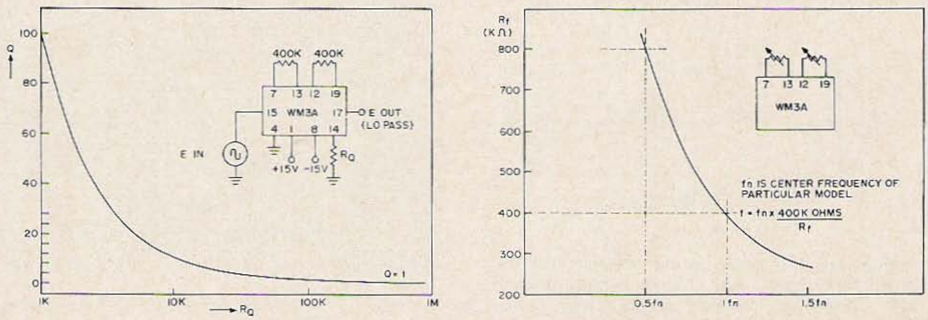


Fig. 5. The above graphs indicate how by simple external potentiometer control, the frequency as well as the Q of the filter can be varied.

sharpness of the response at the nominal center frequency of 1 khz. Actually, both the center frequency as well as the sharpness of the filter response can be tuned by making various of the external resistors variable as shown in **Fig. 5**. Thus, the center frequency of a nominal 1khz filter can be tuned from about 500 to 1500 cycles. The Q can be varied from about 1 to a maximum of 100.

As might be imagined from looking at the arrangement of the external resistors and the output terminals used for each specific application of the filter, you can devise various switching arrangements to select different outputs, different specific center frequencies, etc. The possibilities in this direction are pretty well only limited

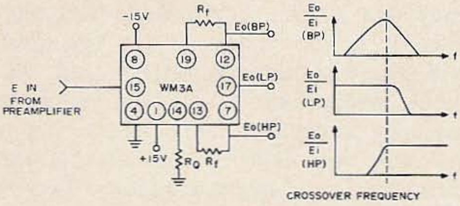


Fig. 6. The above diagram illustrates how the filter can be used to simultaneously produce different output characteristics. Rf and Rq are chosen according to Fig. 5.

by your imagination. **Fig. 6** shows one simple circuit which provides simultaneous or switch selected different output possibilities.

Summary

The type of filter described is available now from firms such as Western Microwave. The price of such a filter—about $30 depending upon the type of casing used—will restrict its use in amateur equipment until greater sales will invariably bring the price down to that of regular integrated circuits. However, even though one may not be using such a filter tomorrow, such filters will be the type of component that will become common in amateur equipment as the micro-miniaturization of components for use if communications circuits continue.

. . . W2EEY

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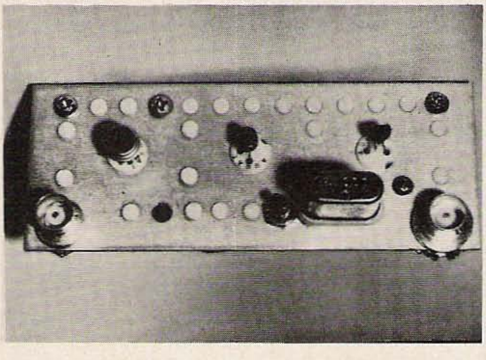
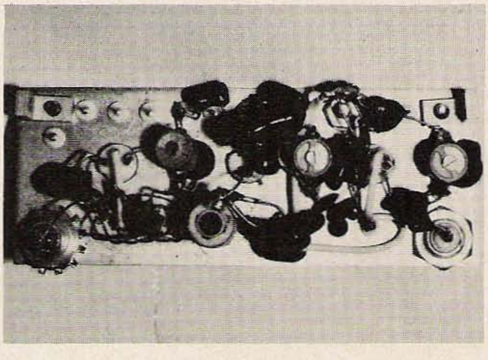
INTEGRATED CIRCUIT 6 METER CONVERTER

At the present time, amateur 6-meter converters are built around nuvistor tubes or field-effect transistors. The former requires a b-supply in the order of 100V and filament power; both types usually require neutralization, which is tedious and requires additional components.

The 6-meter converter described in this article uses an integrated circuit in the front-end, eliminating the need for neutralization and yielding far better gain characteristics than the nuvistor or all-FET counterparts.

The amplified 6 meter signal is mixed at the gate of a 2N3819 FET mixer with the local oscillator signal, generated by a crystal controlled 2N3819 FET overtone oscillator operating at 49.5 MHz This produces a difference frequency of 1.0 MHz which is in the middle of the broadcast band, making the converter ideal for mobile applications. If a 7 MHz difference frequency is desired, a 43.5 MHz crystal is used and the 3900 pf capacitor is the mixer drain tank circuit is changed to 100 pF





Circuit Description

This converter uses a CA3028A integrated circuit in the rf amplifier, which is connected in cascode configuration. The cascode circuit behaves as a pentode tube, and thus prevents tendencies toward oscillation. These tendencies are further reduced by using toroidal coils, which prevents generation of stray magnetic fields and eliminates the need for shielding the input from the output tank circuits.

The converter has a gain of 36 dB up to the mixer drain tank circuit. However, since the tank circuit is high impedance, a link coupling must be used to match to the receiver input impedance, which is usually in the order of 50 ohms. The link consists of three turns of no. 22 wire around the mixer drain tank coil. Matching losses are unavoidable, but a gain of 24 db can be achieved without much difficulty. Typical bandwidth is 100 kHz.

Alignment

With a VTVM connected at the oscillator gate, tune the oscillator tank circuit for maximum negative voltage. Remove the VTVM, and connect an oscilloscope at the mixer drain terminal. With a 1mV 50.5 MHz signal connected at the input, tune the output tank circuit of the rf amplifier for maximum signal. The signal at the mixer drain terminal should be sinusoidal, at a frequency close to 1 MHz if it is not sinusoidal, detune the oscillator plate tank circuit slightly. Now tune the mixer drain tank circuit for maximum signal, and tune the rf amplifier input and output tank circuits for maximum signal.

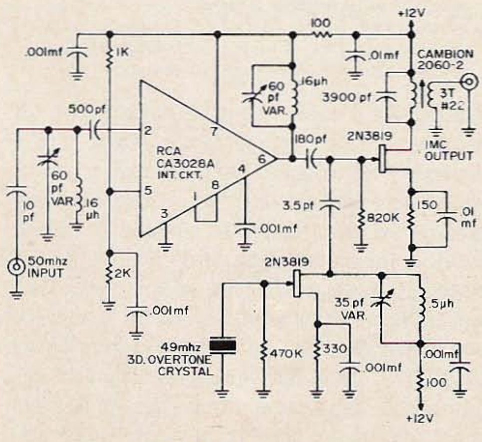


Fig. 1. Schematic

Construction Details

The converter was built on a piece of aluminum, with teflon sockets and terminals used for mounting components, although if built on a punched phenolic board with standard terminals the circuit will work as well. The only precautions to observe are making the connections as short as possible and to keep the coils well separated from each other.

The toroidal coils are not visible in the photographs because they are mounted under the trimmer capacitors.

The converter costs less than $20.00 in parts and outperforms by far many of the commercial units that are presently available for almost twice the cost.

. . . WB4KMB

Trap-Type VERTICAL Antenna

The addition of a few stubs can add effective 2 meter operation to most trap-type vertical antennas without degrading the regular performance of such antennas and without requiring any change in transmission line connection.

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Brooklyn NY 11227

Usually one erects a trap-type vertical antenna for use on the lower frequency bands because of antenna space restrictions. When carefully adjusted, such antennas are capable of reasonably good performance. Many operators who use such antennas would also like to have some antenna facility for operation on a vhf band–particularly 2 meters–and look fondly at the trap vertical structure trying to visualize how advantage might be taken of its height, etc., for use on 2 meters without erecting a completely separate antenna installation for the latter band. One could mount some small two meter antenna, such as a ground plane, on top of the trap vertical, but structural problems are involved with the relatively thin upper section of the trap vertical, a separate transmission line required (or a changeover relay to the trap vertical transmission line), and the basic trap vertical performance may be affected. A much better solution to the problem, of course, is to somehow utilize the trap vertical antenna itself as an antenna array with a low loss transmission line, such as RG-8, if it has been properly installed. So, there is no problem with the basic transmission line run to the antenna for use on two meters. The problems which do exist are with the trap vertical antenna itself as to how it can be modified into a useful antenna form on 2 meters that will correctly match the transmission line.

This article presents an easy method of modification that can be used with most trap verticals which permits use of the antenna on 2 meters while operation of the antenna on its basic design frequencies is not affected.

Basic Antenna Considerations

The usual trap type vertical can be electrically represented as shown in **Fig. 1(A)**. The various tuned circuits isolate sections of the antenna on different bands such that the basic antenna structure always remains a ¼λ vertical. Above their resonant

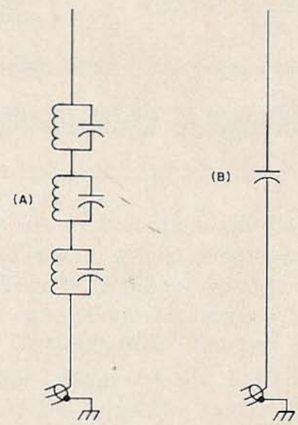

Fig. 1. Multiband trap type vertical antenna (A) forms a vertical antenna which can be represented as at (B) when operated on a frequency which is several times higher than its highest normal operating frequency.

frequencies, each tuned circuit would present a capacitive reactance. Thus, if the antenna were operated on a frequency several times higher than the resonant frequency of the highest frequency tuned circuit trap, the antenna could be electrically represented as shown in **Fig. 1(B)**. The capacitive reactance still present would be very small because of the frequency being considered, although the series effect of the equivalent capacitors from the individual tuned circuits works to increase the total reactance on 2 meters. The total reactance

for the experimenter!

INTERNATIONAL EX CRYSTAL & EX KITS

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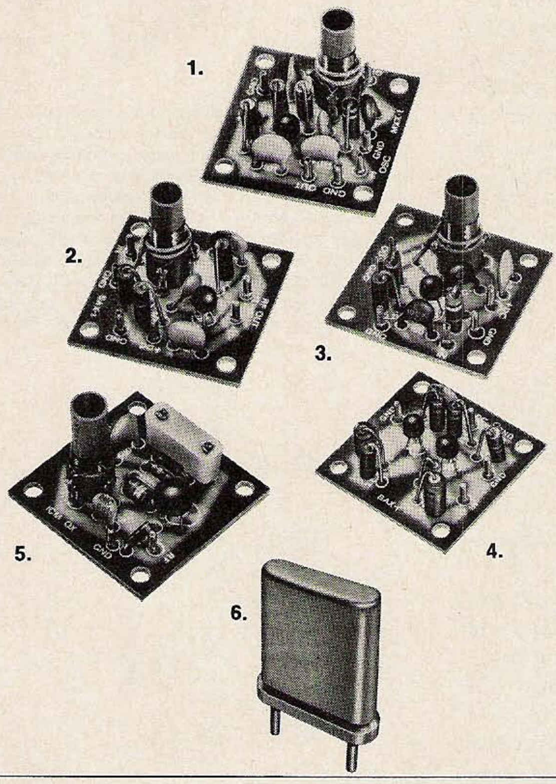

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present on 2 meters depends upon the number of traps used in the antenna and their specific parameters, but it can be as low as 30 ohms in a typical antenna.

For the moment, it can be considered that the series capacitive reactance on 2 meters is insignificant, and the antenna acts as a straight rod. If the antenna were excited on 2 meters, a situation similar to that shown in **Fig. 2(A)** would result. If the total length of the antenna happened, by chance, to be correct, it might still match the transmission line impedance. The chances of such an event taking place are rather small, however. Even if it were to occur, the total length of the antenna would be such that a number of current reversals (one every ½λ) could take place. Since the currents in different sections would be out of phase, the resultant radiation pattern would split into a number of lobes in a manner similar to that for a long wire antenna. The result would be radiation and useful for little more than communicating with an aeronautical mobile station directly overhead.

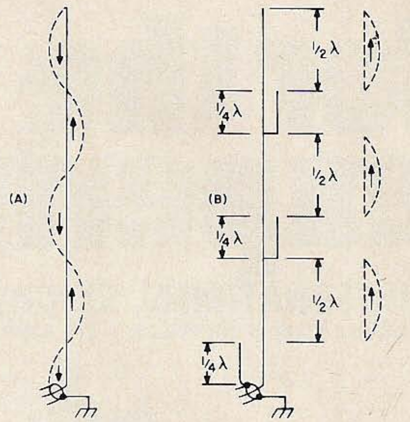


Fig. 2. Exciting a multiband antenna on 2 meters without any modifications being made to the antenna may produce some useful radiation but usually the antenna will not impedance match the transmission line and the current distribution on the antenna (A) will produce mostly useless high angle radiation. Both correct impedance matching and correctly phased current distribution for effective low angle radiation can be achieved by the use of a few simple stubs (B).

Stub Placement

The use of a few simple ¼λ stubs on 2 meters can provide both proper matching of the antenna to the transmission line and correct phasing of the antenna currents. This situation is illustrated in **Fig. 2(B)**. Note that the stub on the bottom of the antenna is connected differently than the other stubs. The "closed" end is connected to the ground terminal (shield of the transmission line) and not to the antenna (center conductor of the transmission line). Calling it a "stub" is actually a misnomer since it functions on 2 meters as a quarter wave transmission line transformer to match the low impedance of the transmission line to the high impedance of the first ½λ section of the antenna. The operation is the same as the well-known "J" antenna. The other stubs cause a phase reversal between the ½λ sections so that the currents in each section line up properly. The result is that a radiation pattern is produced which is omnidirectional in the horizontal plane and also which has several db of gain with low angle radiation in the vertical plane.

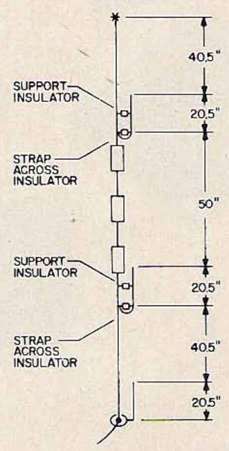
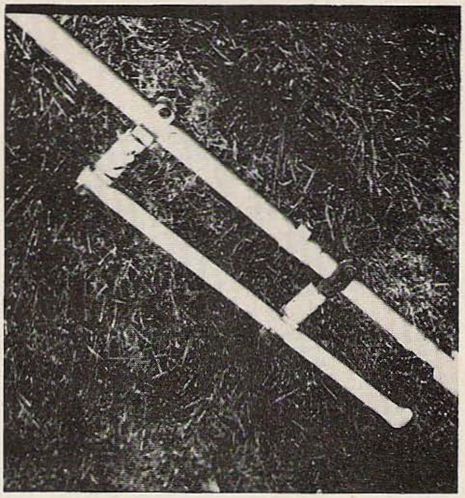


Fig. 3. Dimensions of stubs and placement for two meter operation of a typical hf multiband trap vertical antenna.

Fig. 3 shows an example of how the scheme of **Fig. 2(B)** was used with a 14AVG trap vertical (remove the rf choke in the base connector). The matching stub is simply ground end connected to one of the mounting bolts on the antenna base connector. A standard pillar insulator (Birnbach 440F) with pipe clamps on each end is used to support and insulate the other end of the stub. The other stubs are mounted in a similar manner but using two insulators with a shorting strap across the bottom insulator. The photograph illustrates the construction used. The spacing of the stub is not critical nor is the diameter of tubing used for the stub. In the example shown, a center to center spacing of about 3½" was used and ¾" aluminum tubing for the stub.

The second stub (first phasing stub) is placed ½λ above the end of the matching stub. This stub can be placed below the first trap on almost all trap verticals which are designed for use down to 10 meters. The second ½λ section will encompass the physical length of all the traps in the usual 2 or 3 trap antenna, since these traps are placed relatively close together. As was mentioned before, however, the traps will still act to present some capacitive reactance on 2 meters. Therefore, in order to effect an electrical ½λ section, the physical length between the first and second phasing stubs must be made longer. In the example shown, the length required was about 50" which placed the second phasing stub just above the top trap. The last ½λ section above the last phasing stub is formed by the remainder of the antenna. Usually, the necessary length can be secured by slight adjustment of the top section length or adding to the capacity top-hat on the antenna. A slight adjustment of this length does not affect the antenna performance on the hf bands, since the length is not effective except on the lowest frequency used. The stubs themselves are insignificant electrically when the antenna is used on the hf bands. The physical placement of the small stubs does not in any way affect the mechanical strength of the antenna structure.

The only question about adjustment that may arise is the spacing to use between the first and second phasing stubs in order to allow for the capacitive reactance of the traps. Probably the easiest way to determine the correct length is to temporarily remove the section of the antenna above the top trap. Then using a field strength meter placed at a height equal to about the middle of the antenna and as far away as possible, the antenna is excited and various lengths of top section tried for maximum field strength indication. The regular top section is then replaced and the bottom of the second phasing stub placed a distance above the top trap equal to length just found necessary to peak the field strength reading. The last ½λ section above the top phasing stub is determined by direct measurement. In case the dimensions of a trap antenna are such that a stub would fall between traps, the same procedure as just described using a field strength meter should be followed to peak any ½λ section which contains a trap.



Two standard pillar insulators are used to support the ¼λ stub. Note the shorting strap across the lower insulator. The spacing of the stub from the antenna is not critical and is shown as being about 3½".

Summary

Most trap verticals can be modified at minimum expense into very effective 2 meter antennas by the method described. The performance will easily equal or exceed that which would be effected by placing a ground plane antenna at a height equal to the top of the trap antenna. The swr will remain reasonably low over most of the 2 meter band but can be dipped in any desired portion of the band by adjusting the length of the matching stub on the base of the antenna.

. . . W2EEY

Gus Gercke K6BIJ
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RESURRECTING A GRANDDADDY

Part One: Granddaddy

A page in an old notebook, with a couple of circuits and the words "Crystadin" and "Losev," brought a few memories and forced me to plug in a soldering iron and run a few experiments.

Time–middle 1920's; Place–Moscow, Russia; Time of the day–just after midnight; Picture–15 year old ham (later K6BIJ), sleepy, but determined, trying to adjust *two* catwhiskers on *two* crystals at the same time, while listening to weird sounds emanating from *two* earphones.

This was "Crystadin," a circuit introduced by a Russian ham Losev, a "temporary" invention – something to get by until the industry (in ruins after the WW1 and the Civil War) started to produce tubes. Somehow the circuit was able to produce regeneration, and also worked as an rf amplifier[1], using "Zincite"[2] crystals and steel wire catwhiskers. Looks like it was one of the granddaddies of some semiconductor devices "invented" later.

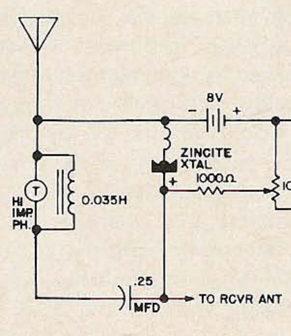

Fig. 1. RF amplifier.

I will not attempt to explain the theory of the Crystadin – I do not know how it works, but it looks like a mixture of regeneration and parametric amplification. The semiconductor junction, dc bias, and the pump freqency are all there.

Crystadin was used for reception of European BC stations; there was only one Russian BC station (in Moscow) at the time, and we hams had to wait till midnight for it to quit, before we could start fishing for DX. Very little was known at the time about short waves; there were no ham transmitters (no tubes), and a "ham" was just a guy that built his own crystal receivers, spent a lot of his spare time on the roof, and was generally responsible for the absence of what you place on the hook in a telephone booth.

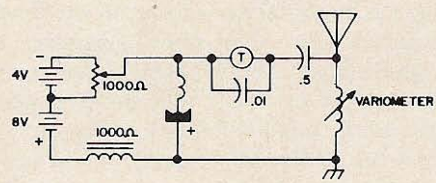

Fig. 2. Receiver

The poor granddaddy died at the age of three, killed by a "micro tube" (micro referring to a low filament current of 60 mA) that appeared on the market in the late 1920's. The death was very premature.

Passing (too briefly) through the regenerative circuits[3] – the tubes made possible a monstrosity called "superhet," the Supreme Ruler of the receiver world, still being worshipped by the hams and engineers alike. Like anything else, being worshipped, it did not improve any since its invention (only the components did), and is still a contraption to bury weak signals in the noise and hiss generated by it.

1. See "RF Q Multiplier," 73, May 1962, page 80.
2. Zincite–ZnO, a zinc ore (mineral), melted and cooled to produce a lump covered with red crystals.
3. See "Superhet or Regenerator," 73, March 1964, page 58.

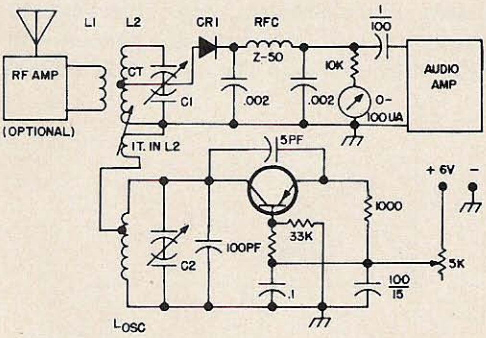

Fig. 3. Schematic.

Part Two: Resurrection

The circuit shown in Fig. 3 can be visualized as a superhet with local oscillator removed from the receiving frequency only just enough to produce an i-f that is, at the same time, your audio (this is true also in case of a regen, only there the oscillator and detector functions are performed by the same tube or a transistor). Let us compare a block diagram of Fig. 3 with that of a conventional six meter superhet. We can see that to produce the same gain, the audio section of the Fig. 3 must have as much gain as the two mixers, two i-f's, and the audio of the superhet *combined*. This means quite an audio amplifier, but it also means quite less

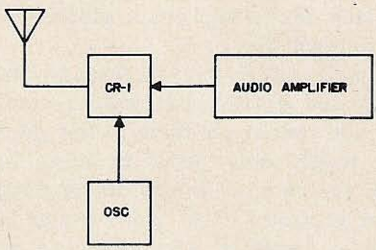

Fig. 4. Block diagram of receivers.

noise generated in the receiver because mixers are notorious noise generators and because transistors are much less noisy at lower frequencies than at high.

You probably saw in some manual that a certain transistor has a noise figure (nf) of let us say "4" at 200 MHz, but only "2" at 100 MHz, etc. In the audio range the nf is of course still lower. This, coupled with a complete absence of images, birdies, and all the other byproducts manufactured within any self-respecting superhet, explains the low internal noise of the Fig. 3 circuit.

Certain deficiencies of the K6BIJ engineering department, coupled with a complete inability to penetrate the semiconductor jungle existing in this country, and viewed through a large hole in the pocketbook – resulted in working, but far from perfect, audio amplifier. It consists of Fig. 1, WIDTY's article, March, 1967, in 73, followed by Fig. 14 (operated at 6 volts and

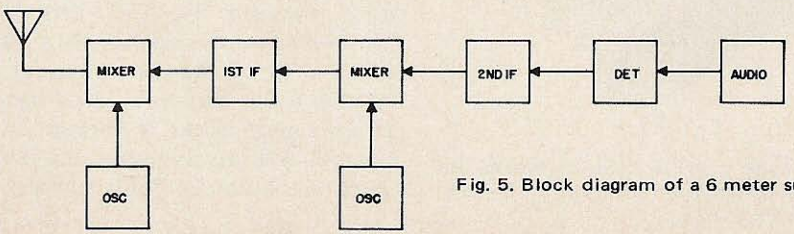

Fig. 5. Block diagram of a 6 meter superhet.

with the filter centered around 800 cycles), and followed by an existing amplifier designed for crystal microphone input and one watt output. Transistors were PNP units marked 033, and taken from IBM surplus boards (disregarding the "0" – if the number is less than 50 it is PNP, if over 50 it is NPN). Failure to produce a quiet audio amplifier naturally will defeat the purpose of the project; in this case I suggest that you temporarily retain the rf amplifier – it will be a step backward, but a much simpler audio unit will do.

Normally regenerative receivers are stable, selective and sensitive, but you can wreck all this if you overcouple them to the antenna or try to get more "gain" by using higher voltage and current through the regenerating tube or transistor. The "gain" should be in the audio amplifier. The ARC-5 receivers, that are supposed to be "as broad as a barn door," are broad only because they have practically no audio, and hams are trying to compensate for this by cranking up the rf i-f gain wide open. Result – the "barn door." I added two stages of audio (also transistor bfo) and am using it on 80 meters SSB and CW without any "barn door" effects.

Now comes CR-1; I connected twelve diodes of all kinds to a twelve position switch, and just tested them in the circuit. Some of the diodes were transistor base-emitter junctions. Those that did not work were replaced by other "unknowns," and so on. As a result it was found that 1N21 always performed fairly well, but some of the glass encapsulated catwhiskers from the IBM surplus boards outperformed the 1N21 quite a bit. Using an ohmmeter to choose the diodes resulted in a failure; my best diode has 30% reverse leakage, and the second best has practically none.

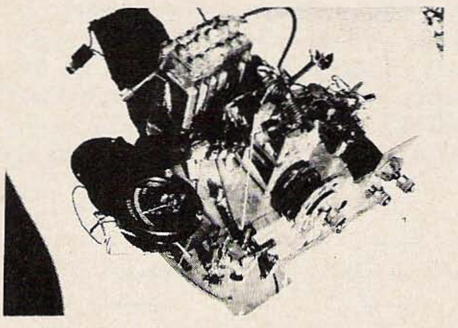

Photo of audio amplifier inside the chassis. The nicad battery pack at the rear of the unit supplies about 7.2V.

What takes place at the junction in CR-1? I do not know, but whatever it is, it makes possible a darn good receiver for really weak signals. Whether it is a regen, parametric amp, or a superhet with low internal noise, it *works.* And if someone will tell me that the three circuits are just variations of one and the same principle, I will not be surprised.

Further improvement can be made by using a vxo instead of a vfo (Fig. 49, page 21-A, 73, March, 1967; a search for a better diode should bring some results, and, of course, there is no limit in improving the audio system.

Variable condensers *must* be of the split-stator, insulated-rotor type, otherwise the noise produced by the rubbing contacts will split your eardrums. The meter shown in the circuit is useful only as an indicator of oscillations in your oscillator circuit, and also for tracking (just tune the trimmer condensers and adjust the coils for maximum reading on the meter). Minimum voltage should be used on the oscillator just enough to start it.

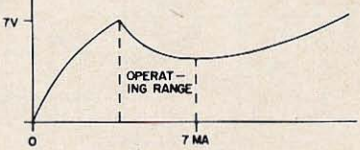

Fig. 6. Voltage/current in crystal in receiver. (see Fig. 2)

The circuit outperformed on six meters a usual converter (rf FET 2N3819–mixer 2N3819–crystal oscillator–RCA SK 3006) followed by an average receiver; it had less internal noise; therefore, weak signals were received much better. It worked best on SSB and CW; AM was somewhat difficult to tune unless the station was fairly strong.

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"Your frequency is 3637.490 kHz, OM. Would you please move 10 Hz higher to get on the teletype auto-start frequency?"

You'll never hear this on the ham bands? Wait 'till you contact me!

Ever dream of building a receiver/transmitter, or maybe an rf signal generator that would give a digital readout of frequency to the nearest hertz? Well, just you read this article about the digital indicators, and put a little tin on your dream rig.

In building such a project as this, there are 4 main considerations that must be kept in mind:

1) Usages, actual and possible.
2) Reliability (bulb burnout, etc.).
3) Component availability (readout Indicators, transistors, integrated circuits, resistors).
4) How complex; number of parts, amount of wiring (transistors vs integrated circuits).

Having come this far, I now wish to show you the different ways you can get a 0-9 number, then discuss various driver circuits to light up your chosen indicator.

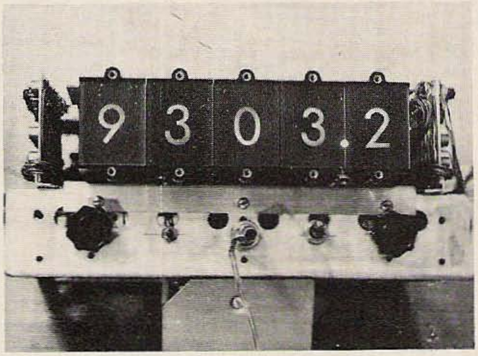
Numbered Light Bulbs

The simplest of all digital displays would be those of either **Fig. 1a** or **1b**. **Fig. 1a** is merely a piece of clear plastic painted black on the front except where the number is. Lamps are placed behind each number, and shielded from showing through to the adjacent number.

Fig. 1b shows a similar method, only the light bulbs were encapsulated in plastic and little plastic letters were glued over the top of the appropriate bulb. Other arrangements, such as bulbs in a circle, etc., are also a possibility in this general type.

Advantages: Low cost—only the ten bulbs and a little plastic need be bought. Simplicity.

Disadvantages: Relatively short bulb life; small image, necessitating close reading; Out of line reading of long numbers, making the reading slower.



Front view of my digital frequency counter with a range of 50 Hz to 100 kHz and beyond, with a readout of 1/10 of a cycle. Projected image type of readouts are shown, driven by 5 digital decoder #2's.

Light Bar Matrix

Fig. 1c shows a system used by the Simpson III digital voltmeter and others, which presents several advantages while adding a few disadvantages too.

Seven lights are placed so as to form 10 distinct numbers by lighting up various combinations of light bars. To get a "1", bar

C & F are lit; "2" has bar A, C, D, E, & G lit to give 2; "3" has bar A, C, D, E, F, & G lit to give 3; "4" has bar B, C, D, F, & G lit to give 4; ' 5" has bar A, B, D, F, & G lit to give 5; "6" has bar A, B, D, E, F, & G lit to give 6; "7' has bar A, C, & F lit to give 7; "8" has all bars lit; "9" has all bars lit except E to give 9; "0" has all bars lit except D to give 0.

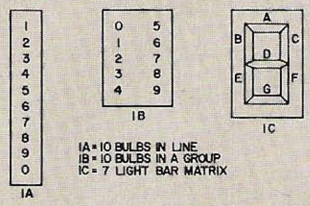


Fig. 1. 1a) 10 bulbs in line; 1b) 10 bulbs in a group; 1c) 7 light bar matrix.

These lights may take a number of forms. They may be a piece of plastic backlighted to give a bar on the front. Another possibility is to use long lamps similar to those used in car dome lamps, only with low amperage. Even NE-2 neon bulbs may be used, along with high voltage switching transistors.

Advantages: Larger Number
Brighter number
Inline reading of long numbers
Cheaply made in comparison with commercially available readouts.

Disadvantages: Proper lamps difficult to find.
More difficult assembly as compared to simple numbered lights.
Brightness varies according to number of bulbs lit.
More current is drawn due to a number of lamps being lit.
Electronic driver circuit is more complex, though not much more expensive.

Edge Lighted

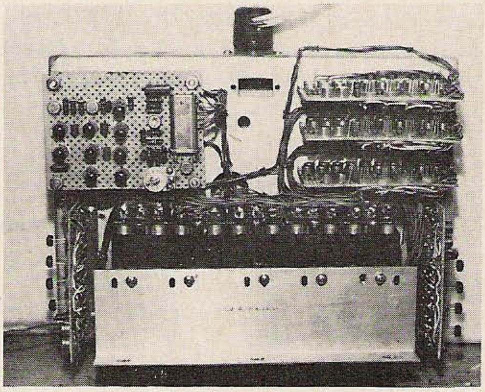
Some manufacturers have produced digital readouts which consist of 10 concentrically placed pieces of plastic, each with a number placed on it which is edge lighted to show the desired number. An example of this type is the readout sold by Radio Shack Corp. for $9.95.

Advantages: Very compact
Well formed number
Inline reading of long numbers.

Disadvantages: Dimmest of all displays.
Small angle of viewability.

Projected Image

This system consists of 12 light bulbs, 0-9 and + and -, which are projected on the back of a ground glass screen. Various bulbs may be used to achieve different levels of illumination. A #44 bulb will give the most brilliant display, but it requires a rather high current from the switching transistor, 250 mA. On the other hand, an 1819 bulb @ 40 mA is rather easy on the transistor, but is quite dim, having a relative character brightness of 15 as opposed to 145 for the #44 bulb.



Top view, showing how I mount the various decoders. Section at back left is the crystal oscillator and gating circuitry. Not shown, but beneath this section are the 24 flip-flops in the ' divide by one million" section.

By reducing the voltage 10%, bulb life of 3000 and 1000 hours, respectively, will be increased 5 times, for 15,000 hours for the #44. Relative brightness will be cut in about half. The popular #47 at 150 mA will perform at about ½ the brilliance of the #44.

