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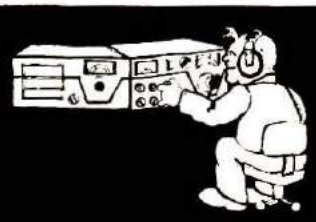

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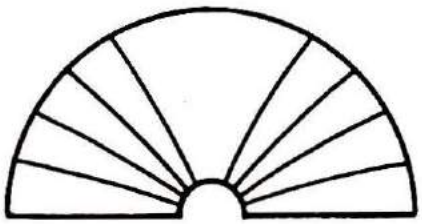
THIS MONTHS



HORIZONS

High-Frequency Mobile

Operating mobile on the high-frequency bands can be a lot of fun, and has a loyal following, even in this heyday of vhf. There are many advantages to this mode of operating, including not having to think about timing out the repeater. W1EMV tells you what some of the bands hold in store for the traveler, and shows that an installation for high-frequency mobile is not much different from that for any other part of the spectrum.

Noise Pollution

Radio amateurs have been grumbling for a long time about the noise produced by most automotive electrical systems, but very little was done to make their life easier. Then came CB and the millions of rigs that roared to the tune of spark plugs and whined with the energy of alternators. Editors W1XU and W1SL visited an old-time New England manufacturer who has a definitely modern grip on the noise problem. They learned a lot and are happy to tell you about it.

Three-Band Antenna

There are times when an amateur thinks perhaps he should have taken plumbing lessons, especially when it comes to antenna work. The materials list reads like a hardware-store inventory — Tee, PVC, eye-bolts, conduit, plumber's tape. But this assortment of oddities can be manipulated into a useful antenna for three amateur bands. W6HPH tells us about it in this reprint from *ham radio* for October, 1968.

Stalking the Ionosphere

There has been some publicity in the amateur and electronic press about creating ionized layers by heating the upper atmosphere, but did you know that the same fellow involved in those experiments was also a prime mover for ssb in its early days? Or that he developed a radar-like system to determine to what areas the bands were open? This is only a partial list of the interests and accomplishments of Dr. Villard, W6QYT, as told to author Blakeslee during a recent interview. Fascinating, and it all started with his involvement in amateur radio! Part 1 starts on page 34:

Golden Years — 1937

Those were the good old days, when everyone built his own equipment! Right? Not necessarily. Manufacturers then, as now, recognized a market when they saw one, and a few produced receivers and transmitters for the amateur bands. Bill Orr talks about a budget station that you could obtain off the shelf for an outlay that was not out of the question, even in those post-depression days.

Questions? And Answers!

This installment of the License Study series deals with some of the active elements found in radio circuits: vacuum tubes and what they do, transistors and what happens to the electrons, and diodes for signal or power-supply uses. It's all a prelude to a later section that puts several components together in a circuit for you.

Remembering Basic Electronics Theory

One problem that almost every prospective amateur faces is that of remembering all the technical material for the amateur license exam. In this article W6NIF discusses some memory joggers called mnemonics, which are used by the scientists and engineers. The article originally appeared in the December,1969, issue of *ham radio*; it is repeated here to help those wishing to get over the hump in memorizing basic electronics theory.

Tribulations of a Traffic Man

If you think that handling messages in amateur-radio circles is easy — take a second look. Oh, sure, they sound so self-confident and proficient as they check into a net and pound out a message to aunt Minnie in Sioux Falls, and accept one in return for cousin Freddie, but they put in a lot of hours before they reached that stage of smooth response. Maybe, as the saying goes, "Half of the fun is in the getting there." It must be so, otherwise VE3GFN could not retain his sense of humor as he tells us about it.

The Cover

Long before there were such things as vhf repeaters, amateurs were operating portable and mobile on the bands between 3.5 and 30 MHz, and they are still doing so. It's a great world that can be reached with a few watts, a good rig, and an antenna clamped to your back bumper. W1EMV tells us a bit about what to expect, starting on page 12. Original painting by Tom Broscius, WA2RWA.

HAM RADIO HORIZONS May, 1978, Volume 2, No. 5. Published monthly by Communications Technology, Inc., Greenville, New Hampshire 03048. One-year subscription rate, $10.00; three-year subscription rate, $24.00. Second-class postage paid at Greenville, New Hampshire 03048 and additional offices.

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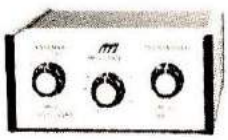

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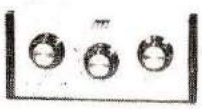

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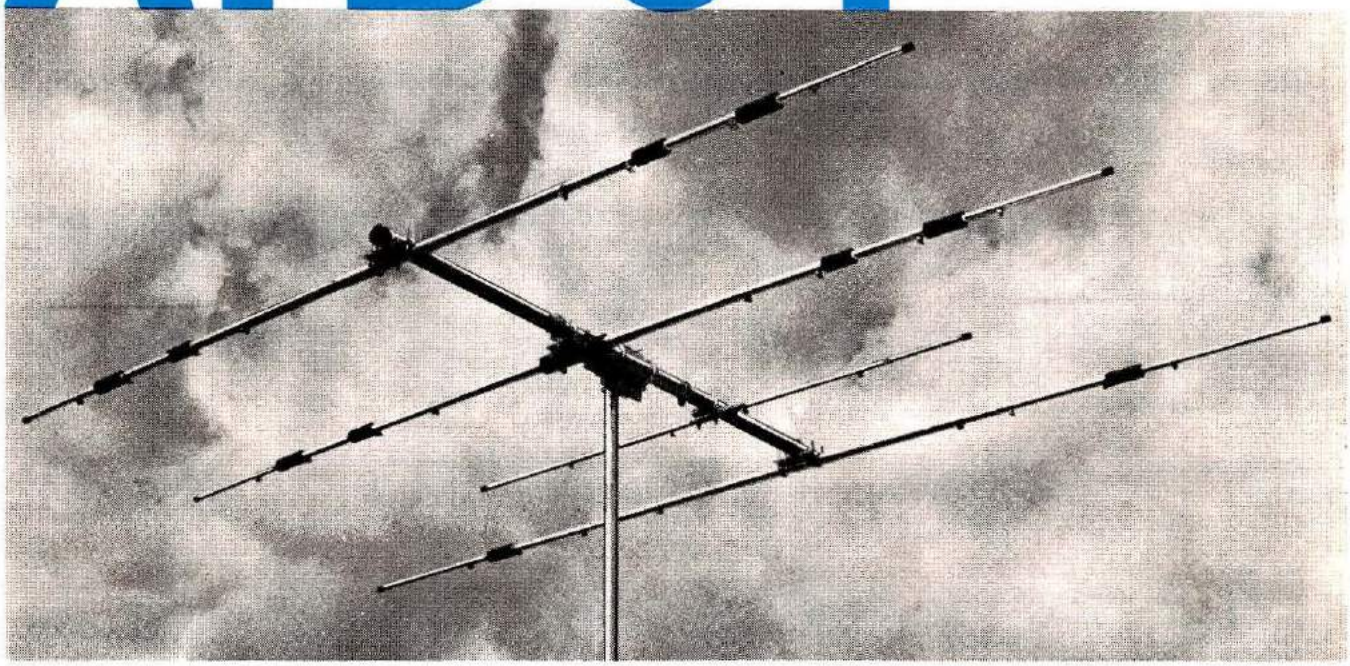

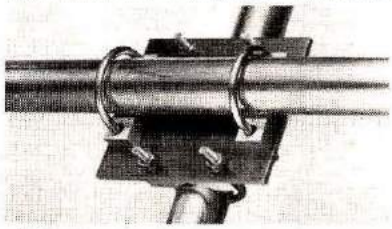

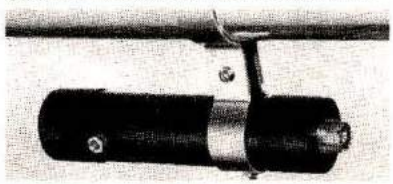

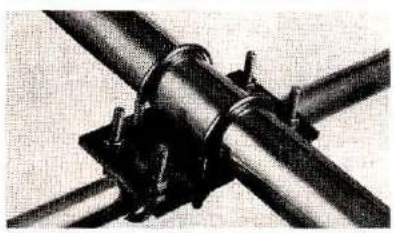

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CONTENTS

If you've been watching our monthly propagation reports, you're probably aware of the fact that DX conditions have improved dramatically over the past few months. The 20-meter band has been open late into the evening and 15 meters has been open nearly every day; ten meters has even produced some choice DX openings from here in New England. With propagation conditions the way they are right now, and improving by the day, the high-frequency amateur bands are a DXer's paradise. If you're interested in making DXCC, you should be able to do it in a month or less — if you *listen*.

It's amusing to scan up and down the 20-meter band looking for rare DX, noting all the locals calling "CQ-DX," and picking up FB8WF on Crozet, ZS2MI on Marion Island, and 3D6BP in Swaziland in between the CQ-DXers. It's more frustrating than amusing when you hear a strong W/K station calling "CQ-DX" right on top of AP2TN, 7P8BC, or UJ8AI. The point is, if you want to work the rare ones, you've got to *listen* — listen, listen, and listen some more.

You can work some pretty good DX by calling CQ if you have a powerful signal or live in a rare state, but you'll improve your country total a thousand times faster by listening more. I know you're not all interested in working a new one, but even if you're interested in chewing the fat, you're not going to do it by calling CQ a dozen times and signing your call once. You'll wear out your mike, your key, and your final, but you won't put very many entries in your log. More power isn't the answer either — good operating is the only thing that will do the job.

With DX conditions improving, I thought it would be worthwhile to pass along some words of wisdom gleaned from successful operators with average equipment but above-average operating know-how. It's difficult to compete against high power and elaborate antennas, but it *can* be done. The formula is simple: sharp operating and a little luck. The idea is to refine the first so the second will be a free bonus.

Consider the inevitable pile-up of stateside stations trying to work a choice DX station. The DX station will be making contacts at a tremendous clip. Often he won't send his call for 15 or 20 minutes. To compound the problem, many U.S. hams will work him and *they* don't send his call either — it takes too much time. Not only is this senseless, it's illegal for U.S. hams.

If you're with it, you'll note the DX station's frequency, move on and work others, then check his spot at frequent intervals. Sooner or later his identity will be made public.

The next step is to plan your strategy so you can leap in, latch on, and leap out. This is by no means as easy as it sounds. Here are some ideas that will help: Note how the DX station answers calls. Perhaps he replies to stations clustered above and below his frequency. Or maybe he works stations who transmit a few kHz higher each time. After a few contacts, a pattern will emerge. For example, how often does he answer stations on the low side of his frequency before he changes to those on the high side? By playing the law of averages, eventually you'll score.

If it all seems useless despite your efforts, the wise thing to do is to move on and work other stations. Later you can return to the original pile-up, which will probably have diminished, and you can try again. With patience and good operating skills you'll make contact!

Jim Fisk, W1HR
editor-in-chief

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FOCUS & COMMENT

There's another amateur satellite in the skies! That breath-holding moment, the launching, went well and so did the separation of the satellites from the vehicle, much to everyone's relief. It was very exhilarating to listen to the reports coming in from various stations around the world as they copied telemetry information and passed it along to the AMSAT contact station in Maryland on Sunday afternoon, March 5th. There were strings of numbers from South Africa, Germany, Hawaii, the United States, and other parts of the world — numbers that told the designers what was happening on board the new OSCAR 8 as it looped around the globe.

In addition to the data indicating the condition of the satellite, there were reports of antenna elevation for best reception, doppler-shift information, times of acquisition and loss of signals, all of which enabled the orbital parameters to be pinpointed. For those of you who like to exercise your mathematics, here are some of the numbers available as I write this: Height at apogee, 912.53 km; at perigee, 908.07 km; period is 103.23 minutes; inclination is 98.989°; and the eccentricity is 0.000905.

The bird is going through a period of monitoring and tests, but the various transponders should be turned on for amateur use long before this appears in print. You can get the latest information by monitoring the AMSAT net on 3850 kHz each Tuesday evening (Wednesday morning GMT) at 0100 in the east, 0200 in the midwest, and 0300 on the west coast. You can obtain equatorial crossing times by copying the bulletins from W1AW on several frequencies and at various times every day.

It is easy to be impressed by the technology that put the new satellite together, what with all the conditions that had to be met — ability to perform during wide temperature excursions, power-supply reliability, spectral purity of emissions, receivers that are sensitive but hard to overload, and on and on.

However, what is even more impressive to me is the ability to get so many groups pulling together toward the same end. To work out a design acceptable to all, and especially that is acceptable to the people who provided the launch vehicle — NASA — is both an engineering feat and a diplomatic success. Ideas, expertise, parts, assemblies, and advice came from opposite sides of the world, and had to be coordinated into a final package that met some stiff specifications.

The new transponder, 2 meter input/70 cm output, named Mode J in honor of its Japanese designers, will add a new dimension to amateur satellite communications. Many amateurs have obtained equipment to transmit on the 70-cm band in order to use the Mode-B capability of OSCAR 7. Now they can install receiving equipment for that band in order to use Mode J; this will have a most beneficial side effect of allowing them to use the 70-cm band for point-to-point, non-satellite communications. Perhaps the band will become populated at long last — and there's plenty of room for the newcomers.

So, there's your incentive to join the space age, to upgrade your license, to explore a new band and a new mode of operating. If you are still in doubt, listen in for a few passes of either OSCAR 7 or 8; it's contagious.

And to AMSAT, ARRL, JAMSAT, NASA, and the many others who helped put number 8 in the sky, a hearty thank you and well done!

Thomas McMullen, W1SL
Managing Editor

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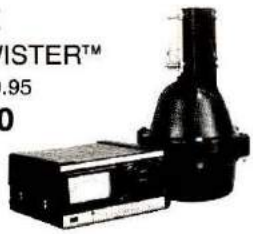

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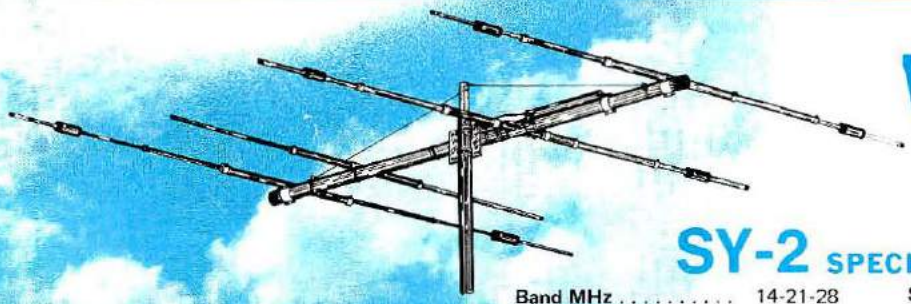
THE SYSTEM TWO™ TRIBANDER ANTENNA . . .

Top Performance for 20 - 15 - 10 Meters!



Wilson

SY-2 SPECIFICATIONS

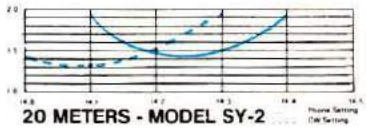
Band MHz	14-21-28
Maximum Power Input	4 Kw
VSWR (at Resonance)	1.5:1
Impedance	50 Ohms
F/B Ratio (dB)	20-25
Boom (O.D. x Length)	2" x 18'6"
No. Elements	4
Longest Element (Ft.)	26'7"
Turning Radius (Ft.)	16'4"
Mast Diameter	2" O.D.
Boom Diameter	2" O.D.
SHIPS BY U.P.S.!!!	

Surface Area (Sq. Ft.)	6.15
Wind Loading at 80 mph	153
Assembled Weight (Lbs. - Approx.)	47
Shipping Weight (Lbs. - Approx.)	50
Matching Method	Beta
Only One Feed Line Required	

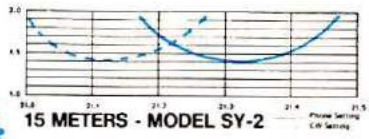
Delivers outstanding performance on 20, 15 and 10 meters. Features Wilson's large diameter High-Q Traps, feeds with 52 ohms coax, a beta match method presents tapered impedance which provides most efficient 3 band matching and DC ground to eliminate precipitation static. The result is SWR less than 1.5 to 1 at resonance on all bands and maximum front-to-back. An added feature is the separate 10 meter reflector for correct monoband spacing. Add to this the rugged boom to element mounting, heavy duty taper swaged elements, and you have

SYSTEM TWO™

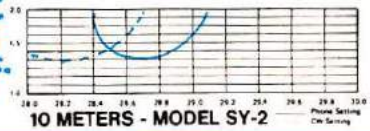
. . . a space efficient, high performing, cost effective new tribander . . . value priced at $199.95!



20 METERS - MODEL SY-2



15 METERS - MODEL SY-2

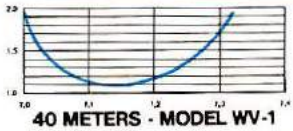


10 METERS - MODEL SY-2

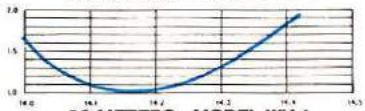
DEALERSHIPS AVAILABLE!!!

We are looking for new Dealers for certain areas of the country. If you are interested, contact us for details.

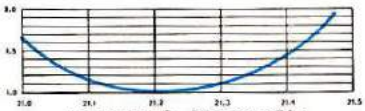
40 THRU 10 METERS VERTICAL TRAP



40 METERS - MODEL WV-1



20 METERS - MODEL WV-1



15 METERS - MODEL WV-1

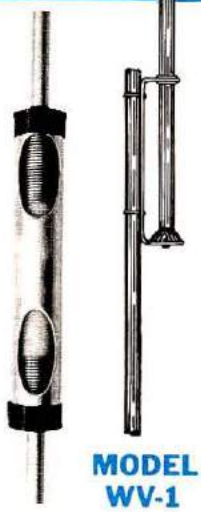
10 METERS - MODEL WV-1

WV-1 WILSON VERTICAL TRAP ANTENNA

No bandswitching necessary with this vertical. An excellent low cost DX antenna with an electrical quarter wavelength on each band and low angle radiation. Advanced design provides low SWR and exceptionally flat response across full width of each band. Featured is the Wilson large diameter High-Q traps which will maintain resonant points with varying temperatures and humidity. Easily assembled, the WV-1 is supplied with base mount bracket to attach to vent pipe or to mast driven in the ground. The new WV-1 Antenna is priced at $65.00 . . . and ships via UPS!

SPECIFICATIONS

Input Impedance: 50 Ohms • Powerhandling capability: Legal Limit • Two High-Q Traps with large diameter coils • Low Angle Radiation Omnidirectional performance • Taper Swaged Aluminum Tubing • Automatic Bandswitching • Mast Bracket furnished • SWR: 1.5:1 on all Bands • 1½" O.D. Heavy wall aluminum tubing • Does not require guying • Overall length: 25' 1½".



MODEL WV-1

Wilson Electronics Corp.

4288 SO. POLARIS AVENUE • P. O. Box 19000 • LAS VEGAS, NEVADA 89119

TELEPHONE (702) 739-1931 • TELEX 684-522

NEWSLINE

OSCAR 8 IS UP AFTER A flawless launch that lifted off the launch pad right on schedule on March 5th. Listeners to the AMSAT 20-meter net heard the actual countdown and blastoff relayed by WA3NAN, and the ejection of OSCAR 8 from the launch vehicle was so perfect that the 435.095-MHz beacon signal showed the satellite was tumbling far less than had been expected. This permitted extension of the 10-meter antennas Sunday evening on the fifth orbit instead of waiting several days as had originally been planned, and on the following orbit Mode A was turned on as OSCAR 8 came over the southern horizon and its 29.402-MHz beacon laid a strong signal across the entire U.S.

Preliminary Tests Show the new bird to be a fine performer, with good Mode J signals and Mode A performance apparently even better than OSCAR 6 was. OSCAR 8's orbit came very close to predictions, with preliminary calculations showing it nearly circular with a 909.583 km mean altitude, a period of 103.193 minutes, and an inclination of 99.146° resulting in a 25.7983° progression at the equator each orbit.

10-METER AMATEUR LINEARS WERE BANNED by the FCC Commissioners at their February 16th meeting, and it seemed evident that most had already decided on the ban before the meeting began. The ban covers the commercial manufacture, distribution, and sale of any RF power amplifier covering the 24-35-MHz range, and will become effective almost immediately. As to linears in manufacturers' or distributors' inventory when the ban begins, their sale will also be prohibited without specific FCC waiver — which will be given on a request-by-request basis to insure that they are legitimate Amateur amplifiers going to legitimate Amateurs.

Amplifier Sales between individual Amateurs are still permitted, and individual Amateurs can still build their own 10-meter linears, of course. Limited Type Acceptance of Amateur amplifiers below 144 MHz was also adopted with technical standards similar to those already in Part 97; actual implementation of Type Acceptance won't take place until detailed specifications and procedures are ready, probably early this summer.

FCC Has Bigger Teeth Now as a result of legislation recently signed into law by President Carter. The new law gives the FCC jurisdiction over unlicensed as well as licensed operators and increases the maximum fine ("monetary forfeiture") the Commission can levy to $2000. The new law shouldn't change things much for licensed Amateurs, but should make a lot of difference in FCC's efforts to go after HFers and other scofflaws.

"RF RADIATION IS DANGEROUS and that danger is unappreciated in the United States" is the theme of a just-out provocative new book, The Zapping of America, by Paul Brodeur. Though the author's premise is hotly contested in the scientific community, the book, which is principally concerned with microwave radiation but does also touch on the HF and VLF spectrums, is fascinating reading and is being widely promoted. Whether or not it is accurate, its sensational claim could cause difficulty for an Amateur whose neighbors read and believe all it says. Ham Radio's Communications Bookstore is making The Zapping of America available for $11.95 plus 35 cents postage and handling.

A 3825-MILE 2-METER SSB contact between KP4EOR and LU5DJZ set a new DX record for the band February 12. KP4EOR also worked LU8DIN, whose 10 W, 145.1-MHz signal was 5-4 to 5-5 during the TE mode opening. CX8BE also heard KP4EOR and KV4AD heard the LUs.

VHF RECEIVERS AND SCANNERS are still illegal in an automobile in New Jersey without a special permit, but Senate Bill S-729 (CA3471-1977) by Senator Thomas Yeats would exempt Amateurs from that restriction. This bill replaces a previous similar bill which died at the end of the last session, and New Jersey Amateurs should urge their state Senators to get it out of the Transportation and Communications Committee, where it's presently stuck, and support its passage.

ADD-ON SYNTHESIZERS can trigger in- and out-of-band spurs due to mixing problems when the rigs they're used with are operated crystal controlled. Shutting the synthesizer off when it's not in use will solve the problem.

Local Oscillator Radiation is apparently a problem with some Bearcat 210 scanning receivers. Repeaters in the Cleveland area have reported a key-up problem from antenna-radiated LO signals, and the FCC is looking into the problem.

27-MHZ CB has its 20th birthday this year. In case anyone wants to plan a big celebration, it was on September 11, 1958, that the FCC authorized the Class D Citizens Radio Service.

W-PREFIX BY 2 CALLSIGNS are all now used up in call areas 1, 2, 5, 6, and 7.

BY KAYLA HALE, W1EMV

Don't leave the DX bands at home—put a high-frequency rig in your car

The band is starting to come alive now — a few of the signals that were barely readable a few minutes ago are strong enough for good copy, and still building up. Listen a moment. "CQ DX, CQ DX, CQ DX, this is W5. . . in Houston, calling CQ DX and listening." Good signal, but he's looking for some DX, so don't call him. Here's another. "Sure is good to hear from you up bright and early today Bob. What's new since I talked to you last week? Go ahead." Must be someone running a schedule. Wonder where he was — that accent placed him somewhere in the deep South. There's your chance — a W7 in Tucson calling CQ; a nice contact to start the day.

Chicago's Loop is over an hour behind you, and the sun is two hours into the sky this morning. What band is this? Twenty meters, of course. With your 100-watt rig and a well-matched antenna you'll have plenty of company on your trip downstate to southern Illinois. Maybe you'll catch a few European stations when the band really gets going. You had a lot of fun talking to some of the area stations on 75 last night as you got into town, but there's not a lot doing on that band right at the moment.