Cost of these units varies considerably. New ones run in the neighborhood of $30

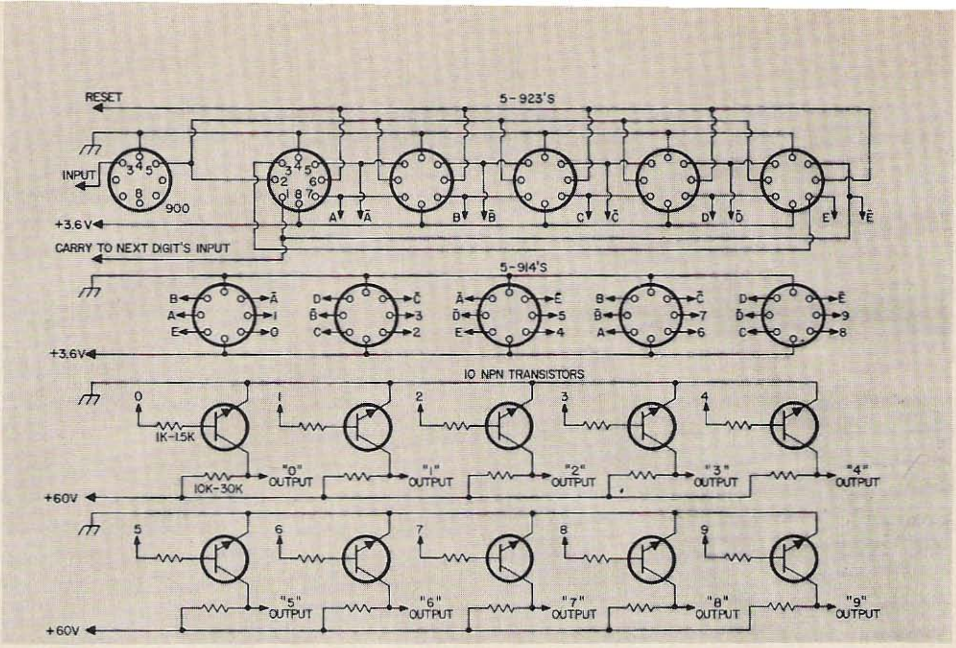


Fig. 2. Digital decoder #1. Reset to 0 by momentarily placing +3.6 v on reset line. All resistors of a similar function are the same value.

RESET TO ZERO BY MOMENTARILY PLACING 3.6V ON RESET LINE.
ALL RESISTORS OF A SIMILAR FUNCTION ARE THE SAME VALUE.

each. However, various surplus stores do have them at prices from \$6 to \$10, the former being about the most that I would pay. At that price, a bank of 5, as I myself use, makes a very attractive display unit for \$30.

Advantages: Nice looking image
Ease of mounting
Simple and cheaper driver circuits
Low cost (if surplus)
Inline reading of long numbers

Disadvantages: Bulb burnout
Bulky

Nixie Tubes

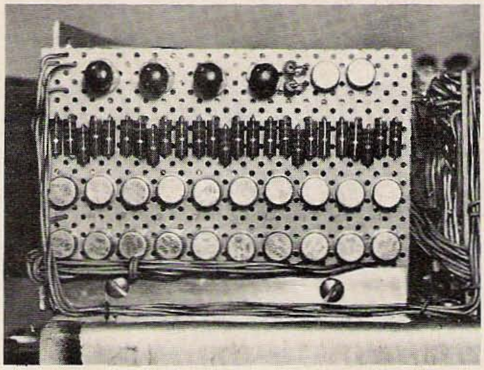
These readouts are a gas filled, cold cathode type tube. They are somewhat similar in basic idea to a vr tube or a neon tube, only they display a given number depending on which of a number of cathodes is hooked up to negative voltage. When this happens, the gas around this element ionizes and glows. Prices on these devices vary according to size and construction. Units of interest to amateurs run from \$8 to \$30 in price, the \$8 one looking like a miniature tube, giving numbers .6" high. These units require special sockets running about \$1 apiece. I have seen Nixie tubes on the surplus market as low as \$3 apiece. For information, write to: Burroughs Corp., Electronics Components Division, Plainfield NJ 07061.

Advantages: Very long life (200,000 hours)
Bright and easy to read
Compact
Wide angle of viewability
Simple driver circuit
Different sizes available

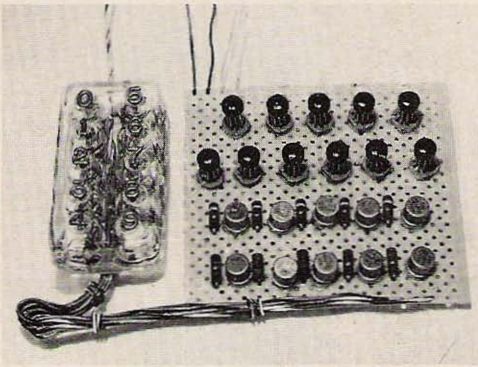
Disadvantages:
Require power supply of about 200V
Special circuit needed for dimming
(I don't like their red colored number.)

Pixie Tubes

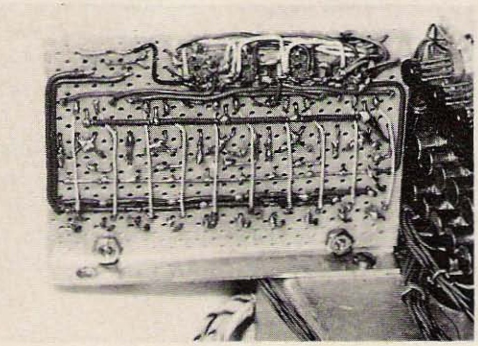
These are units similar to the Nixie, but instead of seeing a relatively large number lit up, a small number is visible through a perforated plate above the lit-up cathode. The advantage of these units over the more common Nixie lies in the fact that they are much cheaper, costing only \$5 new, and much less surplus. The main disadvantage is that the number images are so small, about 3/16", that it is very difficult to read them at a distance greater than 6 feet. Besides this,



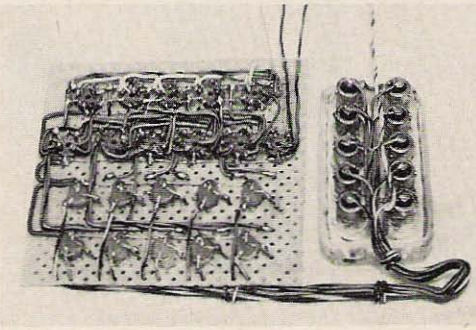
Top view of digital decoder #2. At the top are the IC and 2 transistor gates. In the middle are the other gates. At the bottom are the drivers.



Top view of digital decoder #1. At the top are the 5 flip-flops. The 2nd row has the 900 driver at the left, and the other 5 IC's are the 914's. The other transistors are the drivers. At the left is a digital display which consists of 10—#49 light bulbs encapsulated in plastic.



Bottom view of digital decoder #2.



Bottom view of #5.

a long number would be read slower due to the individual digits out of line.

High Vacuum Readouts

Though similar to a Nixie, these are tubes which project an image quite similar to the way a CRT works. For more information, write to: Industrial Electronic Engineers, Inc., 7720 Lemona Ave., Van Nuys CA 91405. This company can also give you more information on the projected image type readouts, which they make.

Advantages:
- Long life if brilliance reduced
- Other advantages of the Nixie
- Can be dimmed by a simple circuit

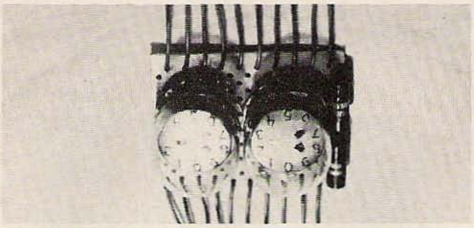
Disadvantages:
- Hv supply of 1-3 kV required, plus 1.1V filament supply
- Smaller image and slightly higher cost than the Nixie.

Digital Drivers

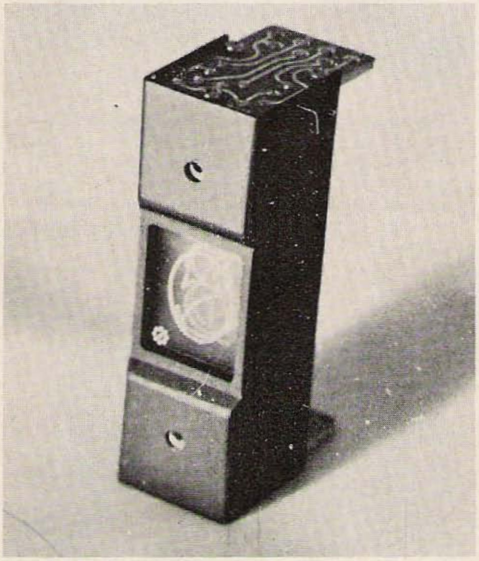
So that you can arrive at the desired digital signal to your selected type of readout, you have 3 items to consider now.

First, you must have a set of flip-flops which will have 10 different states, and then start over. There are a number of different ways to hook up 4-6 flip-flops and additional gating transistors to achieve this. In this article, I have selected 2 ways as being the simplest to work with.

Secondly, you must select the outputs of the flip-flops and steer the proper voltage to the driver stage, which comprises the third part of the whole digital decoder.



Two Pixier indicators, mounted on some keyboard.



An edgelit indicator showing internal construction.

Digital Decoder #1

This decoder needs 31-41 parts: 5–JK flip-flops (Fairchild 923 IC); 1–Driver/Buffer (Fairchild 900 IC); 5–Dual 2 input gates (Fairchild 914 IC); 10–1K-1.5K ½ watt resistors; 10–10K-30K ½ watt resistors (only if Nixie/Pixies used); 10–Driver xstrs (Surplus NPN, or, if Nixie/Pixie used, hv xstr as Fairchild 2N3568)

Cost: $20 if you use Nixie/Pixies and buy the resistors; $12 is you use lamps and have the resistors.

Wiring time: about 6 hours from start to finish.

To build this circuit, a great deal of care is necessary to avoid errors. The way that I wire them is to put all of the ICs in the order shown in the diagram, then wiring the common pins, 4, 8, and 6 of the 923's. Next, wire the common pins of the driver and gating transistors and ICs. After this, put in the resistors and complete the wiring except the wiring of the 914 decoding gates which is the last to be wired and the most prone to error.

As you can see in the parts list, there are a few different ways to build this decoder. If you plan on using the Nixie/Pixie type of indicator, then you will need to use such transistors as the Fairchild 2N3568 or others with a 60V or more collector-to-emitter voltage rating. The 60V line and 10 resistors to the driver transistors is only necessary when Nixie/Pixies are used also. **Fig. 3a** shows how to hook up lamps to the decoder, and **3b** shows how to hook up Nixie/Pixies.

Digital Decoder #2

This is the unit which I use in my present digital counter. It has only 4 ICs, so cuts down on the cost of the unit, but uses 22 NPN computer transistors, which, while cutting down on the cost, adds to the complexity.

Parts used are as follows: 4–JK flip-flops (Fairchild 923 IC); 22–NPN switching transistors (Surplus computer); 2–2.7K ½ watt resistors; 5–470-680Ω ½ watt resistors; 10–4.7K-6.8K ½ watt resistors; 10–1K-2K ½ watt resistors.

Cost: Well under $10.

Wiring time: About 6 hours.

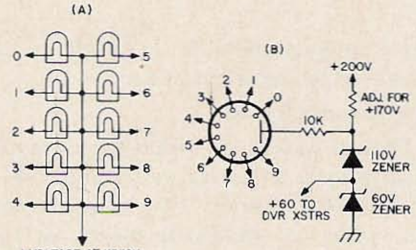


Fig. 3. 3a) How to hook up lamps to the decoder; 3b) How to hook up Nixie/Pixies.

As you can see, there is a definite cost advantage to decoder #2, if you can come by the transistors and resistors cheaply. I find the wiring of decoder #2 easier, due to less wires in the decoder, which is the most confusing part. Should you desire to use decoder #2 with Nixie/Pixie readouts, then change the driver transistors to hv types, and add a 10–30 kΩ resistor to each driver's

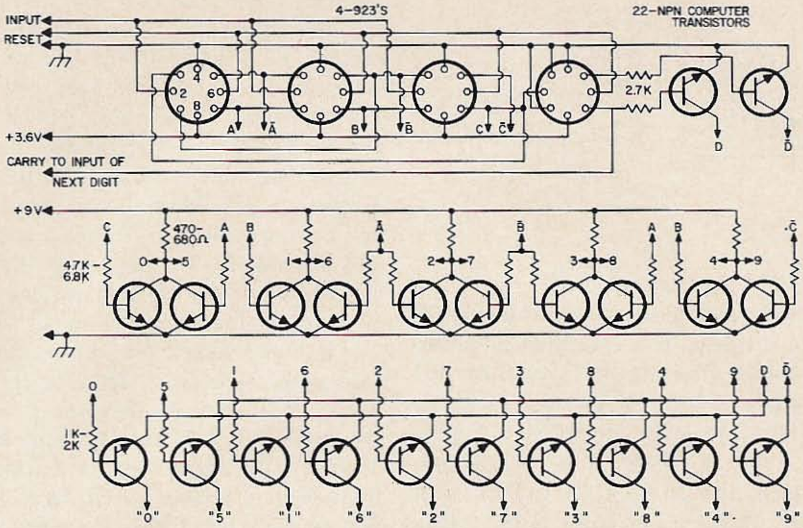


Fig. 4. Digital decoder #2. All resistors of a similar function are the same value. To reset to 0, place +3.6 v on reset line momentarily.

RESET TO ZERO BY MOMENTARILY PLACING 3.6V ON RESET LINE.
ALL RESISTORS OF A SIMILAR FUNCTION ARE THE SAME VALUE.

collector from a +60V source, as in decoder #1. Please note on the decoder #2 diagram, **Fig. 4**, that the outputs are not in numerical order. This is due to the fact that the ICs are in a biquinary count configuration, which means that they count to 5 twice to reach 10, then start over.

Digital Decoder #3

This particular unit is made up of either of the two preceding decoders plus a diode

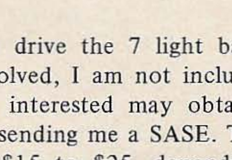


Fig. 5. A simple count checker.

matrix to drive the 7 light bars. As it is rather involved, I am not including it here, but those interested may obtain the schematic by sending me a SASE. The cost will approach $15 to $25, depending on parts availability, and the construction time will be about 10 or more hours.

Count Checker

A simple count checker which can be used to see that everything is counting correctly is shown in **Fig. 5**. Before you hook up the counter to read a multidigit number, make sure you have each digit counting correctly!

Improved Input Sensitivity

Fig. 6 shows the addition of an emitter follower to my original input circuit; this considerably improves the low frequency performance.
mance.

Digital Frequency Divider

As many have mentioned to me regarding the binary counter, it would be a shame to depend on the 60 Hz line frequency for a timing standard for such an accurate instrument as a digital counter. Therefore, I am now using a 100 kHz crystal as the standard. **Fig. 7** shows that I am using one of Jim Fisk's little crystal circuits into a 914 monostable pulse shaper. This in turn drives 24

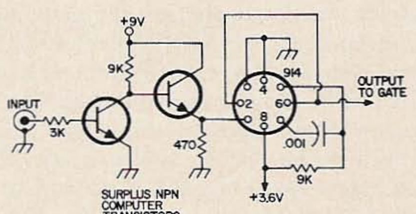


Fig. 6. Addition of an emitter follower to original input circuit of the binary counter.

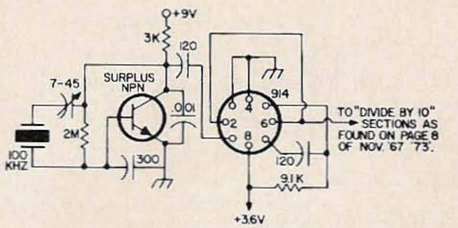
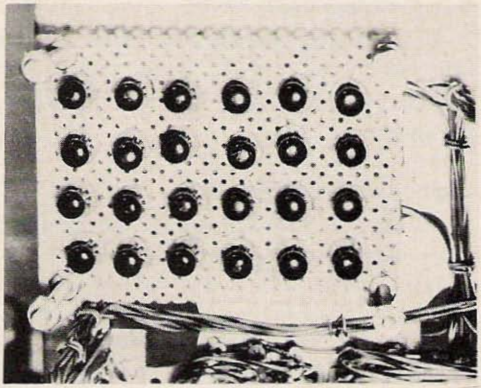


Fig. 7.

923 flip-flops hooked up as 6 "divide by 10" frequency dividers. This results in a "divide by one million," giving me a final output frequency of one hertz in ten seconds. Using this to trigger the count controller and gate, I take a count of all pulses in 10 seconds, thereby giving me an accuracy to one tenth of a hertz. The decimal point is inserted as hertz. The decimal point is inserted as shown in the picture. Various other frequencies are tapped off the divide by one million set of flip-flops to achieve other values of counts. This is described in my previous article.



Top view of the 24 923's in the ' divide by one million" section.

Flip-flops

A number of people have inquired about other types of ICs which might be used. Suppose that you wanted to count up higher in frequency. To do this, you would have to change the time constant of the input shaper by putting in a smaller condenser, and then using higher frequency ICs Say you wanted to read the output of a 7 MHz vfo. Simple. Use Fairchild 926s (freq. to 8 MHz as opposed to 2 MHz of the 923). Make a frequency divide section which will give you the desired accuracy, say 100 Hz. This will require a divide-by-1000 section, or 12 flip-flops. Now you can read out the frequency of that vfo to, say, 7034.8 Hz. How about 20, 15, and 10? Simple too! for 20 meters, add one more flip-flop to the 1000 divider to get 50 Hz. This way, you get double the count, or 14069.6 Hz. For 15, add a divide-by-3 to the divide-by-1000 to get 21,104.4 Hz. For 10 meters, add two divide-by-2 for a divide-by-4. . Exciting? Certainly is! Accurate? Just as accurate as when you zero that 100 kHz crystal with WWV. Of course you don't have to read out the whole number, but can read out the last 3 or 4 only, since you should know your frequency to within a megahertz. Where do you do from here? Well, I've given you some ideas on the fundamentals. The rest I leave to you.

. . .WØLMD

Bibliography

For those people who are interested in the theory behind digital readouts and decoders, I would like to recommend the following free literature.

Nixie/Pixie tubes: Bulletin 1104A
Bulletin 1095
#616E (General Catalog & Applications.

Write: Burroughs Corp., Electronic Components Div., Plainfield NJ 07061.

High Vacuum/Projected Image readouts: Request information from:

Industrial Electronic Engineers, Inc., 7720 Lemona Ave., Van Nuys CA 91405.

Fairchild IC's: Applications brief 36 on 9960 series
Circuit Notes RTL 1 through 5.
App-120/2, App-118/2 & SL-218

Write: Fairchild Semiconductor, 313 Fairchild Dr., Mountain View CA.

Fairchild parts and information: Request "Designing with Integrated Circuit Components"

Write: Hyer Electronics Co., Denver Technological Center, PO Box 22227, Denver CO 80222.

General Digital information:

Write: Interstate Electronics Corp. 707 E Vermont Ave., Anaheim CA–Request S-139A and Updates. Digital Equipt Corp., Technical Publications Dept., 146 Main St., Maynard MA 01754–Request "Logic Handbook."

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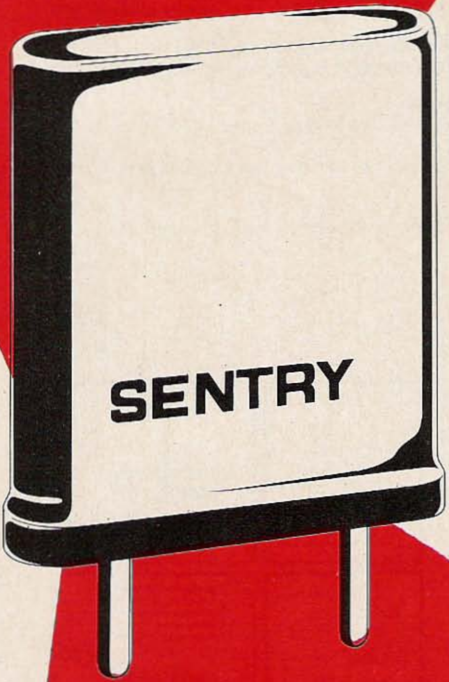

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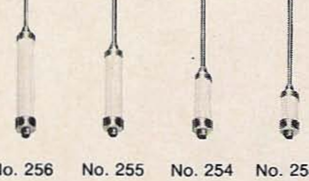

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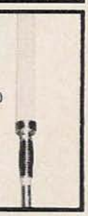

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Frequency Range	144-148 MHz
Sensitivity	0.35 μv (nom.) 20DB Quieting
Selectivity	6DB Down $\pm$ 16KC 50DB Down $\pm$ 32KC
Audio Output (3-4 Ω Speaker)	3 Watts 10% Distortion 5 Watts Maximum
Channels	6 Crystal controlled with provision for adding an additional 6 channels
I.F. Frequencies	10.7 MHz & 455KHz

TRANSMITTER

The HR-2 transmitter uses phase modulation for the ultimate in carrier stability. Built in SWR load mismatch circuitry provides protection against open and shorted antenna conditions.

Frequency Range	144-148 MHz
Power Output	10 Watts (min.) @ 13.6 VDC
Modulation	Phase Modulation with automatic deviation limiting
Deviation	Automatic Limiting with internal adjustments from 0-15KC deviation
Microphone	Plug-in, hand held, high Z Ceramic supplied
Channels	6 Crystal controlled with individual trimmer capacitors for Frequency netting

GENERAL

Power Requirements	13.6 Volts (nominal)
Receive (Squelched)	180 MA.
Receive (Max. audio output)	800 MA.
Transmit	2.5 Amps (max.)

STANDARD EQUIPMENT

Built-in 4″ Speaker
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IDENTIFYING SURPLUS ELECTRONIC EQUIPMENT

by Bill Welsh W6DDB

Most hams are vaguely familiar with the two- and three-letter prefixes used on military electronic equipment. The JAN (Joint Army-Navy) designations have been expanded upon and superseded by the Joint Electronics Type Designation System (JETDS). JETDS designations apply to all Air Force, Army, Marine, and Navy electrical/electronic equipment.

The following tables provide information which permits quick classification of any military electronic item which bears the customary letter identification. Table I shows the three-letter classifications used with the complete systems, sets, and groups. Table II shows one and two-letter classifications used with units and components which are basically parts of the systems, sets, and groups detailed in Table I.

The information shown in Tables I and II is primarily extracted from MIL-STD-196B (Joint Electronics Type Designation System), dated 7 April 1965.

Table I. System/Set/Group Classifications

First Letter (Installation)		Second Letter (Equipment Type)		Third Letter (Equipment Purpose)	
A	Piloted Aircraft	A	Invisible Light, or Heat Radiation	A	Auxiliary Assembly (Not Complete Operable Sets)
B	Submarine or	B	Pigeon (Obsolete)	B	Bombing
C	Air Transportable (Obsolete)	C	Carrier	C	Communications (Receiving and Transmitting)
D	Pilotless Carrier	D	Radiac	D	Direction Finder, Reconnaissance and/or Surveillance
		E	Nupac	E	Ejection and/or Release
F	Ground-Fixed	F	Photographic (Canadian only)		
G	Ground-General Use	G	Telegraph or Teletype	G	Fire Control or Searchlight Direction
				H	Recording and/or Reproducing (Graphic, Meteorological, or Sound)
		I	Interphone or Public Address		
		J	Electromechanical or Inertial-Wire Covered		
K	Amphibious	K	Telemetering	K	Computing
		L	Countermeasure	L	Searchlight Control (Obsolete - use G)
M	Ground-Mobile	M	Meteorological	M	Maintenance and/or Test Assemblies, including tools
		N	Sound in Air	N	Navigation - including Altimeter, Beacon, Compass, Depth Sounder, Landing & Approach, and Racon
P	Portable	P	Radar	P	Reproducing (Obsolete - Use H)
		Q	Underwater Sound and Sonar	Q	Special or Combination of Purposes
		R	Radio	R	Receiving-Passive Detection
S	Water-Surface	S	Special Types, such as Magnetic or Combination of Types	S	Active Detection and/or Range and Bearing
T	Ground-Transportable	T	Telephone (Wire)	T	Transmitting
U	General Utility				
V	Ground-Vehicular	V	Visual and Visibile Light		
W	Water-Surface and Underwater Combinations	W	Armament, Not Otherwise Covered	W	Automatic Flight or Remote Control
		X	Facsimile or Television	X	Identification or Recognition
		Y	Data Processing		

As an example, the AN/APS-80A(V) is (first letter A) installed in a piloted aircraft, (second letter P) is a Radar type equipment, (third letter S) is used for search purposes, is Model number 80, is modification A, and consists of a variable grouping. Model numbers and modification letters are used in sequence. The T, V, X, Y, and Z suffixes respectively indicate Training, Variable Grouping, Voltage Change, Phase Change, and Frequency Change in the basic equipment.

The two-letter unit/component identification is commonly identified to the system/set it is designed for by suffixing a slant bar and the identification of the system or set. As an example, the AM-3474/APS-80A(V) is a synchro signal amplifier designed as part of the APS-80A(V) airborne search radar system.

Identification	Unit or Component	Typical Description
AB	Antenna Support	Antenna mounts, mast base, mast section, tower, etc.
AM	Amplifier	Audio, electronic control, frequency, interphone, power, radio, video, etc.
AS	Simple or Complex Antenna	Array, dipole, loop, mast head, parabolic, reflector, telescopic, etc.
BA	Primary Battery	Non-rechargeable battery, batter pack, etc.
BB	Secondary Battery	Rechargeable battery, storage battery, etc.
BZ	Audible Signal Device	Buzzer, gong, horn, etc.
C	Control	Control box, remote tuning control, etc.

Table II. One- and Two-Letter Unit/Component Classifications

CA	Sonar Commutator Assembly	All types
CB	Capacitor Bank	Power Supply, etc.
CG	RF Cable Assembly	RF cable, waveguide, transmission line, etc., with connectors
CH	Drawer/Door Chasis	Framework which accepts (but does not include) plug-in modules. Circuitry and/or receptacles may be included. This is not a storage facility or blank chassis.
CK	Crystal Kit	Kit of crysals with holders
CM	Comparator	Compares two or more signals
CN	Compensator	Electrical and/or mechanical compensation, regulation, or attenuation
CP	Computer	Electronic and/or mechanical mathematical computing device
CR	Crystal	Crystal, in a crystal holder
CU	Coupler	Impedance matching device, directional coupler, etc.
CV	Converter	Electronic device which changes phase, amplitude, or frequency; or changes from one medium to another
CW	Cover	Bag, cap, cover, nacelle, radome, roll, etc.
CX	Non-RF Cable Assembly	Cable with terminals, test leads, or composite cable with non-RF and RF conductors
CY	Case or cabinet	Rigid or semi-rigid structure for enclosing or carrying equipment
D	Dispenser	Bomblet, chaff, flare, leaflet, napalm, etc.
DA	Electrical Dummy Load	RF or non-RF test load
DT	Detecting Head	Hydrophone, magnetic pickup, search coil, etc. (see RF)
DY	Dynamotor	Power supply
E	Hoise	Sonar hoist assembly, etc.
F	Filter	Bandpass, noise, telephone, wavetrap, etc.
FN	Furniture	Chair, desk, table, etc.
FR	Frequency Measuring Device	Frequency meter, tuned cavity, etc.
G	Power Generator	Electrical power generator without prime mover (see PD and PU)
GO	Goniometer	All types
GP	Ground Rod	Ground rod, stake, etc.
H	Handset, Headset, or Chestset	Includes earphone
HC	Crystal Holder	Crystal holder, less the crystal
HD	Environmental Apparatus	Cooling, dehumidifying, heating, pressure, vacuum, etc.
ID	Non-CRT Type Indicator	Calibrated dial, calbirated meter, indicating light, etc.
IL	Insulator	Feedthrough, standoff, strain, etc.
IM	Intensity Measuring Device	Field intensity meter, noise meter, slotted line, SWR gear, etc.
IP	CRT-Type Indicator	Azimuth, elevation, panoramic, etc.
J	Junction Device	Jack box, junction box, terminal box, etc.
KY	Keyer	Coder, electrical keyer, electronic keyer, interrupter, mechanical keyer, etc.
LC	Line Construction Tool	Cable plow, etc.
LS	Loudspeaker	Intercommunication station, enclosed loudspeaker, etc.M
MA	Magazine	Magnetic tape, magnetic wire, etc.
MD	Modulator, Demodulator, or Discriminator	Device to vary amplitude, frequency, or phase
ME	Meter	Multimeter, power meter, VOM, VTVM, etc.
MF	Magnet or Magentic Field Generator	Electromagnet, magnetic tape or wire eraser, permanent magnetc, etc.
M1	Microphone	Hand, radio, telephone, throat, etc.
MK	Miscellaneous Kit	Maintenance, modification, etc., except crystal (CK) and tool (TK) kits.
ML	Meteorological Device	Barometer, hygrometer, scale, thermometer, etc.
MT	Mounting	Frame, mount, rack, stand, etc.
MU	Memory Unit	All types
MX	Miscellaneous Equipment	Otherwise unclassified equipment, including subassemblies. Use a definitive indicator instead of MX, if possible.
O	Oscillator	Blocking, master, multivibrator, etc. (See SG for test oscillator)
OA*	Miscellaneous Group	Otherwise unclassified group. Use a definitive indicator instead of OA, if possible.
OB*	Multiplexer and/or Demultiplexer Group	All types and composites
OC	Oceanographic Device	Bathythermograph, etc.
OD*	Indicator Group	All types
OE*	Antenna Group	All types
OF*	Adapter Group	All types
OG*	Amplifier Group	All types
OH*	Simulator Group	All types
OJ*	Console or Console Group	All types
OK*	Control Group	All types
OL*	Data Analysis or Data Processing Group	All types
OM*	Modulator and/or	All types and components
ON*	Interconnecting Group	All types
OP*	Power Supply Group	All types
OQ*	Test Set Group	All types
OR*	Receiver Group	All types
OS	Oscilloscope	Scopes for general test use
OT*	Transmitter Group	All types
OU*	Converter Group	All types
OV*	Generator Group	All types except power-generation
OW*	Terminal Group	Radio, telegraph, telephone, etc.
OX*	Coder, Decoder, Interrogator, or Transponder Group	All types and composites
OY*	Radar Set Group	Where applicable, use a more definitive indicator such as OE, OR, OT, etc.
OZ*	Radio Set Group	Where applicable, use a more definitive indicator such as OE, OR, OT, etc.
PD	Prime Driver	Diesel motor, electric motor, gasoline engine, synchro, etc.
PF	Pole Fitting	Cable hanger, clamp, protector, etc.
PG	Pigeon Article (Obsolete)	Container, loft, vest, etc.
PH	Photographic Article (Obsolete)	Camera, projector, sensitometer, etc.
PL	Plug-in Module	Where applicable, use a more definitive indicator such as AM, R, T, etc.
PP	Power Supply	Non-rotating type such as vibrator pack rectifier, thermoelectric, etc.
PT	Plotting Equipment	Rotating power equipment other than dynamotor or motor generator
R	Receiver	All types except telephone
RC	Reel	All types (See RL)
RD	Recorder-Reproducer	Disc, facsimile, film, graphic, magnetic, mechanical, sound, tape, wire, etc.
RE	Relay Assembly	Electrical, electronic, etc.
RF	Radio Frequency Component	Composite component of an RF circuit. Where applicable, use a more definitive indicator.
RG	RF Bulk Cable	RF cable, transmission line, waveguide, etc., without terminals
RL	Reeling Machine	Mechanism for dispensing and rewinding antenna wire, field wire, recording wire, recording tape, etc.
RO	Recorder	Disc, facsimile, film, graphic, magnetic, mechanical, sound, tape, wire, etc.
RP	Reproducer	Disc, facsimile, film, graphic, magnetic, mechanical, sound, tape, wire, etc.
RR	Reflector	Confusion, target, etc., but not antenna reflector (See AS)
RT	Receiver-Transmitter	Composite radio/radar receiver and transmitter
S	Shelter	House, tent, etc.
SA	Switching Device	Impact, manual, motor-driven, pressure, etc.
SB	Switchboard	Fire control, panel,power, telephone, etc.
SG	Signal Generator	Noise generator, test oscillator, etc. (See O)
SM	Simulator	Aircraft, flight, signal, target, etc.
SN	Synchronizer	Device to coordinate two or more functions
ST	Strap	Harness, etc.
SU	Optical Device	Boresighting scope, periscope, projector, telescope, etc.
T	Transmitter	All types, except tleephone
TA	Telephone Apparatus	Miscellaneous telephone equipment
TB	Towed Body	Buoy, fish, paravane, target, etc.
TC	Towed Cable	Articulated towing strut, faired cable, etc.
TD	Timing Device	Electronic gate, electronic timer, mechanical timer, multiplexer, range device, etc.
TF	Transformer	Separate identification only when used as a separate item
TG	Positioning Device	Tilt and/or train assembly
TH	Telegraph Apparatus	Miscellaneous telegraph equipment
TK	Tool Kit	Miscellaneous tool assemblies
TL	Tool	All types, except line construction (LC)
TN	Tuning Unit	Antenna, receiver, transmitter, etc.
TR	Transducer	Magnetic head, phono pickup, sonar transducer, vibration pickup, etc. (See H, LS, and M)
TS	Test Set	Test and measurement equipment not otherwise categorized
TT	Teletype or Facsimile	Miscellaneous facsimile, tape, teletype and similar equipment
TV	Tube Tester	All types
TW	Tape and Recording Wire	Electrical tape, insulating tape, recording tape, splicing tape, recording wire, etc.
U	Audio or Power Connector	Adapter, plug, receptacle, socket, tee, union, etc.
UG	RF Connector	Adapter, choke coupling, elbow, flange, plug, socket, tee, union, etc.
V	Vehicle	Cart, dolly, trailer, truck, etc.
VS	Visual Signalling Equipment	Flag set, serial panel, signal lamp, etc.
WD	Two-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WF	Four-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WM	Multiple-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WS	Single-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
WT	Three-Conductor Cable	Non-RF, cable and cordage in bulk (See RG)
ZM	Impedance Measurement Device	Measures C, L, Q, R, power factor, etc.

*Represents a collection of items which are part of (or used with) a system/set or a series of system/sets.

The two-letter unit/component identification is commonly identified to the system/set it is designed for by suffixing a slant bar and the identification of the system or set. As an example, the AM-3474/APS-80A(V) is a synchro signal amplifier designed as part of the APS-80A(V) airborne search radar system.