Ahh, yes, 75 meters. Great band. Remember the time you drove from Rhode Island to Florida? It was just like old home week all along the way. All the old buddies that you had talked to from your home station were really glad to hear from you as you went through their towns. It was hard to resist the offers for a visit (eyeball QSO, to use the jargon), and you could have gained 20 pounds on the dinners that you were invited to share. Real hospitality, and you took some of them at their word when you made the return trip — time was not so pressing then and you could spare a little for a side trip and a stay of a few hours now and then.

Two meter fm? Oh, sure, you have a portable little rig and a magnetic-mount antenna, and it has come in handy from time to time. But your real contact with old friends — and some new ones gathered along the way — comes from the part of the spectrum called the high-frequency bands: 80 and 10 meters.

Two meter fm is great for the ham who lives in a big city and has to drive to and from work. It allows the use, in many cases, of phone patches to let people know when you expect to arrive in the case of a delay. Usually you talk with friends you can meet face to face at association meetings. This makes two meters even more fun.

However, if you travel long distances from home, two-meter fm can be limited, even with repeaters. It can be helpful when arriving in a strange town to find out where the best motel or restaurant is located, but there are some areas where access to repeaters is poor. For example, I have driven through much of the Appalachian area in the Eastern United States. Unless you happen to hit a favorable spot in this hilly country, you can drive for a considerable distance without making a single contact on 144 MHz. Once contact is made, it really doesn't stay in for long; there is always another hill just ahead.

Then, too, there are the wide-open spaces of the western United States — areas where "towns" are a hundred miles apart and usually do not have a repeater. I put "towns" in quotes, because when you look them up in the index of your trusty atlas, you find a population of 50-100 people, none of whom are hams. Many don't even have TV, much less a repeater! They do have CB in some cases, but that is another subject. Incidentally, I must admit that CB has its place. I own a CB rig and have a license to operate it, but except for listening for road conditions, I rarely use it.

As hams, we have lots of bands to use for various propagation and operating conditions. Most of them are well suited for mobile operation. Let's explore them, band by band.

75 meters

This is a rag-chewing band. You can find a round-table discussion going on about every 5 kHz, and covering topics of all kinds. Some of the groups have a reputation for not welcoming strangers, but, I assure you, this is an undeserved reputation. Most of the operators or nets will welcome a mobile, especially, and will take the time to answer questions about roads and towns. The best suggestion is to get acquainted with a group on 75 before going mobile, then you will get red-carpet treatment when you are out on the road.

Just as two meters has limitations, so does 75, depending on the time of day. On most days you will find the skip is long very early in the morning and after dark at night. During the mid-day hours, 75 is a short-skip band (480 km — 300 miles or so). At night, there is some interference from foreign broadcast stations with whom we share the band. It is not impossible to cope with this situation, however. Most of us zero beat the foreign station and work right through it. This is often much better than trying to find a clear spot and then be plagued by a heterodyne. Traffic nets and weather nets, as well as informal round-tables, abound on 75 meters, so you may be able to find someone near home to pass a message for you. Many of the hams on 75 keep a road atlas in the shack to give directions to mobiles. Some even keep marine charts and tide tables to help out the boating crowd when they follow the sun each winter and spring.

The Atlas transceiver fits nicely below the two-meter fm unit under the dash. The transceiver provides coverage of the amateur bands between 3.5 and 30 MHz. A power and SWR meter help to see that all is well with the transmitter and antenna system.

In most cases the "nets" on 75 are casual. Identification is once each 10 minutes to satisfy the FCC requirements. Otherwise, they are like a group sitting in the living room chatting. At times there is some doubling, but it is remarkable how little. Most use VOX (voice-operated transmitter) and pause after each comment to see if anyone else is talking. VOX operation is not always satisfactory in a mobile due to transient noise, but it is always possible to release the push-to-talk button after each comment and achieve the same goal.

40 meters

This is probably the most popular mobile band. It has everything 75 does (including nighttime foreign broadcasts), but is open over longer distances during daylight hours. It is a much more businesslike band and has special nets which are run 24 hours a day just to keep track of mobiles (EastCARS, MidCARS, WestCARS). There is less of the casual rag-chewing and more of the "check in, state your purpose, wait your turn" kind of operation. You may not get much time to chat, but you *will* find cooperation from all parts of the country when you need it most. Of all the ham bands, 40 is probably the most service oriented for day-time mobiles. At night, you will be hard pressed to find a spot where there is not interference from the foreign a-m stations, along with jammers from countries who don't wish the broadcasts to get to their destination. Like 75, 40 is a shared band. In other parts of the world, 40 and 75 meters are not exclusively ham bands; the low ends are for amateurs, but our voice bands are allocated for broadcast use. One learns to live with these conditions, although there are some unprintable words we sometimes mutter under our breath.

20 meters

Ah-ha! Now we come to the band which is consistently useful, day and night. It has long skip (1600 km — 1000 miles or so), and open to all kinds of fun! Like 40, 20 is fairly businesslike. You'll find Intercontinental nets, County Hunters nets, traffic nets, phone patches, plenty of rag-chewing, and just general good times and company for that long trip you are taking. If you happen to find yourself in a rare state or county, you will be a very popular ham, indeed! After your vacation or business trip, you will return home to a stack of QSL cards begging to be answered. There is virtually no interference (except for other hams) on 20. You can work DX late at night when most of the band is quiet. All in all, 20 is a good mobile band.

15 meters

As of this writing, 15 is a little unreliable. It has been picking up of late, and should continue to get better. Operation on 15 is primarily long skip and DX oriented. When the band is open, it is unusually quiet and interference is at a minimum. Conjure up a picture of yourself out in the middle of nowhere, having an unbroken chat with a New Zealander or Australian as you drive along. I guarantee you will not be bored and will not fall asleep at the wheel. Success will, of course, depend on monitoring the band to make sure it is open. You won't find many nets, but you may be lucky enough to set up schedules back home and have reliable contact for phone patches.

10 meters

Once again, as of this writing, 10 meters is uncertain. One way to determine if it is

open for you is to check the skip on CB. If the long skip is in on CB, 10 meters should be just as good. When this band is open, it is a ball! It can sound completely dead, and suddenly a DX station is there sounding as if he is in the car with you.

Finally, 160 meters

I have left this one for last as there is not much to be said about it for mobile use. The size of the antenna pretty much takes it out of the running for most mobile installations. Save that band for the home station where you have lots of room to string wire.

How much power?

Power requirements vary with each band. A general rule is the lower frequencies require higher power. You can do well with a good antenna system and very low power on 10 meters. I used to keep regular schedules between Hawaii and Kansas with less than one watt. My introduction to amateur radio was from Hawaii — I sat in a friend's car and talked to a ham in South Africa on 10 meters, using 25 watts. That's how I got hooked! You can manage to get by with about 100 watts output on 75 meters.

Now to the nitty-gritty! I have painted a rosy picture of mobile operation on "those other bands." Where is the catch? It boils down to money, strength of both spirit and back, and a certain amount of know how.

With few exceptions, a 5- or 6-band transceiver takes up more space in the car than does a 2-meter box. With our cars getting smaller, and the amount of stuff under the hood getting larger, it is a challenge to install a rig in many cars. As the new models come out, I get the feeling that the dashboard is coming closer and closer to the front seat, and there is less space between the dash and floor. This is especially true in a rear-wheel-drive vehicle where you have a hump in the floor just where you want to put the rig.

If you need more power for your mobile excursions, this DenTron MLA-1200 with mobile supply will provide it. The unit is capable of 1000 watts input on CW, or 1200 watts PEP on ssb. Be sure your generator, battery, and electrical system are in good shape before using this much power.

Choice of equipment

I will not go into the advantages of one make over another. This is up to you and your pocketbook, the space available, and personal preference. A transceiver is not something to rush out to buy without first taking stock of what is available in your price range. Talk it over with other hams who are operating mobile and see what they are using. Then, and perhaps most important, listen to them on the air and see how they sound to you. Many of us are guilty of bragging about our own special piece of equipment without ever knowing how we sound to the other fellow. I know hams who are very enthusiastic about their rigs, but who sound almost unintelligible over the air. Another ham may have the same rig and sound beautiful.

When you have made a decision to spend your money, first get someone to loan you an instruction manual. Study the manual carefully, and find out if you are going to be able to service the rig yourself or have to ship it off for months at a time for adjustments. Reliability is probably the prime factor in a mobile rig. There is nothing quite as frustrating as having the car all packed and ready to take a trip across the country, only to find the rig is not working. There goes the fun in mobile operation.

To insure reliability, you must know what is inside. Even if it is working well at the start of the trip, things can go wrong; Murphy's Law applies especially to mobile rigs. If the rig is going to break down, it will be when you are in Podunk Junction, a long way from the nearest radio store. Therefore, go through the manual with a special eye for those components (tubes, transistors, diodes, etc.) which are most likely to break down under the stresses of bumps and jolts and poor voltage regulation, and cold and hot climates.

Now make up a care package to nestle in the trunk in a readily accessible spot. This should contain all the just mentioned component parts, and should also contain the tools needed to make the repairs. You can't change a

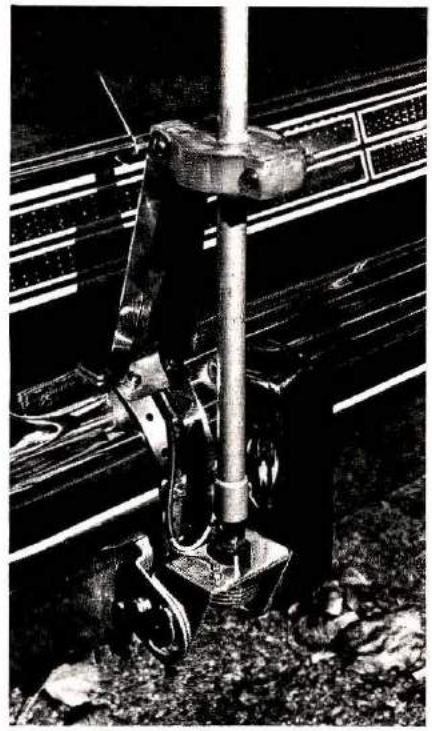
tube if you don't have the right screw driver to open the case, can you? Not to mention changing a diode without a wire cutter, a soldering iron (battery operated), and some fine solder. Plan ahead! You should have spares for emergencies; don't forget the fuses. Be sure to take the manual along! You can't find your way around in those boxes without a diagram. You need a road map to work your way across the country, and you need a manual to find your way around the rig. Now that you have decided to go mobile on the lower bands, you have just begun.

Installation of the rig

The accompanying photos are not of my installation. They are the genius of one Clarence Snyder, W3PYF, who is not only a fine ham, but a superb photographer. His little Atlas transceiver will fit in any car, large or small. It is compact and, for him, efficient. My rig is a Swan 500; the Atlas would fit in one fourth of my Swan and get lost. I had a problem with space. The dash was low to the floor, the space between the dash and the seat inadequate, and I thought I'd never get things to fit. Then I decided to ask some used car dealers how they felt about drilling holes where there weren't supposed to be any. I found that the book price is the book price regardless of extra holes.

So, being brave (or was that reckless?), I took the drill bit in hand and proceeded to drill two holes in the imitation leather covering of my dashboard. The Swan is suspended by two pieces of scrap metal and rests almost on its back on the hump. This leaves room behind the rig for the power supply. All is neat and tidy, and the dials are facing up so I can see what I am doing without taking my eyes off the road too much.

The installation will have to fit your own circumstances. However, depending on your size and the size of the rig, you may find it extremely helpful to be something of a contortionist! Whether you do it the way I did, or use a conventional mobile mount under the dash, you have to drill at least two holes. The position you must assume to accomplish this is almost painful to describe. How you get there is your business, but usually you must have your back running up the back of the front seat, your legs draped into the rear seat compartment, and your head dangling between the front seat and the dash. Oops, you forgot to bring the drill into the seat with you. Now, holding the drill upside down, you get to the work at hand. You may have to go on a diet for a few months to get to this stage, or you might consider hiring a talented midget. Now that you have, I assume, accomplished the drilling and mounting step, you need to have power. Unlike a 10- or 20-watt 2-meter rig, you may not use the cigar lighter. The best method is to go directly to the battery, using wire no smaller than no. 8 (3.3 mm). I may get some arguments on that point, but the heavier the wire, the better regulation you will have to insure proper voltage to the rig.



A strap-on mount allows a whip antenna to be fastened to almost any shape of bumper your car may have. The plastic block clamped to the whip provides additional support to reduce the strain on the base insulator. A small shunt inductor to help match the antenna to the coaxial cable is tucked out of the way underneath the bottom part of the mount.

Now you must get the wire through the fire wall, which is not always an easy job. In some cars, it is possible to snake the power wires through where other wires are located; in others, it is necessary to drill a new hole. Even with large wire, the length should be as short as possible. However, even the used car dealer won't know the hole is there, so don't worry about it.

Some rigs have a built-in dc supply, but others require a separate supply for both dc and ac. Some rigs have a built-in speaker, others do not. Take all this into consideration before your spend your hard earned money.

The antenna

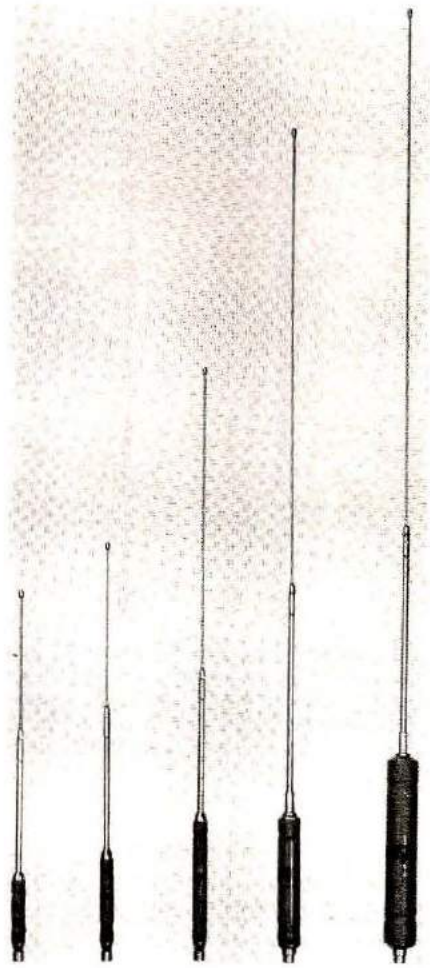
The optimum location for your antenna is on the left rear bumper. However, they don't make bumpers the way they used to, and some will not support the mast, coil, tip, and the stress of motion. On some cars it is almost impossible to find a mount which will fit. The next best bet is a deck mount. The fender material is not much better than the bumper, but you can (and should) put a heavy steel or aluminum plate under the fender to reinforce the metal and keep it from tearing under stress. Here, again, don't worry about drilling holes — they can always be filled.

Now you have the rig installed, and the antenna mounted, how do you get the coax from the antenna to the rig? This is fun and games. The coax must go through the

trunk; no problem. Next you remove the rear seat, which is easy. (Just try to get it back in without the assistance of a wrestler.) The coax can be run in the trench under the metal strip which runs alongside the doors on the floor of the car. It then runs under the floor mat to the rig and *voila*! You are mobile, right? Wrong!

Mobile antennas are a different breed from those you have at home. A good vswr bridge and a dummy load/ wattmeter are important in tuning the antenna. A length adjustment of 1.5 mm (1/16 in.) can make a difference in both resonance and power output. In the mobile installation you want to get the maximum power output; you are, after all, operating with less than optimum antenna efficiency and want to squeeze every possible extra watt out of your rig. This can only be achieved with patience and time. Depending on the type of antenna you buy, it may be necessary to add capacitance at the base to make a good match. If your rig is not looking at 50 ohms, it is not going to put out its maximum power. Pruning and tuning the antenna makes the difference between a solid signal and just barely being heard. I mentioned earlier that you should get to know a group on 75 before going mobile. This is because, in most cases, you are going to be operating near a particular frequency. Mobile hf-band antennas are unforgiving if you move more than 5-10 kHz, thus every move means some loss of signal strength. There are ways to beat the system — one is to get out of the car and go through the steps of retuning the tip. The easy way is, while you are still at home base, make up a set of alligator clip leads. Get a supply of small clips and make your tests at home. My experience has been that one clip alone will let me move 20 kHz down the band. Others can be made up with short wire leads sticking out to lower the frequency by greater amounts. This is a by-guess and by-golly situation, and takes some time. If you plan to use this method, tune your antenna for the highest frequency you plan to use, then work from there to move down the band. Remember, the lower you go, the longer the antenna must be.

Changing bands, with most antennas, means changing coils. They should be readily available, especially in bad weather. There are adaptors such as the Waters Band Adder, still available from B&W,* which makes operation on 75-20-15 and 10 meters possible with fairly good efficiency.



The Newtronics Hustler RM series of high-frequency mobile antennas allows you to cover the different amateur bands by changing a top section, each with its own resonator coil.

Noise

Unlike 2-meter rigs with a squelch system, you are undoubtedly going to hear automotive noises emanating from your rig. If you are lucky, the manufacturer has shielded and grounded all electrical systems so you will not have too much trouble; don't count on it. You can have all kinds of noises, from alternator whine to just plain noises which sound like static. Curing these noises takes time and patience. (Are some of you beginning to get discouraged? Don't! It is all worthwhile in the end, I promise.)

They don't build cars the way they used to. Most modern cars are not designed with a separate frame and body. Transient noises can drive you up a wall when you are on the road, trying to hear weak signals. Once you have gone through all the steps to make sure you have a good outgoing signal, remember that the old rule still applies: if you can't hear them, you can't work them.*

If you want to mount your antenna on the rear bumper, the first step is grounding the bumper to the frame or body. If your car has been out on the road and has more than 1000 miles on it, you will have to clean film and dirt off down to shiny metal. Use a good ground strap (which can be made from the shield braid of a scrap piece of coaxial cable) to make a good connection. The same procedure should be used on the exhaust system; ground it in at least two places, just behind the manifold and again at the rear of the tail pipe. This is often the biggest culprit for

*Available from G. R. Whitehouse, 15 Newbury Drive, Amherst, New Hampshire 03031, or from other B&W dealers nationwide.

*For a discussion of noise problems and cures, see "Automotive Noise Pollution," by Jim Gray, W1XU, and Tom McMullen, W1SL, page 20, this issue.

creating noise. If you are buying a new car and plan to have it rustproofed with a product like *Ziebart*, be sure you make these ground connections prior to rust-proofing. Then have them seal the car with the ground connections in place.

Other hazards and precautions

The average 2-meter or loaded CB antenna doesn't create any trouble with overhead obstructions. It will take you some time to realize that you are not, I repeat, NOT to drive into the garage without first folding the antenna over. You will also learn not to drive on picturesque country roads with those overhanging branches. Nor will you park in underground garages without folding the antenna. This latter will be accompanied by loud honking of horns of other cars trying to gain access to the same garage. Ignore them.

Measure the height of your antenna and be careful going through toll booths. It is best to follow the truck lanes or you may find your antenna dragging on the ground. In some 20 years of mobile operation, I have broken at least as many antennas. I have also broken a series of fluorescent bulbs in public garages; once I took out four lamps at the Boston Airport. My insurance company paid for the damage, but they took a dim view of the whole thing. They assured me that this was the one and only time they would come to my aid for this purpose.

Mobile CW

You read it right — Mobile CW is not only possible, it's fun. When you sign your call/M, you create a good deal of activity on the CW part of the band. I have one friend who used to say, "you are not a CW operator unless you can work 40 wpm mobile." Naturally, you are not going to have pencil and paper, so you must copy the code in your head, and remember what was said. I haven't done this for about ten years, but I did in my early days of mobile operation. I strapped a Vibroplex bug on my knee and joined my friends on a CW net. I would not advise doing this on a crowded road, but out on the open highway where you are not in danger, it is a fine way to pass the time.

Bottom sections for the New-Tronics mobile antennas include a hinged section to allow the antenna to be folded over — a necessity if you are going to park in a garage or travel where there are low overhead obstructions.

Security

Two-meter rigs and CB rigs are too much alike to the average rip-off artist, who probably would not take the time to notice the small differences anyway. However, the high-frequency rig is noticeably an oddball. It's bigger, more complicated, and the antenna is really something else. These differences are not absolute protection, but they do lessen the chances that your rig will be stolen.

Never-the-less, it is a good idea to plan for some sort of protection for *any* rigs in your car, or for the car itself. This can be in the form of an alarm system, or, as in my case, a large German shepherd dog in the back seat. I have both — the dog on short trips and the alarm for long trips. The little that a good alarm system costs will save many times its price in secure equipment.

Summary

The equipment is available, the antennas are available, and the bands, with friendly hams to talk to, are available, so take advantage of it all and join the mobile gang on the high-frequency bands. You need to upgrade your license to gain those privileges? Don't let that slow you down — you need to do it anyway, right?

In my opinion, 2-meter fm and CB is not enough — try total communications, you will enjoy it!

HRH

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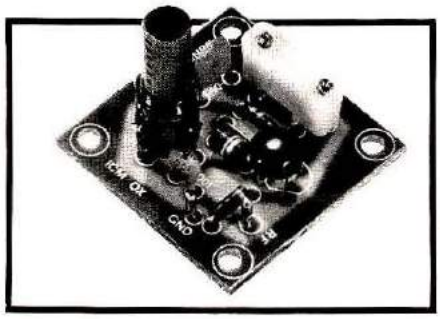

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Crystal controlled transistor type. 3 to 20 MHz, OX-Lo, Cat. No. 035100. 20 to 60 MHz, OX-Hi, Cat. No. 035101.
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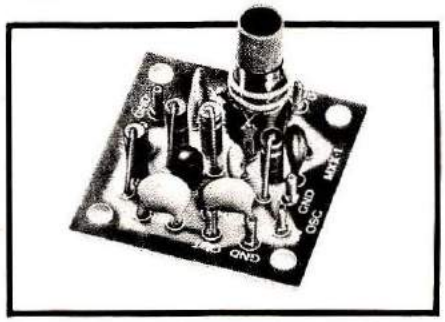

MXX-1 TRANSISTOR RF MIXER

A single tuned circuit intended for signal conversion in the 30 to 170 MHz range. Harmonics of the OX or OF-1 oscillator are used for injection in the 60 to 179 MHz range. 3 to 20 MHz, Lo Kit, Cat. No. 035105. 20 to 170 MHz, Hi Kit, Cat. No. 035106.
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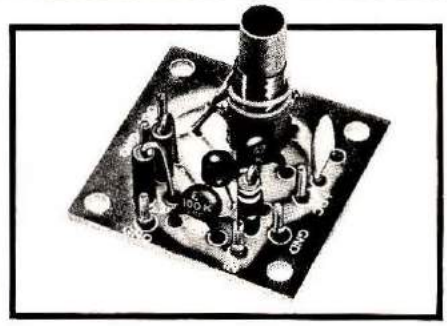
$5.50 ea.



PAX-1 TRANSISTOR RF POWER AMP

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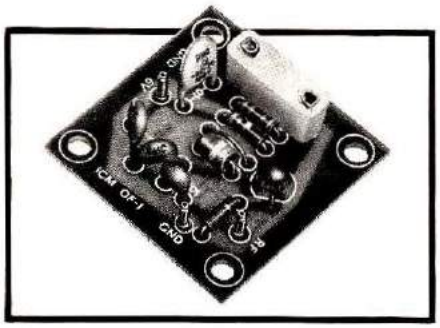

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Resistor/capacitor circuit provides osc over a range of freq with the desired crystal. 2 to 22 MHz, OF-1 LO, Cat. No. 035108. 18 to 60 MHz, OF-1 HI, Cat. No. 035109.
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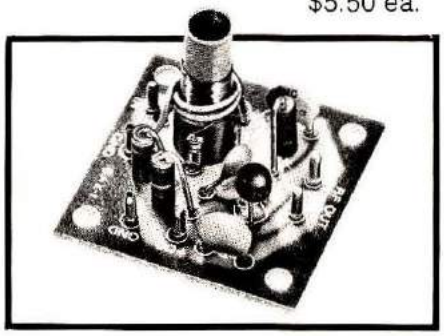

SAX-1 TRANSISTOR RF AMP

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

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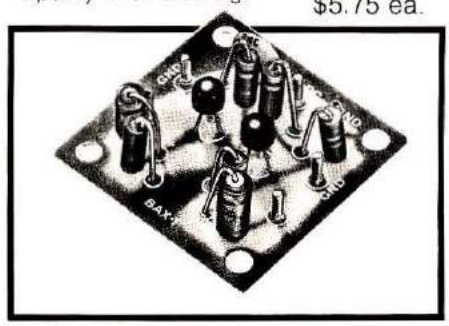

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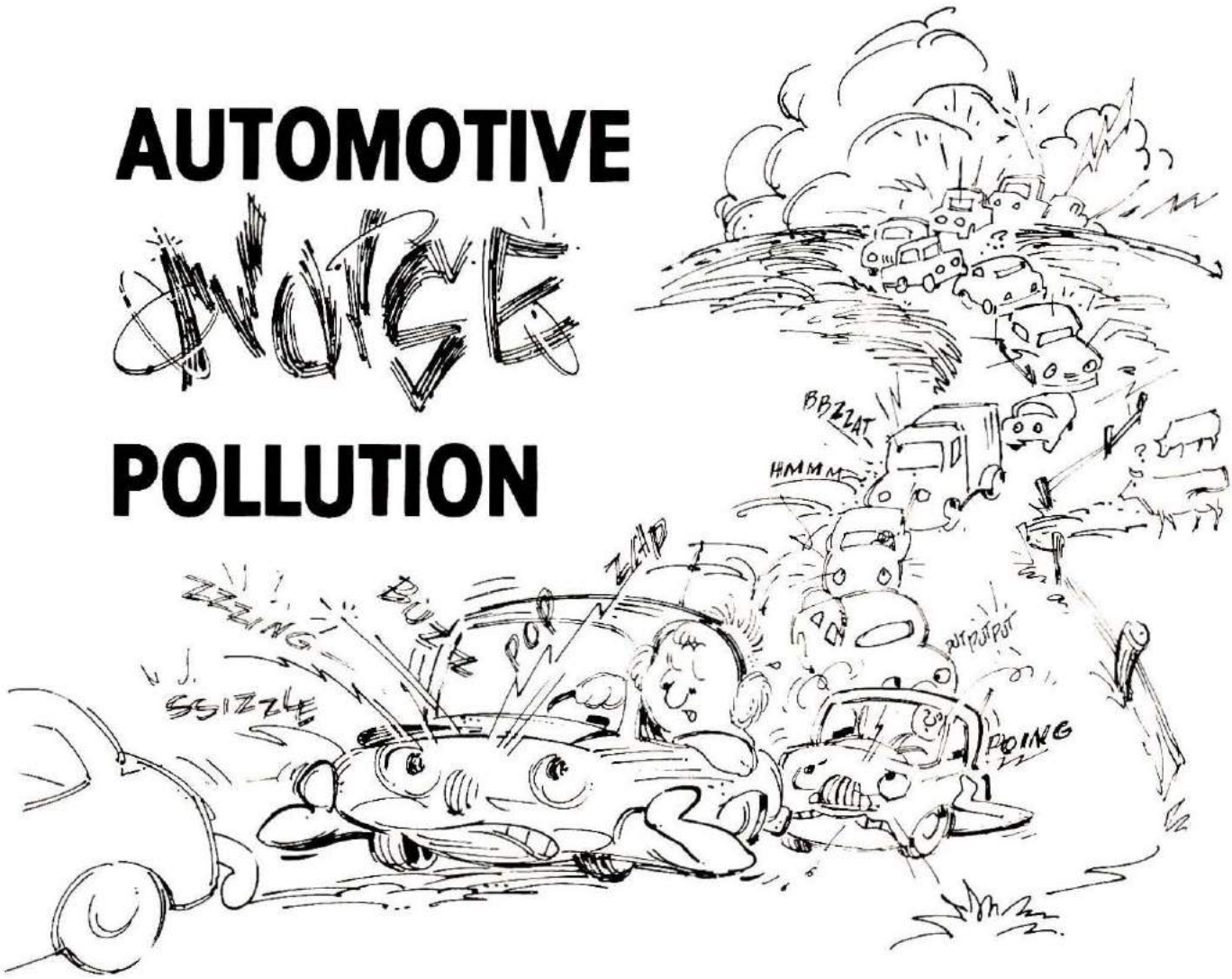


Everybody is hearing it, but is anybody listening?

BY TOM McMULLEN, W1SL, AND JIM GRAY, W1XU

"Martha, turn off that vacuum cleaner (mixer, hair dryer, whatever)! Why do you always have to run it when I'm trying to work DX?"

"Boyd, I just can't hear you through this ignition noise; please wait a minute until I pull over to the side of the road so we can finish our contact."

"Daddy, there's a funny buzzing on my shortwave radio, and I can't hear the stations, can you fix it?"

Noise, noise, noise — everywhere you listen: electric-appliance noise, automobile ignition noise, fluorescent and neon lighting-fixture noise, where will it all end? The noise pollution explosion is every bit as real as the population explosion, and not unrelated. Man's energy-saving devices tend to radiate noise throughout the entire radio spectrum and create interference to radio and TV sets, stereo systems, shortwave radios, amateur radios, and — in short — nearly every kind of electronic receiving device. What can be done about it, and who will do the work to try to suppress all this interfering noise?

Well, the editors of *Ham Radio Horizons* are just as concerned about this problem as you are, and we decided to begin looking for someone, somewhere, who is doing something about it. Fortunately, we didn't have far to look because right here in New England there is a company that has been concerned about electrical and electronic noise for a long time, and — even better — is doing something about it.

Not long ago, we received some literature on a new line of noise suppressors and filters that had just been introduced by Cornell Dubilier Electronics (CDE) for the CB radio market;

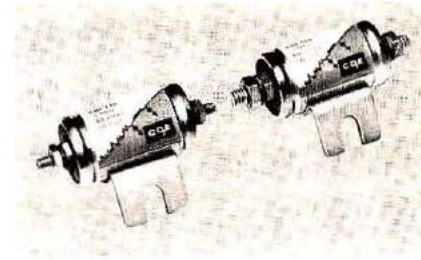
specifically, filter *kits* that can be installed by an amateur-radio or CB operator on his automobile or boat to reduce or eliminate noise from the engine's ignition system or other sources. Many of you have heard of CDE because of their antenna-rotator products; some of you know of them as producers of capacitors for both replacement and original-equipment purposes.

The literature — in the form of a trouble-shooting chart — recommended certain types of filters for different vehicles and for different noise sources on a particular vehicle. Intrigued, we called Ron L'Italien, Marketing Manager for CDE's Filter Division, and asked if it would be possible to visit the New Bedford, Massachusetts, facility and talk to some people about electrical and electronic noise problems. Shortly thereafter, we were on our way to meet and talk with Ron, Dale Knox, Engineering Manager of the Filter Division, and Joe Rapoza, Systems Test Engineer. What we learned in an afternoon's visit had the makings of a fascinating story of "search and rescue" by some dedicated researchers in the noise-reduction and abatement field. Here's that story, as we discovered it.

Test facilities

In the 1800s New Bedford, Massachusetts, gained worldwide fame as a whaling center, and its people were known far and wide as seafarers. Located across Buzzard's Bay from Cape Cod's elbow, New Bedford is still a major port and fishing center, where ferry boats take off several times a day for the trip to Nantucket and Martha's Vineyard.

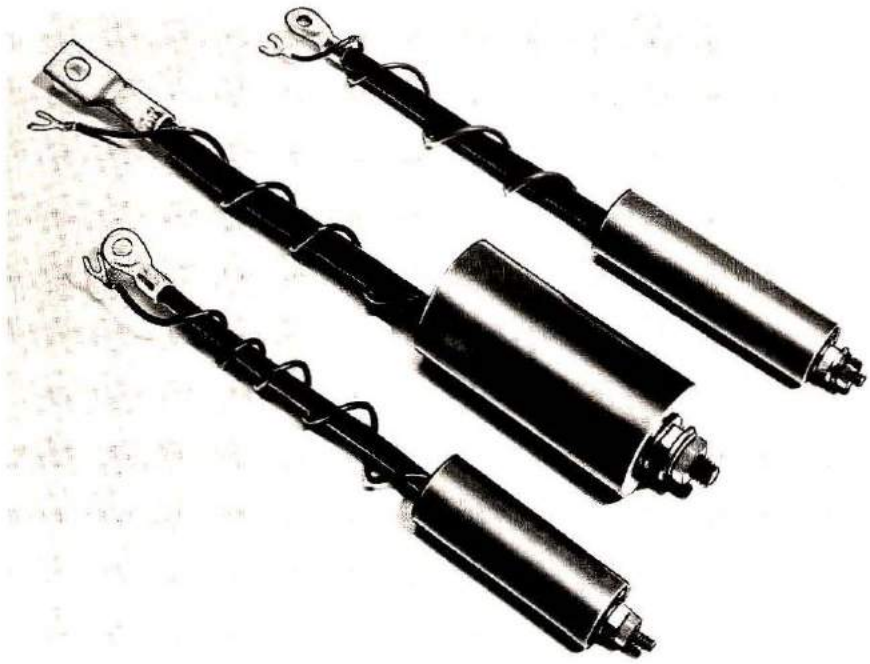
Not far from the waterfront, located in a sturdy brick building, reminiscent of New England industry at the turn of the century, reposes Cornell Dubilier's modern capacitor-manufacturing facility and Filter Division. The multi-story building's first floor contains the EMI Lab (Electro-Magnetic Interference) which is built like a vault and conforms to Military Standard 285 for shielding. This means that its shielding is so good that outside electrical interference is reduced at least 100 dB (one ten-billionth) from 10 kHz to 10 GHz, and its magnetic shielding is equally effective from 10 Hz to 30 MHz.



Feedthrough capacitors such as these from CDE are a most useful tool in reducing noise in automotive systems. They are available in different amperage ratings, to handle the various loads throughout the wiring. The chart in **Fig. 3** will guide you in selecting the right one.

To achieve this kind of isolation, every line into and out of the room is bonded, bypassed, shielded, screened, and housed to minimize the transmission of interference by conduction or radiation. All electric wiring, telephone lines, public adress system wiring, air conditioning ducts, and the like have been given "the treatment" to ensure electro-magnetic deadness. Doors are copperclad with mating fingerstock material to seal the openings and, inside, benchtops are likewise copperclad to provide low-resistance contacts for grounding the test equipment. To accurately measure interference, you must be able to read the output from sensitive probes and meters without introducing even the slightest extraneous noise that can affect the measurement. All of the measuring equipment is thoroughly noise-suppressed to prevent any false readings.

Located on various test racks, stands, and benches are the measuring instruments — highly sensitive receivers such as the *Singer* NF 105A that covers the electromagnetic spectrum from 14 kHz to 10 GHz, and the *Stoddart* NM 40A



These CDE filters are designed specifically for use with alternators. Some are capable of handling the high current generated by heavy-duty alternators, and others fit the standard alternator in most cars. The heavy flexible lead connects to the alternator output, and the small lead is a ground connection.

that covers 30 Hz to 15 kHz — plus various oscilloscopes and display devices for looking at, and listening to, the noise sources.

The file cabinets in this room contain copies of test data generated over the last five years under the supervision of Joe Rapoza, who runs the EMI Lab. There are data from measurements made on widely diverse noise producers, such as a pair of Renault 5 automobiles and their electro-mechanical devices including fuel pumps, alternators, voltage regulators, windshield wipers, and the like. Yes, the room is large enough to test the cars inside it.

There are charts showing just how much interference is caused by each component of every device tested. Vacuum cleaners, fish-tank heaters, fluorescent fixtures, CB base stations, computer-processing and data-storage equipment, military heating systems for tanks and airplanes, windshield wipers for destroyers, light dimmers, photocopying machines, and hundreds, if not thousands, of other devices.

Data, by itself, is interesting but worthless if something isn't done with it, and this is where CDE offers the second step in their customer-service program: recommendations. Joe Rapoza, working with Dale Knox and his staff of engineers, designs and constructs filters to reduce — and sometimes totally eliminate — the interfering noise. Once the prototype filter has been designed it is installed on the offending device, and more measurements are taken to determine the effectiveness of the filter. Sometimes, many combinations of inductance and capacitance are tried in series or parallel to bring the noise to acceptable levels. Occasionally, a change in design is suggested to help cure a stubborn case.

Standards

In the course of their investigations and work with various companies and organizations around the world, CDE has learned that European standards for noise emitted by electrical and electronic devices are very stringent, and that the governments of most European countries enforce the standards by fining the manufacturers who don't meet them, and, in some cases, refuse the licensing or sale to consumers of these interfering devices.

Unfortunately, the United States government has not established civilian standards for noise ceilings as applied to consumer goods; that is, appliances, automobiles, or the like. However, devices manufactured for the Armed Forces must meet anti-noise specifications.

There is a ray of hope on the horizon: Canada is leading the way on this side of the Atlantic with a five-step, three-year program for eliminating noise pollution produced by domestic appliances, fluorescent fixtures, and commercial apparatus. The Canadian Standards Association (CSA) has set forth a new standard which is expected to become effective in April, 1978. In

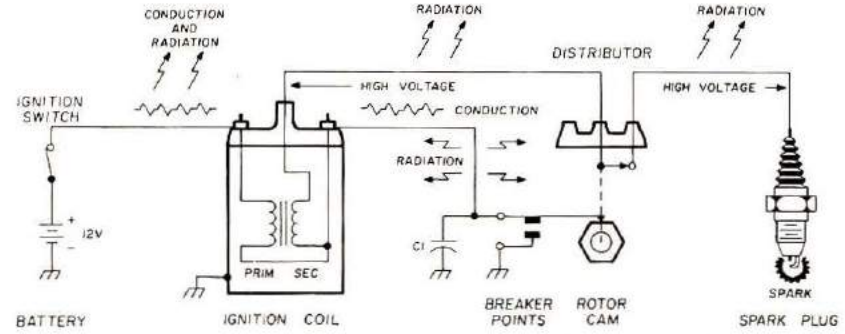


Fig. 1. A typical automotive ignition system. The low-voltage wiring, from the ignition switch to the coil, and from the coil to the points, can both conduct and radiate noise. The high-voltage wiring that carries the pulse to the spark plug (through the distributor) is the prime offender because it radiates considerable energy to its surroundings. See **Fig. 2** for some suggested cures.

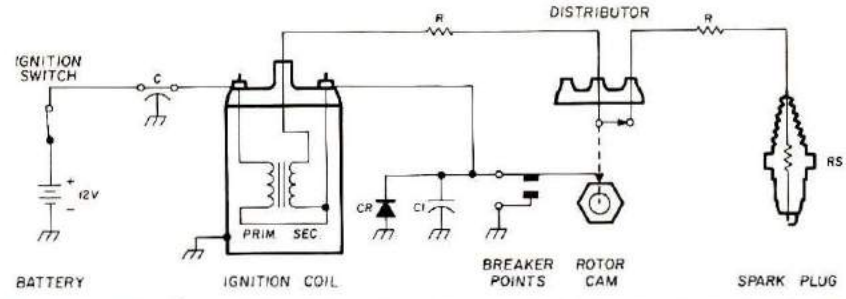


Fig. 2. A feedthrough capacitor, **C**, can be placed in the primary wire from the ignition switch to suppress noise that is propagated by that source. **CI** is the normal ignition-system capacitor as found in the distributor. Resistance in the high-voltage wiring, **R**, takes the form of distributed resistance built into the spark-plug wires. Most modern cars are equipped with this type of wiring as they are sold. Vibration and rough handling can damage the wires, so they should be checked or replaced periodically. In some cases, you may need spark plugs with built-in resistors, **RS**. They are available as replacements for most common spark plugs — check with your local automotive parts distributor. A diode, **CR**, can be placed across the breaker points to help suppress radiated and conducted noise, but this technique should be approached with caution; it could upset the timing of the system. If used, be sure the diode is reverse biased (cathode toward the wire, anode grounded in most cars) or it will act as a continuous short circuit. The purpose of the diode is to clip (and dissipate) any negative-going pulse that occurs when the points open.

essence, the CSA recommendation follows the European system in test and measurement methods, and in prescribing acceptable noise limits.

In spite of our best efforts, it is probable that noise cannot be totally eliminated; it can only be reduced to acceptable levels. A definition of acceptable levels will have to be established, and will depend upon the ability of a given device to meet a given noise level within a certain period of time, coupled with a realistic evaluation of how low the level should be set.

Let's take an example to illustrate this situation: automobile ignition noise. Obviously, it would be best to eliminate noise at the source, but that isn't always the best solution. It is unfortunate that automotive ignition systems interfere with radios because of the noises created by the coil, spark plugs, distributor, and breaker points. These circuits cannot be greatly changed because to change them would drastically reduce the efficiency of the engine — not only with respect to the horse power produced, but also because of the adverse effect of chemical pollution from poorly burned fuel mixtures. Right away, we can see that there is a two-part problem to noise elimination: stop noise at its source, or reduce its effect at the receiver. When part one can't be undertaken because of other considerations, part two is the remaining solution.

Another example: suppose you managed to eliminate the effects of ignition noise produced by your own automobile — you now have a quiet receiver that is completely satisfactory. But wait! What about taking your car out on the highway where there are other cars without noise suppression at the source? Right! The answer is that you can't operate your radio much better than you could before. You must kill the noise at two places: at the source *and* at your receiver, whenever possible.

How do you eliminate noise in an automobile?

Quite simply, you can't, at least not economically; but you can reduce it to a degree that is tolerable. You can achieve a level that will allow you to operate mobile as easily and effectively as you operate your base station. Good enough? In almost all cases it is.

The first thing you must do is to determine exactly *how* the noise is getting into your receiver. If this sounds absurd, consider a couple of facts. Are you sure it's coming in on the antenna — by radiation — or could it be coming in by way of the power wiring? Perhaps the noise could be coming in *both* ways, and your job is to find out which, or if it is both.

The first thing to do is to put a well-shielded dummy load on your transceiver terminals — in place of the antenna. Start the car, turn on the radio, and listen. You won't hear signals,

Fig. 3. This filter selection chart from CDE will help to pick the right type of filter for some of the more common types of noise that bother amateur and other mobile radio systems.

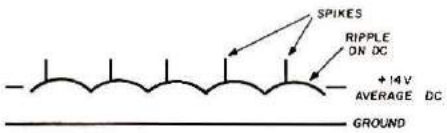


Fig. 4. Noise produced by most alternators has two types of waveforms. The most annoying one is the sharp spike that can be radiated and conducted into radio systems. It is usually heard as a high-pitched whine that changes with engine speed. A low-frequency ripple is also produced which can be bothersome in some cases. Different filter techniques are required for the two noise types: a feedthrough capacitor, **Fig. 5**, will usually remove spikes, and an inductance along with the feedthrough capacitor will reduce the ripple in some cases, see **Fig. 6**.

of course, but you may hear noise! If so, the noise is coming in by conduction, not radiation, and you have to cure that problem first.

The next step is to determine what *kind* of noise you hear. Is it spark-plug noise, high tension coil noise, alternator whine, or just what? In most cases you will hear ignition noise that disappears when you turn the engine off. Once you do all of the things to suppress ignition noise, you'll begin to hear other noises that were originally masked or swamped by the ignition noise. One by one, you eliminate these, until your radio is as quiet as a mouse.

Noise types

Radio interference from automotive electrical systems can be divided into two categories : high-frequency noise and low-frequency noise. Ignition noise is somewhat typical of the high-frequency variety. It is a strong pulse type of interference that varies directly in relation to the engine speed (see **Fig. 1** for a typical ignition system). If you could slow your engine down enough, you would hear a loud pop as each spark plug fired in turn. As the engine speeds up, the pops blend into a steady roar that wipes out all but the very strongest radio signals. This type of noise is caused by the energy pulse that was produced at the output of the ignition coil to cause a spark to jump across the gap of the spark plug. All wiring associated with the ignition system should be suspect as carrying this noise in one form or another.

Alternators and generators often have both a low- and a high-frequency noise component. The high-frequency part is usually referred to as alternator whine, and is a product of the rectifier diodes at the output of the windings in the alternator. The noise varies in pitch from several hundred hertz up to a couple of thousand, increasing directly with engine speed. It can be radiated and conducted from the alternator wiring to the radio system.

Ignition-noise suppression

In the primary ignition system, a 0.1 μF capacitor (of the feedthrough type), can be placed in the 12-volt lead at the coil itself. This should reduce the noise that might be conducted from the coil back toward the ignition switch and other wires that are common to that point. Caution! Some capacitor-discharge or other electronic ignition systems may not work properly if a capacitor is connected at the wrong place. Check with the manufacturer of the system for their recommendations. Additional noise-suppression methods, such as resistive suppressors at the distributor and spark plugs, and resistance wire, will reduce the amount of ignition noise that is radiated, see **Fig. 2**.

A reproduction of a filter-selection chart from CDE is shown in **Fig. 3**. It can help you to obtain the correct filter for different parts of an automotive electrical system. Similar filters are available from several manufacturers.

Shielding the ignition system is certainly effective, but necessary only in extreme cases. The procedure is expensive and difficult, and when you get through you can still hear the other fellow's ignition noise. Only if you expect to operate your mobile rig far from the crowded highways will you notice a real difference in noise with a shielded system.

After you have treated the ignition system you can remove the dummy load and put the antenna back on. It is likely that the ignition noise will be back — radiated from the wiring to the antenna. At this point you must decide whether you can get a significant decrease in noise by moving the antenna farther away from the engine. Sometimes it is good planning to do this in the first place — the noise

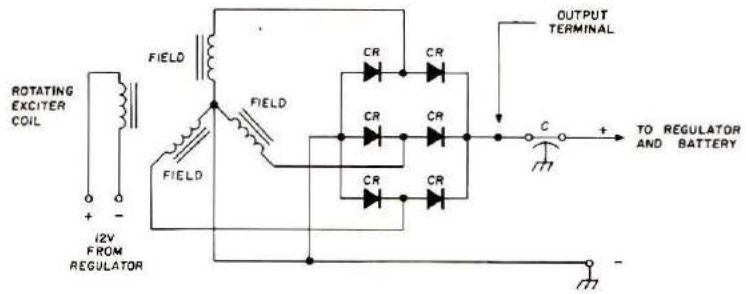


Fig. 5. The spikes from an alternator are caused by the diodes associated with the windings in or on the unit. When they stop conducting they become an open circuit, allowing the magnetic field around the winding to collapse, producing a large pulse. A feedthrough capacitor, **C**, can reduce the amplitude of the spikes, and keep them from being conducted and radiated by the wiring from the alternator output. Do not attempt to filter the lead to the rotating exciter winding. This winding is often called the field, and is usually marked **F** on the alternator and the voltage regulator; the term is a left-over from the days of generators, when the field was the fixed winding, providing excitation for the rotating armature.

reduction might be enough that you could live with the results.

Alternator noise

The alternator can produce two types of noise, but the most prevalent is the high-frequency whine that is triggered by rectifier diodes as they cease conducting at the end of a cycle. When they stop conducting, in effect they open the circuit and the magnetic field around the winding collapses, creating a spike of energy (**Fig. 4**). This short-duration, high-energy spike can be radiated by wiring associated with the alternator, or it can be conducted along the wiring to reach other parts of the circuit. **Fig. 5** shows a typical alternator and a method of suppressing its noise. Note: in either an alternator or a generator, you should never connect a capacitor to the FIELD terminal. This terminal, sometimes marked F, returns to the voltage regulator which can be ruined by capacitance across its contacts. The energy stored by the capacitor can cause pitting, burning, or sticking of the contacts, with possible burn-out of the alternator as a consequence.

A second type of noise that is created by an alternator is a low-frequency ripple. It is caused by the diodes, again, but in a different way. As each diode conducts during its part of the cycle, it adds a bit of ripple to the waveform — just the same as it does in an ac operated supply at home. However, in this case, it cannot be smoothed out by placing a large filter capacitor across the alternator output. This would cause the alternator to overheat because it is expending some energy just to keep the capacitor charged. An inductor (choke), made of a few turns of heavy wire through a ferrite core, is sometimes effective in reducing low-frequency ripple. A combination of inductance and a feedthrough capacitor, **Fig. 6**, can be connected at the back of the transceiver to further reduce alternator ripple and other types of low-frequency noise.