The Horizontal Output Linear

Warren L. MacDowell W2AOO
11080 Transit Road
East Amherst NY

Many amateurs who are not fortunate enough to be wealthy will find this article of interest. Many of us desire higher power so as to cut through the QRM present on 20 meters but do not have the spare cash to purchase exotic tubes such as the 4-1000, 4-400, etc.

It has long been known that it is possible to parallel various tubes such as the 807 or 1625 and create an operable linear. This linear is merely a modern version of this paralleling circuit which works well and is simple and inexpensive to construct. In addition to this, the unit exhibits no instability.

With a well stocked junkbox, the average amateur should be able to construct this amplifier for under $20.

I concentrated the design of the linear shown in Fig. 1 about the 6JE6 tube, which is commonly used as the horizontal output tube of many of the present color television receivers on the market. The specifications of the 6JE6 from tube manuals do not show it as a powerhouse. When looking at the size of the plate on the 6JE6, it becomes apparent that it must be capable of a good amount of dissipation. Also, as a pentode, it would have the necessary isolation between cathode and plate that is required for unneutralized operation. We are grounding all the grids, so essentially the tubes are working as triodes for this application.

Six of the 6JE6s are paralleled in the final. All of the grids are grounded directly to the shell of the 9-pin socket. It is essential that these grids are grounded as close as possible to the shell or instability will result. Simply bend down the socket pins and solder them directly to the shell.

I attempted to operate the cathodes at ground potential; however, the resting current of the linear was in the neighborhood of 225 mA – which, of course, is excessive. The choke that isolated the cathodes from rf ground is wound on a half-inch piece of ceramic stock 4 in. long. Fill the entire length of this with 26 AWG enamel wire. It was necessary to bias the cathodes of these tubes to lower the resting current to 80 mA. This was done with the use of two 75Ω, 160W wirewound resistors in series with the cathode choke to ground.

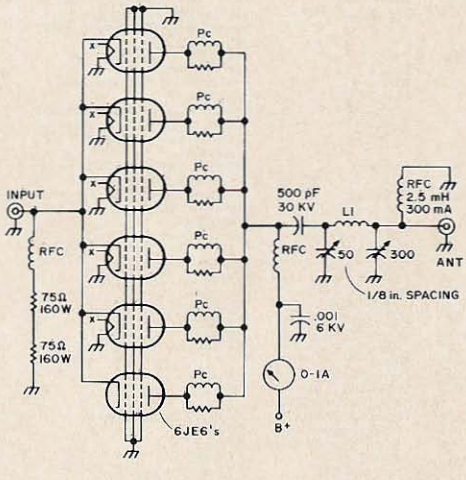

Fig. 1. Schematic diagram of the "horizontal-output" linear amplifier.

(These large resistors are only $2.50 each.)

At this point, you may think that it would be easier to bias the grids. I tried this but instability resulted. Also, it is easier to solder in two large resistors than build an entire bias supply. In operation, these two resistors run very cold even at 500 mA instantaneous current.

It was necessary to use parasitic chokes in the plate lead of each of the tubes. These are constructed from 5 turns of 14 AWG copper wire (½ in. diameter coil) around a 92Ω, 1W resistor. With these chokes in the circuit, there is no trace of parasitics.

The plate rf choke is also homebrew. In fact, it is identical to the cathode rf choke. This is mounted at a central point in the group of tubes and is bypassed to the chassis with a 0.001 μF, 6 kV disk ceramic capacitor. The dc blocking capacitor (rf coupling) is merely a TV "doorknob" capacitor rated at 500 pF, 30 kV.

The final tank coil is constructed from 5 turns of ¼ in. copper tubing, 2½ in. in diameter. This is resonated in a pi-network configuration with a 50 pF variable for resonance and a 300 pF broadcast variable for antenna loading. Make sure that the 2.5 mH choke going from the output lead to ground is in the circuit or a brilliant display of fireworks will occur in the test stages of this rig.

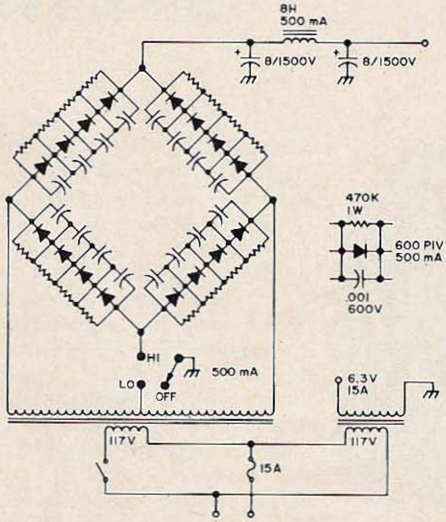

Fig. 2. Linear power supply.

The power supply (Fig. 2) uses a 1 kV secondary, 500 mA power transformer. You probably could use two identical TV power transformers phased in parallel to achieve the necessary current capability. We were fortunate enough to have this transformer lying about from a military regulated supply. With 1 kV going into the diode rectifier bridge, the output voltage will fall at approximately 1.3 kV with 80 mA of resting current and will drop to 1 kV when the linear is drawing 500 mA. Of course this represents 500W dc input, or 1 kW sideband power.

The bridge consists of bargain silicon diodes which are rated at 600 PIV, 500 mA each. In each leg of the bridge, four of these diodes are in series and equalized, which gives each leg a 2.4 kV rating. Each diode is voltage equalized and protected from surge and transient spikes by paralleling 470 kΩ, 1 watt resistors and .001 μF, 600V disk ceramic capacitors about the diode. The high voltage is activated by grounding the negative side of the bridge with a toggle switch. Filtering is achieved through two 8 μF, 1.5 kV oil-filled capacitors and an 8H, 500 mA filter choke.

It may sound surprising but each of the 6JE6s draws 2.5A of filament current at 6.3V ac. When you consider that there are 6 of these, it takes 15A at 6.3V to keep these bottles heated. Make sure that the filament transformer is adequate to handle this current.

When tuning up the linear, apply drive to the input and resonate it as with any final. There should be no current drawn above 80 mA with no drive applied. Do not hold the linear at 500 mA for any length of time as it will overheat the finals. The linear is designed for CW or sideband operation where the average will be much lower than 500W dc. Of course the rf peak will be 1 kW in this mode.

I have been driving this linear with a DX-35 in CW mode and have had fine reports with a clean signal. This indicates that 50W drive will excite the linear nicely.

The simplicity and performance of the linear will make it well worth the time and effort of construction.

. . . W2AOO ■

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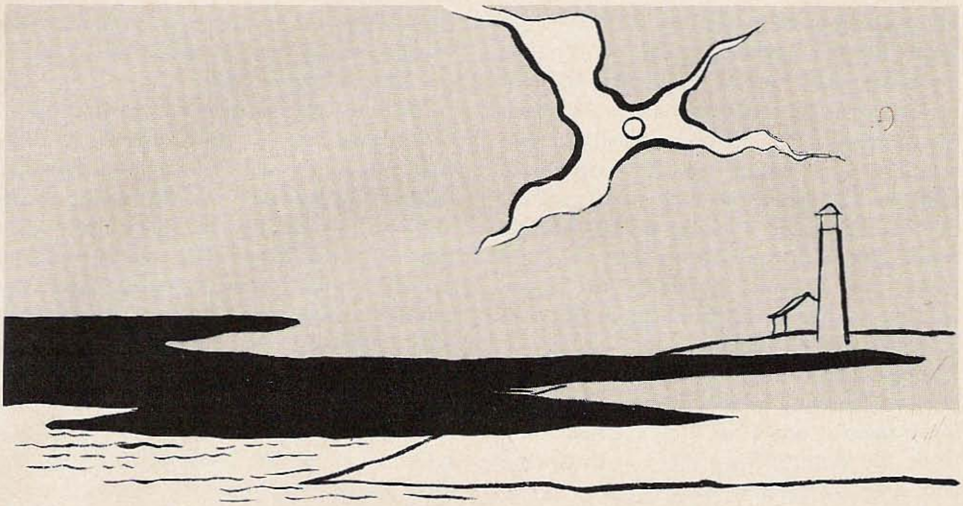

DX AMERICA FIRST

Rev. Robert O. Gardiner W6LZJ
595 E. Pacific Coast Highway
Long Beach CA 90806

One of the real thrills offered to the licensed amateur radio operator is the opportunity to work DX. That thrill is trebled when the DXing is done from some exotic out-of-the-way place. Unfortunately, most of us have neither the time nor the money to travel extensively . . .crossing oceans to far-flung islands or dense jungles. We may never visit the other continents nor hope to ham from the moon. However, there is nothing to prevent any ham from sharing in the thrill of a DXpedition within reach of simple transportation, in short vacation periods, and best of all, within the range of the billfold.

The wife permitting, the rig usually accompanies the family on every summer vacation. Installing the antenna and rig is as important as setting up the tent and preparing the first meal. The working of DX is fairly simple if the equipment includes the low frequencies. If you have never taken 6 and 2 meter equipment as your only station on a DXpedition you have missed one of the most exciting and interesting pleasures in all of ham radio.

Because of the short distances normally covered by VHF rigs, a good antenna is recommended. On the other hand, the smaller dimensions make this an easier antenna to pack along with all the other gear. Having decided what is to go, it is well to talk over with the rest of the family where the vacation is to be spent. If you are fortunate enough to live near a large lake or on either coast, an island makes an ideal hideout for the family and for hamming.

Recently, we made such a decision; and since we lived in New England, we decided to visit the island of Matinicus, 25 miles off the coast of Rockland (Maine). The old Merc was laden with clothes, the Clegg Zeus, Interceptor, a borrowed 40 ft mast, miles of stranded aluminum guy wire and coax, a CDR rotor, all the tools I could pack, and a 1.25 kW alternator manufactured under the name of Zeus. We had written ahead to the skipper of the *Mary A* making reservations for the 7:45 a.m. departure on August 1.

On the ferry next morning, I heaved a real sigh of pleasure when I noted all our things safely loaded on deck. Paint cans, a live chicken or two, and tons of fresh foods were stacked between piles of building materials, plumbing supplies, and the raw materials for lobster traps and floats. When the morning sun came out through the fog, an island appeared on our starboard. Up to then we had been aware of an occasional bit of something floating in the grayish water, but with the clearing fog, we could make out literally hundreds of multi-colored lobster floats bobbing in the cold blue water of the Atlantic.

What before we had only heard as a chug, chug, chug now turned out to be the lobstermen's boats as they visited their traps. We were to learn more of these men and their adventures later in our stay on the island. I was told that each lobsterman makes and paints his own floats and unerringly travels to each one marking a lobster trap baited and lying on the sea bottom. For the life of me, I could never tell how he knew where each was placed as he looked for the trap in the fog. I was told they never lose one except to a storm.

By this time we had become accustomed to the fascinating accent of the other passengers. They were mostly natives of Maine who lived on Matinicus or who were visiting their families and friends on the island. Our skipper was apparently too busy avoiding the rocks which began to appear more numerous as we neared our destination. The island is approximately three miles long and about a mile across. The skipper brought us deftly through the maze of other boats in the harbor, and at last – three hours from the time of our departure – we arrived at the dock. I immediately learned that if I was to have assistance in getting my freight off the ferry, I would have to pitch in and help unload the boat. After the restful trip and the invigorating air clear of all man-made impurities, I was ready to work and joined in the line relaying the cargo from hand to hand until all was now dockside.

Our letter affirming our desire to rent a small cottage, the only one then being offered to let, had brought an accommodating fellow, Mr. Bunker, down to the dock with a pickup truck. He helped me load our gear, and with the family riding in front with him, I hopped into the back and bumped along over the dirt roads taking in the view of land and sea.

One of the things we learned about vacationing on a small island in New England is the importance of buying all necessary provisions for the larder at the local store. We had heard of those who came up from New Jersey and Long Island in the summer time bringing cases and boxes of canned goods with them. This not only alienated the local people whose economy depends on the local store, but was also costly as by the time the food was carried on the ferry the price of it was higher than at the local store. Also, the local people were unhappy to the point of refusing transportation to the outlying camp. All our goods were hauled free by our landlord, Mr. Bunker, and he took us back to town so that we could do our grocery shopping, and later delivered it for us.

We were now safely established in our vacation cottage on the shore of a small cove with a northeast exposure allowing us to see nearby Birdrock better known as Gull Rock, Cannonball Island, and Ragged Island. We had a late lunch, had the freezer section of the refrigerator (which ran on bottled gas) well stocked, the ham gear set up in one corner of the front room near the fireplace, when Mr. Bunker drove up with a five-gallon can of gasoline and two quarts of motor oil for the alternator. We were all set to begin our DXpedition except for installing the antennas.

News travels fast in New England, and it travels even faster on Matinicus. I was wondering how one man, one woman, and a lad of fourteen would get the 40 ft telescoping mast erected, guyed, and sporting two beams without accident. Ed, the junior op, mentioned that there was a man coming along the shore and into our cove. In that delightfully informal way that the people of Maine have, he introduced himself and then said, "I hear you have some radio equipment with you."

Not being short of words myself, I quickly introduced him to the family and then the ham gear. He was Charlie Pratt, the local telephone man on Matinicus. He

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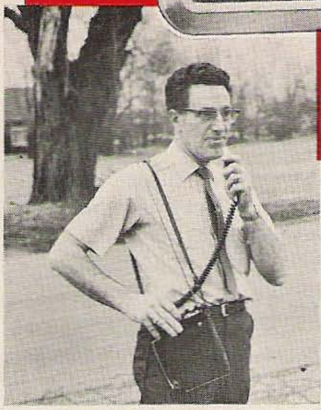

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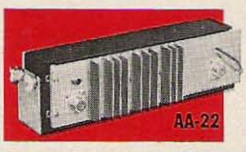

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had singlehandedly installed telephone wires throughout the island to all the residents who for a small sum per month could keep in touch. In the meantime, the telephone company on the mainland had installed a microwave telephone station on the island and employed Charlie to take care of the power generators and make periodic checks by radio with the home office. He also was the designated Civil Defense contact for the island and the CD net on the mainland. His interest in ham radio had led him to visit us and glad I was to see him. He said he would help me get the antenna up; and with Bette, Ed, and me on the three guy wires, Charlie did what I have never since seen done. He stood on the next to the top rung of a small ladder which in turn was leaning untied against the mast. We had guessed the approximate lengths of the remaining guy wires which were fastened at the top of each 10 ft section except the last one. The 2 meter beam was at the top and spaced below was the 6 meter "hilltopper."

Charlie, although short of stature, is sturdy and his years of pulling up his lobster lines have developed muscles I don't even have. He would give a tug on a 10 ft section of mast, hauling along the antenna; guy wire, and coax. And up it went!

It still is hard to believe as I think back on it, but there it stood, and well guyed too, as it turned out. We had one whale of a summer thunderstorm with wind and lightning during our stay one memorable afternoon.

Our first contacts were strictly local Maine coastal stations, and evoked some comment since Matinicus had neither electric power nor licensed amateurs. Every expedition is subject to minor irritations and difficulties, and ours was no exception. About the second day on the air the Clegg Zeus went dead without a sputter. Charlie again proved himself a ham's best friend. When he came over after his day out in the lobster dory, he learned of my problem and asked if I could use a VOM. I traced my difficulty to one of two ballast tubes in the modulator power supply. Since the ferry makes its trip to the island on Tuesday, Thursday, and Saturday, sending and receiving an order by mail would mean at least a week off the air.

The island's 6 meter rig was connected to our antenna, the beam pointed southeast, and attempts were made to make a contact with one of my buddies, K1WPS, Murray of Marblehead, Massachusetts, who knew I was on the island and would be looking for my signals. As it turned out, I heard two of my friends in New Hampshire. It was difficult to break them as they lived on opposite hills from one another and I was not giving them more than a few watts of antenna power. Before they did sign off, I managed to get through with my order for replacement tubes and asked them to pass the traffic on to Murray.

The very next ferry had a package addressed to me with the necessary ballast tubes. Needless to say, we had no more technical difficulties for the rest of our stay. I was able to get into Massachusetts regularly several times a day and with no trouble each evening except one. I learned that every ham with any kind of gear on 6 meters was trying to raise K1OXK/1 on Matinicus Island. The QSLs began to come in from Long Island, New York, Connecticut, Rhode Island, Maine, New Hampshire, Vermont, and with some partial openings customary in August I worked North and South Carolina and several other southern states.

The real thrill of the DXpedition came one night as I was in QSO with a fine YL camping with her father in southern Maine when I heard a breaker calling me from W2-land. I had several contacts with other 2s and 3s on what appeared to be a very effective aurora. Suddenly, they were gone and I was in contact with the midwest. In short order I was working stations at the rate of four or five every two or three minutes. Each time that I signed over it was like turning on the switches on ham rigs all over the country. In a matter of moments every ham who could copy my signals was calling: "Hi Bob, do you copy WAØXXX?"

I had to do what you have heard Wayne

Green and all those other fellows do who go on rare DXpeditions. I began looking up and down the band 20–30 kHz to find one voice among the many that could be copied. You will readily imagine my surprise the following morning when I learned that Massachusetts had had no opening on six meters that eventful night. It was the only night I didn't keep schedules with my friends in Massachusetts.

I hesitate to close this account without telling you that we witnessed the fiery results of what appeared to be a feud on the neighboring Ragged Island. It seems that whenever there are *claim jumpers* or perhaps more appropriately trap robbers, all *hades* breaks loose on their Maine Islands. Whole families have been known to disappear and never be heard of again on their home island. It was one of those beautiful clear days with a soft breeze blowing across our cove. I could hear the ignitions of the engines on the lobster boats buzzing in my speaker sometime before they crossed into sight of the cottage. I looked out the window to see if the lobsterman was going to enter our cove and spotted instead a wisp of smoke where I thought there shouldn't be any. I rushed out to the bank which protected us from the storm's high waves during inclement weather, and caught a good view of what by now was obviously a great fire burning on Ragged Island. What I had thought was a boat's ignition proved to be the Coast Guard plane flying back and forth observing the blaze at Creehaven.

Later that day we learned at the general store that one of the residents of the neighboring island had somehow made enemies who took advantage of his absence from the island to burn his house down. So you see fellows, and gentle readers, all is not always sweetness and light, calm and peace, even twenty-five miles out in the Atlantic. Should you care to walk the trails among the blue spruce, pick wild blueberries, and strawberries, and apples, and feast on Aunt Lizzy's homegrown vegetables, I think that I should warn you. Today you don't need to take your own generator for there's power on the island now. Right, you guessed it; Charlie Pratt, the telephone magnate and lobsterman supreme, the CD chief, and antenna installer, is the new utility expert. He has installed power lines to each home and no longer do the residents have to run gasoline powered washing machines nor generate power for their color TV. I had the honor of being the first ham ever to have his signals read on a color TV on Matinicus Island. Fortunately, the owner of the TV was more intrigued by the situation than the ones I have met with at home. (Besides, if I remember correctly, he was Charlie's uncle – and Charlie could square anything.)

We had planned to return to our cove the next year, but our inquiries about the cost of such a cottage led to an unanticipated early purchase by the judge who had been renting it in all the previous years. We can't go back to that cottage, but I know we shall never forget how we spent an August "down Maine" and met one wonderful lobsterman trying out our own version of *DX America first*.

. . . W6LZJ■

R. L. Morgenstern WA2EAW
141-60 73 Avenue
Flushing NY 11367

PHONE PATCH NO COST NO WIRES

In the past I have read many articles about phone patching. All of these had some form of actual wire attached to the telephone company lines. Similar attachments are needed for the commercial patch, either in kit form[1] or purchased as a complete and finished piece of gear[2]. Another point which was hammered at, was the impedance matching to the telephone lines, which seemed to scare me away more than anything else. Then there was the fact of a \$20 to \$30 outlay for the patch (I always found something better to do with the \$20 or \$30).

In my travels along the shelves of used-book stores, I came across an article[3] which seemed, with a little revision, to be just what I wanted in the way of a patch without any of the bugaboos I had read about in the past. The cost turned out to be not a single red cent and nothing was wired into the precious lines of the telephone company. I will attempt to go through my construction of the patch as I revised it and present the problems that showed up and what I did to clear them up.

The construction is simple, straightforward and noncritical. The heart of the patch as I constructed it was a used automobile ignition coil. New, an ignition coil can cost about \$9 or more. This cost can be avoided by asking a local service station operator for a used, discarded ignition coil. Maybe I was fortunate in the first coil I tried. A few may have to be checked out. The coil that was given to me was grease covered. I wiped it clean and used steel wool to clean the 3 terminals. One binding post terminal is primary positive, one is common negative, and the third is the "tower" secondary positive. The continuity of the primary and secondary coils are tested with an ohmmeter to see if it is shorted beyond use. The primary positive to common negative was about 1.5Ω. The tower secondary to common negative was about 10 kΩ. The remaining needed parts for the patch came from the overflowing junkbox. These were:

1. About 40–50 ft of thin enameled wire. I used 24-gage because I had a spool of it, but any small-size wire can be used if it is insulated and not so fragile that it breaks with a small amount of abuse.
2. Two-conductor shieled wire about 18 in. long.
3. Two alligator clips.
4. A two-conductor coiled cable, the kind that contracts when not in use and can be pulled out to a length of 3–4 ft on extension. I took this from an old telephone. This was used only as a matter of neatness. The patch will work just the same without it.
5. Assorted nuts, bolts, washers, tape, etc.

Construction

Clean up the ignition coil, check it out, and set it aside. Using the 40–50 ft of enameled wire, I left a lead of about 2 ft and started to wind the remainder of the wire around the earpiece of the telephone. I found that if I confined my turns to the screw-on cover of the earpiece and not let my turns work their way on to the handpiece, it was much easier to remove and tape the turns together. I made about 60 turns of wire around the earpiece rim and left about a 2 ft lead when I finished.

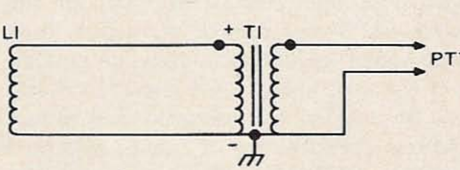

Fig. 1. Schematic representation of induction patch.

I had precut four pieces of tape about 1 in. long and as I lifted part of the formed loop from the earpiece I bound that portion of turns together with the tape. This was repeated at four spaced intervals; as the wire loop was completely removed from the telephone it retained its shape. I was now able to replace this loop back on the earpiece with slight pressure.

The phone patch works even with this induction loop held about ½ in. away from the earpiece. So do not worry if the loop will not go back onto the earpiece and fit as it did before removing it.

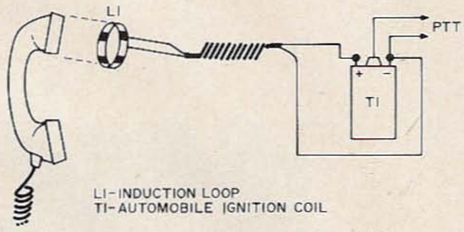

Fig. 2. Pictorial schematic shows patch connections.

If the coiled cable is used, the following steps should be taken. The coiled cable I used had four conductors: two white, one pink, and one black. This was great because I only needed two of these and this meant I had a built-in color code. I removed the insulation from both ends of the pink and black wires. The ends of both white wires were cut short to be out of the way. After removing the insulation from the wires I discovered that these wires are special in that they are multistranded and that every two strands were braided with a thread. This thread was unraveled by rolling the two wires between the fingers. The freed thread is cut away.

After all the ends were ready for soldering I found out I could not solder these wires. In order to secure the induction loop to the coiled cable I first cut the lead lengths on the induction loop down to about 4 in. and steel-wooled the enamel of the last 2 in. A homebrew binding post was made to secure the induction loop leads to the coiled cable leads. Two such binders were needed. These consisted of a small bolt, long enough to accommodate two washers, the two leads to be united, and a nut.

One washer was slipped on the bolt up to the head of the bolt, the two wires were wound on the shaft of the bolt up close to the washer, one lead from the induction loop and one lead from the coiled cable. (It does not matter which lead goes to which wire of the loop.) The second washer is slipped on and the nut follows this and is tightened to clamp the two wires between the washers. The remaining lead from the induction loop and the remaining wire from the coiled cable were united in the same way.

We now have, if you used the coiled cable, one induction loop attached to the end of a coiled cable. If the coiled cabled was not used, you have an induction loop with 2 ft leads, cleaned of insulation for about 2 in. at the ends.

The free ends of the coiled cable or the ends of the induction loop leads are now attached to the ignition coil binding posts. It does not matter which lead goes to which of the following binding posts. One lead to the primary positive and one lead to the common negative. The primary positive post can have its nut tightened at this time, but leave the nut on the common negative loose. Prepare a 2 in. length of insulated wire with an alligator clip on one end and no insulation on the other for about ½ in. This bare end is placed around the binding post of the common negative and the nut is tightened.

Remove the tower terminal and clean it with the steel wool. Prepare another insulated wire as just done. I soldered this wire to the inner portion of the tower conductor and I replaced the conductor inside the tower. These last two leads that are from the tower terminal and the common negative I elected to connect to my mike PTT switch because this saved me the trouble of going into the rig and it also provided me with an extra control switch in addition to the PTT switch on the rig.

The preparation of the mike to the ignition coil is the final step in completing the patch. On the breadboard circuit I used two separate wires for this step without any problem.

The PTT switch on my mike is on the upright hand grip. The hand grip is hollow, so this is ideal. I unscrewed the PTT switch and pulled it away from the hand grip to expose the switch tie points. At this time both ends of the shielded cable were prepared. One end of the shielded cable was slipped up the hollow center of the hand grip from the bottom of the open base and fished out the hole of the PTT switch. My PTT switch has two tie points, and one of the leads was soldered to each tie point. It makes no difference which wire goes to which tie point. I did not solder the braid of the shielded cable to anything. It was cut back close to the insulation to get it out of the way, because I found that if I touched it when the rig was on VOX my rig went into the transmit mode. The PTT was replaced after making sure that there were no shorts and solder bridges.

The remaining end of the shielded cable coming out of the bottom of the mike has the end prepared as follows; about 3 in. of outer insulation and the shielding braid were removed. The remaining insulated wires were cleared of insulation for about ½ in. These ends were each given a coating of solder to keep the strands from wandering and to give it some strength. Some 1/8 in. spaghetti from the junkbox was cut to give me two pieces each about 2½ in. long. These were slipped over the soldered tips of the shielded cable conductors and pushed back far enough so that the bare wire was exposed. Do not connect the leads from the shielded cable to the ignition coil at this time.

I turned on the rig and while it was warming up I placed the induction loop over the earpiece of my telephone. This was a real live telephone. I replaced the telephone handpiece to its cradle to kill the dial tone. I tuned to an unoccupied frequency and tuned up the rig. I placed the PTT switch on the rig in the OFF position and the PTT switch on the mike in the ON position. I then attached the two alligator clips from the ignition coil to the leads from the shielded cable just installed in the mike.

I advanced my mike/CW level just a bit more than I usually have it during normal voice operation. I now placed the rig PTT switch in the active position which is VOX on my HW-100, and I heard a hum in the speaker which was never there before. I will get back to the hum later. I lifted the handpiece of the telephone from the cradle and the dial tone activated the rig into the transmit mode. I replaced the telephone handpiece and the rig went into the receive mode.

If the dial tone does not activate the rig to transmit, raise the mike/CW level. If this does not make the dial tone activate the rig then replace the handpiece and reverse the alligator clips to the shielded cable. Lift the handpiece again and the rig should go into transmit when the dial tone starts. Make a note of which lead goes to which clip.

The patch is now ready to transmit through your rig from the telephone. In fact, that is all this patch does: It lets the telephone earpiece activate the rig and whatever is coming into the earpiece is transmitted. So how is the signal received by the rig sent over the telephone? This I have done by the very simple method of plugging in my earphones and placing the earphone over the mouthpiece of the telephone. It may not be the latest in circuitry but it works.

You can also place the mouthpiece of the telephone near the speaker, but since all transmissions from my station are my responsibility I monitor all patches. This was simplified by fashioning a retaining ring that slips over the mouthpiece of the telephone and holds the earphone in place. In this way, I can hold the telephone as in normal use or I can rest it on my shoulder, leaving both hands free. If your hearing is better than mine, you can leave the whole thing on the operating table in front of you.

As this phone patch now stands it must be worked on a PTT basis. The mike is active on my circuit and I can break in by use of the mike or the telephone mouthpiece.

Now about that hum I heard: I found that it was dependent on where the ignition coil was placed on the operating table, so I kept moving the coil around until I found a spot where the hum went away and this is where I place the ignition coil whenever a patch is to be made. When not in use, the induction loop is removed from the telephone and hung over the tower terminal. That takes care of all the attachments to the telephone. The alligator clips are removed and clipped together and the patch is put away.

Now for the two leads coming from the bottom of my mike stand: The spaghetti pulled over the exposed ends of the two wires and the wires are bent back on themselves and tucked up the hollow mike stand.

Summary

My ignition-coil phone patch is shown in Fig. 1, and the deployment is pictured in Fig. 2. There are no interconnecting wires to the telephone lines. Since the audio introduced into the telephone lines is nothing more than audio there is no worry about adding any voltages to the telephone lines. I wonder what would happen if I cascaded a few ignition coils?

. . . WA2EAW■

1. Heath kit.
2. Johnson phone patch.
3. QST, July 1969 "Ductopatch."

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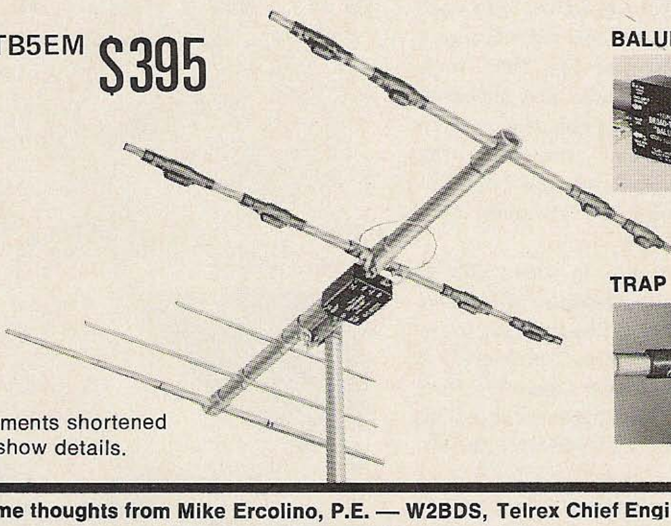
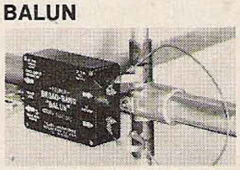
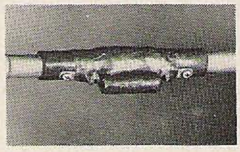


Elements shortened to show details.

BALUN



TRAP



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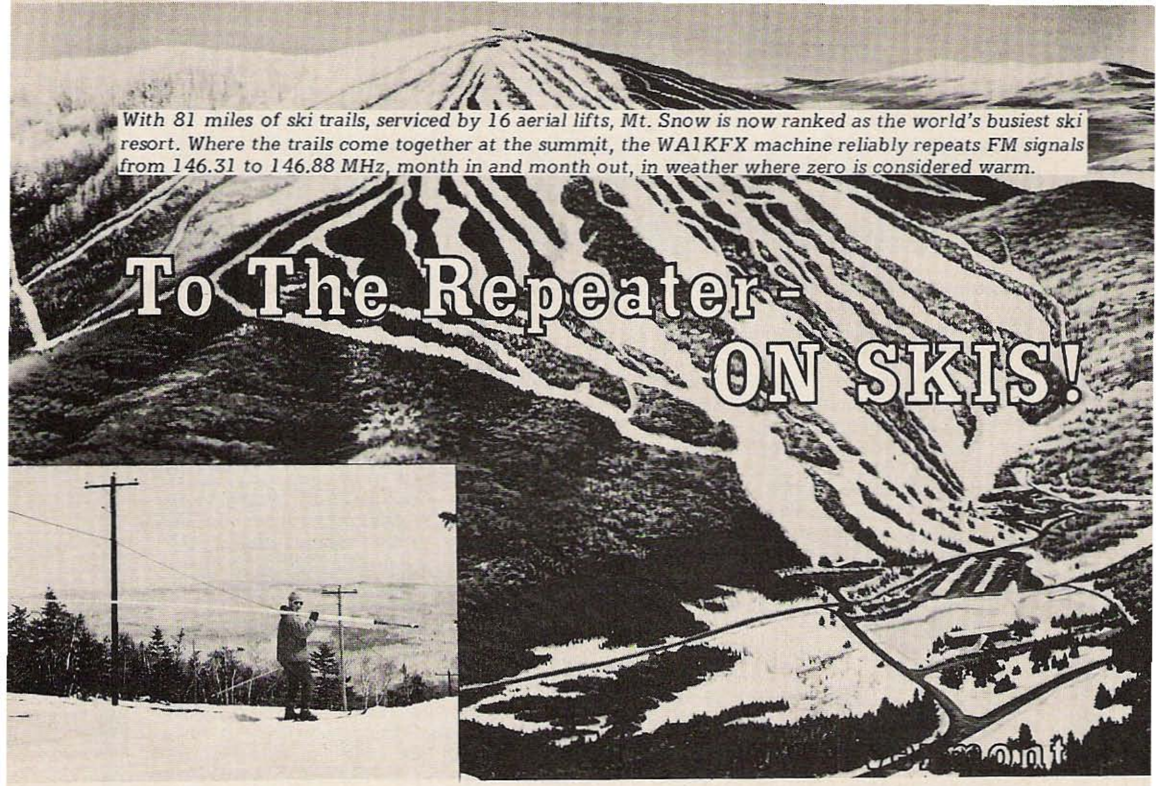


With 81 miles of ski trails, serviced by 16 aerial lifts, Mt. Snow is now ranked as the world's busiest ski resort. Where the trails come together at the summit, the WA1KFX machine reliably repeats FM signals from 146.31 to 146.88 MHz, month in and month out, in weather where zero is considered warm.

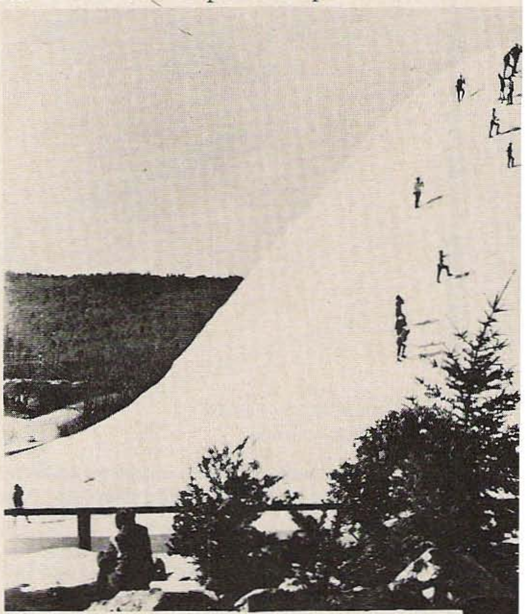
To The Repeater – ON SKIS!

Installing and maintaining a repeater on an isolated mountaintop usually means a lot of lonely hours for the fellow who does the work. But at least one repeater man feels it doesn't have to be that way. Gordon Pugh, W1JTB, who has probably set up more repeaters along the eastern seaboard than any other amateur in the country, makes it a point to select his sites so that he can combine his "business" with his pleasure.

Gordon's "business," in this case at least, is setting up repeaters that have greater coverage than other systems in his area of the country. The "pleasure" is skiing. And Gordon's most laudable effort recently has been the deployment of his 146.31/146.88 MHz FM repeater at Mt. Snow, Vermont.

Mt. Snow is an extraordinary place. Europeans and Americans alike might find it difficult to believe that Mt. Snow is actually the largest ski area in the world – but it really is! With as many as 10,000 visitors on a good skiing day, Mt. Snow goes unchallenged as "biggest." Not even those renowned resorts in Switzerland can compete with Snow in terms of human traffic.

The mountain is not particularly high – at least not by worldwide standards. But at its 3600 ft perch atop Mt. Snow's

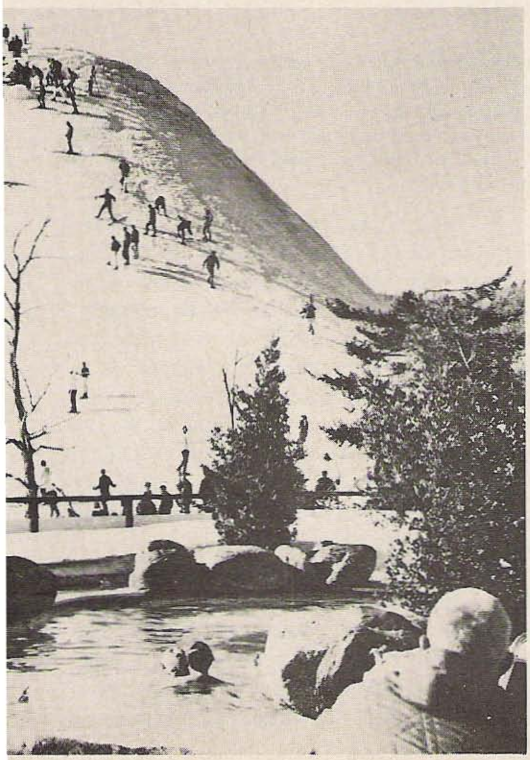


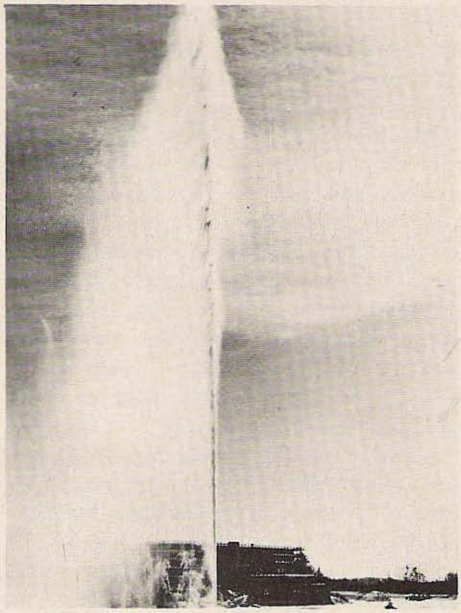
The glacier towering above the pool is called Fountain Mountain, and it was created by the snowy fallout from a geyser jet of water shot at tremendous pressure from underground. Fountain Mountain takes nearly two months to build; but it "happens" every year.

famous *North Face,* the .31/.88 machine, licensed under the call of WA1KFX, provides effective automatic relay coverage in five states – New York, New Hampshire, Massachusetts, Connecticut, and, of course, Vermont.

When Gordon Pugh services his Mt. Snow repeater – which is curiously nearly every weekend in winter and virtually never during summer months – he arms himself with all the tools he's likely to use and myriads of items he's not; then he packs up his skis and vacation gear, and off he goes – sometimes for days at a time.

If things really need fixing at the repeater site, Gordon's first day is usually spent in earnest. He's been known to spend as much as seven hours on the top of a tower at one sitting. He makes a marathon of the repeater repair job, staying with it until the task is done. In the unheated, open area where the WA1KFX repeater is installed on Mt. Snow, the temperatures frequently drop to the uncomfortable side of zero and remain there for long periods. But Gordon simply plugs in a 1 kW bulb





(for heat more than light) and hacks away at the problem. When it's licked, the funtime starts.

From the top of North Face, Gordon has a wide choice of trails on which to descend. An expert skier himself – and a part-time ski instructor, Gordon usually chooses one of the brisker slopes – like Snow's *Jaws of Death* or the *Challenger* both carefully marked, "For experts only."

If there's still daylight left when the repeater is once again operational and he's descended to the Snow Lake lodge area, Gordon will take maximum advantage of the remaining hours. With no less than 16 lifts to choose from, and 42 descent trails, he'll spend the day tackling the Main Mountain, with its thousand acres of ski facilities.

"The trip to the top is almost as much fun as the race down the mountain," Gordon says. And he's not kidding. There aren't many thrills equaling that of scaling the mountain in one of Mt. Snow's "skis-on," enclosed gondolas. The gondola lifts you high above the tree-studded mountain side and offers a breathtaking panorama of scenery.

"What I like about Snow," says Gordon, "is the solitude. The 80-odd miles of ski trails are sufficient to accommodate the hordes of visitors without crowding.

There's something about a solitary trip down the mountain that puts you in pretty close contact with Nature." With an almost reverent, poetic tone, Gordon added, "When the wind isn't blowing too hard, the only sounds you hear are the swishing of your skis and the rustle of the trees."

At the lodge, Gordon always winds up his day with a swim in the heated outdoor pool. It doesn't look comfortable when the air temperature is in the low teens, but Gordon insists that it is. The water temperature in the winter is rarely below 100° F, he says, and a swim is more refreshing than a hot shower.

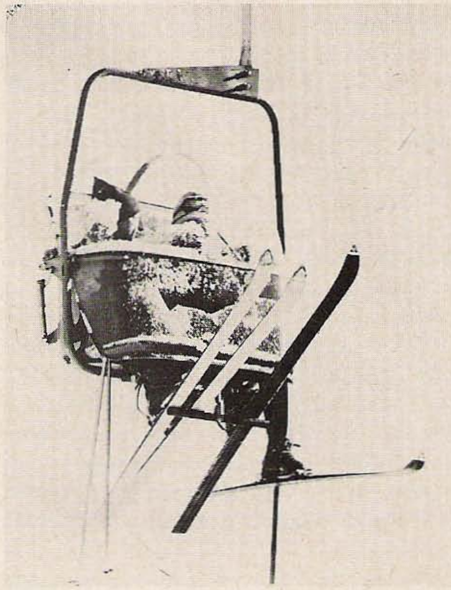
Some of us conservatives remained skeptical about the comforts of swimming outdoors in below-freezing weather, though. And it didn't help a bit to see Gordon's hair freeze into brittle spikes when his head came out of the water.

It certainly made an interesting picture, if nothing else. What is more incongruous than a photo of swimsuit-clad bathers with bundled-up skiers gliding over a snowy slope in the background?

That "slope in the background" is one of Mt. Snow's more interesting attractions. The hill, called *Fountain Mountain,* is a glacier made as a cooperative enterprise by man and nature. The management at Mt. Snow provide the geyser-fountain – tons of water jetting nearly 400 ft into the sky. Nature provides the water-to-snow conversion. The result is a glacier that takes several months to build.

The water geyser gets turned on when low-temperature season comes around – usually late in November. For a month or two, the geyser continues, day and night, while the glacier grows and grows. When the water is finally shut off, the glacier, with its ski-able snowlike surface, stands a full 200 ft. Skiers can then negotiate the miniature mountain until well into April.

Mt. Snow is an ideal repeater site, as the coverage performance of the WA1KFX machine will attest. It towers high enough above the surrounding countryside to make the .31/.88 machine accessible from even flea-power units like hand-held transceivers and battery-operated portables. But there are FM'ers who use Mt. Snow for communicating on frequencies other than those of the Snow system. Wayne Green, for example, likes to take his Motorola Handie-Talkie down the slopes of Snow, talking to distant amateur stations on a "direct" basis.

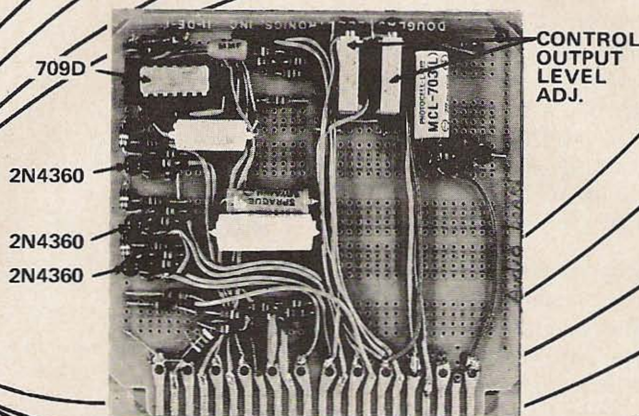


When Gordon makes a repair trip to the repeater site, he does it in style. During summer, he'd have to walk up; but in winter, it's easy going all the way – in an enclosed skis-on gondola that offers warmth as well as a panoramic view of the mountain.

Wayne also noted that other New England repeaters are accessible from Mt. Snow's *Main Mountain*. Heading down on skis at a neckbreaking clip, Wayne managed to combine two hobbies in one, and was able to talk through a number of New England repeaters during the course of one trip. Transmitting on 146.34 MHz, Wayne communicated through W1ABI, W1KOO, W1ALE, K1ZJH, W2NSD/1, and probably other repeaters that weren't active during the minutes of his descent.

For people who question Gordon Pugh's frequent trips to Mt. Snow, he offers a two-edged answer. If the query comes from a skier, he'll say, "There's more to snow resorts than skiing." And to curious amateurs, he says, "There's more on Mt. Snow than a repeater."

REPEATER AUDIO MIXER



Paul Hoffman W1ELU
169 Millham St.
Marlboro MA 01752

Ray Pichulo W1IRH
172 Dent Street
West Roxbury MA 02132

The audio mixer described in this article, although designed primarily for repeater use, can be used anywhere it is desired to mix a number of audio inputs with a high degree of isolation between inputs. The mixer is adaptable to almost any configuration which may be required to suit the individual's requirements. The number of inputs can be increased by a factor of two or three to suit the user's needs. The isolation between individual inputs of over 40 dB makes it possible in repeater operation to have tone command information on one channel not be affected by another input. The mixer shown in this article is the one designed for use in the WA1KFY repeater. It has eight inputs – three of them squelched, the other five continuously on.

Operation

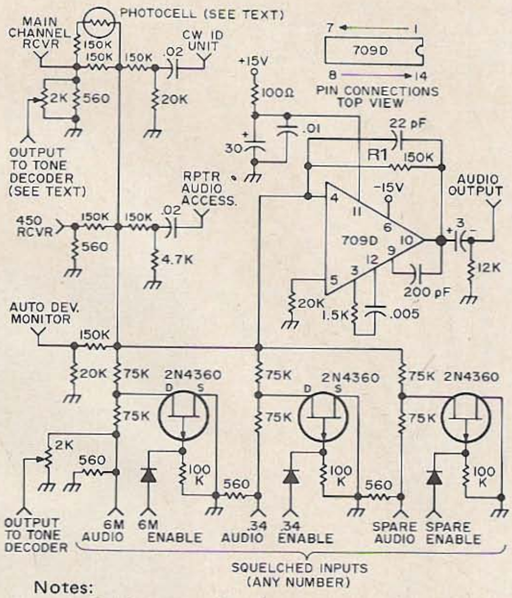
The amplifier uses a single 709D opamp plus one FET for each squelched input. The audio inputs as shown in Fig. 1 are applied to the opamp's inverting input. The output is fed back through 150 kΩ resistor R1. Notice that the signal from each input is applied through 150 kΩ also. The resultant voltage at the input terminal of the opamp is the combination of the input signal plus the out-of-phase feedback voltage. Since both are applied through equal series resistances, the resultant voltage is zero. This condition results in the opamp's having an extremely low (almost zero) input impedance. This resultant low impedance, together with the high series resistance on each input, accounts for the high degree of isolation between inputs. The squelched inputs use a FET across each input as a switch. With zero volts on the gate, the FET exhibits a drain-to-source resistance of about 350Ω, effectively shorting its associated input to ground. When +15V is applied to the gate, the FET switches off, enabling the input channel. The 75 kΩ resistors between each FET and the input bus prevent the input bus from being shorted by the FETs.

The gain of the opamp is determined by the ratio of the feedback resistance to the input series resistance. In this case, the gain on all the inputs is unity. If more gain is desired on a particular channel, the input resistance can be lowered to change the ratio (and therefore the gain). For example, it was found necessary to increase the gain from the main channel receiver when the phone patch was connected in order to increase the level into the phone line. (The phone patch does not load down the output; rather, the gain had to be raised in order to properly drive the line.) The gain change is accomplished by a photocell–lamp assembly, with the photocell in series with a second 150 kΩ.

The frequency response of the amplifier is essentially flat from dc up to about 8 kHz. Beyond that point, it rolls off. The 22 pF capacitor across the feedback resistor determines the rolloff frequency characteristc. The audio output voltage swing can go as much as ± 10V. This is more than ample to drive 10 or more high-impedance inputs. The audio amplifier in WA1KFY is presently used to drive three transmitters, a phone patch, and a monitor earpiece. The number of inputs can be expanded to suit individual requirements. The unsquelched inputs require only an additional 150 kΩ series resistor and load resistor for each leg. The squelched inputs each require an additional FET switch in addition to the load resistor and series resistors.

The opamp requires 15V (positive as well as negative) to operate it. The current requirements are approximately 30mA. The components shown in the detail schematic (1.5 kΩ 0.005 mF, and 200 pF) are used to compensate the amplifier against instability. The 100Ω resistor, 30 μF capacitor and 0.1 μF capacitor on the +15V line form a decoupling network.

Two trimpots at the top edge of the board (see photo) are used to provide audio outputs for tone-operated command functions. They are connected across the load resistors of the six meter receiver and the main-channel two-meter receiver as shown in Fig. 1. The arms of both pots connect to pins on the edge connector and



Notes:

1. Resistance values in ohms, capacitance values in microfarads unless otherwise noted.
2. Diodes are IN457'S.

Fig. 1. Audio summing amplifier.

go off the board to their associated tone decoders on another board. These pots are mounted on the audio mixer board as a matter of convenience and would not be used if it is not required to bring audio to another point in the system for tone command or other functions. The photocell–lamp assembly for gain changing on the main channel input is on the right side of the board. Similarly, it could be deleted if this feature is not required.

Summary

This audio mixer provides the repeater owner a high-quality audio mixer system which has minimal space and power requirements. It is especially attractive for use in more sophisticated repeater systems where several receiver/transmitter combinations are used. However, if the same construction techniques as those described in this article are used, it is just as good to use with a simpler repeater system because there is more than adequate room for expansion at a later time.

. . .W1ELU,W1IRH■

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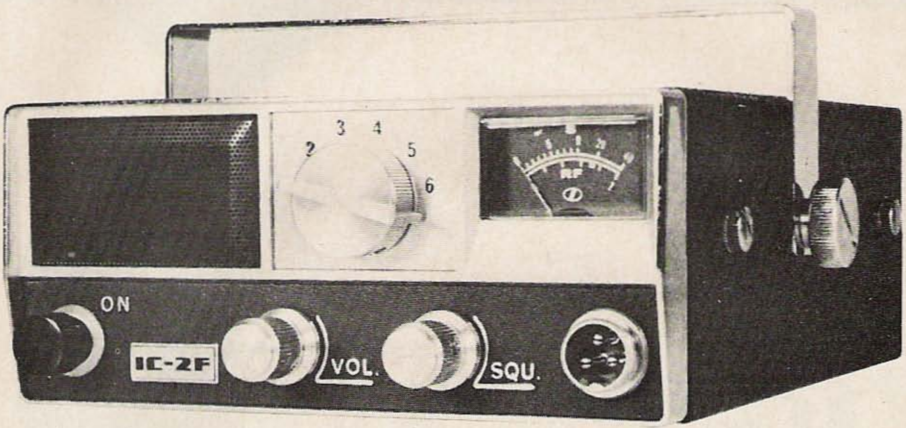

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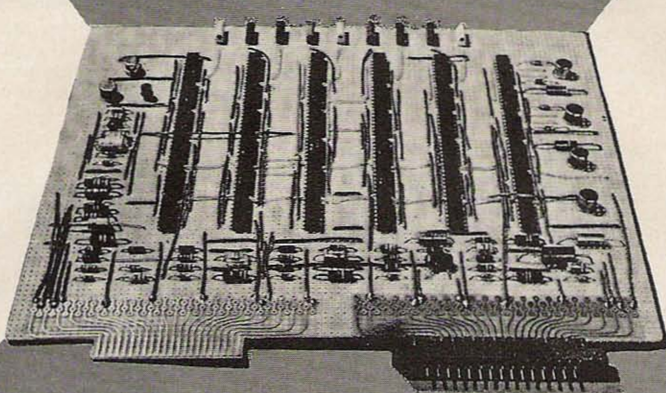


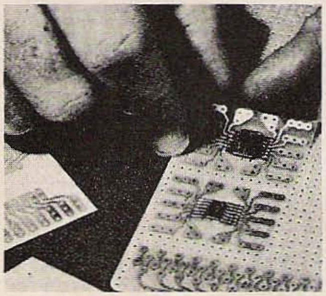
SOMETHING NEW IN PC CONSTRUCTION

One of the nice things about being associated with a major ham magazine is that I get a chance to preview a lot of interesting products. Some of the things I get to see are obviously gimmicks that will never take hold. Others are reasonably new good ideas, most of which are doomed to oblivion because the cost exceeds the ultimate value to the user. But once in a while – not often, mind you – but just on rare occasions, I get the chance to see something that smacks of real greatness.

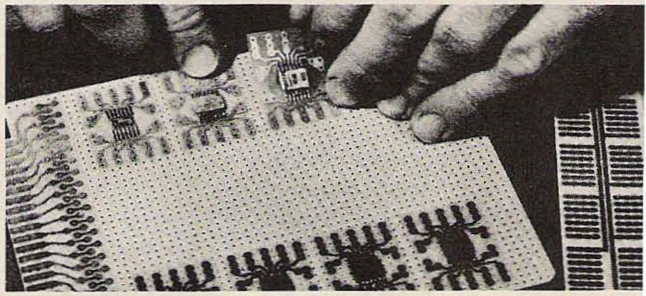
Such is Circuit-Stik, an item that I think is the most important development in the history of printed-circuit construction. I think this item is important because it will permit any amateur to make even the most complex circuit boards without any art, camera work, photoresist exposure, or etching. And that's really something!

You can get Circuit-Stik in a kit that includes everything you need to make professional circuit boards, but I haven't the faintest idea what the price is. A quick letter to the manufacturer will get you that information in no time, I would imagine. It's the *process* itself that I'm excited about. The trouble is, it's extremely difficult to describe it adequately, even with pictures.

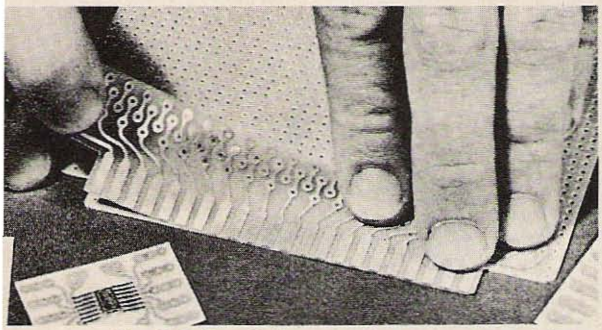
I'll try explaining it anyway: The kit includes a fairly large sheet of perforated board with very close-spaced holes (on 100-mil centers). From this sheet, you can cut your basic circuit board to whatever size your project might require. But rather than etching circuit paths onto a copper-clad layer, you can lay the circuit paths down onto the board with already-



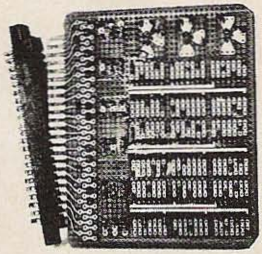
A wide variety of circuit-element patterns are available allowing the user maximum flexibility in his selection.



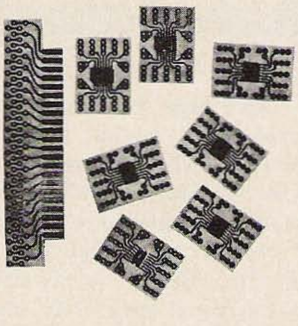
When MSI or LSI components are pre-lead bonded to Circuit-Stik subelements, (as the "flat-pack" units have been in the photos), they can be immediately tested in a circuit or become part of a permanent circuit board in minutes.



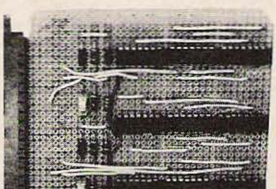
Circuit-Stik subelements are pressure sensitive and the adhesive formula offers exceptionally good adhesion strength, withstands soldering temperatures and yet may be removed for easy circuit design modifications.

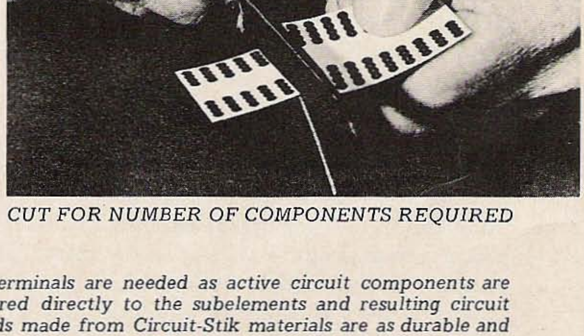


Circuit-Stik "1000-series" subelements are designed "on-grid," are pre-drilled, and when used in conjunction with .100 inch punched board, require no drilling



All subelement conductors are preplated and ready for soldering





CUT FOR NUMBER OF COMPONENTS REQUIRED

No terminals are needed as active circuit components are soldered directly to the subelements and resulting circuit boards made from Circuit-Stik materials are as durable and reliable as conventional printed circuit boards.

prepared patterns that are gold-plated or tinned copper on thin adhesive sheets of epoxy-glass.

The adhesive-backed conductive patterns are called "subelements," and they are available for virtually any transistor or IC package you could dream up. There are even subelements for all conventional card-edge connectors. The beauty in the system is that the subelements are all predrilled, and the holes fall directly over the holes that already exist in the perfboard. So making a complete board for any project is nothing more complex than laying out the board with a pencil and paper, then dropping the subelements onto the board in their proper positions.

I don't know what kind of adhesive is used on these superthin patterns, but it certainly does hold. And no matter how much you solder to the patterns and paths, they stay down. If you place a sharp knife under a pattern or circuit path, you can lift it without sacrificing any of its holdability, then reposition it anywhere else on the board.

...K6MVH■

READING 5 CODE RTTY in BINARY

000 000 111 011 000 000

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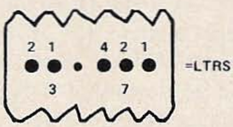
Hamburg NY 14075

Ever try and read the tape that you just printed off your Model 19? Here is an interesting way of reading it, using the binary system. Look at the tape from the top with two holes to the left of the sprocket and three holes to the right of the sprocket. Group the two to the left, to read 2-1 and the three to the right to read 4-2-1. Now all you have to do is add up all the holes that are punched to the left as one digit and all the holes punched to the right as one digit. This will give you two digits which can be converted to a function on the machine.

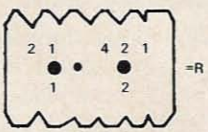
Example 1. If all holes are punched, add up the two weights on the left (2+1=3). Now add up all the weights on the right (4+2+1=7). You now have two digits which put together is 37. Look on the table and you find 37 would be the LTRS function.

Example 2. No. 1 hole on the left with a weight of 1, and the No. 2 hole on the right with a weight of 2. Put together, this is 12. Look on the table and you find 12 is the function R.

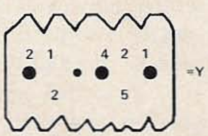
Example 3. No. 2 hole on the left weight of 2 and the number 4 and 1 hole on the right summed is a weight of 5. Putting the two digits together gives 25. Look on the table and find 25 is the Y function.



EXAMPLE 1



EXAMPLE 2



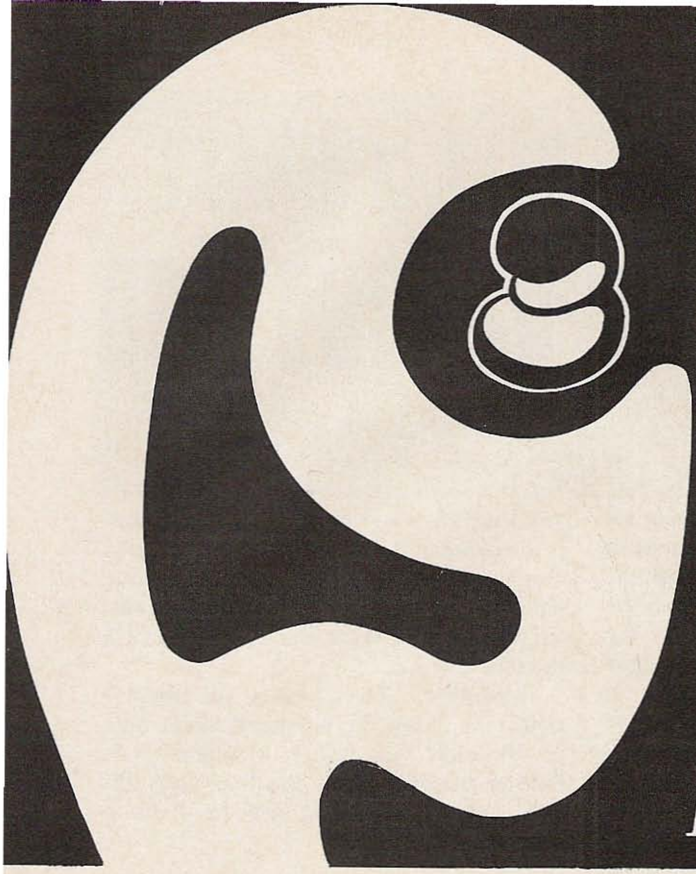
EXAMPLE 3

TABLE

01 = T	20 = E
02 = CAR RET	21 = Z
03 = O	22 = D
04 = SPACE	23 = B
05 = H	24 = S
06 = N	25 = Y
07 = M	26 = F
10 = LINE FEED	27 = X
11 = L	30 = A
12 = R	31 = W
13 = G	32 = J
14 = I	33 = FIGS
15 = P	34 = U
16 = C	35 = Q
17 = V	36 = K
00 = BLANK	37 = LTRS

If you study the table you can see that there is no wasted functions. There is a possible combination of 32 functions. If you add the 26 upper case operations we have 58 different possibilities. When reading the tape you should know if the tape is in upper or lower case. This should not create any problems. You could add one more function which is the blank.

Anthony Sperduti WB2MPZ ■



Unique Digital TTY Accessories

J. A. Murphy K5ZBA
4105 S Pittsburg
Tulsa OK 74135

This article describes three accessories for the RTTY station. The first is a regenerative repeater; you put highly distorted, biased signals in one end and get nice, clean, properly timed signals out the other. The second forms the basis of an electronic stunt box; it performs the "cleaning up" function of the first, plus converting the serial TTY signal to a 5-line parallel signal which can be used to perform various functions on receipt of a specified group of characters. The third performs all the functions of the first two plus speed conversions; with this little goodie you can put 100 wpm gears in your machine for copying the commercials and use the speed conversion function to operate at 60 wpm on the ham bands.

In order to understand the operation of these three devices, let's take a moment to review the manner in which a TTY printer decodes a signal. The start element of the code drops the selector magnet, initiating a mechanical timing cycle. Five times during this cycle the machine mechanically "samples" the condition of the selector magnet and positions the code bars accordingly. In a 60 wpm machine these samples are 22 ms apart and about 4.4 ms long. The length of time between the beginning of the start element and the first sample can be varied with the range adjustment. With the range control set at 60 the samples occur 33 ms, 55 ms, 77 ms, 99 ms, and 121 ms after the beginning of the start element. The Regenerative Repeater

The Regenerative Repeater

The repeater electronically samples the TTY signal in much the same manner as the printer. A start element initiates a series of seven sampling pulses. The input signal is sampled in the middle of the start element, in the middle of the five signal elements, and 11 ms into the stop element. The condition of the signal at the time of each sample is loaded into a flip-flop memory where it is stored until the next sample is taken. Thus, the output of the

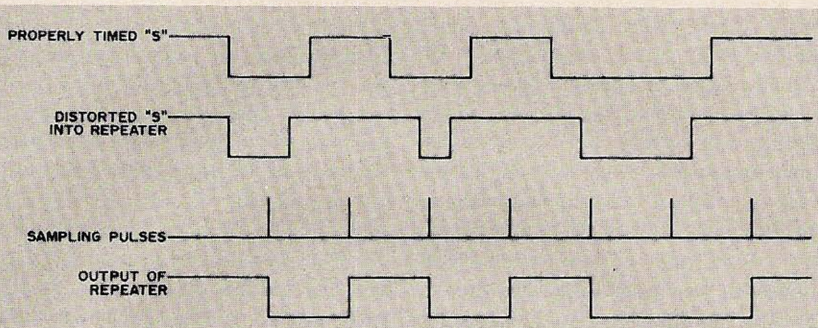


Fig. 1. Simplified timing diagram for regenerative repeater.

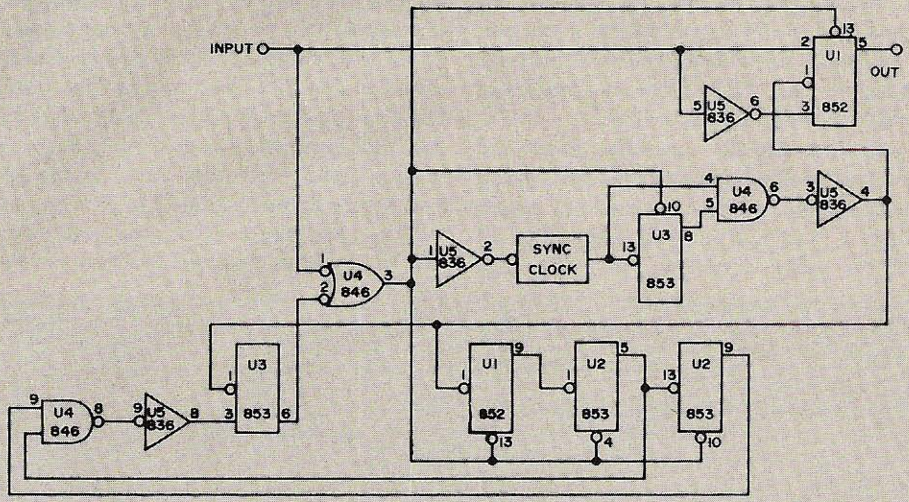


Fig. 2. Logic diagram for regenerative repeater.

flip-flop is a perfectly timed TTY signal, delayed 11 ms from the input signal, with signal elements corresponding to the condition of the input at the time of sampling (see Fig. 1). After the stop element is sampled, the circuit resets and waits for the next start element.

The logic required to perform these functions may be implemented in many different ways. The diagrams included here show 803 series DTL integrated circuits. It should be noted, however, that the same functions could just as well be accomplished with RTL, TTL, ECL, or HTL ICs, discrete transistors, or even tubes or relays, to name a few! with this series of DTL a high logic level is approximately +5V and a low logic level is approximately ground.

Referring to the logic diagram of Fig. 2 and the timing diagram Fig. 3, a start element (space) puts *nor* gate U4 input pin 1 at a low level, forcing output pin 3 and inverter U5 input pin 1 high. Output U5 pin 2 goes low, starting the 91 Hz synchronous clock.

"Synchronous clock" is simply a high-powered term for an oscillator that can be turned on in an orderly fashion; that is, the first cycle after the start command has the same period as all the following cycles. A simple oscillator of this type is shown in Fig. 4. It produces a series of narrow positive-going pulses at 11 ms intervals, the first occurring 11 ms after the input goes low.