Voltage regulator

Noise from the voltage regulator is an intermittent popping sound which will vary in repetition rate, depending upon the electrical load placed upon the generator and battery. In most modern regulators, contacts open and close to change the amount of current that flows through the field windings (the rotating exciter windings in an alternator) which in turn changes the amount of magnetic field produced. The contacts stay closed for longer periods of time when the load is great, and open frequently when the load is light and the battery is at full charge. Most of the noise from the regulator is conducted, and can usually be cured by placing feedthrough capacitors on the battery, ignition, alternator (or armature), terminals. Again, do not place a capacitor on the field (F) terminal. It is sometimes helpful to replace the wire from the regulator field terminal to the alternator field terminal with a piece of shielded wire. Coaxial cable, such as RG-8/U, can be used for this purpose. Make pigtails out of the braid at each end and connect them to a good ground, see **Fig. 7**. A few automotive electrical systems use transistorized voltage regulators which do not usually produce noise.

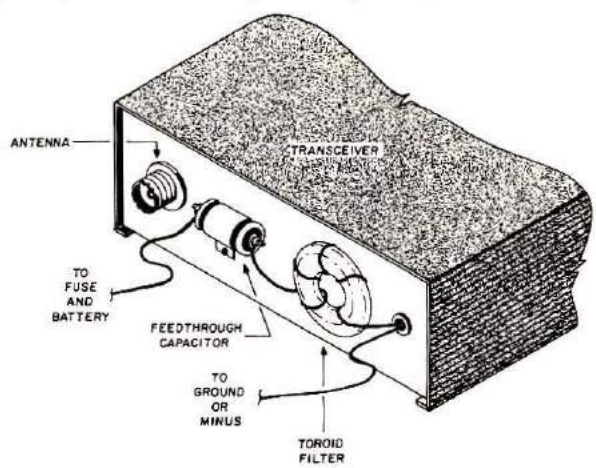


Fig. 6. A combination of inductance and capacitance will reduce or eliminate most types of noise that enters your radio equipment by way of the power leads. It is difficult to make inductances with wire large enough to carry the high current output from the alternator so in most cases you must place a filter on each piece of equipment. Some of CDE's filters are made in a similar fashion, and then encapsulated for ease of handling and to prevent damage to the components. If you make your own, the number of turns of wire through the toroid must be determined by experiment — each case will require different treatment.

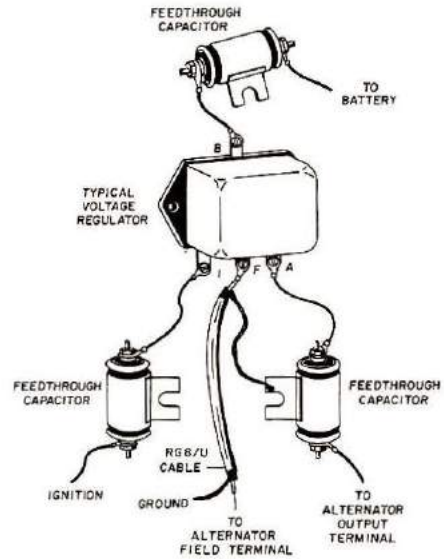
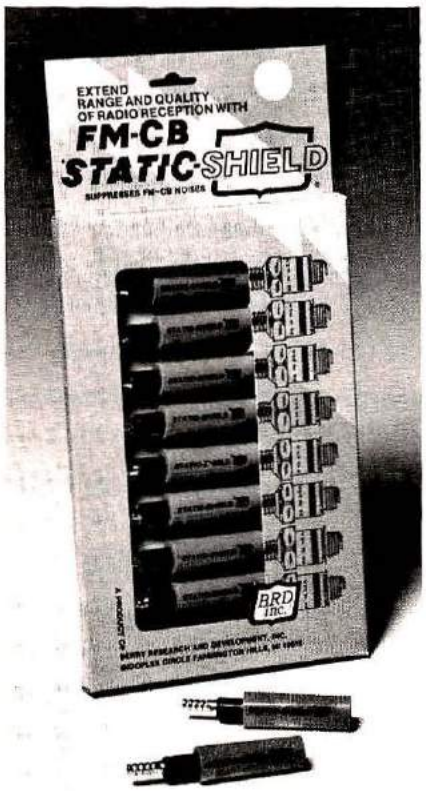


Fig. 7. Noise suppression at the voltage regulator takes the form of feedthrough capacitors to "clean up" the wiring so that it will not radiate. Be sure that the paint is scraped away under the mounting tabs for the capacitors. Do not put a capacitor on the F terminal; this part of the circuit supplies voltage to the field (exciter) winding through a set of intermittent contacts; a capacitor across them can cause them to weld shut, which will destroy the regulator, alternator, battery, or all three. Shielding this wire with a short piece of RG-8/U or similar cable is the only recommended cure.

Bonding

The next step is to discover all those places on the car that

could be picking up noise and carrying it to the antenna. Any piece of metal that is ungrounded, or even grounded at just one point, can pick up noise in just the same manner as an antenna does; it can also radiate it just like an antenna. The exhaust system is a prime offender. It is connected to the engine, which is usually "hot" with ignition noise, and the mounting brackets are electrically insulated with rubber or composition straps and pads. Many exhaust systems are 8 or more feet (2.5 meters) long, which makes them pretty good antennas at the 11-meter CB and 10-meter



An ignition-noise suppressor that fits right on the spark plug might do your installation a lot of good. This is the *Static Shield* by BRD, Inc. Installation is easy — remove the ignition wires, one at a time, place the *Static Shield* on the spark plug, and replace the ignition wire on the exposed *Static Shield* terminal. The units are especially effective on vehicles that use ordinary wire-center ignition cables, and usually provide some additional quieting if used with noise-suppressing types of wiring. Look for them at automotive dealers and radio supply houses.

amateur frequencies. **Fig. 8** shows several points that should be considered for grounding or bonding. The exhaust system should be bonded to the frame or body at several places. Give the engine itself a good treatment by installing at least four ground straps: two from the firewall to the engine block, and two across the rubber engine mounts. A grounding strap from the alternator to the body or frame is also a good idea. See **Fig. 9** for an effective method of installing a bonding strap. Remember that good bonding requires that the metal parts be scraped clean of paint, rust, and grease, right down to the bare metal.

The hood and trunk lid should also be treated. Place a flexible-braid strap across each hinge, and install metal clips that ground the large metal surfaces at several points opposite the hinges. This can be done by scraping the metal bare in a few spots, and making a pad of braid material that will be pressed into place by the sponge rubber weatherseal strip.

Don't overlook the bumpers, metallic grills, or any other large metal parts. Be sure each is grounded to the body or frame. If your car has body-and-frame construction, be sure to put bonding straps across the shock-mounts that are used between the body and the frame members.

Other sources

At this point your radio should be pretty quiet, but because the major noise sources have been suppressed, you may be able to hear other things creeping in: turn signals can make a clicking or popping noise; windshield wiper motors produce a whine; electric fuel pumps can cause a popping sound; the heater blower motor can create noise. These sources may or may not be severe enough to annoy you, but if you need to de-bug

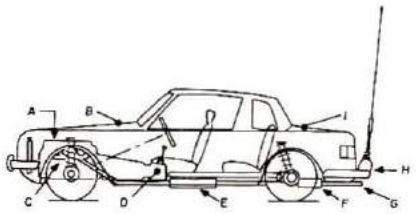


Fig. 8. Several points on an average vehicle require treatment to minimize noise. The engine, **A**, should be bonded to the frame and firewall in at least four places; the hood, **B**, should be bonded at the hinges, and have metallic clips or pads to ground it at several points along the sides and opposite the hinges; shock absorbers and suspension, **C**, should have all rubber-mount portions bridged by flexible braid straps; the transmission and drive train assembly, **D**, should be grounded to the frame or body wherever possible; exhaust pipe, muffler, and tail-pipe assemblies, **E**, **F**, **G**, should be grounded in several places. The bumpers, **H**, and the trunk lid, **I**, should also be given a bonding treatment, especially if the bumper is mounted on rubber cushions. A recommended method of bonding to body or frame using braid straps is shown in **Fig. 9**.

them, the same filtering, shielding, and bonding techniques apply as you used for the ignition system. Often a small feedthrough capacitor will do the job. Again, see **Fig. 3** for recommended filters.

Many transceiver manufacturers advise the user to run the power lead directly to the positive battery terminal. You should be sure that there is a fuse in the line if you follow their recommendations. It is possible to pick up conducted noise from the battery because all systems return there for their power. However, a battery in good condition is usually a very effective filter, especially for low-frequency noise.

All of this sounds like a lot of work — and it is. That's why the manufacturer of your automobile can't afford to do the complete job (and usually doesn't have to); time is money, and you can do it less expensively than he can.

In all probability you won't need to do such a complete job of filtering, shielding, bypassing, and bonding on

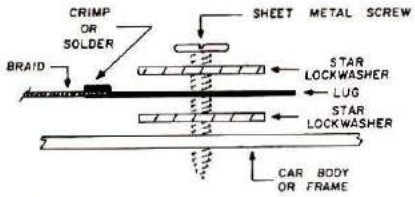


Fig. 9. An assembly such as this will provide a good connection to the body or frame for bonding straps. The braid can be the flexible material sold for the purpose at automotive or electronic suppliers, or you can use the braid from scrap pieces of coaxial cable. RG-8/U or RG-11/U cable will provide straps approximately 1/2-inch (13mm) wide; RG-17/U cable has a braid that, when flattened, will be almost 1-inch (2.5mm) wide. The lug can be either the crimp-on or the solder type.

your vehicle. For example, if you only want to listen to your broadcast radio, the factory-installed noise suppression kit should be sufficient. Even if you plan to use an amateur or CB transceiver, you may not have to go through *all* the steps mentioned here. Remember: bond first, filter and bypass second, and shield last.

What about the rig?

Some of the things you should do at your transceiver can help reduce the noise from the automotive electrical system, and can have other benefits as well. You can place a feedthrough capacitor on the 12-volt lead on the back of the set, and as an additional filter, place a small inductance in series with the lead again, (see **Fig. 5**). The inductor can be made by winding a few turns of heavy insulated wire through a toroid core.

The cabinet or enclosure of the transceiver should be connected firmly to ground — do not expect the braid on the coaxial cable, or the dc power wire, to provide a good rf ground. If your dashboard (or wherever you mount the rig) is metal, be sure to scrape the paint away to a bright surface. Use star lockwashers under the bolts and cabinet to maintain good contact. If the mounting surface you choose (or are stuck with) happens to be plastic, then you must run several pieces of braid or a wide copper strap to the nearest chassis or frame surface. Auxiliary equipment, such as synthesizers and amplifiers, should receive the same treatment. This technique will not only reduce the noise that gets into your equipment, but will prevent the rf from going back into the automotive electrical system.

Rf can cause a multitude of problems when it reaches such sophisticated devices as the electronic fuel-injection control, cruise-speed control, anti-skid brake system, or any other device that uses electronics in its brain. This brings to mind a true story about a guy who installed a two-meter rig and amplifier in his new car (with a plastic dashboard). Every time he keyed the rig, the air conditioner would change state, either on or off. It was disconcerting, to say the least. Several heavy braid straps from the rig and amplifier to the firewall restored things to normal.

Home stations

So far, we have touched mainly on automotive troubles, but it is obvious that home stations can have noise problems too. The situation at home is worse, in many ways, because not only are there more sources of noise, but the devices operate at a higher (and more dangerous) voltage. If you make a mistake while working on an automotive electrical system, sparks can fly, things can get hot — and sometimes burn — and fuses blow; but it is unusual to receive a shock from a 12-volt system. Carelessness while working on appliances and devices at home can be hazardous — even fatal — so the procedures should be undertaken with more caution.

There are some filters made for reducing noise in the home electrical system, as shown in the chart of **Fig. 3**. Some are used to eliminate noise that enters through the 120-volt ac line, and others can reduce noise (and rf) pickup by leads such as those to speakers or accessories. You'll see many types of appliance and radio filters on the market by CDE, Sprague, Marine Technology, and other manufacturers. A comprehensive treatment of the methods of suppressing noise in the home environment would require more space than is available here, but perhaps it can be the subject of a future investigation.

Some tips from CDE

All of the people we talked with at CDE emphasized one point: *every noise problem is unique*! Solutions that work for one vehicle or device do not necessarily work for all vehicles or devices, even if they are the same make, model,

To touch briefly on noise in the home environment, this CDE filter for the 120-volt ac line is a popular unit. It is designed to plug into the wall outlet, and the rig or equipment is plugged into it. The screw terminal on the side should be connected to a good ground. (If your electrical system does not have a good ground, it should have — that's part of the noise problem.) Although designed for CB base station use, it will also do a fine job on low-powered amateur equipment.

or year. The best that can be said about attacking a noise and interference problem is that there are some general steps that can be taken, but, beyond that, a systematic point-by-point approach is required.

During the course of our discussion about noises and cures, a couple of interesting case histories came to light. One was the air-conditioner compressor problem; another was the case of identical techniques with different results.

Joe Rapoza was tracking down and eliminating noise sources in a car that was equipped with an air conditioner. Since the day was warm, the decision to turn the conditioner on and do some of the work in comfort was only natural. Shortly thereafter, he noticed an intermittent characteristic to the ignition noise that he was chasing, often timed in such a manner that made it impossible to evaluate any filtering techniques. In fact, at times the noise seemed to become worse. Then he noticed that the noise change was timed to coincide with the coolant-compressor activity; when the compressor was on, the noise was off, and vice versa. Investigation showed that the wiring from the temperature sensor to the compressor was in a cable along with some primary ignition-wiring, and this wire was acting as a pickup device, conducting noise to the radio. When the contacts were closed, the wire was grounded, presenting a low-impedance circuit which did not conduct the noise. When the temperature-sensing switch opened, the wire became a high-impedance antenna.

In another instance, a particular car had been debugged, so Joe decided to try identical techniques on another car that was the same make and style, but separated by one model year; the results were very disappointing. The second car required much additional treatment before the noise was down to an acceptable level.

Both of these cases serve to emphasize what both Joe and Dale told us: each system, each car, each component, can be different. You have to be prepared to do considerable detective work if you want to obtain the lowest possible radio noise level.

Another line of noise-suppression devices is manufactured by Marine Technology. Some of the more interesting filters are the EMI-15A, for suppressing ignition noise in the primary wiring, the EMI-80A for EMI-200A, for alternator noise treatment, the EMI-ACE for noisy accessories, and the EMI-ISO for use at the electronic equipment itself. They have a brochure, *The CB Noise Story*, which you can obtain by writing to them at 2780 Temple Avenue, Long Beach, California 90806. The brochure lists their distributors across the country so you will know where to buy the filters. The noise suppression techniques discussed in the brochure apply to amateur equipment as well as to CB.

Conclusion

While noise-suppression techniques can vary from car to car, and from one source to another, be of good cheer — you might not need all of the ones outlined here. It doesn't have to be expensive either; a few dollars worth of filters and a few hours of your time will make mobile operation much easier and more enjoyable.

Of course, that still leaves the other fellow and his noisy car, but perhaps he will soon be out of range, reducing the noise as he moves away. You can always hope that as more people get amateur and CB radio in their cars, they, too, will have to suppress ignition systems, alternators, and the like. Happiness is a freeway full of traffic, and not a spark plug to be heard!

We wish to thank Cornell Dubilier Electronics, and particularly Ron L'Italien, Dale Knox, and Joe Rapoza, for their courtesy and time devoted to showing us what is being done, and what can be done, to deal with the noise problem. **HRH**

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As a representative group of importers exporters, manufacturers and dealers in amateur equipment, ARMA is the official spokesman for this highly specialized industry, and has a vested interest in the fostering of continued growth of the radio amateur service, worldwide.

To further these goals, ARMA disseminates information from its headquarters on various proposals and actions that may affect its members, represents the industry in meetings, and on various committees to develop a favorable public attitude toward amateur radio, directs and advises the industry as to its best interests, and interprets industry wide technical standards as required. ARMA supports amateur radio worldwide through club, government and industry liasons.

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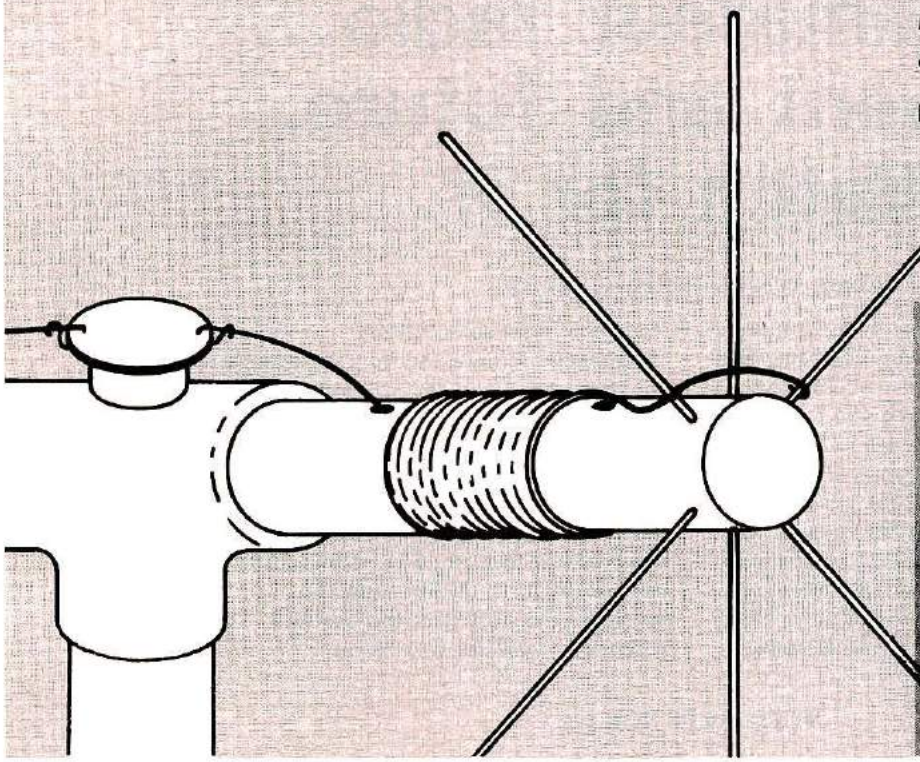
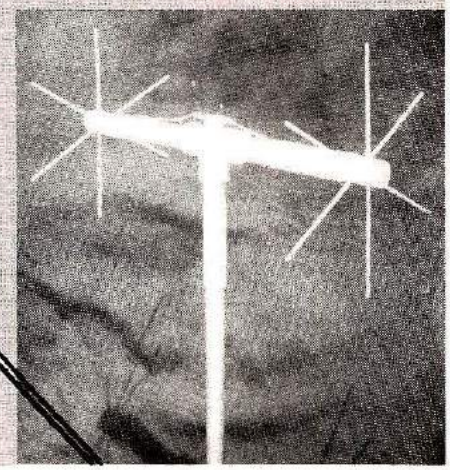
More details? Ad Check page 86.

THREE BAND GROUND PLANE

Low-Cost, High-Performance, and Omnidirectional

BY FRED BROWN, W6HPH





This antenna was inspired by a mobile contact; a solid 20-meter QSO with a Los Angeles station from G3NMR/mobile. This is rather spectacular performance for a mobile in motion down on the street level of London. I was even more impressed when I saw that G3NMR's antenna was only 1.8 meters (6 feet) long. It was a commercial three-band mobile antenna for 20, 15, and 10, known as the Mark Products HW-3.

Since this antenna worked so well mobile, I thought it would work even better as a home-station antenna, especially if I made it bigger and put it up in the air. The active length of the HW-3 is about 1.5 meters (5 feet); by extending this to a quarter wave on ten meters, I thought it should be possible to eliminate the ten-meter loading coil and improve efficiency on 20 and 15 at the same time.

Construction

For the monopole, I used ordinary thin-wall steel conduit; it's available in 3-meter (10 foot) lengths from any building supply store. At first I thought the 20- and 15-meter loading coils would act as a slightly capacitive load so the resonant length on ten meters would be somewhat less than 2.4 meters (8 feet). After cutting one piece of conduit to that size — then to successively shorter lengths — without obtaining any resonance on ten meters, I finally realized that the loading effect is really *inductive*! Therefore, the length should be *more* than a ten-meter quarter wave; a 2.75-meter (9-foot) length worked out very nicely.

Most of the construction details should be evident from the drawing shown in **Fig. 1**. Plastic water pipe which is actually 22mm (7/8 inch) OD is a perfect fit over the conduit. You'll need 1 meter (3 feet) of plastic pipe and one tee. The top of the tee is bored out so the conduit sticks through for connections to the loading coils.

The loading coils for 20 and 15 are terminated in capacity hats made from three pieces of 2.6mm (no. 10) wire forced through the ends of the plastic pipe. This permits loading coils with far less turns than would be the case if they were

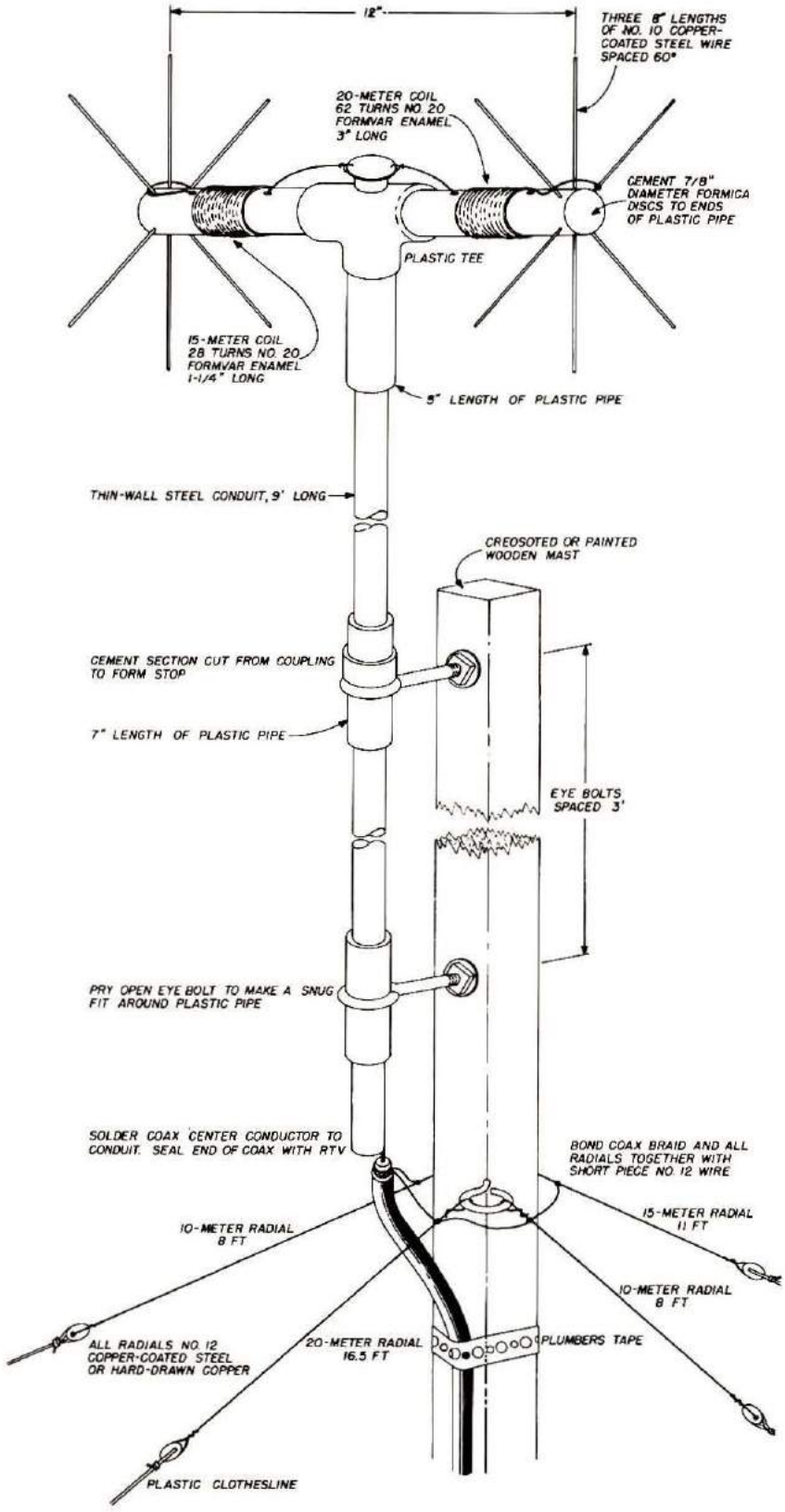


Fig. 1. Construction details of the 3-band ground plane. The top tee is bored out so the end of the conduit sticks through; then a copper plate is soldered to the conduit for connecting the loading coils. Coil leads must be soldered to all three spikes.

unterminated and helps reduce coil losses. It also improves the bandwidth since the L-to-C ratio is reduced. The coils would exhibit higher Q if they were larger in diameter, but in the interest of low wind resistance they were wound directly on the plastic pipe.