The clock output drives divider flip-flop U3, the output of which is a square wave with a period of 22 ms. *Nand* gate U4 picks out every other clock pulse and drives inverter U5 input pin 3. The signal at U4 pin 4 is the string of positive going sampling pulses. The first of these pulses causes JK flip-flop U3 output pin 6, which has been high until now, to go low. As long as the K input, pin 3, of this flip-flop remains low the following sample pulses will have no effect on its output. The low output at pin 6 goes to *nor* gate input U4 pin 2, causing the timing cycle to continue regardless of the signal at the input. Note, however, that this happens only after 11 ms of continuous spacing signal. This means that a spacing condition must exist at the input for at least 11 ms to initiate a timing cycle. This provides protection against noise on the signal line.

The first sample pulse also loads the start element into output flip-flop U1 pin 5 and causes the counter outputs, U1 pin 9, U2 pin 5, and U2 pin 9 to step from all (lll), the reset condition, to (Hll). The second sample pulse loads the first signal element into the output flip-flop and steps the counter to LHL. This process continues for pulses three through six. At this time the last signal element has been loaded into the output flip-flop and the counter outputs are LHH. This makes both U4 pin 9 and U4 pin 10 high, so U4 pin 8 and U5 pin 9 go low. Inverter output U5 pin 8 JK flip-flop U3's K input, pin 3, go high. The next sample pulse, which loads the stop element into the output flip-flop, also causes JK flip-flop output U3 pin 6 to go high. This, together with the condition on the signal line, causes *nor* output U4 pin 3 to go low, stopping the clock, resetting the counter to LLL, and forcing the output flip-flop to remain in the mark condition until the next start element initiates a new timing cycle. Just add some simple level converters to make your TU, printer, keyboard, and keyer DTL compatible and you're all set to clean up distorted received

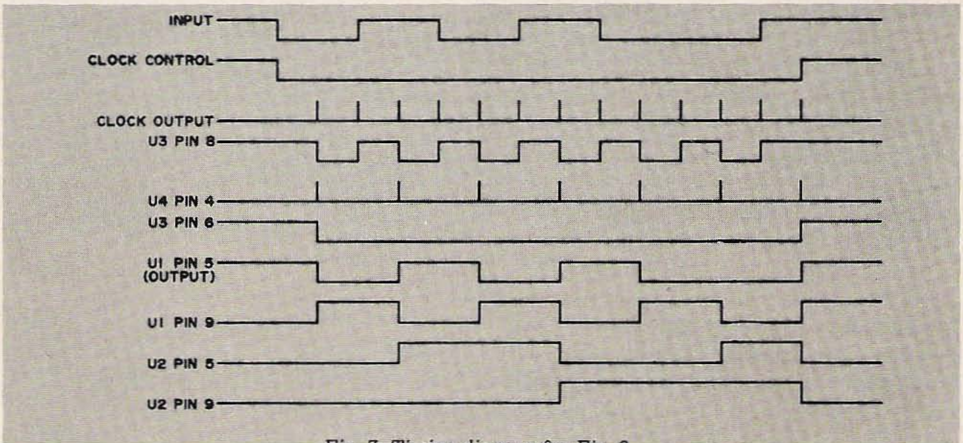


Fig. 3. Timing diagram for Fig. 2.

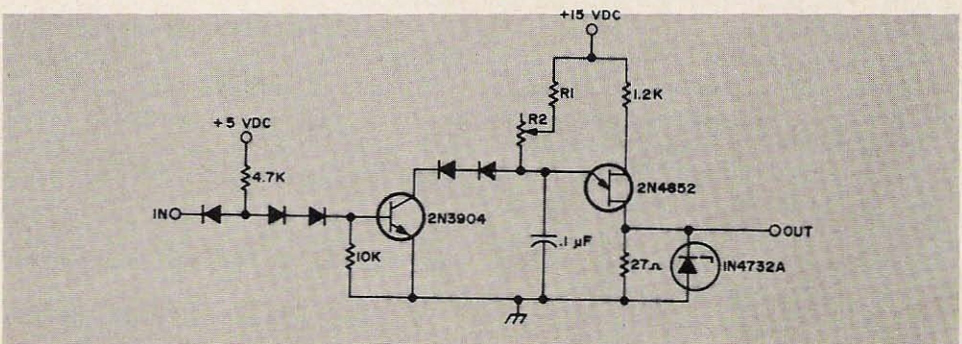


Fig. 4. Synchronous clock.

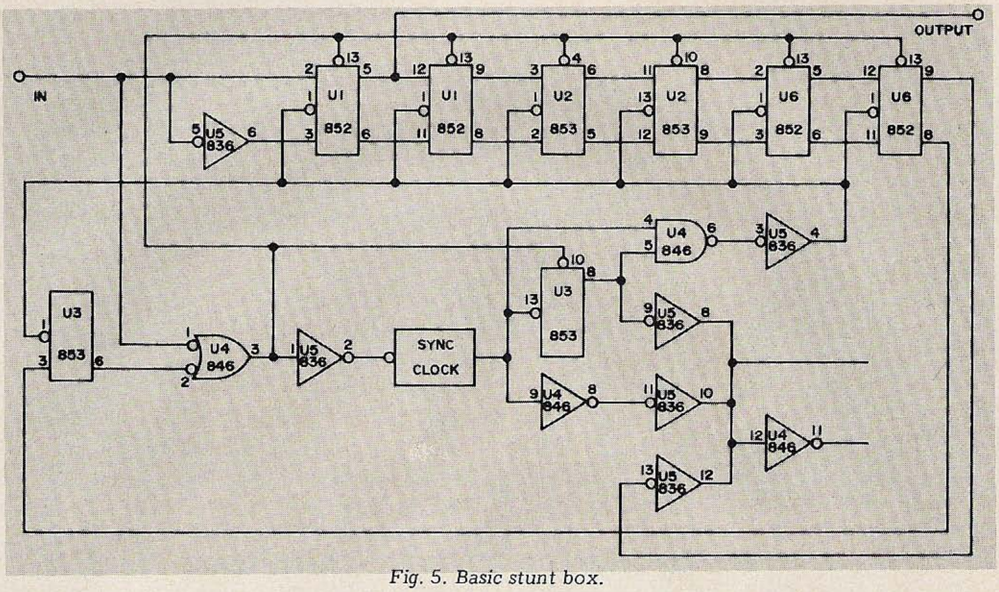


Fig. 5. Basic stunt box.

signals and to transmit perfectly clean signals from your aging keyboard!

The Stunt Box

The stunt box is a relatively simple expansion of the repeater, requiring only a few more parts and the rerouting of a few wires. Comparing the stunt box (Fig. 5) and the repeater, (Fig. 2), we find three differences: First, the output flip-flop is now the first stage of a six-stage shift register; when the first signal element is loaded into U1 pin 5 the start element moves to U1 pin 9, and so on until after the sixth sample, when the start element is present at U6 pin 9 and the five signal elements are stored in the first five stages of the register.

Second, instead of counting out seven sample pulses with a counter, we now wait for the start element to move into the last stage of the register, causing U6 pin 8 and U3 pin 8 to go high. Now, as before, the seventh pulse samples the stop element and resets the whole works.

Third, 11 ms after the sixth pulse we find that U5 pin 9, U5 pin 11, and U5 pin 13 are all low, allowing U5 pin 8, 10, and 12, and U4 pin 12 to go high and forcing U4 pin 11 low. Thus, we get both a positive and a negative strobe pulse which occur once each character, and at a time when the entire character code is stored in the register. This is all the information we need to decode a character.

A simple stunt box decoder is shown in Fig. 6. This decoder is set up to respond to the two character sequence ZB. When the positive strobe pulse occurs the two flip-flops sample the *nand* gate outputs U7 pin 6 and U7 pin 8. If the character in the register is anything other than a Z, U7 pin 6 will be high when strobed and U8 pin 6 will remain low. A Z forces U7 pin 6 low and U8 pin 6 goes high after the strobe pulse. If the next character is anything other than a B, U7 pin 8 and U7 pin 6 will be high at the time of the strobe pulse and U8 pin 8 will remain low. If, however, the character after the Z is a B, U7 pin 8 will go low and U8 pin 8 will go high and remain high until the next character is received. Using this decoder as a starting point, much more complex decoders can be built to respond to any number of character sequences of any length and used to set and reset latches to turn your printer, tape unit, or coffee pot on and off on command.

The Speed Converter

Now that we have taken a 60 wpm TTY signal and shifted it into a register where we have it temporarily stored, all that

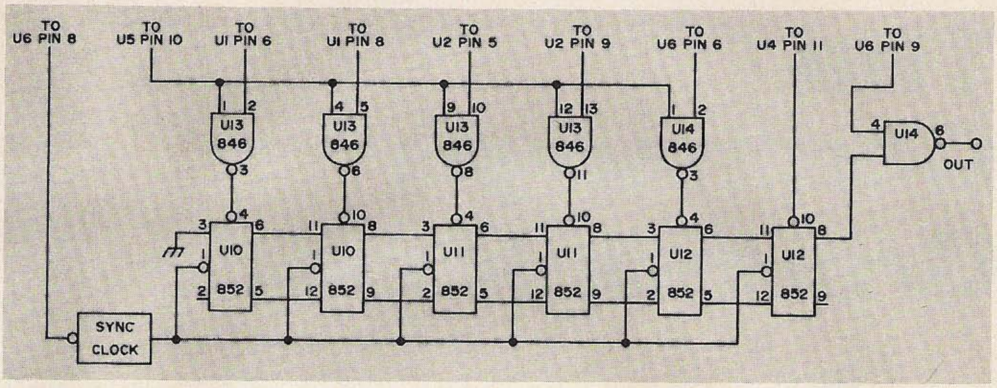


Fig. 6. Simple stunt box decoder.

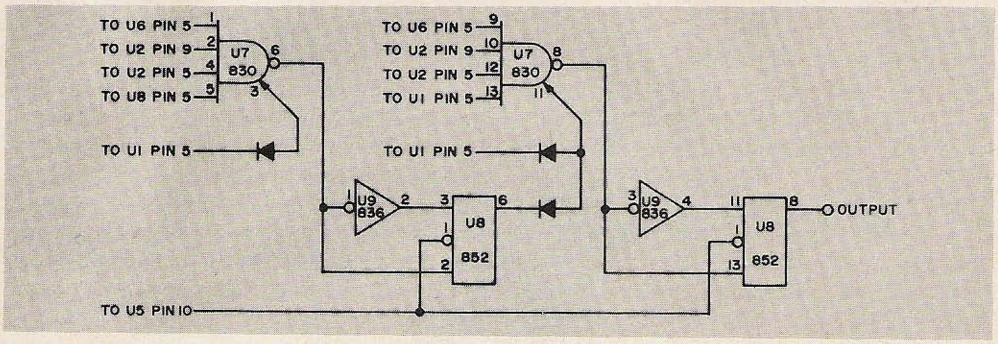


Fig. 7. Speed converter adapter for stunt box.

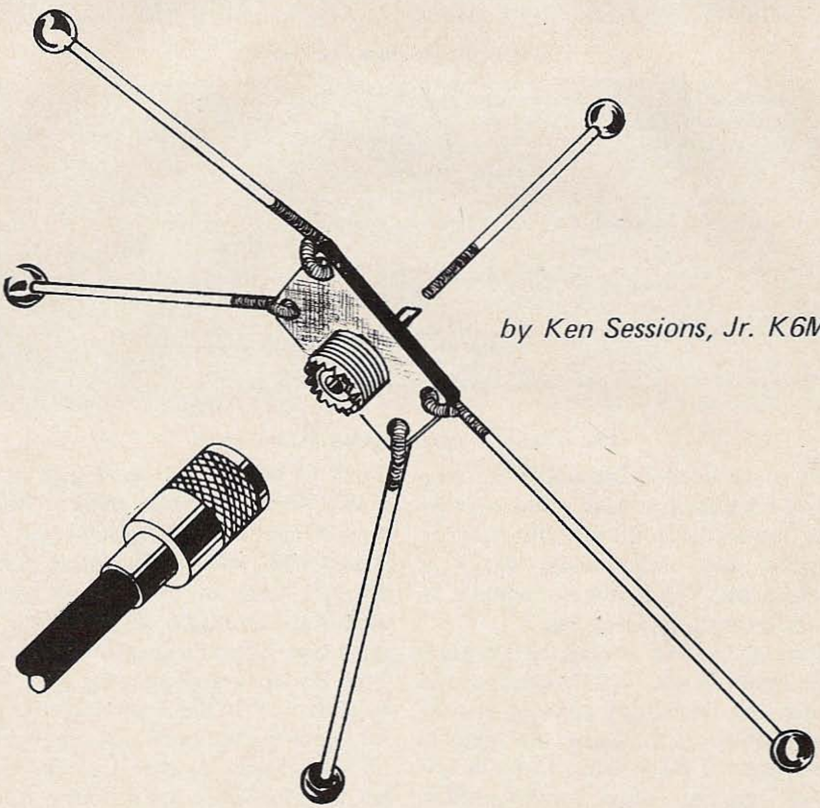
remains to be done to make it print on a 100 wpm machine is to load it into another resister, in parallel form, and shift it out to the printer with shift pulses that occur every 13.5 ms. The hardware required to accomplish this is shown in Fig. 7.

Before a character is received U6 pin 8 and the input to the 74.2 Hz synchronous clock are low, the clock is running, and the register is shifting. But since the input to the first stage of the resister, U10 pin 3, is held low and the output to the printer, U14 pin 6, remains high, or marking. When the start element of a character shifts into the last stage of the first register U6 pin 8 goes high and the 74.2 Hz clock stops. When the strobe pulse occurs, 11 ms later, U5 pin 10 goes high, loading the five signal elements into the first five stages of the second register. At the same time U4 pin 11 goes low, forcing a space, or start element, into the last stage of the second register. The output to the printer remains in the marking condition, however, since U6 pin 9 is holding U14 pin 4 and the input to the output *nand* gate at a low level. When the stop element has been sampled and the first register resets, U6 pin 9 goes high, allowing the start element in the last stage of the second register to appear at the output to the printer. At the same time U6 pin 8 goes low, restarting the 74.2 Hz clock and allowing the character to shift out of the register to the printer. As the character shifts out the register fills up with marks so that 13.5 ms after the last signal element is sent to the printer the output goes to a marking condition and stays there until the next character arrives.

To convert the 100 wpm output of the keyboard to a 60 wpm input for your keyer it is only necessary to reverse the input and output leads of the converter and switch the clock frequencies from 91 Hz and 74.2 Hz to 148.4 Hz and 45.5 Hz. Of course, the keyboard may only be operated at typing speeds up to 60 wpm, but that shouldn't cramp the typing style of too many of us!

. . .K5ZBA■

The Coathanger Groundplane



by Ken Sessions, Jr. K6MVH

For UHF and VHF applications in particular, the groundplane is perhaps the most utilitarián of all antenna types. It is simple to build and offers effective performance for both receiving and transmitting. The most economical of the groundplanes is the "coathanger" type, where the elements are cut from wire coathangers or some other stiff conductor (such as 10 AWG type TW copper wire). With a little imagination on the part of the builder, the coathanger groundplane can be made into a very professional-looking antenna.

To build up a quickie 2 meter groundplane, you'll need five coathangers, five toy plastic beads, a chassis-mounting UHF connector, and some silicone grease.

The first step is cutting. Refer to the cutting chart to determine the lengths of the radials and the radiator, then straighten the wires and cut accordingly.

When the elements have all been cut to length, sand the protective coating from the coathanger wires for ¾ in. at one end of each piece. Most coathangers are coated with a heavy varnish-like compound to retard rust and corrosion. The sanding operation removes this coating and prepares the wire to accept solder.

The beads will be affixed to the unsanded ends of the elements. The beads offer an added measure of safety and give a professional appearance to the antenna. To attach the beads, heat the unsanded end of a wire on the kitchen stove for a few seconds; then, while the conductor is still very hot, press the bead down firmly over the wire end. The heat melts the plastic of the bead so that the stiff wire bores its own hole. Now, as the wire and bead cool, the plastic bead hardens and becomes securely attached to the end of the element.

The four screw holes in the chassis UHF connector will be the "solder lugs" for the radials. Using a pair of long-nose pliers, bend a "U" in the sanded end of each of the four longer pieces. (The shorter piece is the upright radiator, and requires no bend.) Allow no more than ½ in. for each bend, and be sure to keep each piece the same length.

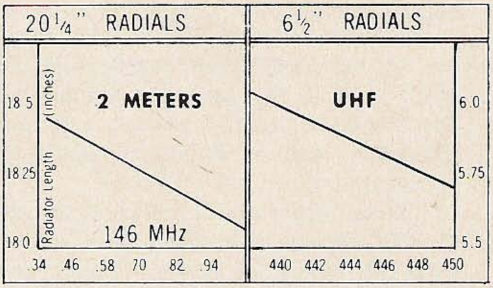
Hook each bend into the UHF connector as shown in the sketch on the preceding page, then compress the joints with pliers. Try to keep each radial positioned so that it maintains a 90-degree interval from adjacent elements.

Before soldering, adjust the positions of the radials precisely so that a symmetrical cross is formed by looking directly down onto the antenna from the top. Then solder all connections with a heavy iron or gun. The chassis connector requires a considerable amount of heat to keep the solder flowing, and insufficient heat will mean cold solder joints.

When the radials have been soldered, insert the shorter upright piece into the "center conductor" soldering point of the chassis connector. Twirl the radiator in the tube as you solder to make sure it is tinned completely, but don't allow excess solder to build up to the point where it exudes onto the dielectric. The characteristic impedance of the connector is determined by the dielectric material as well as the radial distance from the center conductor to the shield. If this distance is shortened in any way – as from a blob of solder – the characteristic impedance will be lowered and a mismatch will result.

When the joints have cooled, carefully bend the radials downward about 30° from the horizontal. This will lower the radiation angle of the antenna and will result in a better match for a 50Ω input impedance. Spread a generous amount of silicone grease over all connections to prevent corrosion and minimize the chance for water entry.

That's all there is to it; the antenna is ready to use. And in appearance, it's "just like downtown."



If you're thinking of building up this antenna to use in conjunction with a repeater or remote installation, there's one other trick of interest: Mount the thing upside down! Of course, this type of an installation would not be beneficial at all in run-of-the-mill applications, but it could mean the difference between "hearing" and "hearing nothing" on a mountaintop.

The groundplane characteristically has a very high angle of radiation. This problem is not too evident when the antenna is put into service in the lowlands; but when it is part of a mountaintop station, a high angle of radiation gets less and less tolerable. By mounting the groundplane so that the vertical radiator is suspended, the angle of radiation can be put to work *for* you. Try it! It really works!

. . . K6MVH ■

STUDY GUIDE GENERAL CLASS LICENSE

Part VII Power and How to Get It

To operate any radio equipment, whether transmitting or receiving, you've got to have power – and it has to be just the right kind. While receivers can get by with a mere thimbleful of energy, transmitters have healthy appetites. The more potent the signal output, the heftier the rig's gulps of power.

So every different kind of equipment has its own power requirements, and the result is that the art of providing the proper power structure to keep a station simmering isn't as simple as might be expected.

Like all other aspects of radio theory, the FCC expects its licensees to be familiar with the theory of power supplies, and devotes a number of questions in the General examination to that subject. This time around in our study course, we're going to take a look at them. The specific questions are numbers 2, 10, 12, 18, 26, 28, and 34 on the official study list:

2. Of what use is a bleeder resistor in amateur equipment?

10. What is meant by the ripple frequency of an ac power supply voltage?

12. How does a zener diode operate and of what use is it in amateur equipment?

18. How do electrolytic capacitors operate and why are they widely used in power supply circuitry?

26. Why is a centertap return connection employed on the secondary of a transmitting tube's filament transformer?

28. Describe ways of equalizing the reverse voltage drops across series connected silicon diodes.

34. How does an ac power supply produce a dc voltage? Distinguish between a choke-input and a capacitor-input filter and compare their operating characteristics. What is dynamic regulation and how can it be improved? How do the output voltages of a full-wave centertapped and a full-wave bridge rectifier compare?

Following our usual practice, we'll recast these questions into more general ones which will, we hope, cover the subject more completely.

For openers, we'll try to learn "How is ac converted to dc?". We can then address ourselves to the question, "How is our new dc made usable?" and find out how filters operate. Next, we will ask "How is power supply performance rated?" to gain some definitions of necessary terms. Finally, we'll see "How can power supply performance be improved?" and look into methods of regulating voltage and current.

How is AC Converted to DC? Most electronic equipment operates from direct current. FCC rules require "pure dc" for the plate supply of any transmitter operating below the VHF region, and good operating practice requires it up into the microwaves. Yet dc of the proper voltage and power level doesn't come out of the wall outlet on demand. We must have circuits which take the ordinary ac available in any home, and convert it to the required dc. Such circuits are known as "power supplies," and they're the subject of our discussions in this installment.

In general, any power supply is composed of three distinct functions as shown in the block diagram of Fig. 1. These are (1) the voltage-determining portion, (2) the rectification portion, and (3) the filter. Operation of each depends upon the characteristics of the other two, yet many choices are possible for each block of the circuit.

The voltage-determining portion usually consists of one or more transformers which step the household ac from its 115 or 230V value up or down as required. For most power supplies, a step up is necessary, although filament supplies normally involve a step down.

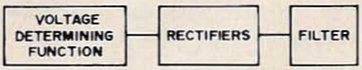


Fig. 1. Any power supply must include these three functions. Voltage is usually determined by transformer, which may step input ac either up or down. Vacuum tubes require step up, usually, while transistors require step down. Rectifiers change ac output of voltage-determining function into pulsating dc, and filter smooths out the ripple in the rectifier output to produce "pure dc."

The amount of step-up required depends both upon the desired output voltage and the rectifier arrangement, as well as upon the type of filter employed. The transformer itself, however, is essentially the same as those employed for impedance matching and examined in our previous installment, except that power transformers need operate at only one frequency and so are somewhat simpler to design.

The stepped-up ac goes from the voltage-determining block to the rectifiers, and there's where wide choice comes into play. At least three different rectifier arrangements are in common use with single-phase power supplies; all three are shown in Fig. 2.

The half-wave rectifier is the simplest of the three, but is also the least efficient since it throws away half the ac cycle. This circuit is seldom used for circuits which are intended to deliver any appreciable amount of power, although it finds frequent application in bias supplies and other low-current uses.

The centertapped full-wave rectifier is probably the most commonly used circuit. While it requires a centertapped transformer capable of supplying twice the voltage desired at the output, it makes full use of the input ac cycle and places no severe demands upon any circuit components. When virtually all rectification was accomplished by vacuum tubes or mercury-vapor bottles, this circuit was almost universal.

The full-wave bridge rectifier, like the

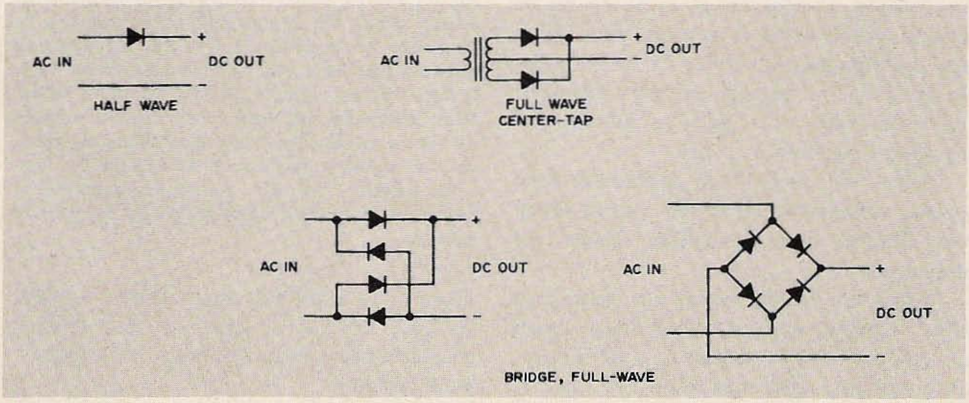


Fig. 2. These three circuits represent the only rectifier hookups in common use. Half-wave circuit is used only in ac/dc receivers and extremely lightweight gear. Full-wave centertap circuit is functionally just two half-wave circuits back to back, with transformer providing two-phase ac. Bridge circuit uses four diodes, but steers ac input through to output without need of transformer while retaining full-wave advantages.

centertapped circuit, makes full use of the input ac cycle, but with some rather significant differences. The centertapped circuit is, essentially, just a pair of half-wave circuits of opposite phase operating in parallel. The bridge, however, is a completely different kind of circuit, in that its diodes "steer" the incoming ac in the proper direction so that it always comes out at the same output terminal regardless of the input terminal it entered.

Because of this steering effect, the bridge does not require a double-voltage transformer. If used with the same transformer as a centertap full-wave circuit, the bridge will produce twice the output voltage – and this arrangement is often used to produce a 100W power supply operating from ordinary TV-replacement power transformers.

The bridge circuit does, however, place additional requirements upon some of its diodes, which limit its attractiveness if tube-type diodes are to be used. Full output voltage appears between cathodes and filaments of the "off" diodes; most tube-type diodes are not rated for this stress. With solid-state rectifiers, though, the bridge is not limited by this difficulty – and since the advent of silicon rectifiers, the bridge circuit has gained wide popularity.

All three of these rectifier circuits involve diodes, which are electronic one-way valves. Diodes come in three major flavors, with subflavors in some cases. They may be high-vacuum tubes, of either high, medium, or low impedance; mercury-vapor tubes; or solid state, such as silicon, germanium, or selenium stacks.

Tubes are used when extremely high reverse voltages are involved, but in many new designs only solid-state diodes are employed.

Tubes are usually rated for maximum direct current per plate, maximum peak current per plate, maximum peak inverse plate voltage, and maximum rms supply voltage per plate.

Solid-state diodes may be rated for peak inverse voltage (PIV), rms supply or input voltage, average forward current, peak one-cycle surge current, peak forward current, forward voltage drop, and thermal resistance. Of all these, the most important are those which correspond to the tube ratings: PIV, average forward current, and peak one-cycle surge current.

PIV is the maximum voltage which can be applied "in reverse" to the diode before it breaks down and permits current flow "against the stream"; when exceeded instant destruction of the diode usually results. If the diode is connected to a capacitor, diode PIV should be at least twice the peak value of applied ac voltage; otherwise, PIV should be at least equal the peak of the applied ac.

Two or more diodes can be connected in series to increase their PIV ratings, provided that equalizing resistors are connected in parallel with each as shown in Fig. 3. These resistors assure that each diode gets only its share of the applied voltage; otherwise, most of the voltage would appear across the diode with highest back resistance.

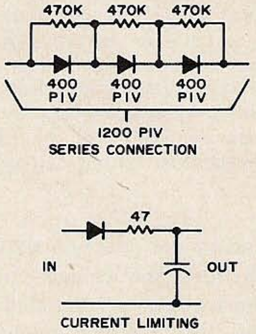


Fig. 3. Semiconductor diodes require their own special tricks. To extend PIV of diodes, two or more can be connected in series, but resistors must be paralleled with each to assure that back voltage divides equally among all units rather than piling up on unit with highest reverse resistance. When capacitor-input filters are used, current through diode must be limited by low-value resistor, to stay within one-cycle surge ratings of 10 to 50A. Value of 47Ω at 1W usually suffices.

Average forward current is the maximum current which the diode can pass without overheating, on a steady basis.

Peak one-cycle surge current, usually at least 10 times greater than average current, is the maximum current which can be tolerated on a "one-time" basis without destruction of the unit. Surges occur each time the power supply is turned on, as the filter capacitors charge, and if this rating is ignored with semiconductors, diodes will behave like expensive (and rapid) fuses every time.

While surge current limitations appear more often in connection with solid-state diodes, they apply to all rectifiers. However, tube-type diodes normally have such high internal resistance that they automatically limit themselves to surge currents too small to cause damage. Solid-state diodes, on the other hand, have much less internal resistance and at the same time are much more prone to damage by surges. For this reason a current-limiting resistor capable of holding maximum current within the "surge" rating even in case of a dead short should always be included in series with solid-state diodes as shown in Fig. 3.

Regardless of the type of rectifier used, the output of the rectification part of the power supply is dc rather than ac. This dc is, however, not yet usable because it is "pulsating" rather than "pure." The waveform of the dc at this stage, were it to be fed into a resistive load, would look like Fig. 4 which shows both half-wave and full-wave rectifier-output waveforms. The continual change in level of this power makes it unusable for our purposes; that's why our power supply contains the final block, the filter.

How is Our New DC Made Usable? When our dc emerges from the rectifier circuit, it's pulsating as shown in Fig. 4,

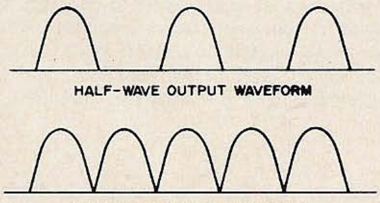


Fig. 4. These waveforms are produced by the rectifier circuits shown in Fig. 2. Half-wave circuit "wastes" half the input ac cycle; full-wave circuit makes use of both halves to produce higher output voltage, and also produces double the ripple frequency which makes filtering easier.

and cannot be used. The filter circuit evens out the voltage and current waveforms, turning it into "pure" dc required by FCC regulations.

Filters are composed of capacitors and inductors, with the capacitors being connected in parallel with the output of the power suply, and the inductors in series. This arrangement makes possible two different layouts for the filter's input circuit, as shown in Fig. 5. Either the series

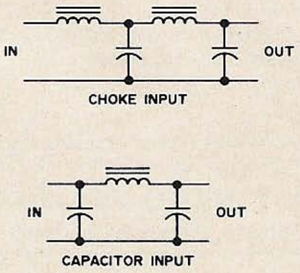


Fig. 5. These schematics show the two types of filter circuits most often encountered in ham equipment. Choke-input filter produces better regulation but lower output voltage; capacitor-input filter is harder on diodes and transformer but produces higher output voltage. Capacitor input is widely used at low power levels but choke input is almost exclusively employed at high power.

inductor can be the first component encountered at the input or the parallel capacitor can be first. If the inductor appears first, the circuit is known as a "choke-input" filter, while if the capacitor appears first, the filter is called a "capacitor-input" type.

Choke-input and capacitor-input filters have very different characteristics, caused by the differences between inductors and capacitors. Compared to a choke-input filter, a capacitor-input filter will produce a higher output voltage at light current drains, but with poorer voltage regulation since at heavy current loads, output voltage for both types is similar. The capacitor-input filter requires higher voltage ratings for the rectifier diodes, and imposes a heavier current load on the transformer.

Because of these differences, capacitor-input filters are most often used for receivers and test equipment, where current loads are not likely to vary widely. Transmitters, on the other hand, use choke-input filter circuits more frequently.

The differences between the choke-input filter actions and the actions of the capacitor-input filter are best understood by looking at the waveforms which show what happens inside the power suply during a single cycle of ac input. The waveforms for a capacitor-input filter are shown in Fig. 6. Full-wave rectification is assumed; half-wave rectification merely emphasizes the differences.

Waveform A in Fig. 6 merely shows what the full-wave ac would look like across a resistor, in the absence of any filter.

When the filter capacitor is connected, with a moderate load current being drawn,

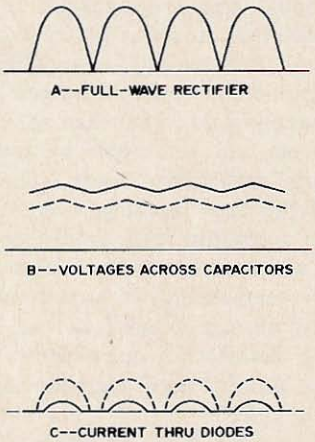


Fig. 6. Waveforms encountered in capacitor-input filter with both light (solid) and heavy (dotted) load currents. Note how both voltage and current waveforms vary as load current is changed. With zero load current and perfect capacitors, output voltage would be pure dc equal to peak voltage of rectified signal; with actual capacitors and light load current, output is slightly less than peak.

the voltage across the capacitor follows waveform B; from point B1 to B2 the capacitor is charging, and from B2 to B3 it is discharging. Current through the diodes, however, flows only during the time from B1 to B2 because the transformer voltage is less than the capacitor voltage for the remainder of the cycle, so the rectifier current waveform follows that shown as C.

With very little current being drawn, the discharge portion of the capacitor-voltage waveform (that from B2 to B3) becomes almost horizontal, and the entire waveform shown at B rises toward the peak of the rectified waveform. Waveform C then becomes smaller and smaller, until it disappears at the limit of zero load current, with output voltage becoming equal to ac peak input voltage.

Under heavy current load, the discharge curve (B2 to B3) steepens, pulling the entire waveform toward the "zero" line and increasing the amplitude and duration of the pulses in waveform C. These current pulses eventually become so large as to limit the performance of the power supply.

The ac component remaining in wave-

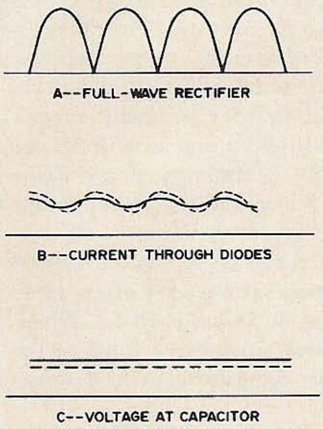


Fig. 7. Waveforms found in choke-input filter are very different from those of capacitor-input circuit. Input choke maintains current through diodes essentially constant, so capacitor voltage does not vary widely between light (solid) and heavy (dashed) load conditions. With half-wave rectifier, output voltage would be only half as great as with full-wave; this difference does not show up nearly so much with capacitor-input filters.

form B is known as the "ripple" frequency of the power supply, and is determined by the timing between voltage peaks in waveform A. In a half-wave circuit, the ripple frequency is the same as the frequency of the input ac, while in a full-wave circuit, the ripple frequency is twice that of the ac input. Amplitude of the ripple is determined by the peak-to-peak excursions of waveform B, and so depends upon the current being drawn from a capacitor-input filter – the less the current drain, the lower the ripple amplitude!