Losses in the twenty-meter coil can also be reduced by using fewer turns and making the capacity hat twice as large. This will also improve the swr bandwidth on twenty. However, if you make the 15-meter capacity hat larger, it will result in too small a coil which will foul up the ten-meter resonance. In the interest of appearance I made both capacity hats the same size.

I used number-21 Formvar insulated magnet wire for the coils because I happened to have this size on hand, but 0.8mm (no. 20) or 1mm (no. 18) would be better. The number of turns is quite critical and it's best to start with too many turns and remove a half turn at a time until the frequency of minimum swr is near the band center. The inductance can also be trimmed by changing the spacing between turns. There is practically no interaction between 20- and 15-meter resonance.

The resonant frequency will be lowered about 150 kHz when the coils are painted, so it's a good idea to be about that much too high before painting. I used several coats of white spray-can enamel. This holds the turns in place nicely and makes the antenna fairly weather-proof. However, the frequency of minimum swr on twenty meters is still lowered about 100 kHz when the antenna is wet. The conduit is zinc plated but sprayed with clear lacquer as a further rust preventive.

The best way to tune the antenna is with an swr meter. You can make a good

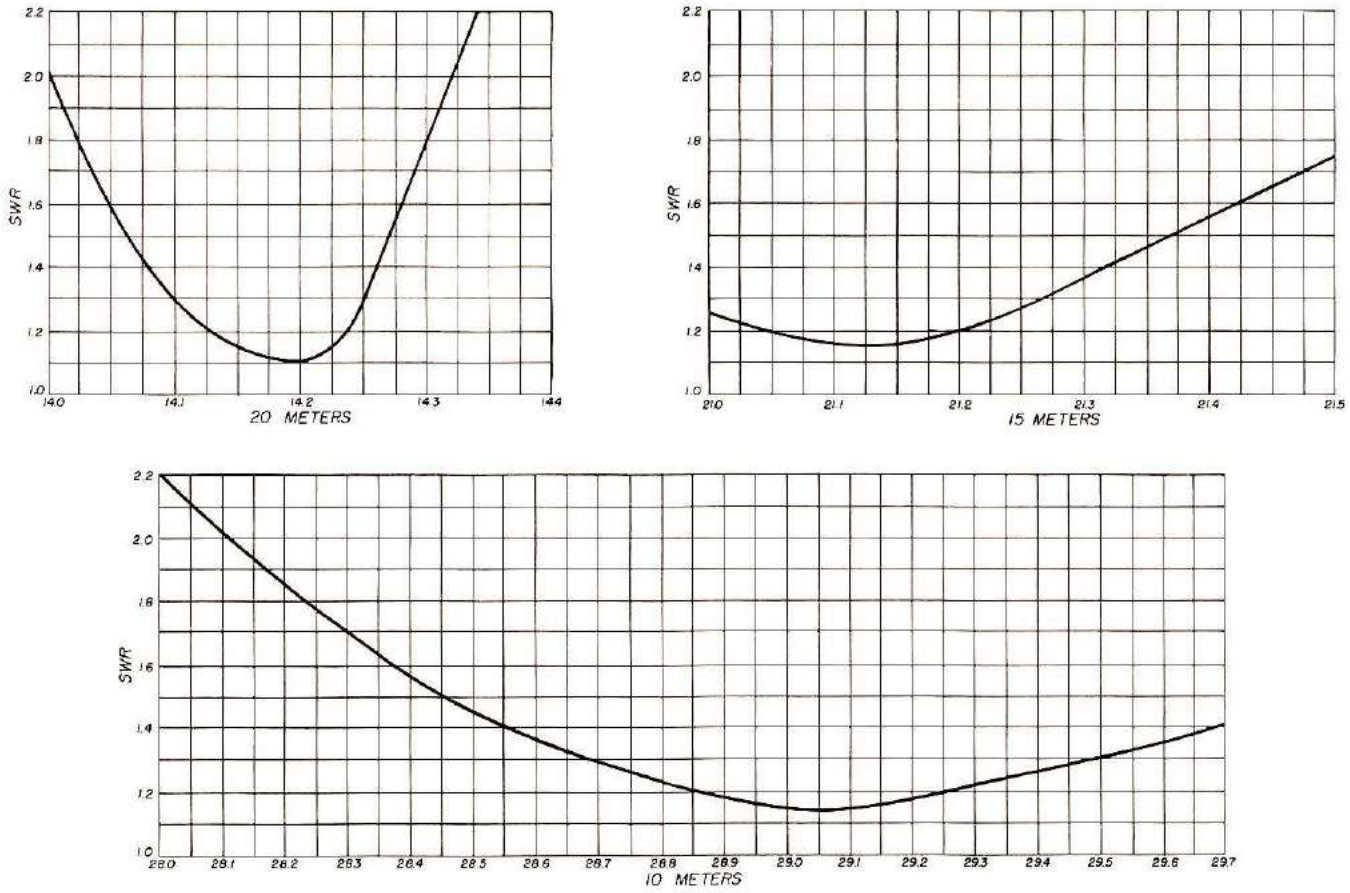
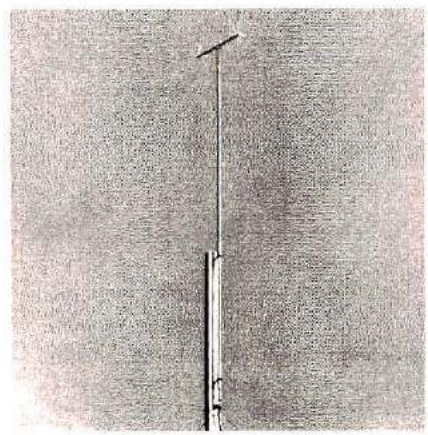


Fig. 2. Swr performance of the 3-band ground plane.

counterpoise by spreading four 2.5 meter (8- to 10-foot) lengths of wire on the ground to make a big X. The monopole can then be suspended over the X with plastic clothesline. This will put the coils not too high off the ground so they can easily be reached with a step ladder. Solder the center conductor of the coax to the base of the monopole and the outer conductor to the junction of the X. Alternatively, you can use a car body or other non-resonant object as the counterpoise.

In its final form, the antenna has four radials which also serve as guy wires, forming a drooping ground plane. Two of the radials are resonant on ten, and these run in opposite directions. One is resonant on 15 and one on 20. I found it important to have at least one radial resonant on each band to prevent rf current from flowing down the outside of the coax. The relative values of rf current in the radials and on the outside of the coax can be checked with an rf current probe. So long as the current in at least one of the radials is more than four times the current measured on the coax, radiation from the coax will be negligible.

The antenna is still in use, and performs well in spite of the author's having moved twice since the article first appeared in *ham radio* magazine in 1968. One turn of wire was removed from the 15-meter coil for improved performance on that band, otherwise everything is the same as originally built.



The final swr-vs-frequency plots are shown in **Fig. 2.** Bandwidth is more than adequate on 10 and 15 meters, but is just barely good enough for covering twenty with an swr below 2.0:1. These measurements were made through 13 meters (45 feet) of RG8/U, but essentially identical results were obtained with a short piece of coax and the antenna mounted over a counterpoise on the ground.

This antenna will not equal the performance of a good full-sized rotary beam, but it will give excellent low-radiation-angle omnidirectional coverage on 20, 15, and 10. Field-strength measurements and flattering signal reports received from DX stations around the world indicate the antenna does all that could possibly be expected of it. Total cost of materials, neglecting the mast and coax, was under $10.00. For this price, you'll find it hard to beat.

HRH

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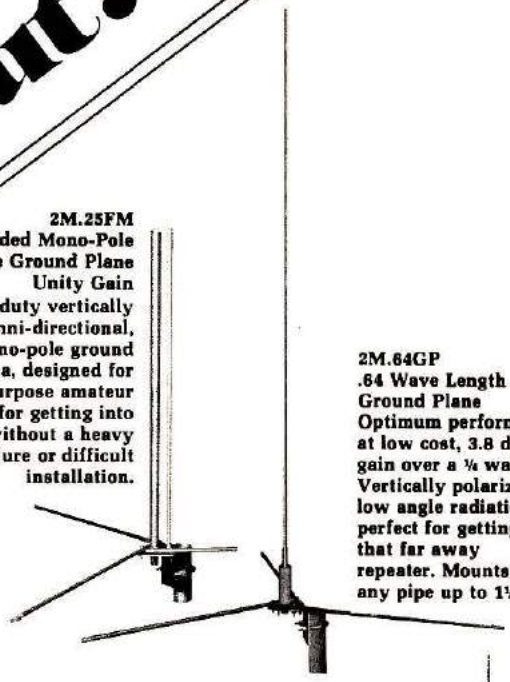
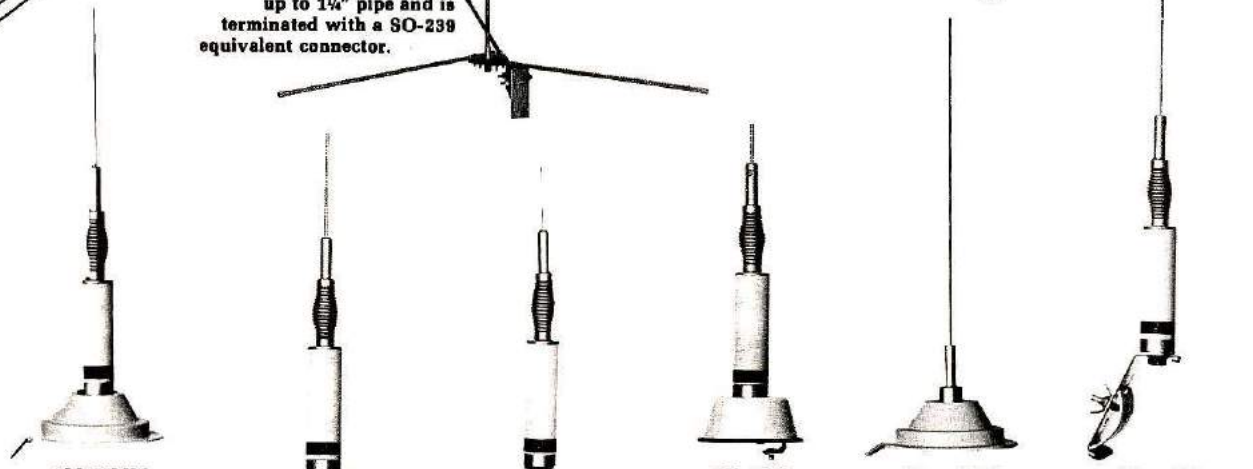


2M.25FM
Folded Mono-Pole
¼ Wave Ground Plane
Unity Gain
Heavy duty vertically polarized, omni-directional, folded mono-pole ground plane antenna, designed for general purpose amateur application, for getting into the repeater without a heavy expenditure or difficult installation.

2M.64GP
.64 Wave Length
Ground Plane
Optimum performance at low cost, 3.8 db gain over a ¼ wave. Vertically polarized low angle radiation perfect for getting into that far away repeater. Mounts on any pipe up to 1¼".

2M.25GP
¼ Wave Length
Unity Gain
Heavy duty ground plane antenna. Vertically polarized omni-directional designed for general purpose application. This antenna mounts on a mast up to 1¼" pipe and is terminated with a SO-239 equivalent connector.



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3.8 db Gain
Magnet Mount
.64 wave-length antenna mounted 80# ceramic magnet-fully assembled - Tested to 120MPH.

2M-64RT
3/8db Gain
Roof or Deck Mount. Mounts ⅜" hole complete - snap-in mount.

2M-64RTI
3.8 db Gain
Roof or Deck Mount ⅜" hole installation where underside is accessible. All mounting hardware.

2M-64TL
3.8 db Gain
Trunk Lip
Mounts front or side trunk lip. No holes, No mar trim washer Complete with wrenches.

2M-1/4MM
Unity Gain
Magnetic mount
¼ wave Complete and ready to wear.

2M-64GC
3.6db Gain
Gutter Clip
Excellent temporary installation complete with no mar pad. Quick on or off.

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Gain figures, where not otherwise specified, are referenced to a quarter-wave groundplane antenna.

STALKING THE WILD IONOSPHERE

Part 1

BY DOUGLAS BLAKESLEE, N1RM

Many amateurs have made substantial contributions to the art and science of radio. But few can match the accomplishments of Oswald Villard, W6QYT. Mike — as he's almost universally known — is currently a Senior Scientific Advisor at the Stanford Research Institute in California. He recently consented to an interview with *Horizon's* contributing writer Doug Blakeslee.

HRH: Your operation using single sideband (ssb) from the Stanford University club station, W6YX, in October, 1947, started a trickle and then a flood of amateurs using the mode. The military services soon followed. How did you first become interested in sideband?

Mike: I first became interested in sideband during World War II, in interludes of dreaming about what the world of ham radio would be like after we amateurs got back on the air. It seemed clear to me that the ham bands would be more crowded than ever, so that ssb should make sense. I had always had trouble building filters (for lack of test equipment) and wondered if there was an easier way to generate a sideband signal. One day, the phasing method occurred to me. It wasn't until later that I learned that it had been discovered and patented by John Stone (a famous radio inventor) back in the 1920s. At the time I first thought of the method, I didn't know how to design a suitable phase-difference network. I was greatly excited by an article published by R. B. Dome, W2WAM, in a 1944 issue of *Electronics*, describing *R-C* phase-difference networks, a really clever idea and a huge step forward.

My main contribution was to devise a high-level-modulated ssb transmitter which essentially consisted of two

high-level balanced modulators connected together. This transmitter was exceptionally easy to adjust. Drive was applied to the grids of the four tetrodes in the final stage as if they were class C amplifiers. Audio voltages were applied to the screens. The frequency-changing and tuning-up procedure was nearly as simple as in a standard high-level amplitude-modulated rig.

"We would call CQ using a-m, then invite people to listen to our ssb."

HRH: What happened when W6YX first appeared on ssb?

Mike: Our high-level single-sideband transmitter, using four 813s in parallel, worked very well and caused a considerable amount of interest. We also had a conventional 1-kW a-m transmitter for comparison. Using a common crystal oscillator, we would call CQ using a-m, and then invite people to listen to our ssb signal. Although a few had trouble, most people immediately appreciated its possibilities. In fact, one of our neighboring hams kept calling his friends and urging them to listen to the W6YX transmission, saying that they were the "wave of the future." It turns out he was correct.

HRH: What sort of equipment did the ssb pioneers use?

Mike: I have heard that the very first amateur ssb operation was by the Editors and Engineers group in Santa Barbara — sometime in the early or middle 1930s.* Theirs was a conventional filter rig, using telephone-company techniques. The big disadvantage of the filter approach in those days was the problem of coil Q. Typically, the sideband-selecting filter, in order to be selective enough, had to have a center frequency in the order of 10 or 20 kHz; as a result, the ssb signal had to be frequency translated (converted) at least twice before it could be amplified by a chain of linear amplifiers and radiated. In contrast, the phasing approach used networks which consisted only of resistance and capacitance elements; because they worked directly at audio frequencies, stray capacitance gave essentially no trouble. The "high-level" generation method actually had only one frequency translation — in the final stage itself. Shortly after we went on the air with our experimental rig, other stations around the country joined us in using the conventional filter approach. Rigs using the phasing method appeared shortly thereafter.

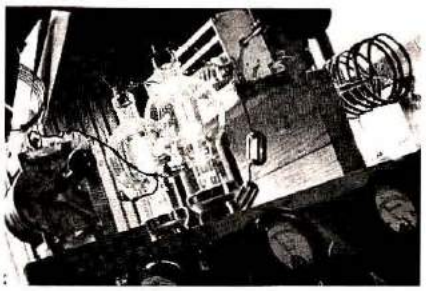
HRH: For the benefit of our readers who are newcomers to amateur radio, would you describe the advantages of sideband transmission over amplitude modulation?

Mike: The first advantage is the saving in spectrum space — only one half as much is required. The second advantage is that the detector used is inherently much more efficient. It responds better to weak signals and handles impulse interference (such as ignition noise) better. For a given communication capability, a phasing-type transmitter which radiates only one sideband is smaller, lighter, and less costly.

HRH: Let's talk about Mike Villard for a moment. How did you get interested in ham radio?

"Once we realized that backscatter came from the ground . . . it was obvious that one could make a radar-like display . . ."

*Editor's Note: A description of an amateur transmitter, using the filter-and-heterodyne technique, was published in a three-part series starting in the September-October, 1933, issue of *R/9*. It was authored by Robert Moore, W6DEI, and the editors of *R/9* — a publication that was later absorbed by *Radio* magazine. Some of the people involved with these publications formed the Editors and Engineers group. The transmitter started with a 10-kHz (then 10 kcs) first oscillator, with a second one at 200 kHz, and the last one at 4150 kHz, to provide lower sideband energy in the 75-meter amateur band. Due credit was given by the authors to the Bell Telephone Laboratories for the development work upon which the amateur system was based.



The final amplifier at Villard's 1936 station. This was long before the days of TVI shielding. Components are mounted on wood, with meters held in place by a single nail. The two large metal plates to the left are an improvised neutralizing capacitor.

Mike: Since my very earliest days I have been interested in electricity. In 1926 everybody was building radio sets from kits. A friend of mine gave me such a set that he had built. I soon became interested in finding out why radios worked the way they did. My father made it possible for me to have some tutoring by a professor of electrical engineering at Columbia University in New York City. It was he who got me started in amateur radio.

"My first rig consisted of two UX210A tubes . . . The receiver was a Pilot Wasp . . ."

The professor was J. R. Dunning, and he had a tremendous influence on my life. He was involved in the development of the atomic bomb during World War II and became very famous. He was head of the electronics research program at Columbia University when he passed away a few years ago.

HRH: What sort of equipment and antennas did you have in your first station?

Mike: My first rig consisted of two UX210A tubes in a TNT oscillator, a circuit taken straight from the *ARRL Handbook*. The receiver was a Pilot Wasp — a popular kit of the day. It had a detector and two stages of audio, using UX210A tubes. Because my parents' home at that time had a 32-volt lighting system, the plate power supply for my transmitter consisted of a pair of surplus World War I aircraft dynamotors. The antenna was an end-fed long wire strung amongst the trees.

HRH: What was the first memorable point of your amateur career?

Mike: When I put up my first rhombic antenna in 1934 or 1935! At the same time, I raised my transmitter power from 10 watts to several hundred. With a dipole and low power, contacts from Connecticut to Europe were rare. Suddenly I was really able to "get out." I had responses from across the Atlantic to most of my CQs. It was an enormous thrill.

HRH: Can you give us some biographical information about yourself?

Mike: My grandfather (who died well before my time) was a co-founder of the General Electric Company, and he commissioned the first ocean-going vessel to be equipped with Edison's "new fangled" electric light.

My father was a well-known liberal publicist; he was editor of the *New York Nation*, and at one point, editor of the *New York Evening Post*. As a newspaper man he was a bit baffled by his son's preoccupation with radio and technical matters.

After graduating from Yale in 1938 I went to Stanford to study under Professor Fred Terman (the author of several well-known radio engineering textbooks). During World War II, I worked at Harvard University in radar countermeasures under Terman. I earned the degree of electrical engineer in 1943; my thesis subject was a vertical incidence ionospheric sounder. I received my doctorate in 1948 at Stanford, and my doctoral subject was the detection of meteors by radio.

HRH: Did amateur radio help in your studies in any significant way?

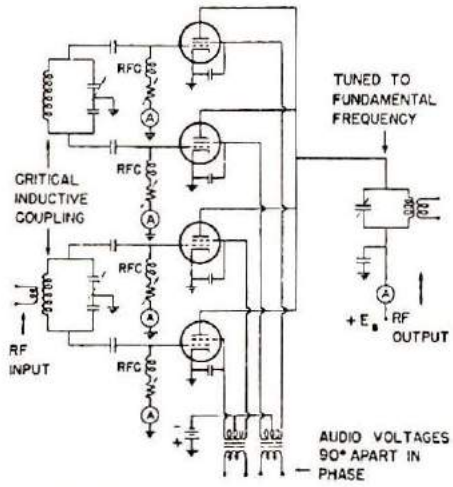
Mike: It sure did! For example, my first experiments in detecting meteors by radio involved using the W6YX transmitter. At the time, no other facilities under our control were available. It was

"I resolved to try to understand the ionosphere, and ham-radio technology came in very handy for this sort of research."

quick and easy to use the ham gear. We were looking for meteors during an intense meteor shower, which was the time to look if there ever was one.

HRH: For the last three decades you've been active in ionospheric research. Several years ago you gave a talk at the ARRL Pacific Division Convention entitled "Stalking the Wild Ionosphere," which would be a good title for your work. What got you into propagation research?

Mike: I had always been fascinated by the ability to talk over long distances by means of radio. It has always seemed to me that better communication



A simplified diagram of Dr. Villard's ssb transmitter that made history from W6YX.

— of whatever type — is essential in lowering the kinds of international tensions that, historically, have led to war. In the early days, long-distance communication depended entirely on the ionosphere, whose variability was notorious. I resolved to try to understand the ionosphere, and ham radio technology, of course, came in very handy for this sort of research.

HRH: You did some work on scatter sounding and backscatter propagation with a group at Stanford. How does the backscatter mode work?

Mike: When I became a student at Stanford University in the fall of 1938, I met Cameron Pierce, then W6HJT (now K6RU), who is an outstanding DXer. He particularly enjoyed operating, and I enjoyed building equipment. We had great fun together. In those days Doc Stuart, W6GRL, of Ventura, California, had the best DX station on the West Coast. We used to try to follow Doc around in contests, because our stations were never as good as his. He usually found the really rare DX first. We could always seem to hear Doc, even though we were located a couple of hundred miles away, and he was supposedly within our skip (dead) zone. The fact that we could almost always hear him, when the books said we shouldn't be able to, bothered me.

Years later, the matter arose again in connection with radio studies of meteor reflections. Backscatter was a nuisance in those studies, so we resolved to understand how it worked. I had an extraordinarily able colleague, Allen M. Peterson, who solved the problem very elegantly. Later on, we learned that others had independently done the same thing at about the same time.

Once we realized that backscatter came from the ground, and not the ionosphere, it was obvious that one could make a radar-like display of those areas on the earth's surface to which communication should be possible at any given time and radio frequency. We proceeded to do this, and got ourselves investigated by the Office of Naval Intelligence (ONI) as a result. It turned out that — quite without our knowledge — the Air Force had been funding essentially the same research at the Raytheon Company, where the work was classified and known as COZI (Communications Operating Zone Indicator). Our radar plot was so similar to theirs that they thought there had been a security leak!

The gang at the Stanford Radio Club, W6YX, in 1939. Villard is second from the right, with Cam Pierce, W6HJT, to his left.

Our work was first published in *QST*; the radar "PPI" (plan-position-indicator) photos appeared on the cover of the March, 1952 issue. They say imitation is the sincerest form of flattery: Peterson and I derived considerable pleasure, some years later, from finding that these same illustrations were used in two Russian textbooks under the title of "Backscatter Ionospheric Sounding." The first, by N. I. Kabanov and B. I. Osetrov, was published in Moscow by the Soviet Radio Press in 1965. The second, by Y. A. Chernov, was published by the Sryaz Press in Moscow in 1971. It seems appropriate to reproduce the Chernov illustration with this article, thus completing the round trip from USA to USSR!

HRH: What amateur bands are likely to produce backscatter signals, and how can a listener tell when he's hearing a signal propagated via backscatter?

Mike: What we today call "backscatter" is the counterpart of ground clutter observed by radars working at line-of-sight frequencies. An ordinary ham rig, using frequencies where ionospheric propagation is possible, can be throught of as a simple radar. If one sends out a short dot in Morse code, and if the receiver recovers promptly enough, one can hear an echo which represents energy scattered back from roughness on the earth's surface. It is easier to do this when the transmitting and receiving stations are separated by a couple of hundred miles, since the receiver will not be paralyzed by the strong local signal from the transmitter.

One of the things that was very unexpected in the early days was the fact that backscatter from the sea is about the same strength as that from land. Initially, it didn't seem plausible that the sea should scatter as efficiently as

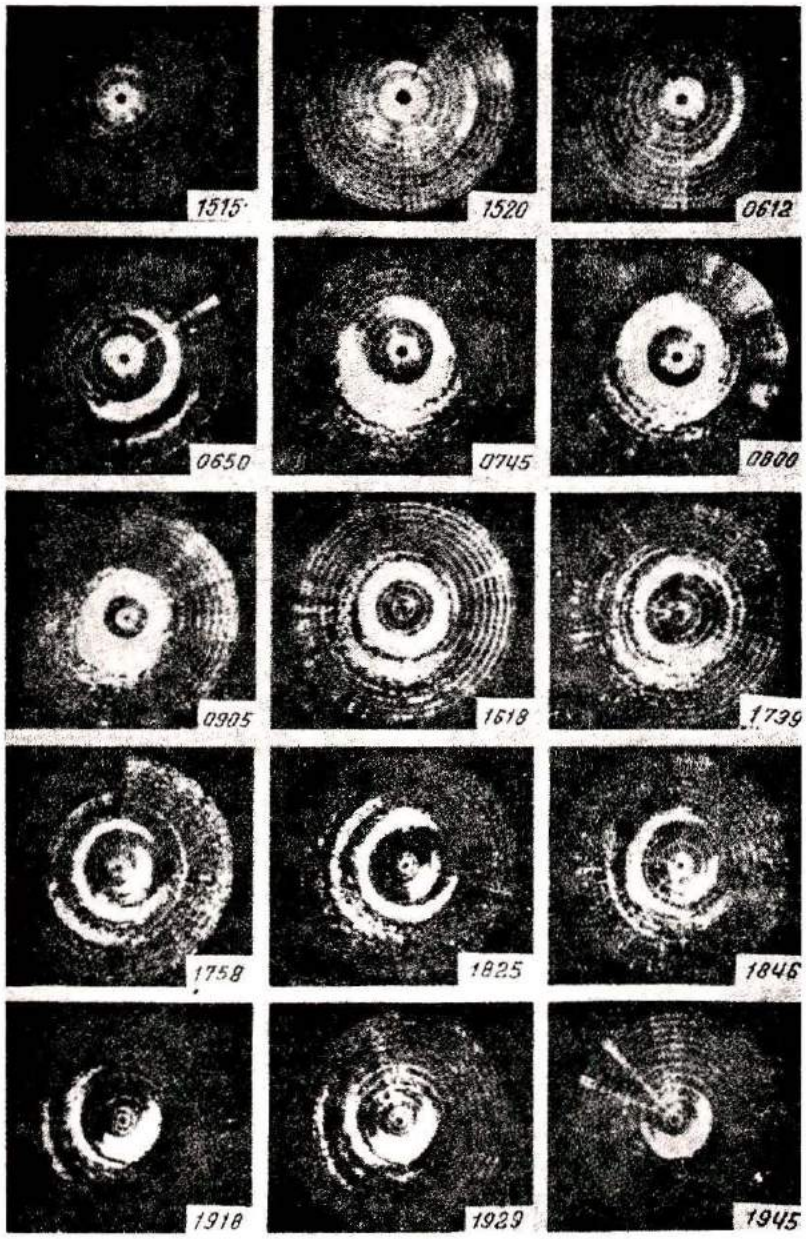
land, which as everyone knows is quite "rough" (mountains, houses, power lines, etc.). Typical short radio waves have lengths of 20 meters or so and it didn't seem reasonable that the ocean would appear to be a rough surface to such radio waves. But we now know that short radio waves actually interact with *trains* of water waves on the ocean's surface — rather than with individual waves — so that the ocean is actually a pretty powerful reflector. By coincidence, it produces backscatter signals nearly as strong as those from land.

Another confusing circumstance was the belief — quite widespread at the time — that what we know as backscatter from the earth's surface was actually originating from the E region of the ionosphere. This conclusion had been reached by a very well respected ionospheric worker who just happened to be wrong on this particular point. Backscatter signals are most noticeable in the 20-, 15-, and 10-meter bands. Backscatter can sometimes be heard at 40 meters, too. The higher the radio frequency, the less competing noise and static there is. Backscatter propagation makes signals sound unstable and hollow; if the transmission is voice, it sounds as though the speaker were talking down a well, while moving around a bit in the process.

HRH: You mentioned that backscatter was a problem during radio studies of meteor propagation. How does meteor-scatter work?

Mike: Meteors are caused by pea-sized (or smaller) bits of space debris which intercept the earth's atmosphere as the earth swings around the sun. These tiny particles of dust or gravel are heated by collision with atoms of the earth's atmosphere, in the same way that the nose-cone of a re-entering space vehicle is heated. Dust particles usually are typically moving much faster than spacecraft, and they heat to incandescence and completely evaporate in one or two seconds. Interestingly, the region in which this occurs (70 to 90km altitude) coincides with one of the ionospheric layers , which means that the atmospheric gas there is easy to ionize. Thus, the meteoric particle, while burning up, creates not only visible light but a column of ionization which is highly reflective to radio waves. The columns are about 15 to 30 km long, in general. Although a given column is a line reflector, whereas the ionosphere itself is a layer reflector, it turns out that signals bounced off meteor trails can have amplitudes that are many tens of dB above the noise level, even when only moderate power is radiated by the transmitter.

Part two of this interview with Dr. Villard will be presented next month, when one of the subjects will be those mysterious long-delayed echoes that have been the object of much research and conjecture. **HRH**



Radar plots of ionospheric propagation paths which were part of the 1962 *QST* article, which later appeared in a Russian text. This print is from the book printed in the USSR.

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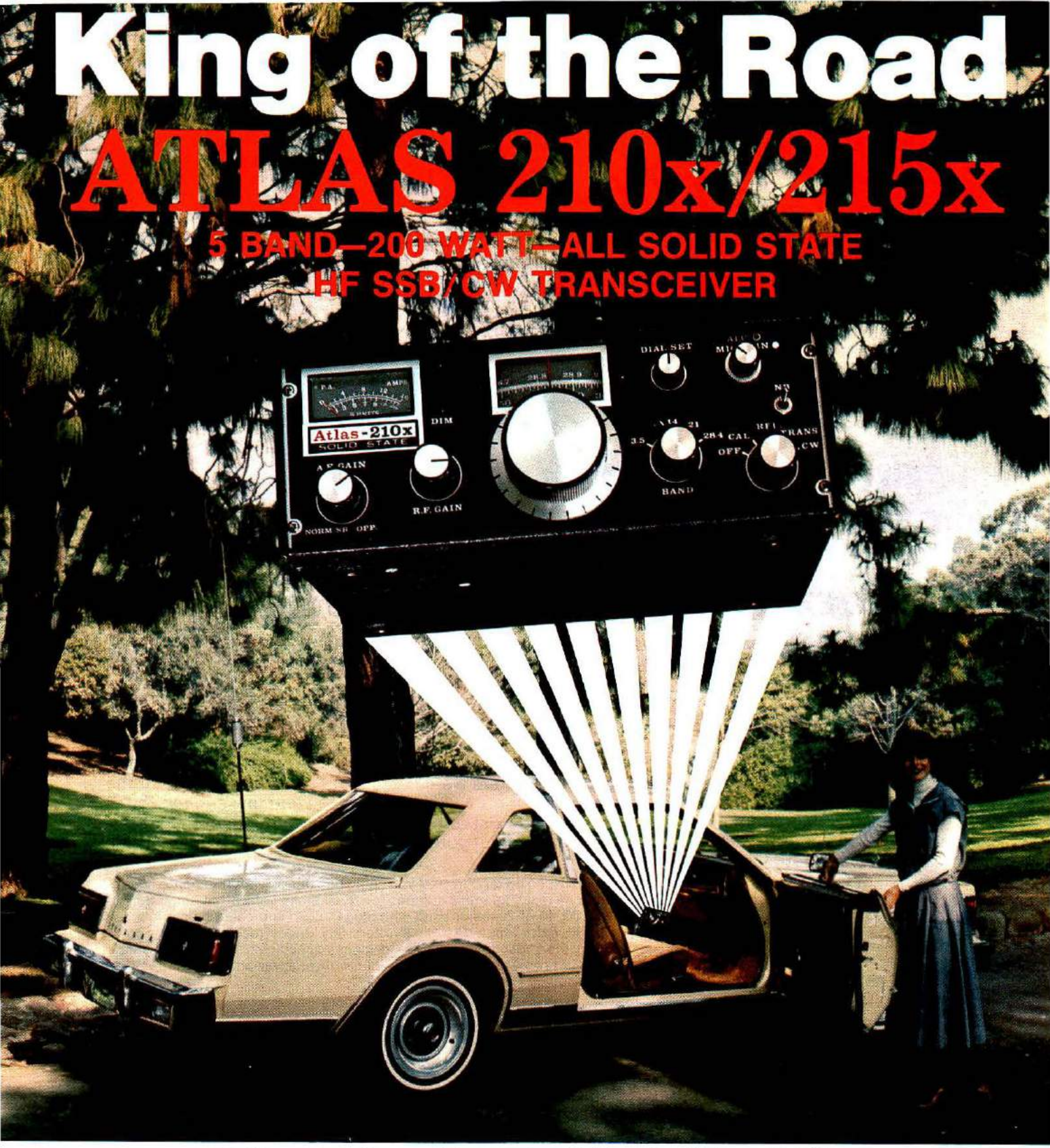

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1937: On The Air For Sixty-One Dollars!

In the year 1937 the United States was a far different place than it is now. No one had heard of sonic booms, tape recorders, rock groups, vinyl flooring, Woodstock, air conditioning, Kentucky Fried Chicken, water beds, hot pants, hula hoops, bikinis, stereo fm, or chain saws.

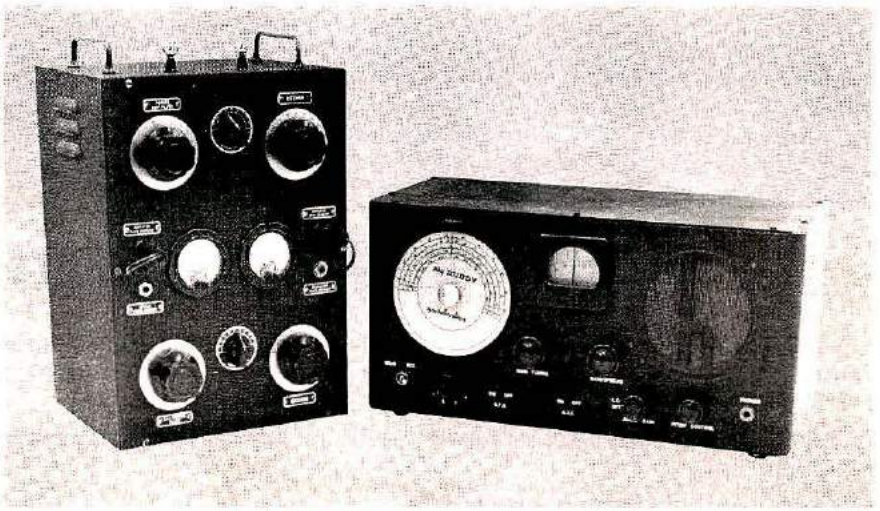
No one knew about Archie Bunker, William Calley, Muhammed Ali, Spiro T. Agnew, Lee Harvey Oswald, Farah-Fawcett Majors, or Jimmy Carter.

And radio amateurs knew little about single sideband, SSTV, repeaters, Oscar, moonbounce, long-path DX, pocket computers, DXpeditions, transceivers, linear amplifiers, or electronic keyers. It was a world that can not be understood unless one had lived in it. A world only dimly seen today through old movies, books, magazines, and the faded memories of those who were there.

The economy was on the way up from the Great Depression. Amateur radio was exploding, the number of amateurs jumping from about 25,000 to over 40,000 in a few years. Hams in the expanding radio business were earning as much as forty dollars a week — more with overtime. At last, hams had money in their pockets and the radio manufacturers were ready for them!

How much did it cost to get on the air? Not much, if you built your own equipment. But the scorn with which most amateurs greeted their compatriots who bought their own equipment was fast vanishing. Ham gear was coming on the market and the prices were low enough to make even the most enterprising experimenter think

On the air for sixty-one dollars! In 1937 you could buy this 50-watt transmitter and four-band receiver for a real beginner's station. The three stage Lafayette transmitter worked on the 160, 80, 40 or 20 meter band with plug-in coils and could be modulated for a-m phone at 30 watts input. The Hallicrafters Sky Buddy receiver was the lowest-priced in a long line of economy receivers designed specifically for the radio amateur. Other manufacturers were quick to come out with receiver and transmitter kits as amateur radio boomed — until December 7, 1941.



twice before he built his equipment which, after all, had no resale value. There was enough business in the amateur-radio market to make it very attractive to a number of manufacturers . . . National, RME, Howard, RCA, Hammarlund, Patterson, and Hallicrafters, to name a few. The superheterodyne had at last proved itself as a sensitive and selective high-frequency receiver and amateurs were eager to buy.

Among the receiver manufacturers scrambling for the amateur market, none was more aggressive than the *Hallicrafters*, the fastest-rising star in a highly competitive field. Located in Chicago, the hub of the broadcast-receiver industry, Hallicrafters brought mass-production techniques to the manufacture of (relatively) inexpensive short-wave receivers with features that appealed to the radio amateur. While others hand-built receivers on a limited basis, Hallicrafters poured them out, backing up the production with a massive advertising effort. There was a receiver model for every purse and a receiver model for every amateur. Indeed, Hallicrafters probably had more different models on sale at one time in 1937 than the combined efforts of all the other receiver manufacturers. And the time was ripe for the "people's receiver," the *Volkswagen* of the radio industry, a receiver for the beginner — the *Hallicrafters Sky Buddy*.

Interior view of the Sky Buddy receiver. An auxiliary power plug on the rear apron allowed the receiver to be run from batteries for portable operation. The use of broadcast-receiver components permitted the rock-bottom price. Thousands of these receivers were sold to beginning radio amateurs. Shortcomings of the simple circuitry prompted many owners to "trade up" to a more sophisticated receiver as time went by.

It is often difficult to trace the exact lineage of some of the older pieces of equipment, and the Sky Buddy is no exception. For instance, the Hallicrafters Sky Buddy was first announced in mid 1936 with a frequency range of 544 kHz to 16.5 MHz. However, this may have been a typographical error, because then the set was subsequently offered through dealers in late 1936, it tuned from 545 kHz to 18.5 MHz in 3 bands. Service data, however, indicated an upper frequency limit for band 3 at 16.0 MHz!

Then, in 1938, Hallicrafters announced a new Sky Buddy in a "modern" package which was called the S-19; it had 5 tubes like its predecessor, and covered the same frequency range. This model was replaced by the "1939 Sky Buddy," designated the S-19R, which featured electrical bandspread, had 6 tubes, and tuned from 545 kHz to 44 MHz in 4 bands. This is the receiver shown in the photographs here, although its outward appearance is very similar to the earlier S-19. **Editor.**

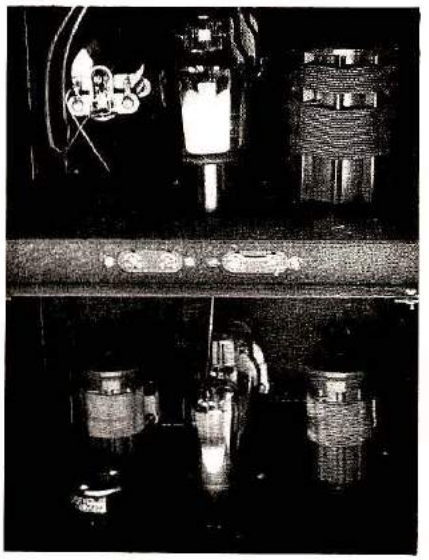
The Sky Buddy receiver

The Sky Buddy receiver was born during the summer of 1936. Based upon the popular "all-wave" broadcast-receiver circuitry popular at that time, the Sky Buddy was a re-boxed version of a basic design produced by the hundreds of thousands by a multitude of manufacturers (**Fig. 1**). No sophisticated circuitry or parts here! A simple superhet circuit, with switching added to catch "police calls" or "foreign broadcasts" on one or two extra wavebands — that was the basic design.

The first version of this little receiver was mediocre and less than a success. It tuned only up to 18.5 MHz (at a time when the 10-meter band was receiving increased attention) and had an unimpressive plastic dial and pointer. At the price of $29.50 it was no bargain. But by late 1936 the receiver had been given a face-lift. A fourth tuning range that ran up to 48 MHz had been added, the impressive "German Silver" Hallicrafters dial was an eye-catching addition, and the gain of the receiver had been boosted through the use of better i-f transformers. For $29.50 it was a lot of receiver!

Judged by today's exacting standards, the Sky Buddy was

The inner workings of the *Trutest* transmitter. On the bottom shelf are the crystal, the oscillator and buffer tubes, and the associated plug-in coils. The power amplifier is located on the top shelf. Terminals on the edge of the chassis permitted the user to make quick connections to a power supply. Since vhf television didn't exist in those days, shielding was unnecessary and all components were out in the open air. Antenna connections were made to feed through terminals on top of the cabinet.



insensitive, unstable, broad-tuning, and full of images and birdies. But for the beginning radio ham who was thrilled to hear signals from across town, the receiver was an outstanding hit! The impressive dial, plus instant bandspread and a beat-oscillator, transformed a simple broadcast set into an acceptable ham receiver that sold over 20,000 units before the model was finally dropped at the eve of World War II.

Hallicrafters had a winner, indeed. And after buying the little receiver, the amateur newcomer still had thirty-one dollars of his budget left to buy a good, husky, transmitter and power supply for his up-and-coming ham station!

The Trutest Junior transmitter

Buy or build your transmitter? In 1937 that was a difficult question to answer. Most hams built their transmitters but bought their receivers. Still, very attractive transmitters were available on the market, although no big electronic manufacturer was yet into the ham transmitter business. Small outfits like *Gross Radio*, *Temco*, and *Collins Radio* built ham transmitters but the "big-time operators" were not interested in such a small market. Nevertheless, a goodly supply of ham transmitting equipment was available for the interested buyer.

A Wholesale Radio Service Company advertisement extolling the virtues of the *Trutest* transmitter. Few amateurs could afford the now-famous National NC-101X when it first came on the market, but sales of the Sky Buddy receiver ran high because of the value and low cost. The 1937 WRS catalog listed these, and other goodies, that made the radio hams' pulse quicken!

One of the "ham havens" near radio row in New York City was the *Wholesale Radio Service Company* at 100 Sixth Avenue (now known as Lafayette Radio Company). This live-wire store had a large amateur department run by Frank Lester, W2AMJ (now W4AMJ). Frank and his boss had strong ideas about amateur radio and the company — WRS as it was known among hams — produced and advertised a whole line of ham gear which was the talk of the ham bands until the war closed down amateur radio in 1941.

Among the unique transmitters developed by W2AMJ was the little *Trutest 25 Watt Junior* transmitter. Despite the belittling name, this was a three-stage job that operated on the 20, 40, 80, or 160 meter bands by the proper use of plug-in coils.

The circuit was simplicity itself (**Fig. 2**). A type 56 triode "hot-cathode" crystal oscillator drove a type 53 high-mu triode buffer stage. The sections of the 53 were parallel connected. This, in turn, drove a pair of type 46 tetrode tubes as a neutralized final amplifier.

The 46 was an interesting tube, and very popular in ham transmitters. It was brought out for class B audio service just about the time the radio industry dropped that type of amplifier for the much-improved "high fidelity" class AB system using low-mu type 2A3 triode tubes. The 46, in

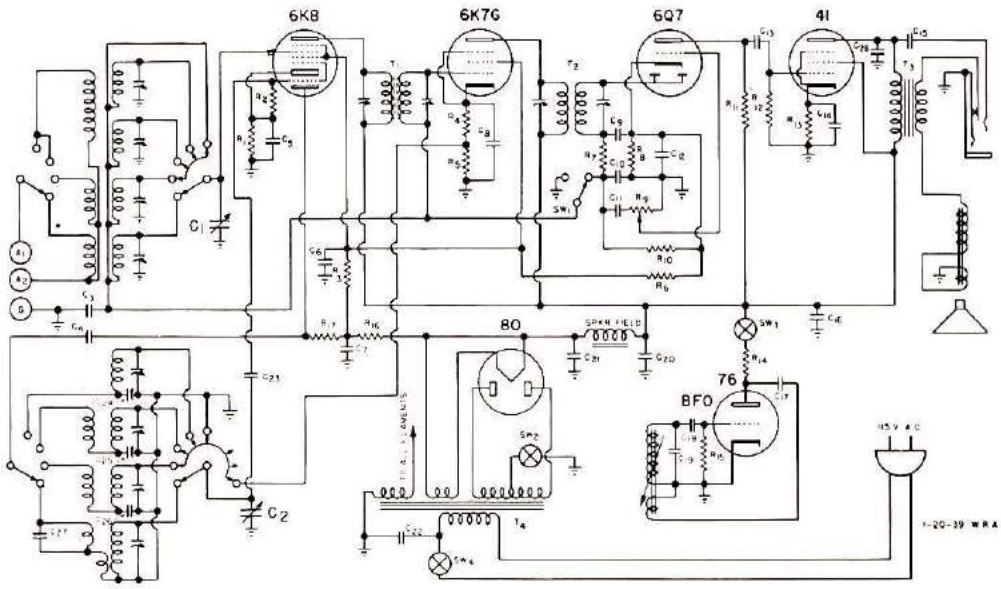


Fig. 1. The way it was — the circuit of the Sky-Buddy receiver. A dual-purpose 6K8 is used as oscillator-mixer (no rf stage!), followed by a 6K7 i-f amplifier. A 6Q7 serves as a combined second detector, avc rectifier and audio amplifier, followed by a 41 pentode audio output stage. The beat-oscillator is a 76 triode. A full-wave power supply with an 80 rectifier is used. Note that the speaker field winding is used as a filter choke — this was before the days of the highly efficient permanent-magnet speaker.

effect, was a tube without a destiny until its use in amateur service as an efficient, zero-bias, class-C amplifier was discovered. Two of these tubes could coast along at 50 watts input on CW or phone, and that wasn't bad for tubes that could be bought six for a dollar on

was a problem. Flashovers, erratic tuning, and plenty of TVI were the immediate reactions. Upon a careful examination of the circuit, it was found that the neutralizing winding of the buffer coil was incorrectly wired. Once the wiring error was corrected and parasitic

coils. A crystal cost an extra two dollars, bringing the total station expenditure to fifty-four dollars, leaving seven dollars to buy a key, build a power supply and put up an antenna. A frugal ham could even include a set of earphones for that price!