In the capacitor-input filter, then, we have seen that current is drawn through the rectifier citcuit only when the transformer voltage exceeds the capacitor voltage, and as a result flows in pulses.

The choke-input filter's waveforms are shown in Fig. 7. Again, waveform A merely repeats the full-wave ac waveform in the absence of any filter.

Since the inductance of the choke acts to oppose any change in current flow through the choke, it will tend to keep current flow out of the rectifier circuit steady, as shown in waveform B. This in turn provides a steady flow of current into the rest of the filter circuit, which produces a steady level of voltage across the output, as shown at waveform C.

Waveforms B and C are obtainable only with "perfect" chokes, and in practice, some ripple will be present just as in the capacitor input filter waveforms. This ripple is due to changes in the inductance of the choke as current flow through it changes.

Whether the choke or the capacitor appears first, the combination of a choke in series and a capacitor in parallel is called a "filter section" and most practical power supplies use at least two sections of filtering in order to reduce ripple to the desired low values. Occasionally, in receivers, the choke will be omitted from the second section, to produce a "pi-section" filter composed of two capacitors separated by a choke.

In addition to the chokes and capacitors, every power supply should include a bleeder resistor across its output.

One of the most important purposes so far as the individual user of the equipment is concerned is safety; the bleeder provides a path for eventual discharge of the filter capacitors, so that they cannot retain their possibly lethal charge for indefinite times. This, though important for safety, is not the primary reason for including the bleeder resistor, however – mere danger does not justify the expense of the components, nor the power required by their presence.

The electrical purpose of the bleeder resistor is to establish a minimum load upon the power supply, which will maintain current flow through the filter circuit at or above a certain critical level. This is necessary because the inductance of the chokes in the filter varies with the current through them; by maintaining a minimum current at all times, smaller values of inductance may be used.

Whether the filter uses choke or capacitor input, both the inductance and capacitance values required are very large in comparison to those required for radio-frequency circuits. Inductance values are usually measured in henrys rather than millihenrys or microhenrys, and capacitors are in the range from 2 to 200 microfarads. These large reactive elements are necessary both because the ripple frequency to be filtered out is low (120 Hz is the highest ripple frequency normally encountered in power supplies operating from commercial ac power), and the energy drain is high, which forces the circuit to operate at a low impedance level.

To achieve the high inductance values, "swinging" chokes are often used, particularly in choke-input filters. When a swinging choke is used, the value of the bleeder resistor becomes a critical item in filter design.

A swinging choke differs from an ordinary inductor in that it has a smaller-than-normal air gap in its core. This smaller air gap permits the choke's inductance to fluctuate as current through its winding varies; with low current, inductance is high, and as current increases, inductance drops. Typical swinging chokes vary over a 10-to-1 inductance range through their rated current range. Only enough copper and iron are necessary to provide the minimum inductance, in this design, which gets by because high inductance is necessary only at low current levels.

No such trick is available to help cut the cost of capacitors – but fortunately a special type of capacitor exists, which finds wide use in power supply circuits. Like all capacitors, it consists of two conductors separated by an insulating dielectric, but in this case the dielectric is a film of metal oxide formed chemically on the surface of one of the conductors, while the other conductor is the chemical solution which forms the oxide layer. Such a unit is called an electrolytic capacitor.

An electrolytic capacitor provides more capacitance in a given space and at a lower cost per microfarad than any other type, but it has several disadvantages which partially cancel this advantage. Since the capacitor is literally formed by the action of direct current upon a chemical solution, it can be used only on dc; any ac in the circuit must be kept small in relation to the dc present, or the capacitor will be shorted out. All electrolytics depend upon internal moisture for their action, even though they may be called "dry." The "dry" means merely that all the moisture stays inside, in contrast to early designs called "wet" which had grave tendencies to drip electrolyte all over everything.

In addition, the highest voltage rating seldom exceeds 500V peak, and any voltage in excess of this can cause instant punch-through. The resulting arc does two things immediately; it dries out the capacitor and vaporizes the chemical. A few milliseconds later, the former capacitor is a mess of sticky goo all over the interior of a once-clean chassis.

Unlike other capacitors, electrolytics have rather high leakage current ratings. This may be as much as 1 mA for every 4 mF of capacitance, but varies widely with temperature, age of the individual capacitor, operating voltage, and many other factors. The need to maintain polarization and the high leakage are the two factors which restrict electrolytics' main applications to power supply filters.

Electrolytics are manufactured in an assortment of voltage ratings from 3V up to 525V (working ratings, with surge voltages of up to 10% higher permissible), and in capacitances from 1,000,000 microfarads (yes, that's one full farad) down to as small as 2 mF. In general, the high capacitance values are obtainable only at low voltage, and vice versa. Typical units found in most power supplies range from 8 to 50 mF, at 350 to 450V. For low-voltage supplies, typical values might be 1000 mF at 15V.

When voltage is first applied to an electrolytic capacitor, leakage current is very high. The current "forms" the dielectric film, however, and leakage drops rapidly. This ability to form a new dielectric gives this capacitor a "self-healing" characteristic in case of momentary overvoltage, provided that the overvoltage doesn't start an arc which prevents the healing action.

Electrolytics are manufactured by wrapping an aluminum foil sheet and an electrolyte-soaked cathode material together, and applying dc with carefully limited current until the dielectric film is formed. The film tends to dissolve when the capacitor is idle, but usually re-forms when power is applied unless the power surge is too great and causes overheating. For this reason, it's advisable to keep power supplies in operation intermittently when equipment is to be shut down for extended periods of time, or alternatively to carefully re-form the filter capacitors before applying full voltage again.

How is Power-Supply Performance Rated? Performance of a power supply, like that of any other item of electronic equipment, can be measured only by comparison to known standards. The process of making such comparisons amounts to "rating" the performance of the supply.

Some of the obvious factors involved in such a rating are the output voltage and output current available from the supply, as well as the input voltage and current required. Not so obvious, however, are some nevertheless important factors, such as "regulation" and "ripple content" of the supply's output.

Let's start this discussion by defining our terms. Then we'll be in a position to find out how to fit values into the phrases, or interpret them should we encounter a statement such as, "This circuit offers a high degree of regulation but cannot tolerate input voltage variations."

One of the major terms,– and unfortunately, one with many contradictory meanings – is "regulation." All of its meanings deal with *changes* of output voltage from a given power supply, but that's about all they have in common. A highly regulated supply maintains fairly constant output voltage, and a supply with poor regulation has an output voltage which can be expected to vary widely – but just what makes the output vary isn't too clearly defined.

One of the meanings often attached to "regulation" is a measure of the change in output voltage as the input ac voltage is varied. For instance, if a supply is designed to operate with 115V ac input and produces 2

One of the meanings often attached to "regulation" is a measure of the change in output voltage as the input ac voltage is varied. For instance, if a supply is designed to operate with 115V ac input and pro-duces 250V dc output under its design conditions, and still produces approximately 250V dc, even when input voltage goes down to 100 or climbs to 130, that supply has good regulation in this sense.

A more commonly intended meaning for "regulation" deals with changes in output voltage as output current is varied, with input voltage held costant. Our well-regulated (for input variations) supply of the previous paragraph might produce its 250V dc output at a load current of 100 mA, yet drop to 200V at a current of 200 mA and climb to 300V dc if current drain is reduced to 50 mA. In this case, its regulation (in this sense) would be rather poor.

That's what we meant by "contradictory meanings," since we've given an example of a well-regulated supply (for input variations) which is poorly regulated (for load changes).

Compounding the situation is the addition of adjectives to the word "regulation," to create such phrases as "static regulation" and "dynamic regulation."

While the phrase "dynamic regulation" appears in the FCC study list as something you are expected to be able to define, we have not been able to find any mention of this phrase in the standard engineering texts and references, such as Terman's "Electronic and Radio Engineering," Eastman's "Fundamentals of Vacuum Tubes," the "Radiotron Designer's Handbook," "Electronic Designer's Handbook" by Landee, Davis, and Albrecht, or "Reference Data for Radio Engineers," all of which have extensive sections on power spply design and measurements. Neither could we find the phrase in three separate editions of the ARRL "Radio Amateur's Handbook," or two editions of the Editors and Engineers' "Radio Handbook." This makes it a bit difficult to provide a guaranteed definition of the phrase!

Some authors have attempted to separate the sometimes-contradictory meanings of "regulation" by attaching "static" to indicate changes caused by changes in input voltage, and "dynamic" to indicate changes due to variations in current drawn. The idea is that input-voltage variations are likely to occur more slowly, and to persist longer, than are current variations caused by circuit operation, thus justifying their being called "static" and using "dynamic" for the more rapidly varying current changes.

This does not, however, remove all confusion, because the idea of a "static change" is in itself a contradiction. And at least a few stubborn souls have reversed these conventions as well, using "dynamic" to mean input-voltage changes and "static" for changes of load.

Another meaning possible for "dynamic regulation" involves the reaction of the power supply to a rapidly changing load such as that produced by a class B modulator or an SSB final. Many supplies which exhibit good regulation under conventional testing go wild under such rapidly changing loads, because they are unable to keep up with the changes. In this context, *static* regulation would be that measured by imposing various loads for relatively long times while making measurements, and *dynamic* regulation would be that shown in action under loads which were continually changing – and this is *probably* the context meant by the FCC.

While we're compounding the confusion, it must be brought out that "regulation" as a general property of a power supply is one thing, confusing though it may be – but "regulation" as a factor to be measured is something else. In the U.S., engineers measure power supply regulation in percent, and the regulation percentage is defined as the ratio between the difference of unloaded and loaded voltage, and the loaded voltage, all times 100. That is, a supply which delivers 250V without load, and 225V when loaded, has a regulation percentage of (250-225)/225, times 100, or 25/225 times 100, or 11.1%.

Regulation percentage doesn't necessarily mean the same thing everywhere. In other countries, it's sometimes figured as the difference over the *no-load* voltage, which would make that same example come out to 10% rather than 11.1, and occasionally it's figured as the loaded voltage over the no-load value, or 90%!

In short, about the only thing you can be certain of when the word "regulation" is used is that changes in the output voltage of a power supply are being discussed.

Hand-in-hand with regulation, but fortunately with much more precise meaning, is the term "output impedance" as applied to a power supply. The output impedance of a power supply is defined as the no-load voltage minus full-load voltage, divided by full-load current, and is expressed in ohms. If the power supply we used as an example to show the confusion possible with "regulation percentage" achieved that performance with a 100 mA current drain at full load, its output impedance would be 250–225 or 25V divided by 0.1A, or 250Ω.

The importance of the "output impedance" is that the power supply acts to any external circuit just like a short circuit in series with a resistor of the corresponding value. If 10 mA is drawn through a 250Ω resistor, the resulting voltage drop is 2.5V. Similarly, if 10 mA is taken from our example supply, the voltage should drop 2.5V from its no-load value, or to 247.5V.

Output impedance is especially important with regard to both "static" and "dynamic" regulation in the final context we examined. In both cases, good regulation demands low output impedance – well below 100Ω in most cases.

"Ripple frequency" is a term we've already met, as is "ripple amplitude." Ripple amplitude is usually specified as a percentage of ripple, which is the ratio of the peak-to-peak value of the ripple component only compared to the average value of the dc output voltage. A more meaningful way to rate ripple is directly in terms of peak-to-peak ripple voltage and frequency. In some cases, any ripple voltage over a microvolt or so is too much; in others, as much as 25 to 30V peak-to-peak of ripple may be acceptable. It all depends on what the resulting dc is to be used for.

Usual values of ripple percentage range from 0.1 to 5%; most charts for filter design appearing in the handbooks are calculated for 5% ripple, but if two sections of filtering are used the result will be 5% of 5%, or 1/4 of 1%, ripple.

Now that we have our terms defined, we can turn our attention to the performance factors to which they refer. The major factor is, as one might expect since it is surrounded by the most confusion, "regulation." Ideally, a power supply should produce an output voltage which is constant, regardless of changes in either input voltage or load. This would be perfect regulation, or "zero" output impedance, and in general it cannot be achieved. But it *can* be attained over a surprisingly wide range of load currents, by use of some special circuitry we'll examine shortly.

Unless special regulator circuits or components are used, however, the regulation of the supply must necessarily be less than perfect. Just how much less depends upon the entire design of the supply. A choke-input filter provides better regulation over its range of operating current than does a capacitor-input one, but requires a higher-voltage transformer to achieve the same output voltage. Large filter capacitors produce better dynamic regulation than do small ones (it's difficult to get too large an output filter capacitor; 500 mF still leaves room for improvement on a 500V supply!) but may produce more loading of the transformer and rectifiers, and at any rate are more costly. A comparison of the output regulation for choke-input and capacitor-input filters appears as Fig. 8, and dynamic regulation of small and large

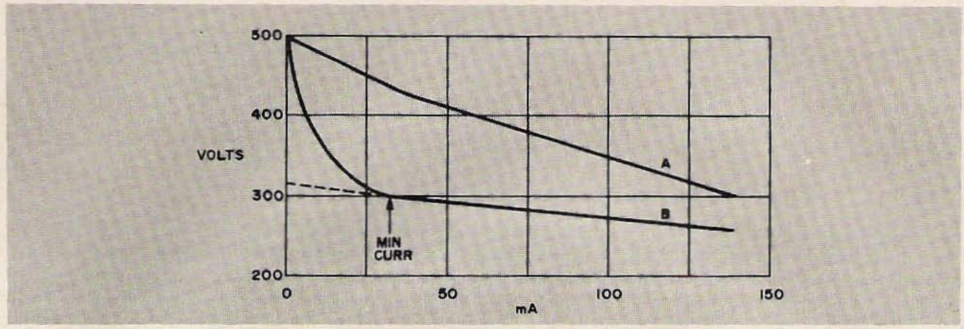


Fig. 8. This graph compares output voltage at various load currents for a typical power supply using (a) capacitor input filtering and (b) choke input filtering, with all other factors held constant. Note that minimum current drain is necessary in order to pull voltage of choke-input filter circuit down into "regulation" region, and that capacitor-input voltage is always higher than that from choke-input circuit.

output filter capacitors is illustrated by Fig. 9.

If better performance than that shown in Figs. 8 and 9 is necessary, then a fourth block must be added to Fig. 1 – a regulator circuit.

How Can Power Supply Performance Be Improved? When the utmost in performance is required from a power supply, some form of regulator circuit is usually included between the filter and the output terminals.

Regulator circuits may be as simple as a gas-tube (VR tube or neon bulb), or more complex than many communications receivers. They may regulate the output voltage, the output current, or both. They may guard against changes in output with changes in load, with changes in input voltage, or both. In general, a wide choice of regulators is available.

The simplest voltage regulator for many purposes is a simple neon bulb. The neon gas which provides the bulb's glow has an unusual characteristic of maintaining constant voltage, regardless of current (within limits, of course) through it. In most cases, this is about 55V. A resistor must be

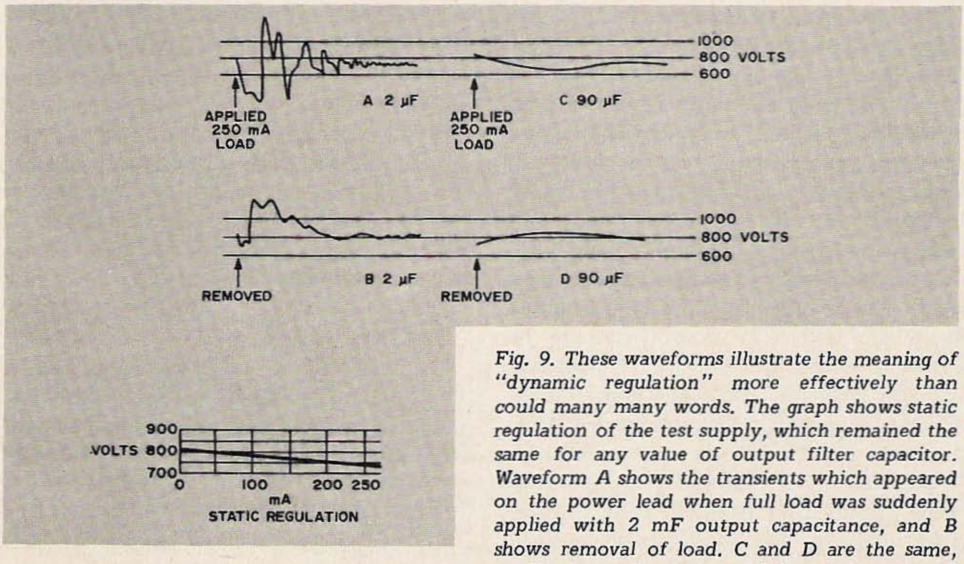


Fig. 9. These waveforms illustrate the meaning of "dynamic regulation" more effectively than could many many words. The graph shows static regulation of the test supply, which remained the same for any value of output filter capacitor. Waveform A shows the transients which appeared on the power lead when full load was suddenly applied with 2 mF output capacitance, and B shows removal of load. C and D are the same, application and removal of full load, but with 90 mF output capacitance.

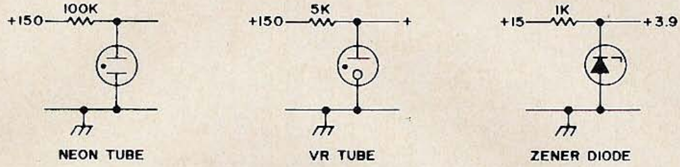


Fig. 10. Three different types of voltage references or simple regulators are shown here, drawn in such a way as to emphasize the similarity of their actions. Each of these produces a voltage which remains relatively constant over a wide range of current levels; so long as their minimum current requirements are met, the voltage is fixed by characteristics of the device. Neon tubes vary in voltage, from 50 to 70V. VR tubes come in specified sizes, as do zener diodes, but the choice is much wider with zeners.

placed in series with the bulb, to limit the current through it to the maximum for which the bulb is rated, as shown in Fig. 10. Output voltage remains constant at the bulb's "maintaining voltage" from zero current drain up to the point at which the current drain through the resistor reduces voltage below the maintaining level and the bulb goes out. So long as the bulb glows, output voltage is regulated.

The familiar VR tube is simply a variation of the same principle. A mixture of argon, neon, and xenon gas is used, and the electrodes in the tube are shaped to permit higher current operation, but the circuit remains the same. VR tubes come in ratings of 75, 90, 105, and 150V, and may be series-connected to produce additional values.

The semiconductor equivalent of the neon bulb or the VR tube is the zener diode. Any silicon diode operated beyond its PIV rating will exhibit the same constant-voltage effect, but zener diodes are especially processed to improve their performance, and to bring the PIV rating down to lower levels. Zener diodes are available to regulate voltages from 3.9 to 150V, and capable of dissipating anywhere from 0.1V to 50W or more of heat while doing so. Like VR tubes, they can be series-connected for "oddball" voltage values, and both VR tubes and zener diodes can be connected in the same series string if need be to achieve some unusual level.

Regulation of these devices is much better than that attained from a bare power supply, but is far from perfect. Output voltage across a VR tube may vary as much as 2V from the full-load to the no-load condition, which is nearly 3% variation for a 75V tube. While this is better than triple the regulation of many bare supplies, it's not good enough for many purposes.

When better performance is required, the electronic regulator becomes necessary. This circuit, in general, combines a voltage reference source, an amplifier, and a control device (series pass vacuum tube or transistor in most cases), to continually compare the output of the power supply with the reference, and to change the output in such a direction as to drive the difference between output and reference toward zero.

Fig. 11 shows the block diagram of a typical simple regulator, while Fig. 12 shows a simplified version of the schematic (omitting such things as rf chokes, parasitic-suppression resistors, bypass capaci-

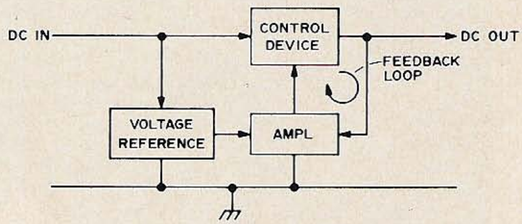


Fig. 11. This block diagram identifies the major functions within a typical electronically regulated power supply's regulator circuit. Input to this circuit is obtained from a conventional power supply. Output is controlled by a series control device, which is in turn controlled by an amplifier stage driven by the difference between the output voltage and an internal reference voltage. The result is that output voltage remains constant over a wide operating range.

tors, etc., which are required in practical regulators).

In this circuit, the voltage reference is a VR tube. Its regulation is much better when used as a reference, however, than when used directly as a regulator, because the load current on the reference remains constant. When near-perfect performance is required, special voltage-reference tubes guaranteed to maintain voltage within a fraction of a percent of rated levels are available.

The amplifier is a bit unusual in its hookup, because it must do the job of comparing output voltage with the voltage reference. In Fig. 12, it does so because the

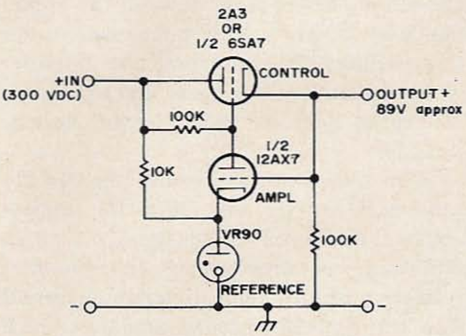


Fig. 12. Simplified schematic of regulator shown in Fig. 11. This circuit omits such items as parasitic suppressors, bypass capacitors, etc., to emphasize those parts which do the job of regulation.

output voltage is connected to the amplifier's grid and the reference voltage is connected to the cathode. This "clamps" the cathode permanently to the reference level.

So long as the output voltage is higher than the reference voltage, the grid of the amplifier is positive with respect to the cathode and the amplifier tube conducts heavy current. This causes a large voltage drop across the amplifer plate load resistor, and as we shall see shortly this in turn reduces the output voltage.

When the output voltage drops below the reference voltage, the difference between output and reference becomes the grid bias voltage for the amplifier, and plate current becomes less heavy. Output voltage rises. As output rises, the amplifier's bias decreases, which makes the amplifier draw more current and pulls down the output voltage. The output level thus stabilizes at whatever point produces an amplifier bias level capable of producing exactly the same output level. This is negative feedback in action, or what engineers call a "servomechanism."

The control device is an ordinary power tube or transistor. Fig. 12 shows a triode tube; tetrodes or pentodes require some special complications to keep the screen voltage at the right level. You can view the control tube as being a cathode follower, in which the cathode voltage "follows" the voltage applied to the grid, or you can look at it as being a variable resistance which forms the upper leg of a voltage divider, with the lower leg being composed of the load connected to the power supply.

The plate of the amplifier is connected directly to the grid of the control tube, so that whatever voltage appears at the amplifier is reproduced (except for a small offset voltage established by the tube's operating grid bias requirements) at the control-tube cathode, which is the output terminal of the circuit.

Now let's imagine that we have such a circuit, with all tubes warmed up and the VR tube glowing at a fixed voltage of +90V, but no power supplied to the amplifier and control-tube plates.

When we first apply power to the plates, the output voltage of the suply is zero, so the amplifier grid is effectively grounded. With the +90V from the reference applied to its cathode, the amplifier tube is effectively cut off and no current flows in its plate circuit. The voltage drop through the load resistor is thus zero, and full plate voltage is applied to the amplifier plate and the control-tube grid.

This full plate voltage is reproduced at the output terminal – but in order to rise from zero, where it started, to the full-voltage level, the output terminal must pass through every intermediate voltage level on its way, and as it does so this changes conditions inside the regular circuit in such a manner that the output voltage never climbs higher than the desired regulation point.

Until output voltage approaches the VR-tube voltage, nothing much happens. As soon as the difference between output voltage and reference voltage is smaller than the cutoff voltage for the amplifier tube, though, current begins to flow through the amplifier tube, and this current flow through the amplifier load resistor reduces the voltage at the amplifier plate and control-tube grid. Remember that the output voltage of the regulator can never be higher than the voltage at the control-tube grid.

As output voltage continues to rise, the difference between output and reference voltages continues to decrease, reducing the grid bias on the amplifier and thus increasing current flow through the amplifier load resistor. This increased current flow reduces the voltage at the amplifier plate and control-tube grid, and so reduces the upper limit to which output voltage can rise.

This action continues until the control-tube grid voltage and thus the output voltage is reduced to the point at which difference betweeen output and reference voltages is exactly right to maintain current flow through the amplifier at a level which will hold the control-tube grid voltage at that same point. Any additional rise in output voltage would then cause a fall in control-tube grid voltage, pulling output voltage back down, and so the action freezes.

The output voltage at which this "freeze" occurs depends upon the characteristics of the specific tubes used in the circuit, but is always a few volts lower than the reference voltage.

When a load is connected to the power supply output, the load current must flow through the resistance established by the control tube, and this increased current flow will cause output voltage to fall slightly. However, as soon as output voltage begins to fall, the difference between output and reference voltages increases, which means the the amplifier's grid bias increases and less current flows through its load resistor. This raises the voltage applied to the control-tube grid, which increases output voltage until the original level is restored. Action occurs so rapidly that the change in output level is usually not detectable – but the change *must* occur in order for the circuit to detect and correct it.

If the power supply load requires additional current, the same thing happens – whenever current drain from the output terminals tends to pull output voltage down, the control tube's grid voltage is automatically increased just enough to bring it back up again. If the current taken from the supply is reduced, the action works in reverse. Any tendency of output voltage to rise above the established "regulated level" causes the control-tube grid voltage to be reduced, pulling output level back down. The action is effective over a wide range of current. Only when the original supply is unable to deliver enough current, or the control tube is unable to pass it, can the output voltage fall.

A regulator circuit such as this normally acts to reduce ripple in the output, as well as to clamp voltage level constant regardless of variations in load current, because any ripple which gets through is also detected as a variation in output voltage, and is canceled just as is any other output-level change.

A regulator circuit of this type acts to improve both the static and the dynamic regulation of the supply, and reduces output impedance of the supply to nearly zero.

A number of changes are possible to the basic circuit, which permit a circuit designer to choose any type of action he may desire. For instance, he may retain good static regulation and low dc output impedance, while deliberately introducing poor dynamic regulation and high ac output impedance, by placing low-pass filters in the amplifier circuit so that rapid changes in output level cannot cause changes in control-tube voltages, and so cannot be canceled. The simplest such low-pass filters are bypass capacitors from grid to cathode on both amplifier and control-tube stages. However, some bypassing is necessary to prevent oscillation, and so it's not safe to assume that the presence of capacitors at these points means that the designer has chosen to degrade dynamic regulation.

Another modification which can be made permits the output impedance of the power spply to be made exactly zero, or even to be made negative. When output impedance is zero, a change in load current makes no change at all in output voltage. When output impedance is negative, output voltage actually climbs as current is drawn, and drops as current demand increases.

To achieve these effects, the designer need only include a low-value current-sensing resistor in the negative lead of the circuit, as shown in Fig. 13, and return the

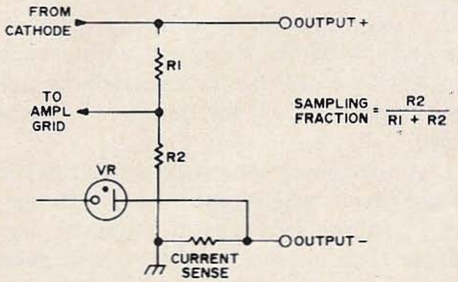


Fig. 13. Modifications to regulated power supply include voltage sensing network which permits output level to be higher than reference voltage, and series current-sensing resistor which allows output impedance to be reduced to (or even below) zero ohms.

negative end of the reference voltage source to the *load* side of this resistor while returning the voltage-sampling network to the *regulator* side.

As load current increases, the voltage across this current-sensing resistor also increases, and this change is added to the reference voltage "seen" by the amplifier. In effect, the reference voltage to which the output level is clamped is made to increase as load current increases, and the automatic clamping does the rest.

The size of the current-sensing resistor determines whether output impedance is zero or negative. The smaller the resistor's value, the less its effect. With a very low value, the effect can be made just enough to cancel the positive output impedance of the rest of the circuit, giving a net output impedance of zero. With higher values, output impedance becomes negative.

Figure 13 also introduced the "voltage-sampling network," which is simply a voltage divider connected across the output of the supply, with the amplifier grid or base connected to its midpoint. This network permits output voltage of the supply to be higher than the reference voltage, because it establishes the voltage fed to the amplifier as a fixed fraction of actual output voltage, and the regulator circuit actually clamps the voltage fed to the amplifier at the reference level.

For example, with a 90V reference source and a sampling fraction of 2/3, the regulator would hold output voltage at something less than 135V. If the bias requirements of amplifier and control stages introduced a 10V offset, so that the circuit would clamp amplifier-input-voltage level to 80V, then output would be 120V (2/3 of 120 being 80).

To change the output voltage of this supply to 200V, all that would be necessary (if unregulated input voltage were 300V or above as noted below) would be to change the ratio of the resistors in the sampling network so that the sampling fraction changes from 2/3 to 2/5. Now, when output is at 200V, 2/5 of this output, or 80V, is applied to the amplifier, and action is just the same as before.

In practice, most regulated supplies use such sampling networks, and include a potentiometer at the junction point to

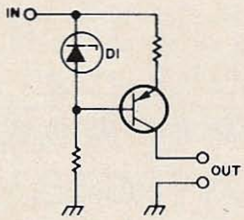


Fig. 14. Current regulator circuit uses two resistors, one zener diode, and a single transistor to regulate current to some maximum value set by design, over entire range from short-circuit to open-circuit load conditions. Naturally, design current cannot be made to flow through open circuit, but regulator assures that regulating level is never exceeded, and is achieved if input voltage is high enough to force that much current through load resistance.

permit variations of the actual output level by permitting small changes in sampling fraction. Some supplies have a wide adjustment range, while others permit only a narrow margin.

Note that a regulated supply of this sort requires an unregulated input voltage considerably higher than the desired output voltage. This additional voltage is necessary in order to provide operating voltage for the control device, and represents "wasted" power so far as the external load circuit is concerned. Current capability of the regulated supply is also limited by the control device. These two disadvantages are the major reasons why regulated power supplies are not more widely used. In ham gear, fully regulated supplies are found only in critical frequency-control circuits and low-current bias supplies, if at all.

While the term "regulated power supply" usually means a supply in which the output *voltage* is regulated, it's also possible to regulate output *current* so that it remains constant regardless of changes in load resistance. This is sometimes called "current limiting," as we did in discussing Fig. 10.

The need for current regulation occurs far less frequently than that for voltage regulation, however, and so in general use "regulation" has come to mean only "voltage regulation" unless specifically called out as applying to current.

Current regulation, when it is encountered at all, usually shows up the in voltage-reference portion of a regulated power supply, where the VR tube is supplied with constant current in order to hold its voltage more constant.

The simplest current regulator consists of a resistor, having a value from 10 to 100 times greater than the resistance of the expected load circuit, in series with a power supply which produces from 10 to 100 times the anticipated voltage requirement. Most of the voltage drops across the resistor, and current remains fairly constant.

For instance, a 300V supply connected through a 300 kΩ resistor will permit a maximum of 1 mA to flow, even if the output is shorted. With a load resistance of 30 kΩ the total series resistance is only 10% (9%, to be exact) less. If load resistance is not permitted to exceed 3 kΩ the resistance variation will be only 1%, and the current varies less than 1%. Voltage across the load rangs from 300 with no current flow down to zero with a short circuit.

For more effective regulation of current, a servo regulator such as that shown in Fig. 14 can be used. This circuit acts in much the same manner as the voltage regulator of Fig. 12, but combines the amplifier and control stages in a single transistor.

The transistor base is clamped to a voltage somewhat lower than the input voltage, by zener diode D1. Emitter voltage, however, varies with current flow through the circuit. With no current flow, the emitter resistor causes no voltage drop, the emitter is at input voltage, and since the transistor is PNP, this turns it on.

Emitter-to-collector resistance is low and high current can flow, just as output voltage could skyrocket (initially) in Fig. 12.

As current flows, however, it produces a voltage drop across the emitter resistor, reducing the difference between emitter and base voltages, and so reducing the forward bias on the transistor. Emitter-to-collector resistance increases.

When enough current is flowing to bring the emitter voltage almost down to the base level (because of the voltage drop in the emitter resistor), the high emitter-to-collector resistance at this operating point prevents additional current flow. Thus, even with the collector shorted to ground, only enough current can flow through the emitter resistor to bring emitter voltage down to base level and turn the transistor off.

For any value of load resistance from zero to infinite (short circuit to open circuit), current flow through the collector is held at the value which develops approximately the zener-diode voltage across the emitter resistor. With a 3.9V zener and 3.9 kΩ in the emitter, current regulated at 1 mA; with 390Ω at 10 mA, and so forth.

Many variations of regulator design and action are possible. It's far beyond the scope of this series to go into any greater detail now, but if your interest in the subject has been whetted you can find much additional data in either of these two books:

"Silicon Zener Diode and Rectifier Handbook," Motorola Semiconductor Products Inc., Phoenix, Ariz. ($2 when published in 1961).

"Electronic Designers' Handbook," edited by R. W. Landee, D. C. Davis, and A. P. Albrecht, McGraw Hill Book Company, Inc., New York, 1957.

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BOONTON 250A RX METER Frequency range 500khz to 250mhz, measures equivalent parallel resistance and capacitance or inductance of networks, R-range 15-100,000 ohms, C-range 0-20pf, L-range .001μh-100mh $345.00

BIRD 8890 Termaline R.F. dummy load, 2500 watt, VSWR 1.1 max, DC to 1000mhz $125.00

AN/UPA-39 Coder-Decoder, used with UPM-6 transponder test test $79.50

TS-186 FREQUENCY METER, 100 to 10,000mhz, .01% accuracy, 115V/60cy $69.00

H.P. 335B FM MONITOR, has two panel meters to show carrier deviation and percentage of modulation with lamp to indicate peak modulation $225.00

G.R. 544B Megohm bridge, combination wheatstone bridge and VTVM, range 0.1 to 1,000,000 megohms, ideal for lab $60.00

TS-155/UP Signal generator, 2400 to 3750mhz $65.00

IE-19 TEST SET in chest, complete with 100-156mhz signal generator, field strength meter, ideal for one who wants a low price VHF test set-up $18.50

UPM-6B Transponder test set with probe, FAA approved $175.00

TS-251/UP Loran test set, used to calibrate all loran navigation equipment $79.00

TS-62/AP Hi-Q resonant cavity, 9320-9420mhz, 50 ohm $14.50

IE-36 test set, used to test VHF SCR-274N equipment $17.50

TS-419/U, same as H.P. 616A or ARC H-12, 900mhz to 2100mhz $125.00

IDEAL INDUSTRIES Type 41-001 Portable insulation tester, 500-2500V, complete with prods $22.50

T-5/NF-12 Empire Devices tuning unit, 10-15kmhz $65.00

TS-226A/AP Power meter, range 405 to 425mhz, 0-1000W, 115V/60cy, ideal for ham TV use $16.50

HOUSTON INSTRUMENTS HLVC-150 servo driven voltmeter and log converter. Has 13" mirror back scale, calibrated in RMS volts and DB, AC/DC 1mv-3.16v, 100mv-316v, DB scale movable from +75 db to -75db, eliminates adding or subtracting from 0 db reference $125.00

WATERMAN S-12-C, 3" rackmount oscilloscope, ½ cycle to 50khz $37.50

NARDA 440 Microwave power meter, 0.01 to 10mw, frequency range is any for which bolometer or thermistor detectors that are available $42.50

G.R. 783A Output power meter, used for direct reading measurements of power output in audio circuits, 0.2mw to 100 watts in 5 ranges, decibel range -10 to +10db above lmw $95.00

COLLINS 478A-1 Zifor, FAA approved to check omni signal generators $185 00

ME-11B/U Termaline R.F. Wattmeter, military version of Bird 611, 60 watt dual range, 0-15/0-60 30 to 500mhz, ideal for AM and FM work $65.00

SG-299D/U Squarewave generator, a wide range 1cps to 1mhz, used with any oscilloscope to determine the frequency response and phase shift characteristics of video and audio amplifiers, amplifier gain measurements can also be made $39.50

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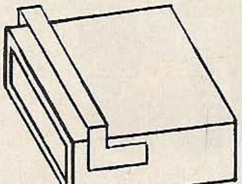

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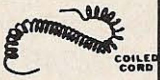

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G.E. TYPE DW-33
DIAL CALIBRATED IN 7 DIVISIONS, WHITE ON BLACK FACE. METER READS TUNE FOR MAX. MOVEMENTS 0 TO 4.2 MA. BUILT IN SOCKET FOR DIAL LITE. SIZE 2-3/8" DIA. FLUSH MTG. SHP WGT 1 LB $.90 EA

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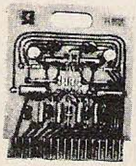

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25,000	6	2 X 4-1/2
66,000	6	2-9/16 X 4-3/4
40,000	7	2 X 5
7,750	10	1-3/8 X 4-1/2
15,000	10	2 X 4-1/2
15,500	10	2 X 4-1/2
30,000	10	3 X 3-1/2
74,000	10	3-1/16 X 5
15,000	12	2 X 4-1/2
7,000	13	1-3/8 X 4-1/2
14,000	13	2 X 4-1/2
10,000	15	2 X 4-1/2
15,000	15	2-1/2 X 4-1/2
20,000	15	2-1/2 X 4-1/2
12,500	16	2 X 4-1/2
11,500	18	2 X 4-1/2
5,500	19	1-3/8 X 4-3/8
11,000	19	2 X 4-1/2
12,000	21	2 X 4-1/8
4,000	30	1-3/8 X 4-1/2
2,500	45	1-3/8 X 4-1/2
3,500	55	2 X 4-1/2
6,000	55	2 X 4-1/2
3,100	75	2 X 4-1/2
3,500	75	2 X 4-1/2
3,750	75	2 X 4-1/2
1,500	80	2 X 4-1/2
1,000	100	1-3/8 X 4-3/8
1,500	100	2 X 4-1/2
250	150	1-3/8 X 4-1/2
1,250	180	2 X 4-1/2
500	200	2 X 4-1/2

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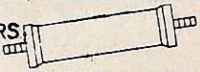

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2K48	3CX2500
2K (any digits)	3CX3000
3-400	3CX5000
3-1000	3CX10,000
3B24	3E29
3B28	3K (any digits)
4-65	4CX350A
4-125/4D21	4CX1000A/8168
4-250/5D22	4CX3000A/8169
4-400A/8438	4CX5000A/8170
4-1000A/8166	4CX5000R/8170W
4X150A	4CX10,000/8171
4CX250B/8321	4X150G/8172
4CX250R/7580W	4PR60A or B
4CX300	4PR (any digits)
5-125B/4E27A	
5R4WGB	
6BL6	75TL
6BM6 or 6A	8D21
6L6	9C21
7D21	9C25
802	
805	TW (all types)
807	TWT (all types)
810	NL (all types)
811A	4000 series
812A	5000 series
813	6000 series
832A	7000 series
833A	8000 series
891	
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VA (all types)	450TL
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ARN 14, 21, 59, 65, 67, etc.

TEST EQUIPMENT

SG1A/ARN	TS330	UPM32
SG2A	TS505D	UPM66
SG12A/ARN	TS510A	UPM98
SG13/ARN	TS621	UPM99
SG24/ARN	TS683	UPM100
MO83/ARM	TS6684	AN/URM25
SG66/ARM5	TS710	AN/URM26
SG376	TS723	AN/URM32
AN/ARM8	TS757	AN/URM43
AN/ARM9	TS823	AN/URM44
AN/ARM22	TS1100	AN/URM48
AN/ARM25	TV2	AN/URM52
AN/ARM26	TV7	AN/URM80
AN/ARM29		AN/URM81
AN/ARM31		AN/USM16
AN/ARM68		AN/USM26
AN/GPM15		AN/USM44
AN/PSM4		AN/USM81
AN/PSM6		AN/USM117

RECEIVERS: R220, R274, R278, R388, R369, R389, R390, R390A, R391, R392, R1051, R1125, 51J3, 51R, 51J4, 51S1, SP600, JX17, APR13, APR14

COMMERCIAL AIRCRAFT: 17L4, 17L6, 17L7, 51X2, 51X3, 51V, 618M, 618S, 618T, 618Z, 621A, 860E, 51R3, 51R4, 578, 479S, 479T, etc.

All Hewlitt Packard, Tektronix, Boonton, Bird, General Radio, CEC, Brown, etc.

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AN/APN	AN/FRR	AN/SRR	UPM
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AN/APS	AN/GRC*	AN/URR	URM
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AN/ARC	AN/SLR	MRC	USM
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HP-618B Signal Generator	1,000.00
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PRICE: $1.00 ea. or 6 for $5.00

TRANSFORMERS
115V-60 cy. input open frame. Sec. 24-24-24-24 @ 10 amp. ea. Can be used in parallel or series.
PRICE: $9.95 ea. . . .SHPT. WT' 24#

TRANSFORMERS
115V 60 cy. open frame. Sec. 36-0-36 V @ 15 amps.
PRICE: $9.95 or 2 for $17.00
SHPT. WT' 22#

ARC 55-IF STRIP AND AUDIO AMP. Unit NEW.
PRICE: $4.95 ea.

CONTROL HEAD C345U
CONTAINS:
- 1 water proof 4" speaker
- 1 dB Meter
- 1 Audio Amp.

In OD color alum. case (8" x 12" x 10"). NEW.
PRICE: $6.95 ea. . . .SHPT. WT. 27#

OSM-80 (SIMILAR TO TEXTRONIX 535) Excellent condition, checked out and GUARANTEED without plug in.
PRICE: $299.00

GENERAL RADIO FREQ. STANDARD 1100A & 1105A. 2 complete racks, EXCELLENT CONDITION, GUARANTEED.
PRICE: $795.00. . . .SHPT. WT. 600#

TAPE RECORD & PLAY BACK AMPLF. Include bias osc., dB Meter, standard 19" rack mount, equalization switchable 3¾, 7½, and 15 IPS.
PRICE: $24.95. . . .SHPT.WT. 50#

DIODES
1 amp. bullet type diodes with silver leads 600 piv @ 1 amp.
10 for $100 or
110 for $10.00

HP 710B POWER SUPPLY 100—360V @ 75 ma. 6.3. VCT
PRICE: $9.95

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 and minimum order is $5.00. All merchandise subject to prior sale.

SELECTRONICS

1206 S. Napa St.
Phila., Pa. 19146
Phone: 215-HO2-5511
• or 215-HO8-7891

HYCON COLOR BAR GENERATOR: Complete with tubes without crystals, unchecked $19.95

TS-186 FREQUENCY METER: 100 to 10,000 MC Accuracy ±.01%. 110VAC Power Supply.............................. $75.00

TS-173 FREQUENCY METER: 90 to 450 MC. Accuracy .005. Only $75.00

TS-174 FREQUENCY METER: 20 to 250 MC $97.50

TS-175 FREQUENCY METER: 85 to 1000 MC $75.00

LM FREQUENCY METER: without book, good condition. 125KC to 20 MC $25.00

OS-8 SCOPE: Portable, compact and light weight $49.50

TS-382 AUDIO OSCILLATOR: 20 to 2000 00 cy $75.00

SPECIAL COLLINS R390A with mech. filter, mint cond. .... $895.00 will Trade????

TS 148 Spectrum Analyzer $75.00

TS 659 Teletype Test Set for checking Teletype by sending out signals, motor driven ... $19.95

MODEL 14 REPERF with synch motor. As is cond. $14.95

TELETYPE PAPER, WITH CARBON***
Case of 12 rolls .... per case/$5.95

REPERF PAPER M-14
Case of 40 rolls............. per case/$6.95

TELETYPE RIBBONS
Box of 12 each.............. per box/$2.49

88MH COILS................. 5 for $1.50

ASR TELETYPEWRITER, COMPLETE MODEL 28 teletype $1100.00

BC 348 Receiver, Complete unchecked. .$49.50

VARIAC 0-250 V at 6 amps $24.50

LS 166 LOUDSPEAKER: A 4" square heavy duty PM loudspeaker with an 8 ohm voice coil housed in a steel case, complete with an 8 ohm to 800 ohm transformer $3.95

URA-8 Teletype: Converter, checked and working. Good cond. $97.50

AC RETRACTABLE CORD: 6 foot cord mounted on spring loaded wheel $1.00

Walkie Talkie Citizen Band: Factory Seconds. Good cond. 2 for $3.95

MUFFIN PAN: Funnel type, many uses. 110V 60 cy $3.50

WEATHER BALLOON MODULATOR: Complete with built-in barometric pressure element. New. $2.95

RT-70/GRC TRANSCEIVER: Compact 14"x7"x5": Late type 46-58 MC FM ..$49.50

RT-109/GRC RECEIVER: 270-390 MC FM $35.00

RT-110/GRC RECEIVER: 380-550 MC FM $49.50

STEEL ANTENNA WHIP: 8½ ft. long .. $1.49

EARPHONES

*Low Impedance phones $1.50
*Phones and Boom Mike comb.
Aircraft type ....
*Tank type $3.95

CRYSTALS

*100 KC $4.95
*200 KC $1.50
*1000 KC for LM or 221 .... $3.95
*1000 KC in FT-243 holder $3.50
ARC 11 for 190 to 550 KC $14.95
URR-13, 200 to 400MC $97.50
2V rechargeable battery $2.49

One Inch CRT Tube Mounted In A Plastic Holder With Cable Lead. $4.95

DIAL TELEPHONE can be used as extension phone $4.95

BEAM FILTER $1.95

JENNINGS VACUUM CAPACITOR: 125-250 at 7500 V.......................... $9.95
10-85 at 35,000 V.................. $29.50
16 to 90 at 3000 V.................. $7.95

URC-4 VHF COMPACT WALKIE TALKIE good to line to sight. Makes good 6 or 2 meters $27.50

SUPER OSCILLATOR - Late Type. Consists of 18 crystals mounted on a turret with oven plus the proper selector coils designed to select over 700 frequencies. Only $14.95

CONVERTER: 12 to 24 VDC at 4 Amps. Rotary type $7.95

Space prevents us from listing all items. Please write us your needs and we will answer immediately..

Terms: Remittance in full or 25% deposit on COD orders. Minimum order $5.00 FOB our warehouse. L.A. Calif.

J. J. GLASS ELECTRONICS

1624 SO. MAIN ST.

LOS ANGELES, CALIF. 90015

CERAMIC FILTERS

455 Khz ceramic filters type BF-455-A. These filters will help to sharpen the selectivity of most sets using 455 Khz IF's. Use across cathode bias resistor in place of a capacitor, or in transistorized sets, across the emitter bias resistor. Impedance is 20 ohms at 455 Khz. DC resistance is infinite. Impedance increases rapidly as you leave 455 Khz. Plan your own LC. filter circuits at very low cost 10 for $1.00 . . . . 25 for $2.00

TOROID POWER TRANSFORMER

T3–Has powdered iron core and is built like a TV fly-back transformer. Operates at about 800 cps.. 12 vdc pri. using 2N442's or equivalent. DC output of v/dblr 475 volts 90 watts. C/T feedback winding for 2N442's . . . . $2.95 ea, ... 2 for $5.00

TRANSFORMERS

P4–105-115-125 v 60 cy pri. 6.4 v @ 11 A. 205v @ ½ A, 17 v @ 45 mA (relay power). Wt. 10 lbs $2.95 . . . . $5.00

P5–Pri. 117 vac/12 vdc. Sec. 1: 295 vdc (v/dblr) @ 85 mA. Sec. 2: 12.6 vac @ 2.6 A & CT winding for vibrator. Double half shell. Wt. 2¼ lbs $2.25 ea. 2 for $4. . . . . $4.00

P6–Pri. 117 vac/12 vdc. Sec. 1: 275 vdc (v/dblr) @ 150 mA. Sec. 2: 12.6 vac & CT for vibrator winding. Wt. 4¼ lbs $2.95

SR-42–46 type . . . . 2 for $5.00

P7–117 vac pri. Sec. 1: 185 vac @ 120 mA. Sec. 2: 6.3 vac @ 4 A. Double half shell mail box type. SX-146 type . . . . $2.75 ea, 2 for $5.00

P8-117 vac pri. Sec. 1: 470 CT. DC out of bridge 660 v 300 mA max. Sec. 2: 100 vac – 10 mA for bias. Sec. 3: 12.6 vac @ .75 A to 6.3 vac @ 6A. Half shell HT-46 type. Wt. 7¼ lbs $3.50

P9–117 vac pri. Sec. 1: 900 vac @ 300 mA. Sec. 2: 100 vac @ 10 mA bias. Sec. 3: 12.6 vac @ 2 A. Double half shell. Wt. 16½ lbs $4.50

P10–177 vac pri. Sec. 1: 960 vac CT @ 160 mA. Sec. 2: 415 vac CT and tap at 100 vac @ 10 mA bias. Sec. 3: 12.6 vac @ 4.5 A. Double shell mail box type. Wt. 8¾ lbs $3.75

OUTPUT TRANSFORMERS

59¢ each or 3 for $1.50

OT-2–Pri. imp. 7000 ohms. Sec. 3.2 and 500 m for phones or 70 volt line. 3 watts. Full shielded double half shell.

OT3–Primary impedance 5500 ohms. Secondary impedance 3.2 ohms. SX-122 type.

TUBES

New bulk packaged tubes made by RCA

6BA7 – $1.00 . . . . 6 for $5.00
6CX8 – $1.00 . . . . 6 for $5.00
12AU6 – $ .60 . . . . 6 for $3.00
6BQ5 – $ .85. . . . . 6 for $4.50
12AX7 – $ .75 . . . . 6 for $4.00

CABLE

RG 196 AU 50 ohm teflon coaxial cable. Outside diameter .080" RF loss .29 db per foot at 400 MHz. Silver plated shielding and conductor. Used for internal chassis wiring, antenna coupling. RF coupling between stages, etc. Random lengths from 35 foot to 150 foot. Colors: black, brown, grey, orange. Regular price 23¢ per foot. Our price 5¢ per ft, $3.00 per 100 ft.

SEMICONDUCTORS

S2–Amperex 2N671, 100 MHz FT. RF amplifier-mixer, 4 lead TO-5 case . . . . . $.40 ea, 6 for $2.00

S3–Amperex 2N2089 RF amp. mixer oscillator $.35 ea. 12 for $3.00

S4–Delco DTS-413 Silicon NPN planar TO-3 case. 400 Vceo 100 mA continuous. Hfe 20 @ 5 v 500 mA. FT 12 MHz. Used as TV vert. output $1.00 ea, 6 for $5.00

S6–RCA 1N3754 Silicon Diode 1.3 A 125 piv. Single ended TO-1 case. Used as biasing diode in power amp base to emitter circuit or general purpose . . . . $.15 ea, 8 for $1.00

S7–Fairchild FD-100 ultra-high speed switching 2 nano sec. recovery time. Up to 500 MHz. 75 piv 10 mA. Used as general purpose rf and signal diode. Silicon planar type . . . . $.25 ea, 5 for $1.00

S8–Texas Inst. 2N746 Zener diode 3.3 v 400 mw $.50 ea. 3 for $1.00

S9–Sarkes-Tarzian 1N3020 Zener diode 10 v 1 w $.60 ea. 2 for $1.00

CAPACITORS

C1–Aerovox transmitting capacitors for use in coupling power amps to Pi-nets. High amperage, high voltage (15 kv) type. HI-QHPA42BC axial screw terminals ¼-20 with screws. Size: 1¾" by 5/8" long. All silver const. Heavy silver plated terminals and screws. 6800 mmfd $2.00 ea. 3 for. $5.00

C2–Plastic Cap Inc. Type "OF" high voltage glass capacitor. .005, 8000 v. Size: 1¾" x ¾" x 8-32 screw terminals . . . . $1.50 ea, 4 for $5.00

C3–Mallory computer grade electrolytic capacitors 1550 mfd 150 vdc. Fresh stock for use during 1971. Size: 2" x 4¾" with plastic insulating sleeve $1.00 ea. 10 for $7.50

C4-PC mounting 900 mfd. 15 vdc. Size 5/8 x 1-7/8" high . . . . $.20 ea, 6 for $1.00

C5–Axial lead 250 mfd. 40 vdc. Size 5/8 x 1¼" long . . . . $.20 ea, 6 for $1.00

C6–Axial lead 15 mfd. 20 vdc. Tantalum Size ¼ x ½" long . . . . $.25 ea, 5 for $1.00

RELAYS

LRY1–Potter & Brumfield latching relay SPST 115 v-24 v/12 vdc dual coils, horizontal mounting. 1¾" x 3" x 2" . . . . $.75 ea, 5 for $3.00

LRY2–Potter & Brumfield latching relay SPDT 115 v-24 v/12 vdc . . . . $.75 ea, 5 for $3.00

RY1–Sensitive relay for use in transistorized circuits. 1000 ohms. Pull in 5 mA at 5 v. SPST. Can be used as SPDT. 1¼" x 1¼" x 1" $.75 ea. 5 for $3.00

RY2-Sensitive relay for use in transistorized circuits. 2000 ohms. Pull in 5 mA at 10 v. SPST. Can be used as SPDT. 1¼" x 1¼" x 1" $.75 ea. 5 for $3.00

Toroid core, reactor or inductor. Core size ½" thick 1" wide 2 3/8" od I 3/8" id. Silicon steel spiral wound plastic covered core. This toroid core now has 296 turns of #18 wire wound around core. Core weight 13 oz. wire weight ½ lb. total weight I lb. 5 oz. Room for additional 12 volt primary and feedback windings. CAN be used for powering FM with voltage doubling circuit. Approximate D.C. output 500 volts. Power input up to 200 watts. . . . . $.90 ea, 3 for $2.50

All prices FOB Racine, Wisc. Orders under $3.00 include 50¢ handling charge. Please allow enough postage, excess will be refunded. All weights are net weights.

TOWER COMMUNICATIONS

1220–22 Villa St. Racine, Wisconsin 53403 632-9014

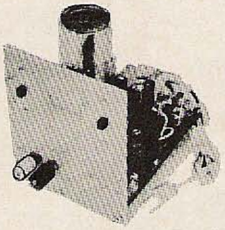
IMPOSSIBLE?... BARGAINS IN SURPLUS ELECTRONICS (AND OPTICS)

☐ **GOVERNMENT SURPLUS GEIGER COUNTER**

"USAF" radiation detectors are in like new condition, with instructions. Shirt pocket size, in gray plastic case. Requires one each 1.35 V and 5.4 volt mercury batteries, cost about $3.00. Will operate fine from less expensive penlite batteries. Quantity limited.

ASAFGC .... $7.50 ppd.

☐ **POWER SUPPLY KITS**



We have taken a select group of surplus components, and put together this bargain kit. The kit includes all components required to make a power supply as shown capable of supplying 24 volts at 2 amps, 12 volts at 4 amps or 6 volts at 8 amps. You couldn't build or buy this same supply at 4 times our low price of $13.50. For an additional $8.00, we supply the P.C. board and components to build an integrated circuit regulator for this supply, using a silicon power transistor and the I.C. regulator described elsewhere in this ad.

☐ Power Supply Kit, Unregulated $13.50
☐ Power Supply Kit, Regulated $21.50

☐ **EXPERIMENTERS TTL LOGIC KIT**

This kit contains sixteen J-K flip-flop, eight dual four input nand/nor gates, eight quad two input nand/nor gates, eight triple three input nand/nor gates and three of our instant ultralarge logic cards with mating connectors. Full information on the integrated circuits, including circuits for counters, decoders, memories, shift registers etc. are included. The I.C.'s are made by T.I. Sprague or Signetics (no choice) and are new packaged in the flat-pak configuration. I.C.'s are or equivalent to 54/7400 series logic.

LOGIC EXPERIMENTATION KIT LEK .... $29.50 p.pd.

☐ **SPECIAL INTEGRATED CIRCUIT VOLTAGE REGULATOR**

Latest type, Motorola MC1460G, RCA 3055 or equivalent. Range 3 to 30 volts at 200 MA, 4 amperes with external transistor. Foldback current limiting makes it short circuit proof. Complete with circuit diagrams and data sheets. MFGS price over $6.00.

Our price .... $2.00 each

☐ **NOISE CANCELLING MICROPHONE**

Carbon microphones used in high altitude Air Force G suits. Impedance, 40 ohms at 85 ma. dc. Uniform response 200 to 4,500 Hz. Construction is brass nivar and bakelite. Rugged blast-proof, sealed, altitude compensated. New with application sheet. Minimum order 5 units.

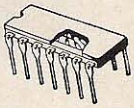
5NCM .... 5 for $2.00 p.pd.

TTL INTEGRATED CIRCUITS

TTL 7400 series I.C.'s need no introduction to the electronics experimenter. They are the latest most frequently used units. Our units are brand new, fully marked and are guaranteed to meet original manufacturers specifications. The low price needs no comment!

☐ 7400 Quad 2 input nand gate .... $ .50
☐ 7410 Triple 3 input nand gate .... .50
☐ 7420 Dual 4 input nand gate .... .50
☐ 7430 8 input gate .... .50
☐ 7440 Dual 4 input driver .... .50
☐ 7450 Dual 2 wide 2 input expandable .... .50
☐ 7470 J.K. flip-flop .... .75
☐ 7472 J.K. master-slave flip-flop .... .75
☐ 7473 Dual J.K. flip-flop 1.00
☐ 7474 Dual type D flip-flop 1.00
☐ 7480 Full adder 1.50
☐ 7490 Decade counter 2.00
☐ 7492 Divide by 12 counter 2.00
☐ 7493 4 bit binary counter 2.00
☐ 7441 BCD to decimal decoder driver 3.00

☐ **DTL INTEGRATED CIRCUITS . . . 80% DISCOUNT**



This is the SP600 series of integrated circuits made by Sprague and Signetics. Compatible with other manufacturers integrated circuits. Each order will include circuits for decade counters, bi-directional counters, decoding circuits, shift registers, memories and many other circuits, in addition to data sheets. These I.C.'s represent one of the latest and most economical logic families for equipment design. Available are the SP620 J-K flip-flop, SP629A R-S flip-flop, SP631A quad 2 input gate expander, SP659A dual 4 input buffer driver, SP670A triple 3-input nand/nor gate, and SP680A quad 2 input nand/nor gate. Removed from new equipment.

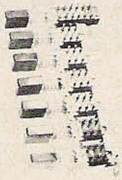
SP616A, SP631A, SP670A, SP680A .... $0.50 ea. p.pd.
SP620A, SP629A, SP659A, ... $0.75 ea. p.pd.

Minimum order $5.00 worth of logic. A 20% Discount on orders of 100 or more units.

☐ **DIODES BY THE FOOT!**

These diodes are packaged in rolls, for automatic machine insertion, spaced 0.2 inches apart, so there are 60 to the foot. They are TRANSITRON SG 2947 general purpose silicon fast switching diodes, 75 volt, 0.1 amps, in glass package. Buy a few feet and you should have diodes handy all the time. Pull them off the strip as you need them. At a BARGAIN low price.

☐ 1 Foot (60 diodes) .... $ 2.00
☐ 10 Feet (600 diodes) 15.00
☐ 80 Feet (5000 diodes) Full Roll 100.00



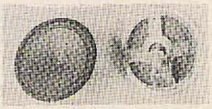
☐ **PUSH BUTTON SWITCHES**

These high grade moulded bakelite push button switches were made to be used as a computer entry device. Uses are limited only by your imagination. Consists of seven sections, six double pole double throw and one four pole double throw. May be cut apart to make seven independent switches. Alternate action, similar to switches on professional audio equipment.

PBS-1 .... $1.25 each

☐ T1 T1S43 Unijunction Xsistor .... 2/$1.00
☐ T1 2N3819 FET Xsistor .... 2/$1.00
☐ 1N3821A (3.3 volts) 1 watt, 1N3822A (3.6 volts) 1 watt, 1N429 reference or 12 volt 3 watt zener.
Your choice .... 3/$1.00
☐ Socket for 14 pin DIP integrated circuit .... 3/$1.00
☐ Integrated Circuits, TTL flat pak, new original packages . . . 5400 quad 4 input, 5410 triple 3 input, 5420 dual 4 input, 5440 power nand, 5470 J-K flip-flop.
Your choice .... 3/$1.00

☐ Hi-Fi Headphone Speakers, MFG G.E. Make your own Hi-Fi headset, lo z.
Price .... 2/$1.50



☐ GIANT 80 PAGE ILLUSTRATED CATALOG jammed with BARGAINS in I.C.'s, Electronics, Optics, G.I. Watches, etc. Free with any order or send $.25.
Price .... $ .25.

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TECH MANUALS

This is a sample listing of our stock. Some are one of a kind, many we have in stock in large quantity. We also have hundreds of others not listed.

All manuals listed are originals, not copies, and 99% are brand new, unused.

ALA-2	HSI	6.00
ALR-5	HSI	9.00
ALR-8	HSI	13.00
APA-5a	HSI	8.00
APA-6	HSI	8.00
APA-11	HSI	7.50
APA-16	HSI	8.00
APA-17	HSI	9.00
APA-17a	HSI	9.00
APA-56	HSI	15.00
APA-81	HSI	7.00
APA-89	HSI	7.00
APA-125	IPB	7.50
APG-30	HSI	9.00
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APM-78	HSI	7.50
APM-123	HSI	7.50
APN-1	HMI	8.50
APN-4	HMI	20.00
APN-9	HMI	20.00
APN-22	HMI	15.00
APN-41	HMI	10.00
APN-59	HMI	10.00
APN-67	HMI	10.00
APN-70	HMI	15.00
APN-97	HMI	10.00
APN-117	HMI	10.00
APN-122	HMI	10.00
APN-130	HMI	10.00
APN-132	HMI	10.00
APN-141	HMI	10.00
APQ-2a,2b	HMI	8.00
APR-1	HMI	9.00
APR-2	HMI	9.00
APR-4	HMI	10.00
APR-5	HMI	15.00
APR-6x	HMI	15.00
APR-9	HMI	15.00
APR-12	HMI	10.00
APR-13	IPB	10.00
APS-2	HMI	15.00
APS-3a	HMI	15.00
APS-4	HMI	25.00
APS-19a	HMI	20.00
APS-20a,c	HMI	20.00
APS-20e	IPB	20.00
APS-31+	HMI	25.00
APS-33+	HMI	25.00
APS-42b	HMI	30.00
APS-44	HMI	40.00
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APS-88+	HMI	30.00
APT-2	HMI	7.00
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APX-1	HMI	8.00
APX-6	HMI	10.00
APX-6b	HMI	10.00
APX-6b	IPB	10.00
APX-7	IPB	8.00
APX-25	HMI	15.00
AQS-4a	HSI	15.00
ARA-19	HMI	10.00
ARB	HMI	8.00
ARC-1	HMI	12.00
ARC-2	HMI	12.00
ARC-5 LF	HMI	12.00
ARC-5 VHF	HMI	12.00
ARC-12-RT58	HMI	12.00
ARC-12 (R-11)	HMI	8.00
ARC-19	HMI	9.00
ARC-27	HMI	9.00
ARC-27	IPB	12.00
ARC-28	HMI	7.00
ARC-30	HMI	8.00
ARC-38	HMI	10.00
ARC-38	IPB	10.00
ARC-39	HMI	10.00
ARC-48	HMI	16.00

ARC-51	HMI	10.00
ARC-52	HMI	10.00
ARC-52	IPB	10.00
ARC-55	HMI	9.00
ARC-94	HMI	9.00
ARC-119	HMI	9.00
ARC-120	HMI	9.00
ARM-5	HMI	7.00
ARM-10	HMI	7.00
ARM-19	HMI	7.00
ARM-24	IPB	7.00
ARM-25	HMI	7.00
ARM-25	IPB	7.00
ARM-35	IPB	7.00
ARM-53	IPB	7.00
ARN-5	HMI	8.50
ARN-6	HMI	9.00
ARN-8	HMI	4.00
ARN-12	HMI	5.00
ARN-14	HMI	12.00
ARN-14a	HMI	12.00
ARN-14b	HMI	15.00
ARN-14c	HMI	20.00
ARN-14d	HMI	15.00
ARN-21	IPB	20.00
ARN-21b	HMI	15.00
ARN-30	HMI	9.00
ARN-32	HMI	7.50
ARN-41a	HMI	7.50
ARN-52	HMI	9.00
ARQ-5	HMI	7.50
ARQ-8	HMI	12.00
ARR-2	HMI	7.50
ARR-5	HMI	8.00
ARR-15	HMI	12.00
ARR-16b	HMI	10.00
ARR-26+	HMI	10.00
ARR-31	HMI	9.00
ART-26	HMI	9.00
ART-28	HMI	10.00
ART-28	IPB	10.00
ARW-26a	HMI	9.00
ARW-56	HMI	9.00
ASA-13	HSI	19.00
ASA-13	IPB	20.00
ASB-3	HMI	7.50
ASQ-8	HMI	15.00
ASQ-10	HMI	15.00
ASQ-17	HMI	15.00
ATA/ARA	HMI	8.00
ATB	HMI	8.50
ATD	HMI	9.00
ATK/ARK	HMI	15.00

BC-348 — specify your series letter — we have manuals for all models . . . $9.00 ea.