At present, the transmitter

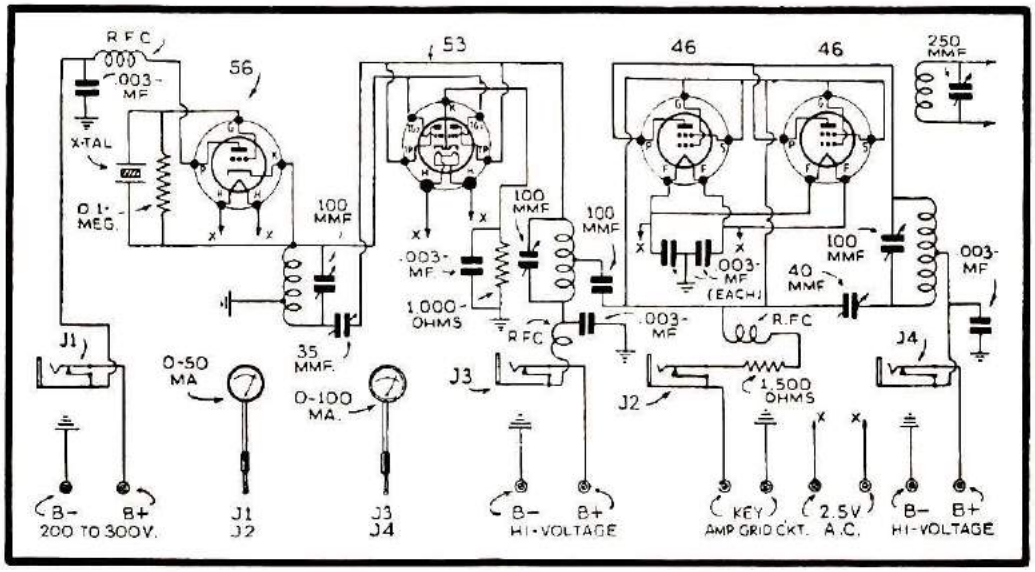


Fig. 2. Circuit of the Lafayette transmitter. Said to have a "range of 1000 miles" on 80 meters and an "unlimited" range on 40 meters, this 50-watt circuit employed three stages in a configuration unknown to most of today's newer amateurs. The 56 oscillator used the then-popular "hot-cathode circuit," with the anode of the tube at rf ground potential. (Circuit connoisseurs will note that the plate bypass capacitor for the 56 tube is missing from the drawing). The 53 dual-triode operated as either a neutralized buffer or as a doubler stage, capacitively coupled to two 46 tubes connected in parallel as a class-C amplifier. The grids of the 46s were connected together to provide high-mu, zero bias operation. Metering was done in the high voltage leads. (This drawing is reproduced from the December, 1936, issue of *Short Wave Craft* magazine, a Gernsback publication.)

radio row, or for 39¢ each via the mail order catalog.

On the air with the Sky Buddy and the Trutest transmitter

By a stroke of good luck I recently acquired a Sky Buddy receiver and a Lafayette Junior transmitter in mint condition, and immediately put them on the air to see how they would work. The Sky Buddy played well on 160 and 80 meters and was acceptable on 40 meters. While signals could be heard on the higher bands, receiver operation was unstable and erratic by today's standards. The particular model at hand, moreover, had a 500-kHz intermediate frequency and San Francisco Marine Radio KFS boomed through the i-f strip until a wavetrap put a stop to this interference.

The Lafayette transmitter

suppressors placed in the plate circuit of the final amplifier, the little transmitter settled down and put out a good TVI-free 25 watts on the lower bands, and about 15 watts on 20 meters.

It is interesting to speculate how many of the Lafayette Junior transmitters were incorrectly wired at the factory and how many of the owners solved the problem. According to the previous owner of my rig, it had been on the air for several years and worked, even though tuning was "erratic." And no wonder! It would have taken the patience and wisdom of Solomon to tune up the beast when it was incorrectly neutralized and full of parasitics!

In any event, the beginning amateur of 1937 could buy the little transmitter for $22.50, fully wired, and with one set of

and receiver occupy a position of honor in the W6SAI shack and are ready to go on the air on special occasions. Real conversation pieces that work today, though designed over forty years ago!

So here's a toast to those forgotten circuit designers, engineers, and manufacturers of the Golden Years of Amateur Radio. Working with imperfectly understood theory in an age of sheet metal, they produced marvels of ingenuity that worked and that still draw admiring glances from today's amateurs who are possibly overwhelmed by the modern world of plastics, ICs, counters, and LED readouts that insulate the operator from the "feel" of the airwaves. Could you or I do as well today with the tools and techniques of yesterday? I wonder . . .

HRH

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ne of the world's finest high performance military the discriminating buyer who knows and appreci- g with a full 2000 watts PEP input on SSB, 1000 . The heart of the MLA-2500 is a heavy duty, self s 2 Eimac 8875's.

QUESTIONS & ANSWERS

Tubes, Transistors, and Diodes

BY THOMAS McMULLEN, W1SL

Last month I talked about some of the more common passive components that are used in radio circuits — resistors, capacitors, inductors, transformers, in their various forms. They are called passive because they just pass the energy along — they do not amplify (increase the power) of any signal or dc that is applied. They can change the *form* of the power, such as from high-voltage/low-current to low-voltage/high-current, but the total *power* coming out of a passive device is the same as that going into it, minus a small percentage for losses, of course.

Now I can tell you about active devices. By active I mean those that can add power to a given signal; a fraction of a watt can be built up to the hundreds-of-watts level, or a current flow of milliamperes can control the flow of amperes. These amplifying functions can be done by vacuum tubes or by transistors, in an almost endless combination of circuits that use many of the passive devices as well.

*For some interesting reading on the background and development of the transistor, see 'Dawn of the Semiconductor Age,'' by Steven Komaniecki, WB9SDN, in the Wrap-Up issue (December 31, 1977) of *Ham Radio Horizons*.

Another active device is called a diode. It's really an offshoot of the vacuum tube — in fact the first ones *were* vacuum tubes — but after several years of exposure to transistors and semiconductors we tend to think of diodes as a cousin to the transistor.* Either type will perform a function called rectifying (for power supply uses), or detecting (turning a radio-frequency signal into audio so you can hear it, or into dc so you can see it on a meter). So, let's explore this vacuum tube thing first, because understanding what happens in this device will help with the transistor theory later.

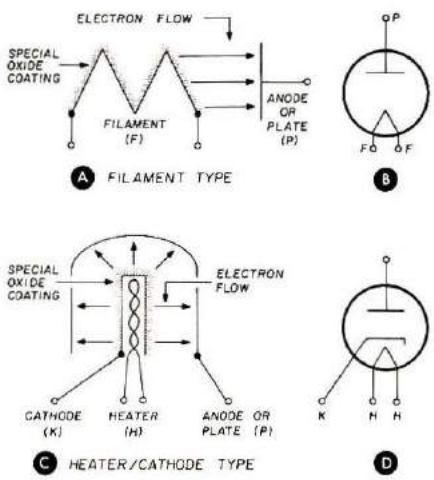

Fig. 1. A vacuum tube diode consists of a heated element, either a filament as in **A**, or a cathode sleeve heated by an internal element, **C**. The filament or cathode is usually coated with a special oxide to help it emit electrons when hot. The electrons flow from the heated element to the anode (also called a plate in much electronic literature).

Vacuum tubes

A vacuum tube is simply a glass or glass-and-metal bulb that has metal electrodes mounted inside it, and the air has been removed so that the electrodes are in a vacuum. One of the electrodes is heated by causing a heavy current flow through it, similar to the way a light bulb gets hot. This electrode, or element, is called either a *heater* or a *cathode* (or sometimes a *filament*). A *cathode* is usually a small metal tube that surrounds the heater, whereas a *filament* has no surrounding tube or sleeve. See **Fig. 1**.

In either case, whether it is a filament or a cathode that is an active tube element, its purpose is to emit electrons. The surface of the cathode becomes hot enough that the electrons are in a very active state, and those close to the surface can be pulled out of orbit by the attraction of an electrostatic charge nearby. If you ever are in doubt about the direction of *electron* flow in a vacuum-tube circuit, just remember that they have to leave this *hot* surface; a cold surface will not let the electrons loose.

The electrons leave the cathode, and travel to the plate (sometimes called the anode), which is a metal electrode that surrounds the cathode structure at some distance, usually a few millimeters (fraction of an inch). The electron travel is aided by applying a potential between the two (plate and cathode) from a battery or power supply. The plate is charged positive (deficiency of electrons) and the cathode is negative (surplus of electrons). This two-element tube is called a diode, which can be used as a rectifier in a power supply, or a detector in a receiver.

Because the electrons can only leave the heated element

(cathode), the diode acts as a one-way street for current flow. When an alternating current (ac) is applied to a diode, **Fig. 2**, it will allow current to flow when the voltage is in the negative half of the cycle, but block the current when it swings positive. (Remember

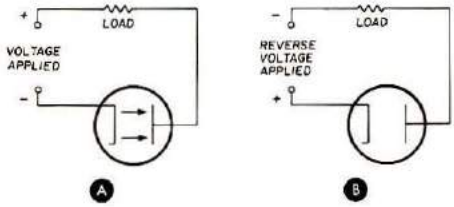

Fig. 2. Electron flow in a diode can only take place when the cathode is negative with respect to the anode. It turns an alternating current waveform into dc by conducting when the wave is negative (at the cathode — positive at the anode) and stopping the flow when the waveform reverses.

that I am talking about the cathode of the tube; many illustrations show the voltage applied to the anode, which is just the opposite of what I described. Either illustration is correct, but I want you to remember that the electrons flow from the cathode to the anode.) **Fig. 2B** shows what happens when the voltage has the opposite polarity.

Other tube types

If you construct a tube in the same manner as a diode, but place a structure consisting of a fine wire mesh, or screen, between the cathode and the anode, you have a three-element tube, called a *triode*. See **Fig. 3**.

Now things begin to get interesting, because you can control the flow of electrons by changing the potential on this third structure, called a *control grid*. The electrons want to leave the cathode to get to the anode, but if they see a negative potential out there in the way, they turn right around and stay on the cathode. However, if they see a positive potential on this control grid, they can leave the cathode and go their merry way. A few of them will stick to the grid, and never reach the anode, but the majority of them will zip through the holes in the structure and get to the anode in fine shape. This is the way an amplifier tube works — a change in potential of perhaps 2 volts on the control grid (a swing from −1 volt to +1 volt, for instance) can cause a change of current flow through the cathode/anode/external circuit that will make the voltage across a load (plate) resistor vary perhaps 20 volts, for an amplification factor of 10.

Other tubes have more elements between the cathode and anode, and you'll find a few of them in amateur transmitters and receivers. One element is called a *screen grid*; it is located between the control grid and the plate, **Fig. 4A**. It is connected to a positive potential, but not quite as much positive as the anode. Its purpose is to attract the electrons that leave the cathode, but because it is a screen or mesh structure, most of the electrons get through it. The action of the screen increases the gain (amplification factor) of the tube.

However, there is a problem associated with this screen grid action, and the designers found a way around it, fortunately. The electrons sometimes went zipping through the control grid with so much energy that they hit the anode

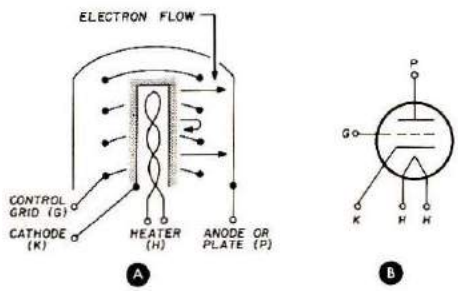

Fig. 3. If you add a grid structure between the cathode and the anode of a vacuum tube, you have a triode (three elements). The varying charge (voltage) on this control grid can repel electrons, or it can aid them on their way toward the plate, depending upon the polarity of the charge.

hard enough to knock some electrons out of orbit there! This is called secondary emission, and is undesirable, because the electrons sometimes bounce back to the other elements to cause them to overheat from excess electron flow. Tube designers

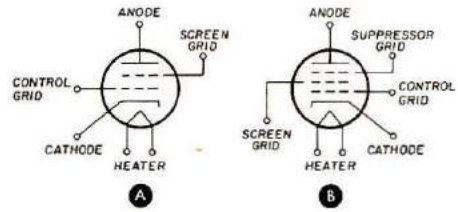

Fig. 4. Adding more elements to the basic triode structure creates more useful vacuum tubes, and often increases the amplification factor. The purpose of each element is explained in the text.

found that they could cure the problem by placing a suppressor grid between the screen grid and the anode. This suppressor grid is charged negative with respect to the anode, but because it is not heated, it will not emit any electrons. The negative charge tends to repel any electrons that are knocked loose from the anode, thus keeping them in their place. This suppressor grid is usually connected to ground, or, in some tubes, directly connected to the cathode inside the tube.

Semiconductors

As you may guess from the name, a semiconductor is something that is neither a good conductor nor a good insulator. The term is commonly used to refer to the entire class of transistors and diodes that are made of semiconductor material.

Semiconductor material is usually *Germanium* or *Silicon* (both are natural elements) that has been altered by adding impurities, such as Boron, Phosporus, Indium, and the like. This alteration, called doping, changes the basic structure so that it has either a surplus of electrons, **N**-type material, or a deficiency of electrons, **P**-type material. By

changing the amount and types of impurities, and the placement of layers of N and P type material, an almost endless vaariety of diodes and transistors can be made.

Diodes are the most basic of semiconductor devices, so let's look at how they work. As you have guessed, they are a two-element device, just as a diode vacuum tube is a two-element tube. In fact, a semiconductor diode works just about the same as a tube diode, but it does not need a heater to get the cathode hot enough to emit electrons. The emitting element in a semiconductor diode is still called a cathode, so the analogy still fits — electrons flow from the cathode to the anode.

A semiconductor diode is made by placing N-type material and P-type material next to each other, and running them through a diffusion process (heating, or other exotic treatment) so that the two layers are bound together. There is a boundary between the two types of material, called a junction, (or depletion zone), where there are few free electrons, which is difficult for electrons to cross (see **Fig. 5**). That's a very useful boundary to have, because without it, all the electrons in the N-material would immediately cross to the P-side, and that would be that — no useful function would be performed.

However, by applying a voltage to the device, enough extra energy can be imparted to the electrons so that they will cross the barrier. The voltage must be great enough to overcome the depletion zone, or energy barrier, and in Germanium diodes it requires approximately 0.2 volt; in Silicon types the required voltage will be from 0.4 to 0.6 volt. Once this barrier potential has been reached, the diode is essentially a short circuit for electrons flowing in one direction. If the voltage reverses polarity, the diode becomes an open circuit again, and only a few microamperes of current will flow because of stray electrons (called minority carriers), or imperfect material. Thus, a semiconductor diode can do the same job that a tube diode can, but you save energy by not having to heat the cathode all the time.

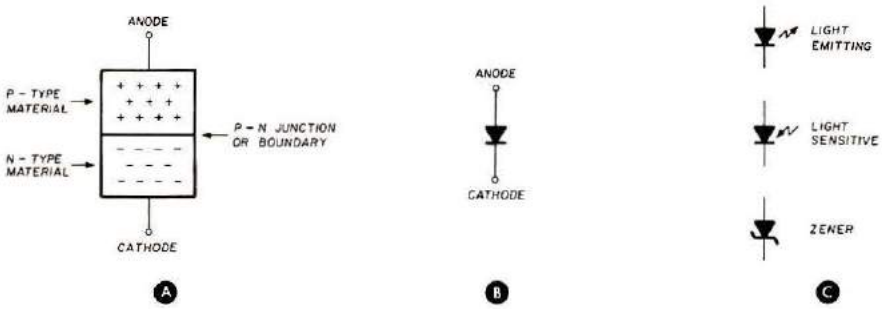

Fig. 5. A basic semiconductor diode is made of **P** and **N** type material. They work as one-way devices for electron flow, just as their tube counterparts do. Some diodes can be made to emit light, some are sensitive to light shining on them (solar cells, for example), and some have a precisely controlled breakdown point. This latter is called the *Zener* point, after its discoverer. Zener diodes are used as voltage regulators.

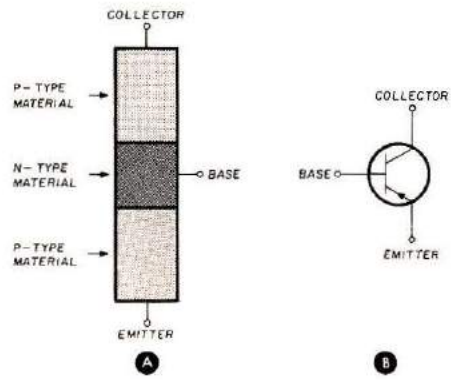

Fig. 6. Bipolar transistors are made of a sandwich of semiconductor material. The **N** material in the **PNP** type controls the flow of electrons from the emitter to the collector. This is a very basic representation of transistor structure, and should not be taken as representing the physical assembly of any manufactured transistor.

Transistors

Transistors are similar to vacuum tubes in many ways, but in many other ways they are quite different. The basic transistor is a three-element device, with an electron-emitting section called the *emitter*, an electron-receiving section, called the *collector*, and a control section, called the *base*. (I'm talking about transistors called bi-polar types now, there are other types which I'll get into later.)

The emitter, as you might suspect, emits electrons, in a manner similar to the cathode in a tube or semiconductor diode. Between the emitter and the collector you will find a layer of special semiconductor material which can influence the flow of electrons on the way to the collector (see **Figs. 6** and **7**). This layer is called the base, and it functions much in the same way that a control grid does in a tube — a small current flow (potential difference) between it and the emitter can control the much larger current flow that goes from emitter to collector.

Some of the differences between a transistor and a vacuum tube are: the transistor needs no heater power; the transistor is a low-voltage device, whereas the tube can work at hundreds or thousands of volts; transistors generally have only three elements (a few companies make four-element types, but they are not common in today's equipment); a tube provides amplification by means of voltage swing across a load, where a transistor usually is better at causing large swings in current flow at low voltages.

Also, common bipolar transistors come in two polarities: **NPN** and **PNP**. These terms have to do with the type of

semiconductor material that each layer is made of, and you must have the right polarity on the right part or the device will not work (it might even burn out). A trick to help remember which is which is to say, "middle letter equals collector polarity." If the middle letter is

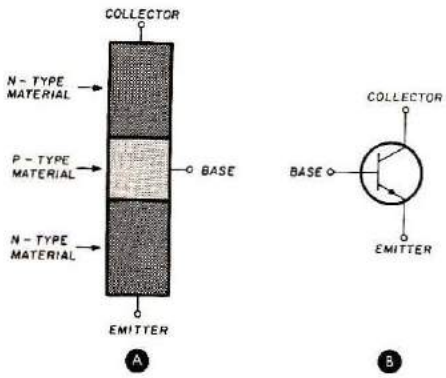

Fig. 7. In an **NPN** transistor, the placement of the **P** and **N** material is changed, but the function is basically the same.

P, then the *collector* must be *Positive*; if the middle letter is **N**, then the *collector* must be *Negative*. Another little trick to reading the schematic symbol for a transistor is, "arrow **N**ot **P**ointing i**N**." This refers to the arrow in the emitter part of the symbol, of course, in an **NPN** transistor. The other type (**PNP**) would have the arrow reversed, but you only have to memorize the key for one type.

There are many different types of transistors and semiconductor devices, and it is just impossible to cover them all here. However, the basic information about tubes and transistors will suffice for your exam purposes, and you can get deeper into transistor theory when you want to go on to a higher grade of license.

FETs

Some transistors are called Field Effect Transistors (FET). They come in various types, with several different names, but all operate in a similar manner. **Fig. 8** shows the basic structure of the JFET (Junction FET), which consists of a section of semiconductor material, of either P or N type, with an "island" of other material imbedded in it. The part of the FET that electrons flow from is called the *source* (of electrons), and the other end, where electrons go, is called the *drain* (for electrons). This island, called a *gate*, is usually of semiconductor material also, and it has an electrostatic charge on it which produces a zone of depleted electrons that influences the flow of electrons in the drain/source material adjacent to it. If the charge on the gate is great enough, the depletion zone becomes large enough to completely "pinch off" the electron flow. Thus, by varying the potential on the gate, you can control the flow of electrons through the device and an outside circuit.

In some FETs, the gate is separated from the source/drain material by a very thin layer of insulating oxide, in which case the device is called an IGFET (Insulated-Gate FET) or a MOSFET (Metal-Oxide-Silicon FET). Some devices have more than one gate, in which case they are called

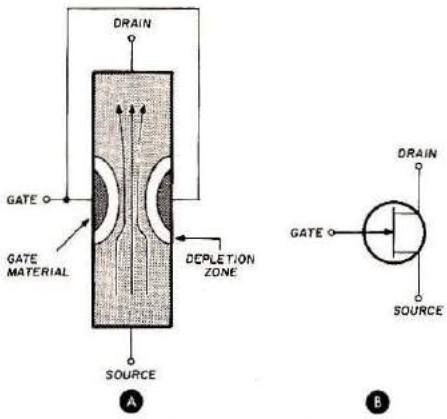

Fig. 8. A field-effect transistor (FET) works by squeezing the electron flow area between two depletion zones (zones of no free electrons). The zones can be increased or diminished by changing the potential in the gate area.

Dual-Gate FETs (or Dual-Gate MOSFETs). The structure and symbol of an IGFET is shown in **Fig. 9**.

Third method?

Oh, yes, that third method that I promised to tell you about — the semiconductor device that will tune a circuit. Well . . . it's like this. Remember that all diodes have a barrier or junction between the P and N materials. This is called a *depletion zone*, because some of the electrons do wander around and find "holes" to fit into, so the area is said to be depleted of free electrons. If the manufacturer uses just the right mix of materials and the correct method of fabrication, this depletion zone can be slightly larger and more stable than usual, so that the diode appears to be a capacitor. Note that a capacitor consists of two conductors separated by an insulating material (insulating material has no free electrons),

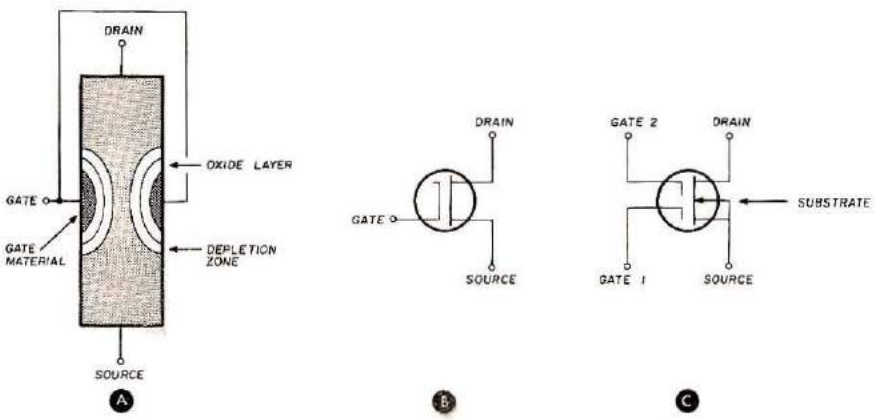

Fig. 9. Some FETs have the gate material insulated by a thin oxide layer, in which case it is called an IGFET (Insulated-Gate FET). A MOSFET is essentially the same, and may have dual gates.

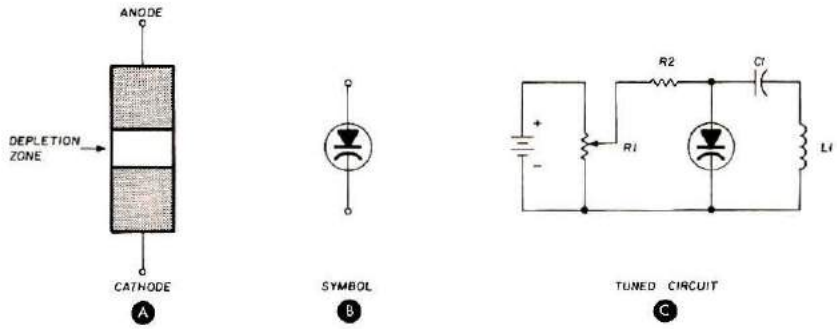

Fig. 10. A semiconductor diode can be made with a controlled depletion area, which simulates a capacitor. Varying the voltage applied to the device will change the size of the depletion zone, thus changing the capacitance. At **C**, the potentiometer, **R1**, changes the voltage applied to the diode, which becomes a variable capacitor to tune the inductor, **L**. **R2** is used to limit the amount of current that can flow in the diode, and **C1** blocks the dc from flowing through the inductor.

and the conductors have a charge on them. It's the same thing with the special diode — you have a charged conductor on each side of an area with no free electrons. This can be called a semiconductor capacitor, but the usual term is *voltage-variable capacitor*.