BC-400	IB	9.00
BC-640a	IB	8.00
BC 949a	IB	8.00
DAE/DAE-1	IB	9.00
DAS/DAS-2	IB	9.00
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DZ-1	IB	8.00
FGC-7a	IB	9.00
GO-9	IB	8.00
GP-6,7	IB	8.50
LAE-1	IB	8.00
LAF-2	IV	8.00
LM-2	IB	8.00
LM-7	IB	8.00
LM-13	IB	8.00
LM-14	IB	10.00
LM-16	IB	10.00

LM-17	IB	8.00
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LR-2	IB	10.00
LR-3	IB	10.00
MAR	IB	12.00
MBF	IB	7.00
MN-26c	IB	9.00
MN-62a	IB	10.00
NA-1	IB	10.00
NGB	IB	9.00
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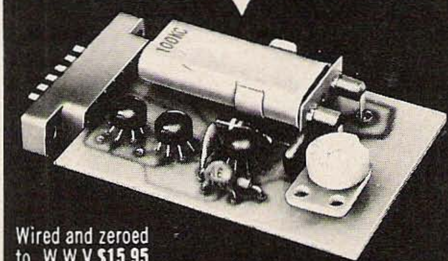

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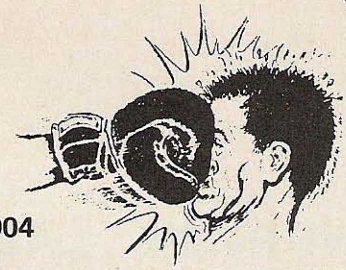

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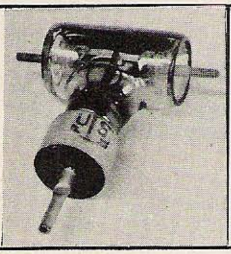

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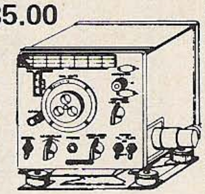

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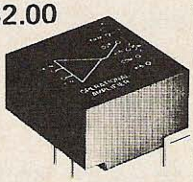

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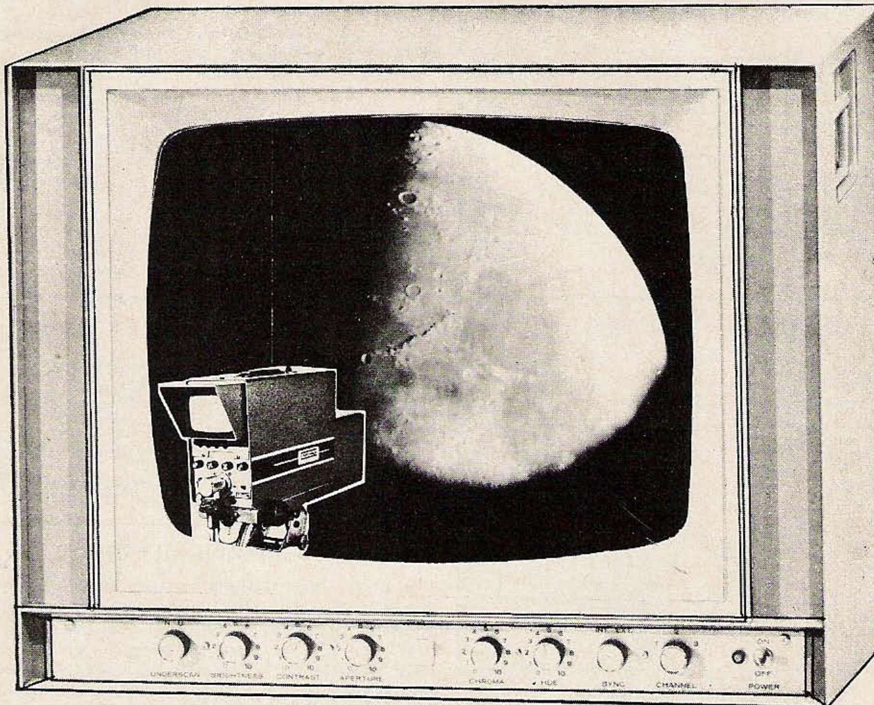

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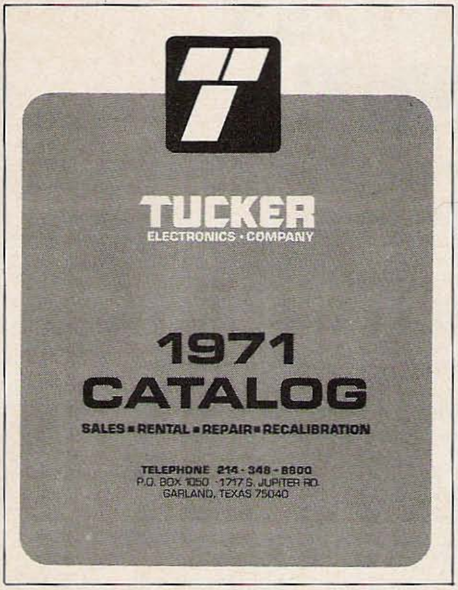

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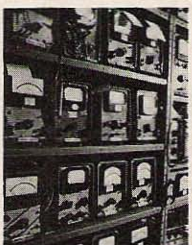

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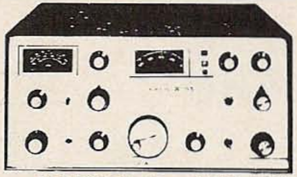

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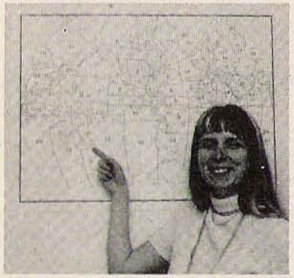

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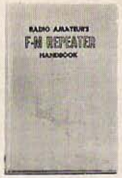

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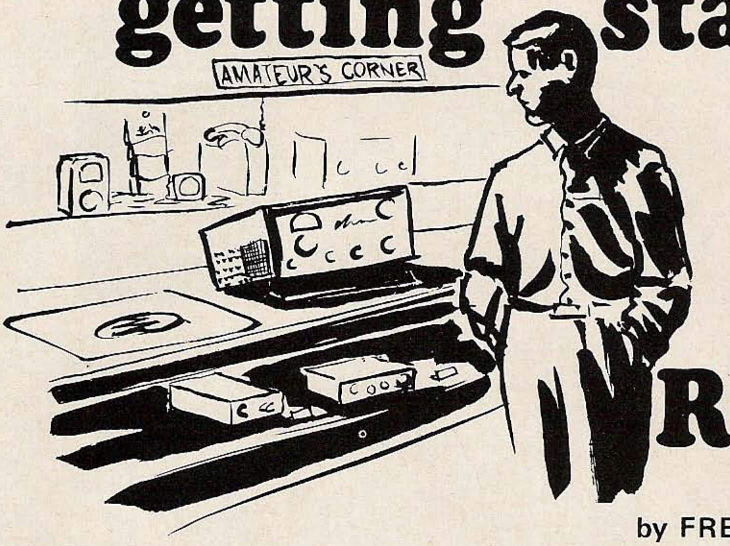


by FRED J. MOCKING

Once upon a time there was a young boy who lived in a big city. He attended school during the day (he was in the sixth grade), but at home in the evenings he "fooled around" with his electrical experiments. Tom's teachers said he was lazy and inattentive. He did not study his textbooks like the other kids did. He had a poor memory and was unable to remember things the teacher had told him the day before.

He was so lazy that he never wrote out the details of his arithmetic problems. He had decided that it was much easier to memorize all the tables up to 20 x 20, than to calculate them every time.

He spent considerable time at the library, looking for books on electricity and radio. He was "friends" with the radio serviceman in his neighborhood and with a neighbor who worked for the telephone company. He also had a very special friend who was a ham radio operator.

His basement workshop was a mess, with parts of old radios, discarded appliances, tubes, meters and assorted miscellany all over. By the time he was in eighth grade, he had built several 1 and 2 tube receivers and his latest project which he was just finishing was a six-tube superheterodyne. He also had built a ham band transmitter and had been on the air for about six months.

He had acquired a number of basic skills using electrical and electronic instruments, troubleshooting all kinds of equipment and doing some simple design work, based mostly on Ohms law.

During high school he continued his ham activities, and did just average in his school work. His math teacher told him he would never learn math and should avoid technical subjects. His physics teacher, however, was impressed by Tom and encouraged him, provided opportunities for him to use school equipment.

As you might expect, Tom decided to study electrical engineering in college. Here again, his grades were average, and studies left little time for ham radio. But Tom picked up some spending money working part time in a radio repair shop and, in his last year, worked as a technical assistant to one of the professors in the EE department.

The professor was working on a project that involved using tube circuits to perform mathematical computations. There were no textbooks to refer to. Every aspect of the equipment was a step into an uncharted land. How do you represent numbers using electrical circuits? What circuits do you need to perform arithmetic operations? How do you get results out of the machine?

The professor didn't want to hire Tom at first, but some of the A students working on the project were completely lost when it came to troubleshooting. And, in designing circuits that weren't in the textbooks, they were rather confused. So Tom got the job. And strange as it seems, this indifferent scholar, with "no talent" and a "bad memory," became a leader and an outstanding engineer on a project that opened up a whole new vista in technology – the computer era.

Why do we spend time to review this thumbnail sketch about Tom? Because what happened here is happening to thousands of Toms across the country. There's a chasm between the world of school and the world outside of school, and considerable misunderstanding about what constitutes learning.

Tom didn't trust words, or textbooks, but he felt intuitively that his experiments were worthwhile. Some educators say "You learn by doing," which is somewhat of an oversimplification. Tom's teachers didn't trust the real world; they only felt comfortable with the world of words, which is to a large extent an unreal world. And what does this all have to do with a magazine ?

If you want to learn electronics, you are going to learn about a lot of physical phenomena which exist without words, and which can be experienced and observed without words. This means that the equipment does the teaching.

If you want to argue, you can say "Wait! A magazine is nothing but words, so what gives?"

So here is the straight scoop:

The words can tell you what equipment to get and what to do with it. You have to *experience* how it works and that's *your* job. But afterwards, if you want to know *more*, people who have also experienced similar experiments and have written about them can communicate with you in the articles in this magazine.

This column will have comments on things to build, some techniques that help us understand the things we see, and some comments about learning, education, and communication.

Now, let's do some experimenting. I will assume that you own or can borrow a general purpose multimeter, also called a VOM (volt-ohm-milliammeter). If you have a VTVM (vacuum-tube voltmeter) you can use it as well for these experiments. You will also need some diodes and a few transistors.

There are many kinds of diodes that can be used. Rectifier diodes are usually readily available, and are often more clearly labeled than some others. Be sure the polarity is clearly shown. Transistors can be obtained as surplus or on surplus circuit cards. You should accumulate an assortment for experimenting. New transistors are fine but are usually somewhat more expensive.

Set the meter switch to the lowest OHMS scale, touch the prods together and "zero" the meter. Touch the test prods to the diode and read the meter. Now, turn

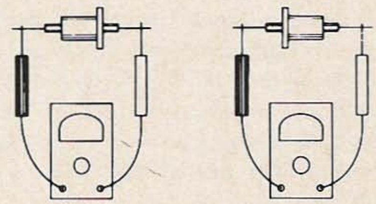


Fig. 1. Checking diode resistance in both directions.

the diode around and read the meter again. (see Fig. 1). One reading will be very low, as meter current flows through the diode in the "forward" direction. The other reading will indicate a high resistance (or open circuit) as the meter tries to "push" current through the diode in the reverse or blocking direction.

I have not given any numerical values of resistance because they would depend on many things, including the voltage of the dry cell in the meter, the diode being checked, and some other things. However, a good diode will read low in the forward direction and high resistance in the reverse direction.

Now, once more touch the meter prods to the diode with the diode in the forward or low resistance direction. Assuming that the diode is correctly marked, as shown, and the prods are two different colors, usually red and black, two possibilities can arise, either A or B (Fig. 2). In A, "current" flows from the red prod, through the diode to the black prod. Knowing this, you can use the prod colors to help decide which way is forward for an unmarked diode. However, if B is the situation with *your* meter, then inter-

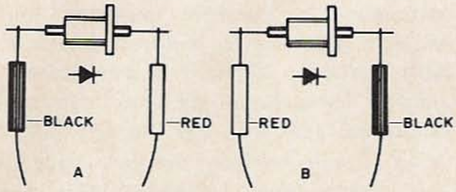


Fig. 2. The two possible arrangements that could give a "forward" reading, depending on the internal arrangement of your ohmmeter.

change the red and black leads *at the meter.* Now, to put current through the diode in the forward direction, your prods will match A, and you can still say that current flows from the red prod through the diode to the black prod.

When you are checking diodes or transistors, you can use the "reversed leads" trick described above. However, for voltage and current measurements, restore the leads to the proper positions. Incidentally, it is a good idea to label your ohmmeter

POLARITY REVERSED ON OHMS, or. . .
POLARITY CORRECT ON OHMS

whichever applies to *your* meter. This can save you from trouble and goof-ups later on.

You have now acquired a "test set" (and some knowhow) that will permit you to do the following:

1. Determine the forward and reverse direction of an unmarked diode,
2. Check diodes for "opens" (high resistance both ways).
3. Check diodes for "shorts" (low resistance both ways).

In addition, this know-how can be directly applied to checking transistors, by testing between two terminals at a time and interpreting the readings as though

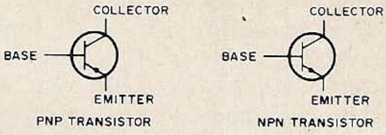


Fig. 3. Transistor symbols.

they were diode readings. Look at the transistor symbols in Fig. 3. The base and emitter form a diode, which can be checked just as we did before, with the ohmmeter. In the PNP transistor, "forward" is from emitter to base, while in the NPN transistor, forward is from base to emitter. These diodes can be normal, open, or shorted just as in any "regular" diode.

In a similar manner, the base–collector pair forms a diode, with polarity, for these tests, the same as the base–emitter diode. The "forward" polarities are:

PNP	NPN
Emitter-to-base	Base-to-emitter
Collector-to-base	Base-to-collector

In order to use this information, we need a guide that tells us which terminal is which on the physical transistor, since the leads are not marked. (See Fig. 4.)

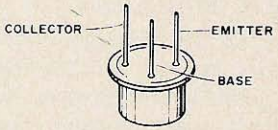


Fig. 4. Transistor lead identification.

You are now ready to take the ohmmeter and some transistors and check them to see if they are PNP or NPN. Then check for shorts and opens. Notice that there is no need to know how transistors "work" or how to design circuits, in order to perform these tests. Yet you will find yourself using this technique many times in the future. Even when you have much more elaborate test facilities you may want to run a quick check on a transistor or diode this way. So go to it, have fun, and the transistors, through the ohmmeter, will be happy to tell you about themselves.

. . .Mocking ■

REDUCING MOBILE NOISE

Ward Stewart VE3FGS
8 Church St.
Penetang, Ontario

With the introduction of transistorized 2m FM transceivers and various amateur receivers for mobile use, there is a natural tendency to pick up the supply voltage from the ignition switch or the switched terminals on the fuse panel. Reduced current demands have rather obsoleted the old power relay . . . but not quite.

Because of the compactness of wiring harnesses, all kinds of voltages are induced into other wires in the same harness. It is quite possible for your receiver to get alternator, gage, and turn-signal noises induced on the supply line, and much of it will get past the receiver's filtering and appear at the speaker terminals.

The best way to eliminate this problem is to run the supply lead directly from the battery terminal, and route it away from other wiring while keeping it close to the metal chassis parts of the vehicle, which of course are at ground potential.

The battery itself is a big fat capacitor and a beautiful hash filter! But taking our A lead directly from it means we have to turn the rig on by hand for now it won't come on automatically with the turn of the ignition switch.

Here we come back to our old friend, the relay. Any relay with the current capacity for your rig and a 12V dc coil is okay. Your local two-way radio serviceman will undoubtedly have some old ones he would be glad to sell cheap (or he may even give them away). If you want a new one, ask for Motorola part number 59K813674. It looks like a horn relay off a car but it isn't! The illustration shows both the physical and electrical layout of this particular relay.

Use of this type of voltage supply will do much to reduce "local QRN" generated by the vehicle. Give it a try. . . . VE3FGS■

PETITION filed by Wayne Green W2NSD/1, Peterborough, New Hampshire.

The Federal Communications Commission has had considerable difficulty with the 27 MHz citizens band. Thousands of operators are using this band for hobby purposes even though this is prohibited by the regulations. Thousands more are using illegal antennas and illegal power amplifiers. Thousands are using the band even without a legal license. It seems obvious that there is a demonstrated need for a hobby band if the appropriate frequencies can be allocated. Such a band would provide a legal way for these operators to communicate and could therefore free the 27 band for its original purpose as a semibusiness band.

The drop in the growth of the amateur radio service is reflecting along to the electronics and communications industries as a drop in the number of new workers entering this field. The needs of these industries are going to be greater than ever as computers and space-age communications gradually involve more and more businesses and sectors of the economy. A drop in men coming into these fields can seriously hurt the future of these industries. In all, it would seem prudent to do everything reasonable to try and encourage the growth of amateur radio at this time.

The major factors influencing the growth of amateur radio would seem to be the discouragement resulting from the introduction of the "incentive licensing" proposals by the ARRL, the institution of $4 license fee by the FCC, and the indescribable mess on the citizens band with 800,000 or so active stations using 23 channels, a situation which has tended to discourage the most likely amateur radio prospects and divert them to other interests.

The FCC in Docket 18802 has indicated that it is interested in making revenue meet expenses and has proposed that amateur license fees be raised to $9 and the citizens band fees raised to $19. The result of this would seem to be even more problems for both services, with the recent very slight upturn in the issuance of amateur licenses possibly turned down again and the impressive increase in completely unlicensed citizens band operation becoming the rule rather than the exception. The Commission is asked herewith to consider an alternative source for the needed income that might be derived from the increase of these two fees, thus eliminating at least the need for the increase in the amateur radio fees.

The Commission has been requested to establish a hobby-type license in the past with allocations in the amateur ten-, six-, and two-meter bands. Each of these requests has had serious drawbacks which have prevented their implementation. Basically, though none of these amateur bands are fully used, all of them are extensively in use and the opening of a substantial range of frequencies for a new amateur license would inevitably cause a hardship to those now using the band and to those amateurs who might want to use the band in the near future. There is one amateur band, however, that has been almost completely passed by and which shows no signs of serious amateur development in the foreseeable future. This is the amateur 220–225 MHz band. It would seem important that this wide and valuable amateur band should be developed if it is to be retained at future international conferences. There are many practical reasons why this band has been skipped in the expansion of amateur radio into the microwaves: The next band up is better for moonbounce work, more commercial equipment is available for the 450 MHz band, repeater controls are on this band, dish antennas become practical at the higher frequency, and television is allocated on 450 MHz.

The Solution. . .

It is hereby proposed that the Commission institute a Hobby class amateur license which will have no code and no theory elements, only a rules and regulations examination which can be administered by, any licensed amateur, General class or above, and which will permit the holder to operate with a power of up to 100 watts using narrowband FM (15 kHz deviation) in the frequency range from 220.5 to 224.5 MHz. This license would be available for a fee of $5 for a five-year period and would be renewable upon proof of use and a $5 fee. The 220.-220.5 and 224.5-225.0 MHz segments of the band would still be open to higher classes of license as presently authorized, thus preserving one MHz of the band for exclusive use of the higher classes of license.

This Hobby class license would provide the band that the citizens band operators need, one where hobby operation is legal, and would thus free the 27 MHz band for business and personal business use as originally proposed by the Commission. The large number of channels available in the 220 MHz band would provide relatively interference free communications for the operators, offering them adequate reasons for changing from the 23 channels on 27 MHz. The coming dropoff in skip conditions on 27 MHz will work to the end of encouraging the changeover. This band, as with all other amateur bands, would be largely self-policing, thus removing a very expensive headache from the Commission.

It is suggested that the Hobby class license permit communication through repeaters, but that a higher class license be required for the installation and maintenance of a repeater, since technical knowledge is much more necessary for the installation than the use of a repeater.

It might be pointed out that the amateur 220 MHz band is above television channel 13 and that interference to television reception would thus be unlikely. Second harmonic radiation would be within the 450 MHz amateur band and would also be unlikely to interfere with commercial bands. The 500 kHz guard bands on each side of the proposed Hobby band would provide adequate isolation for errant operators to keep them from interfering with adjacent commercial bands.

The use of FM techniques would reduce the problems of heterodynes which contribute so much to the frustrations of the 27 MHz band and would provide simple network systems with squelch as is now popular on the 144 MHz band. Though crystal control would not be required, it would probably be extensively used as it is for 144 MHz FM operations.

In order to indicate the class of license by the call letters it is proposed that a new set of callsigns be established for the Hobby class license using the regular amateur call areas, but starting with NA1AAA and going through to NZ1ZZZ, a system which would provide for over 4,500,000 callsigns to be issued. When a Hobby Class operator goes to a higher class of license the last three letters could be passed along to the WA1AAA type of call letter, thus preserving the identity of the operator through this counterpart call.

Summary

The Hobby Class license would seem to fulfill a number of needs without taking anything away from anyone. It would provide a legal hobby band which is obviously needed. It would help the Commission solve the problems of the citizens band. It would provide activity on a virtually unused amateur band. It would encourage an influx of new amateurs. It would provide millions of dollars in fees to offset Commission expenses, with little overhead involved since all of the examinations would be given by volunteer radio amateurs. It would encourage the development of commercial narrowband FM equipment for the VHF bands which would benefit all amateurs as well as the users of adjacent commercial bands. It would encourage the development of fixed station equipment, mobile equipment, portable equipment and handie-talkie equipment, autotuning receivers, autocall signaling equipment, etc. It would also give a number of manufacturers a very bright future.

Thus the Commission gains, the amateurs gain, the country gains, the manufacturers gain, and no one loses.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of)
)
Amendment of Part 95 and Part 15 of the Commission's Rules Concerning the Allocation and Assignment of Frequencies for Unlicensed Communication, Class D Citizens Radio Service and a New Proposed Class E Citizens Radio Service)

PETITION OF PROPOSED RULEMAKING

There has been demonstrated a strong current and growing need for personal two-way radio communications for both safety and convenience of individual citizens in conducting their daily activity of both a personal and business nature. This need initially was served by the establishment of Class D Citizens Radio Service in 1958, providing twenty-three crystal controlled channels with 10 KC spacing in the 27 MHz band. In the establishment of the Class D Citizens Radio Service, the Commission correctly recognized the need and right of individual citizens to have use of a portion of the R. F. Spectrum to conduct their affairs for convenience and safety via personal two-way radio. The technical limitation of 27 MHz and the limited number of channels made available have prevented the Class D Citizens Radio Service from meeting its total objective. We have learned much concerning the public's needs for personal two-way radio communications, even with these limiting factors. We can now more completely define and more adequately serve this requirement for personal two-way radio service.

I. CITIZENS NEED FOR PERSONAL TWO-WAY RADIO

In our mobile society today, we have an ever-increasing need for personal two-way radio communication from moving vehicles and in remote areas where land line communications facilities are not available. The primary need is for short range communications (within ten miles). The cost of equipment must be kept low for the greatest benefit to the greatest number of citizens. The service must offer the greatest flexibility of use so that the citizen may avail himself to this service in all his activities, whether he be in his home or automobile or on a fishing or camping excursion.

The Class D Citizens Radio Service, with 900,000 active licensed operators, has shown that low cost equipment owned and operated by the user provides the most satisfactory service.

II. JUSTIFICATION FOR EXPANSION OF PERSONAL RADIO SERVICE

The benefits of personal ownership and operation of Citizens Two-Way Radio have been proved over and over again in the number of public assistance acts that have been performed on the Class D Citizens Radio Service throughout the country. The examples of assistance, both for safety and convenience, that have been rendered to the general public by Class D Citizens Radio operators is far greater per license than any other radio service except the Public Safety Agencies themselves. There are countless examples of cooperation with law enforcement agencies and other local agencies by the Class D Citizens Radio Operators in providing assistance in time of major and minor emergency that arise every day in communities throughout the country. The cost of providing this benefit to our population could not possibly be met by any practical means other than personal ownership and operation of Citizens Personal Two-Way Radio equipment.

III. REQUIREMENTS FOR IMPROVING PERSONAL TWO-WAY COMMUNICATIONS SERVICE.

A. Operating regulations must be simple to understand and easy to administer. Operating procedures must be established to provide a high degree of self-regulation so that a minimum of cost is required for enforcement.

B. Equipment must be low initial cost and require a minimum of service expense.

C. Flexibility of operation must be provided so the maximum utilization of frequency can be obtained. The service must provide a satisfactory number of channels for local operation so that open channel space can be selected freely by the operator. Operating guidelines must be established so that maximum utilization can be obtained with the least confusion and interference.

D. Proper location in the frequency spectrum must be made to minimize the technical operating problem, short range communications in all types of terrain and populated areas must be accomplished with minimum interference due to man-made or natural interference.

E. Licensing procedures must be simplified to permit efficient handling of the large numbers of licensing that are required for this personal radio service.

The original establishment of the Citizens Radio Service by the FCC and subsequent establishment of the Class D Citizens Radio Service was to "provide the broadest possible public use and benefit of the frequency spectrum of necessary business and personal communications". The following factors concerning allocation of frequencies in the Class D Radio Service.

1. Technical atmospheric (skip) conditions make the Class D Citizens (27 MHz) band more conducive to long distance amateur type operation than the short-range communications to which the operation is restricted.
2. R. F. noise, both man-made and atmospheric, coupled with low power and low antenna height restrictions, limit the range of Class D Citizens (27 MHz) band in metropolitan areas to the point of questionable operational effectivness for its intended purpose.
3. Overcrowded conditions on the 23 channels of the 27 MHz Class D Citizens Radio Service, together with the above factors, has degraded the Citizens Radio Service to a level of ineffectiveness in many areas.

A new "Class E Service" is proposed as the best possible solution to provide the U.S. Citizens with properly regulated frequency spectrum for "personal communications".

A new Class E Citizens Radio Service is requested to be established between 222 and 224 MHz. The current Amateur Radio Service Frequency allocation of 220 to 225 should be changed to 220 to 222 MHz for one class plus 224 to 225 MHz for another class.

This new Class E Citizens Radio Service should then be established by specified channels covering the 222 to 224 MHz range. As a guideline in establishing technical and operating parameters, it is recommended that the VHF Marine regulation be referred to as an excellent example of providing the greatest use to the general public of the limited frequency spectrum available to satisfy the growing need for more short range "personal communications."

The following regulations for operation are recommended with the basic objective of providing communications for the mobile public for convenience and safety up to a reliable range of ten to twenty miles.

A. Power output to antenna limit of twenty-five watts with special "public service" license on base station allowed at one-hundred watts output to antenna.

B. Antenna height limit of twenty feet above the nearest man-made or natural object within 500 yards; or sixty feet above the existing terrain (whichever is higher).

C. Frequency assignments are requested as follows:

Transmission of FM voice only with 25 KC spacing. Crystal controlled transmission only. 80 channels assigned as follows:

Channel		Frequency
1	mobile to same license	222.000
2	mobile to same license	222.025
3	mobile to same license	222.050
4	mobile to same license	222.075
5	mobile to same license	222.100
6	mobile to same license	222.125
7	mobile to same license	222.150
8	mobile to same license	222.175
9	emergency use only per Class D Channel 9	222.200
10	mobile to same license	222.225
11	mobile general calling for contact only; must change to alternate channel for message	222.250
12	travel assistance use only mobile general calling permitted	222.275
13	travel assistance use only mobile general calling permitted	222.300
14	weather advisory use general calling permitted	222.325
15	traffic advisory use general calling permitted	222.350
16	mobile to unit of same or different license	222.375
17	mobile to unit of same or different license	222.400
18	mobile to unit of same or different license	222.425
19	mobile to unit of same or different license	222.450
20	mobile to unit of same or different license	222.475
21	mobile general calling for contact only; must change to alternate channel for message	222.500
22	mobile to unit of same or different license	222.525
23	mobile to unit of same or different license	222.550
24	mobile to unit of same or different license	222.575
25	mobile to unit of same or different license	222.600
26	mobile to unit of	222.625
27	mobile to unit of same or different license	222.650
28	mobile to unit of same or different license	222.675
29	mobile to unit of same or different license	222.700
30	mobile to unit of same or different license	222.725
31	mobile to unit of same or different license	222.750
32	mobile to unit of same or different license	222.775
33	mobile to unit of same or different license	222.800
34	mobile to unit of same or different license	222.825
35	mobile to unit of	222.850
36	road condition information only; power limit of 1 watt TX audio call signs	222.875
37	road condition information only; power limit of 1 watt TX audio call signs	222.900
38	road condition information only; power limit of 1 watt TX audio call signs	222.925
39	road condition information only; power limit of 1 watt TX audio call signs	222.950
40	road condition information only; power limit of 1 watt TX audio call signs	222.975
41	local traffic control use only; for a limit of 1 watt	223.000
42	local traffic control use only; for a limit of 1 watt	223.025
43	local traffic control use only; for a limit of 1 watt	223.050
44	local traffic control use only; for a limit of 1 watt	223.075
45	local traffic control use only; for a limit of 1 watt	223.100
46	in plant use only; limit of 1 watt	223.125
47	in plant use only; limit of 1 watt	223.150
48	in plant use only; limit of 1 watt	223.175
49	in plant use only; limit of 1 watt	223.200
50	in plant use only; limit of 1 watt	223.225
51	local use of units with same call sign; limit of 1 watt	223.250
52	local use of units with same call sign; limit of 1 watt	223.275
53	local use of units with same call sign; limit of 1 watt	223.300
54	local use of units with same call sign; limit of 1 watt	223.325
55	local use of units with same call sign; limit of 1 watt	223.350
56	marine use only limit of 1 watt	223.375
57	marine use only; limit of 1 watt	223.400
58	marine use only; limit of 1 watt	223.425
59	marine use only	223.450
60	marine use only	223.475
61	limited to units of same license; limited to contact only; to contact only; units must change to alternate channel for message	223.500
62	limited to units of same license; forbusiness communications only	223.525
63	limited to units of same license; for business communications only	223.550
64	limited to units of same license; for business communications only	223.575
65	limited to units of same license; for business communications only	223.600
66	limited to units of same license; for business communications only	223.625
67	limited to units of same license; for business communications only	223.650
x68	limited to units of same license; for business communications only	223.675
69	limited to units of same license; for business communications only	223.700
70	limited to units of same license; for business communications only	223.725
71	for units of the same or different license; limited to contact only; units must change to alternate channel for message	223.750
72	for units of the same or different license	223.775
73	for units of the same or different license	223.800
74	for units of the same or different license	223.825
75	for units of the same or different license	223.850
76	for units of the same or different license	223.875
77	for units of the same or different license	223.900
78	for units of the same or different license	223.925
79	for units of the same or different license	223.950
80	for units of the same or different license	223.975

It is recommended that all transceiver equipment be required to have a switch cutting power to one watt transmit to the antenna. It is further recommended that repeater operations be permitted on channels 61 through 80 with the restriction that tone control be required on all repeater operations. Licensing on Class E Citizens Radio Service should be established so that each transmitter must have an individual license with a license fee of $3.00 for each transmitter, valid for five years. A provision should be made that license applicant may be granted the same license identification number he is using on other equipment within the service. An exception to this rule would be a license may be granted on a no-charge basis for any authorized Public Service Agency.

The manufacturer would be held responsible to include a short form Class E Citizens license application with the owner's manual of each set and the dealer held responsible for assuring that an application is passed on to the purchasers of the transceivers at the time of sale of new and used equipment to a user.

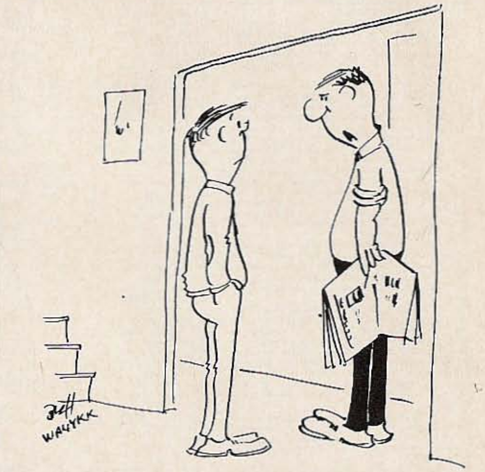
To simplify licensing procedure in the case of individuals, a short form license application (included with each set) may be used to self-assign call numbers which require no response from the Commission. A sample short form licensing procedure is attached.

Further control of illegal or improper equipment sale and operation is established by requiring the Manufacturer and Dealer to certify that the equipment, when sold, complies with the applicable regulation.

It is urged that the Commission move with haste to provide this much-needed rulemaking for the benefit of all citizens and their growing requirement for personal two-way radio communications for convenience and safety.

Very truly youfs,

W. I. Thomas - Chairman
Citizens Radio Section
Industrial Electronics Division
Electronic Industries Association



"A 30 to 50 megacycle rig? Why can't you walk to school like I did?"

73 Reader Service Coupon

Now we don't say that every single reader must buy every last product advertised in 73. We believe that, but we don't say it. The very least every reader can do is to put on a show of interest in the products herein advertised. To make this a simple task, even for the laziest reader (now there is a contest for you!), we have cleverly arranged the advertising index to double as a readers service coupon. All you have to do is tear it out (or photocopy it) and send it in with the appropriate boxes marked. (We have a prize for the most boxes marked . . . a silent prayer of thanks from the publisher). We'll accept postcards, slips of paper, or almost anything else that lists the companies you want to hear from and your address.

No one likes to go into a store without buying something, right? It is the same with these information requests. You will be expected to buy something. Oh, it doesn't have to be a $50,000 antenna system, but it should be something modest . . . a transceiver . . . a linear . . . you know. We'll leave the decision up to you, knowing that we can trust you to do the right thing.

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PROPAGATION CHART

J. H. Nelson

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March 1971

SUN	MON	TUES	WED	THUR	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	$\boxed{18}$	$\boxed{19}$	20
21	22	23	24	$\boxed{25}$	26	$\boxed{27}$
28	29	30	31			

EASTERN UNITED STATES TO:

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

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	21	14	14	7	7	7	7	7	14	21	21	21
ARGENTINA	21	14	14	7	7	7	7A	14A	21	21	21	21
AUSTRALIA	21A	21	14	7B	7B	7B	7B	7B	14	14	21	21
CANAL ZONE	21	14	14	7A	7	7	7	14A	21A	21A	21	21
ENGLAND	7	7	7	7	7	7	7B	14	21	21	14	7B
HAWAII	21	21	14	7	7	7	7	7	14	21	21A	21
INDIA	7	14	14	7B	7B	7B	7B	7	14	7B	7B	7B
JAPAN	21	14	14	7B	7	7	7	7	7	7B	7B	14A
MEXICO	21	14	7	7	7	7	7	14	21	21	21	21
PHILIPPINES	21	14	14	7B	7B	7B	7B	14B	7B7	7B	7B	14
PUERTO RICO	14	14	7A	7	7	7	14	21	21	21	21	21
SOUTH AFRICA	14	14	7	7	7B	7B	14	21	21A	21	21	21
U. S. S. R.	7B	7	7	7	7	7B	7B	14	14	14	7B	7B

WESTERN UNITED STATES TO:

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

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