By changing the voltage on the diode, you can compress the depletion zone, which is the same as moving the plates of a capacitor closer together, increasing the capacitance. Conversely, by lowering the voltage you can increase the size of the depletion zone, thereby decreasing the capacitance. This is a most useful device — you can use it to tune a circuit by remote control simply by using a potentiometer to change the voltage applied to the diode, see **Fig. 10**. There is one catch, though — diodes will not stand much power, so you cannot use them in a transmitter. However, for receiver circuits, they're great! No mechanical linkage to a dial mechanism to worry about, and the expensive variable can be replaced by a low-cost potentiometer.

Next month

One thing that I have not talked about yet is crystals — the quartz type that is used to control the frequency of oscillators. I can tell you about them in a few words when I talk about oscillator circuits in next month's session. In the meantime, look over all of the symbols for the devices I've told you about, so you'll recognize them when we get to the Practical Circuits section from the Study Guide.

Wire-wheel correction

One of our sharp readers called my attention to an error in the "wire-wheel" formula aid in the February, 1978 issue of Horizons (**Fig. 4**, page 58). It

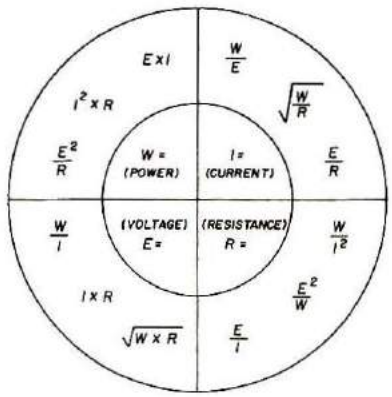

Fig. 11. Wire-wheel correction.

seems that a couple of radicals (square-root symbols) got lost, so I've had them reinstated, and you'll find the corrected wheel shown here as **Fig. 11**. This should make it easier to determine voltage or current if you know the power and resistance. Thanks, Joe! **HRH**

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meet the neat mnemonic

BY ALF WILSON, W6NIF

There are a few individuals among us who are blessed with near-total recall. No event, number, face, name or whatever, seems to elude them. If you happen to be one of these fortunate people, this article isn't for you. But if you're like I am, then you need some kind of crutch to help you remember abstruse information which is absolutely essential in accomplishing a specific objective. The objective in this case is passing the amateur written examinations.

An interesting thing about memory is its specialization aspect. You might remember certain kinds of information extremely well and other kinds poorly or not at all. The trick to increasing your memory efficiency is to devise some method of coding the information you have trouble recalling in terms of information you can remember well. Such a device is called a mnemonic (pronounced with silent "m"). It is used by logicians, mathematicians, psychologists — even by digital computers.

Precautions

There's a subtle trap lurking in mnemonic systems, though. When used in limited fields of high specialization they are quite useful. However, if applied to generalized situations, mnemonic coding tends to fall apart because of its unavoidable complexity and ambiguities. As a matter of fact, it's possible to devise mnemonics so far fetched as to defeat their very purpose: you can get to a point where you can't even remember the mnemonic for the mnemonic you're trying to remember. Used with care and a little thought, however, the system does work for special cases.

Consider now the newcomer to amateur radio. How can he possibly remember the deluge of equations, rules, concepts, and relationships required to pass the amateur written test? "Study," you say, and right you are! But how about helping him over the rough spots — at least until he gets to the point where, finally, the light begins to dawn?

I recall when I was first exposed to the mysteries of radio theory. (We didn't call it electronics in those days.) I took one look at the equation for resonance in a tuned circuit and thought, how am I ever going to remember this stuff? Then I flipped over a few more pages in the book and saw the equation for a damped wave (that's what comes out of a

spark transmitter, youngster). I shuddered, buried the book under a stack of Captain Billy's Whiz Bangs and old Liberty magazines, then took off to see my old pal Ed, W6NHZ.

Ohm's law

Ed was really a very astute fellow. After I explained my problem, he came up with some real help — in the form of mnemonics; only he didn't call it that. I doubt if the word was even in existence then. Anyway Ed said, "For openers let's look at Ohm's law for dc. The law was invented by George Ohm sometime in the early 1800s. If you can remember this basic equation you can solve almost any problem involving dc circuits. But don't ask me why old George assigned the symbol 'I' instead of 'C' to represent current. Possibly he did it to avoid confusion with capacitance, whose symbol is 'C.' "

I said, "Well, the symbols for voltage and resistance I can understand, because E represents electromotive force,and R is obviously for resistance. But why 'I' for current?"

Then Ed said, "I really have no idea. Maybe George had trouble remembering the equation himself. For one thing, you'll notice that E, I and R are in alphabetical order. Perhaps he chose this sequence of symbols in an attempt at helping to remember their relationship."

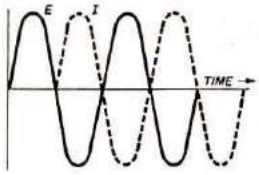
I said, "Okay. All this is fine, but meanwhile I gotta memorize all this junk so I can learn why. Incidentally, why **does** $E = IR$ anyway?"

Ed said, "Because it's the law, boy. Don't you obey the law?"

I said, "Sure, but how am I going to obey it if I can't remember whether $E = IR$, or $I = RE$, or $R = EI$?"

And now we come to the crux of the whole story.

"Okay," Ed said, "If you don't like $E = IR$, how about temporarily changing I to A



1. Phase relationship between E and I

E is the reference. Across a pure inductance E leads I; across a pure capacitance E lags I. For X_L and X_C think: "$+X_{Leads}$ and $-X_{Comes}$ after."

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

2. General equation for impedance

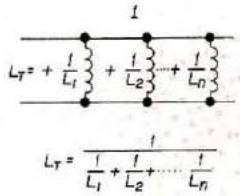
It's assumed you know Z contains R, X_L, and X_C. Impedance equals the square root of R squared plus the net reactance squared. Think: "*Square Root of R squared plus (reactance) squared.*" From problem 1, $+X_L$ leads; X_C comes after. This takes care of the second term under the radical.

$$\frac{Z_P}{Z_S} = T^2$$

3. Impedance ratio of transformer windings

The transformer **primary** is the reference. The symbol resembles the equation. Let the equal sign represent the transformer core.

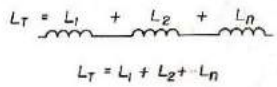
Parallel and Series Elements



$$L_T = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \cdots + \frac{1}{L_n}}$$

1. Combination of inductances in parallel

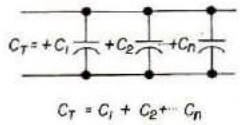
Inductance and the numeral are the reference for parallel elements. The symbol resembles the equation. Think: "One over one over one Lth, plus one over one Lth, plus . . . "



$$L_T = L_1 + L_2 + L_n$$

2. Combination of inductances in series

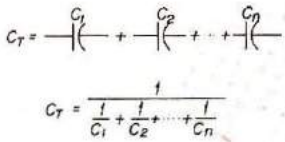
The symbol resembles the equation. Think: "String of coils, L_1 plus L_2 plus . . . "



$$C_T = C_1 + C_2 + C_n$$

3. Capacitors in parallel

This is the exact opposite of the symbol/ equation relationship of the reference mnemonic (inductance).

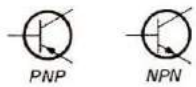


$$C_T = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \cdots + \frac{1}{C_n}}$$

4. Capacitors in series

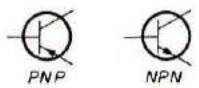
Same rationale as in problem 3.

Transistors



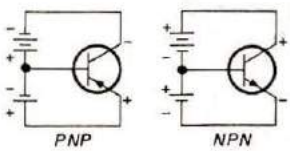
1. Direction of emitter

The transistor **base** is the reference. For PNP, think: "Arrow **P**oints toward base:" **P** NP. For NPN, think: "Arrow does **N**ot **P**oint toward base:" **N** PN.



2. Element names

The emitter is the reference. Think: "Arrow emits" current from, or toward, the base. The other elements are then obvious by deduction.



3. Emitter and collector polarities with respect to the base

The polarities *must* be opposite. The **emitter** is the reference. for **P**NP, think: "Emitter **P**ositive." For **N**PN, think: "Emitter **N**egative." By deduction, the other polarities are obvious.

(for ampere)? If you can't remember $E=AR$ then you may as well give up. $E=AR$ . . . get it? EAR? Them big flappy milk-wagon doors you hear with, old buddy."

Then I said, "Yeah, yeah — I get it! In order to hear it with my ear, it's got to be changed to dc, right?"

I won't repeat here what Ed's reply was, but he got his point across, and for that I'll be eternally grateful.*

So I went home and stared long and hard at all the equations, symbols, and other oddments that make up the basics of our hobby. I then devised a set of coded symbols to help me remember the necessities.

Some ideas

Some of the more basic mnemonics are listed on the facing page with their symbolic derivations. The list is by no means complete because of space limitations. However, enough material is included to get you started; then you can invent your own. I've also added some material on transistors to keep up with the changing world.

My mnemonic symbols suit me just fine, because they're personalized. Perhaps you have better ideas to adapt the mnemonics to your particular requirements. In any event, if I've provided no more than the initial push to help a new amateur get started, then this piece will have served its purpose. **HRH**

*Yet another mnemonic was contributed by Les Hamilton, Ph.D., K6JVE, which appeared in the August, 1970, edition of *ham radio*, several months after the original article was published. Les's comments are quoted directly:

"Here's a mnemonic for you which I learned from Dr. Nolde, my first Electrical Engineering professor at Berkeley in 1956.

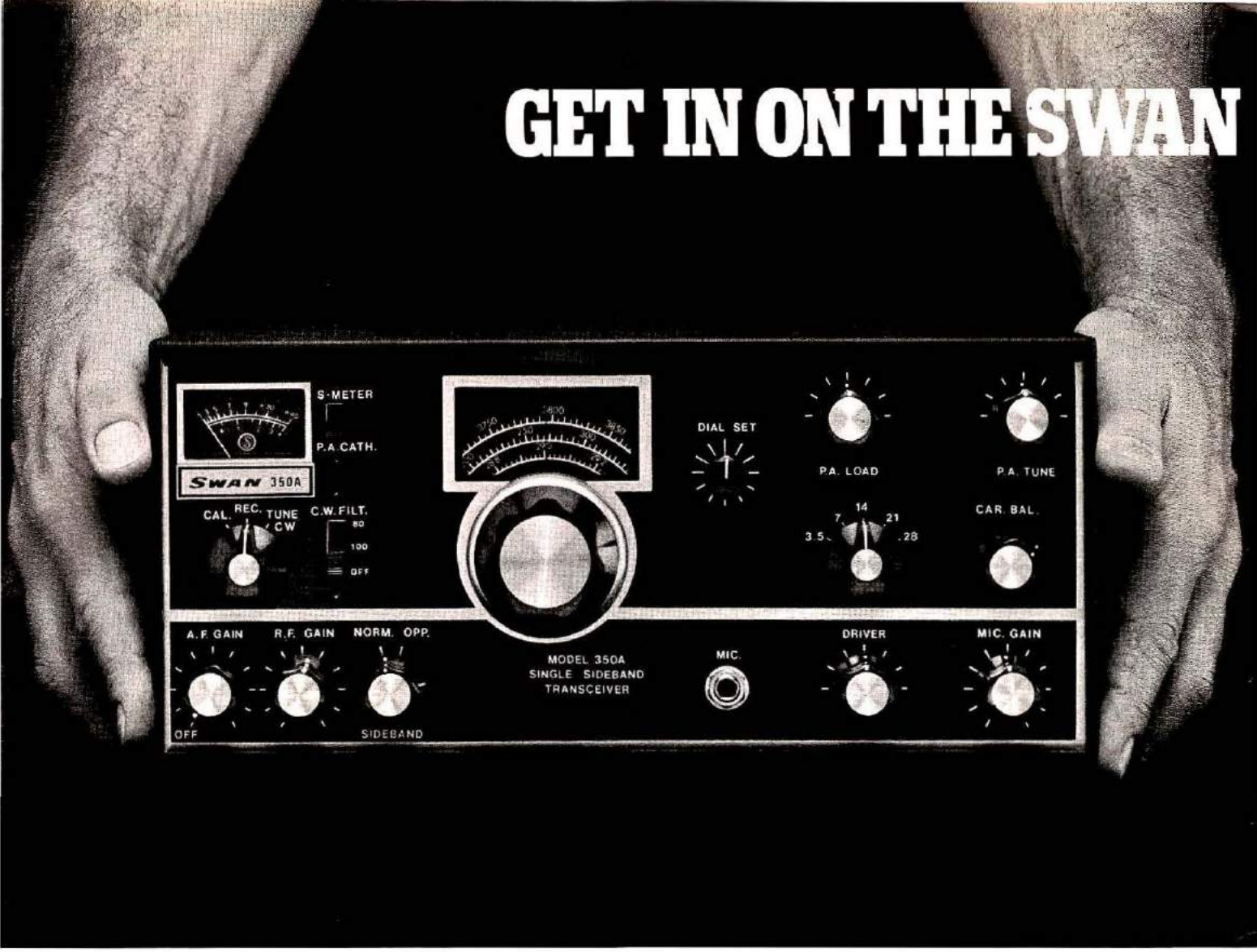
"ELI the ICE man.

"ELI — voltage leads (comes before current in an inductor)

"ICE — current leads voltage in a capacitor

"Thanks for the article — I can use some of the ideas with my students."

GET IN ON THE SWAN



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Trials and Tribulations of a Traffic Man

BY MIKE GOLDSTEIN, VE3GFN

Message handling and dit-dah stuff

The National Traffic System is a continent-wide message-handling organization, devised and administered by the American Radio Relay League, for clearing radiograms on a reliable basis. While intended for emergency purposes, it operates on a daily basis throughout the year, constantly practicing on more mundane message traffic.

Since it provides a method for clearing third-party messages free of charge, it is regarded as one of the major aspects of the public service provided by amateur radio. As such, (and with its emergency-oriented philosophy fixed firmly in mind) its operators tend to take their work very seriously. Therein hangs this tale.

Now, the NTS is a system of message-handling networks, operating at various levels, with an organized system of liaison between the nets. One station, acting as net control, calls up the net on schedule each day (or several times a day). Net members check in, listing their message traffic, and the NTS organizes stations for clearing this traffic, and for acting as liaisons to subsequent networks. Therefore, for each net session, there are scheduled NTS and liaison stations.

So far, this is simple. The plot thickens when you realize that message-handling requires a well-trained operator, with certain amounts of spare time, interest, and no interference problems to keep him off the air at fixed times.

"That stuff . . ."

To add zest to this combination, remember that almost the entire NTS is on CW (that dit-and-dah stuff), at speeds up to 25 words-per-minute and beyond. It is easy to see how our keen traffic operator soon finds himself acting as NTS and/or liaison station for several nets per week, or per night. As a trained NTS operator (and you can only get this training by doing it) he is a valuable property, and the tendency is to utilize him even unto the point of saturation!

Luckily, being public-service oriented, traffic men find it very hard to say "No."

This insidious system awaits the unwary operator who, like myself, innocently indulges in a spot of message-handling to relieve the tedium of day-to-day hamming.

I first approached the NTS in the early 1970s with low power, a home-built receiver, and a landlord with a penchant for interferable toys.

As a keen CW contester and rag-chewer, I figured I would be an asset, but these guys require *written* copy, and I hadn't written copy in years . . . a call sign or a signal report, but that's all. I was horrified to discover my listening speed was in excess of 40 words per minute, while my reliable written copy hovered around 12! Not fast enough for my tastes, so my traffic career was postponed while I nightly pursued the W1AW code-practice transmissions.

Written copy

By neglecting to "dot my Is" and "cross my Ts," I eventually achieved 25 words-per-minute written copy, and a certificate that said so. My code speed is still limited only by my failure to be able to move a pencil at better than 25 words per minute.

Back I went to the nets —

only to discover they use a gibberish, made up of "QN" signals designed for net use. Off I went for two weeks, to memorize 67 Q-signals containing "N."

Now, I was ready.

My first net; someone said: "QSK?" Now, that was cheating, because I hadn't learned that one. Turns out he was asking me if I had perfect break-in; these traffic men can listen and transmit simultaneously.

"Have it?" I replied, "I just heard about it!"

So that's how they talk in the CW equivalent of grunts and groans so quickly!

Two years later, having redesigned my receiver, rebuilt my transmitter, and experimented with TR switches, separate receiving antennas, and vacuum relays, I had perfect break-in.

I checked into a net.

My landlord knocked on my door, and advised me that I was interfering with the new TV, hi-fi, and tape recorder he had bought while I was experimenting.

I bought a house.

Having set up my shack and antennas at my new place, I checked into a net, someone sent me up 15 kHz to clear some traffic. Three hours later I found my partner still calling me. My homebuilt calibrated receiver dial wasn't good enough. Several hundred dollars and some receiver modifications later, I had digital frequency readout, and was prepared to argue receive frequency to the nearest 10 Hz.

I checked into a net.

My main transmit frequency control drifted!

I shut down, bought some temperature-compensating capacitors, borrowed an oven, and spent weeks chasing drift. Eventually, I rebuilt the control oscillator into an enclosure separate from the transmitter, and cured the drift.

I checked into a net.

No one could hear me. We had fallen into a sunspot-cycle minimum, and skip on 80 meters was too long at night.

A resurrection

I sent off to Halifax for an old high-powered amplifier I'd built 17 years ago. After spending hours chasing arcs and sparks through the ancient hardware, I was on the air with a half-kilowatt, no drift, perfect break-in, and a good code speed.

Everyone said, "Hey, a traffic man!" They all leaped at me at once.

I am now the manager of OSN (Ontario Section Net), and assistant manager of ECN (Eastern Canada Net). I hold six NTS schedules, and two liaison schedules. I appear on at least a dozen net sessions a week. I have arrived . . .

But I put up a tri-band beam and discovered DXing. The band is open to Asia during my early nets, and to the South Pacific during my late nets. My wife has finally learned to schedule supper around my net schedules, and I don't DARE suggest a change.

Help! **HRH**

*Reprinted by permission from *Canadian Transceiver*, September, 1977; published by Walgram Publishing, Ltd., Willowdale, Ontario.

No wonder he fainted — his log shows that the NCS told him to QSY up 6 and take 171 thru for CAN!

The *Horizons* selection for Station of the Month for April is one of our Canadian readers, VE3IFS, in Ontario. Just by looking at the photograph you can get the idea that he has packed a lot of hobby into a relatively small space in the corner of a room, all of which shows that if you want to get into amateur radio, you can find a place for the equipment. Here's the story, from Cyril A. Stanway, VE3IFS.

"My station is quite simple, and should help newcomers to ham radio by giving them some ideas about how to set up a station. The large receiver on the bottom is a National NC-183D, which is used for covering the ham bands and, at times, the standard broadcast bands. The cabinet on top of the receiver is a homebrew transmatch which I assembled from scratch.

Just above that, on the shelf, is a transceiver — an Eico 753. I use this as my transmitter and it does a fine job. The top shelf holds, among other things, an MFJ antenna matcher, which I use for long-wire antennas, and an Ultra-com two-meter fm transceiver.

The station is compact and efficient, and takes up only a corner of my bedroom — it has given me a lot of pleasure in the short time that I have been a ham.

My first interest in amateur radio was sparked by my father, who helped me obtain my license. I also took a course at one of the local radio clubs. I have been in the hobby for a year and a half, and have made a lot of new friends and had a lot of fun. I can sincerely recommend amateur radio to anyone interested in challenge and enjoyment.

I really enjoy *Ham Radio Horizons*, and have found it to be very helpful with operating and working DX. My station is not very elaborate, but, using a 150-foot antenna and 65 watts, I have worked over 30 countries, 43 states, and 30 Ontario counties. I enjoy collecting QSL cards, either local or DX.

I am 18 years old, and in grade 13, so there is not a lot of time for amateur radio during the week. However, when the weekend comes you'll often find me on the air from dawn to dusk."

Thanks for telling us about your station, Cy. It's a good example to many newcomers, especially with that old reliable NC-183D receiver. They still can be found at quite reasonable prices at flea markets and used-equipment stores around the country. The Eico 753 transmitter can be found at these places as well, and seems to be rugged enough to stay in service for years.

I notice a unique arrangement of a bug and straight key on your desk too, Cy. The straight key seems to be fastened "side-saddle" fashion under the binding posts on the bug. That's a great way to keep them both handy, but without the extra fuss of connecting cords that could get in the way — an important consideration with space at a premium as it is in your shack.

Oh, yes, that footprint — no, our photoprocessor didn't get careless and step on the negative. That's a wall decoration that Cy has placed adjacent to a *Rag Chewers Club* certificate (signed by *The Old Sock*) just above the equipment shelves. All-in-all, it looks like Cy has a station that puts his hobby within reach, yet doesn't dominate the household. Well done! **HRH**

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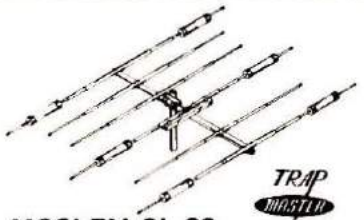

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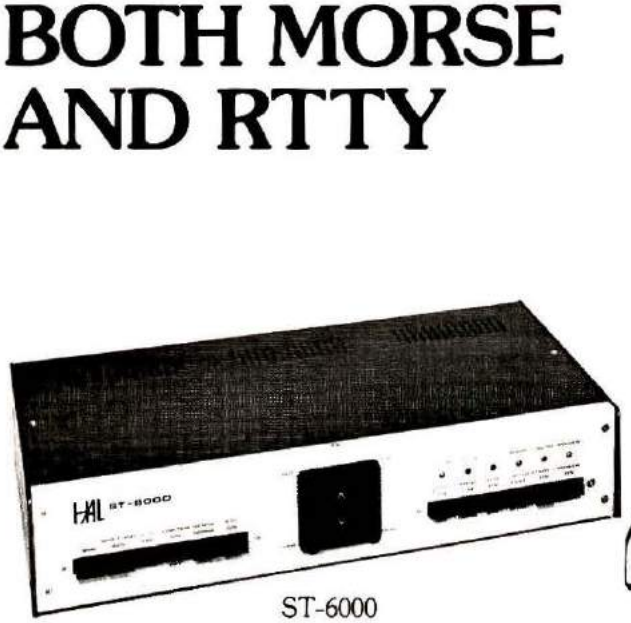

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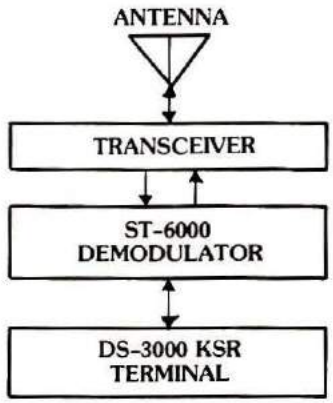

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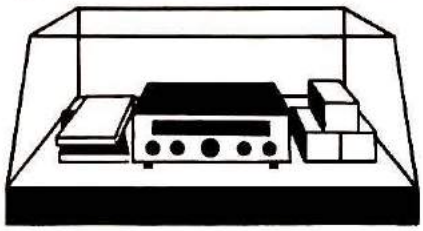


Synthesized Transceiver For 220 MHz

Midland International Corporation's Communications Division has developed the first full-frequency range, PLL-synthesized, mobile transceiver operating in the 220-MHz band. Midland's new transceiver covers 1,000 frequencies in 5-kHz steps between 220 and 225 MHz with no crystals required. In addition, transmitter output power can be switched from 2 watts to 10 watts or 20 watts, as required, for effective direct or repeater communications.

The transceiver, Model 13-513, is designed for mobile operation on 13.8 volts DC, negative ground. It offers a long list of advanced features, including modular construction of major circuits, extensive use of IC technology, and LED frequency display. Crystals are supplied for a 1,600-kHz repeater spacing and there is a second, optional, crystal position for other separations.

The dual-conversion receiver incorporates a helical resonator in the rf section, monolithic-crystal and ceramic filters in the i-f sections, and an audio section delivering 1.5 watts output to an 8-ohm speaker. Sensitivity is rated at better than 0.5 μV for 20-dB quieting; selectivity at ±15 kHz is rated at 70 dB down.

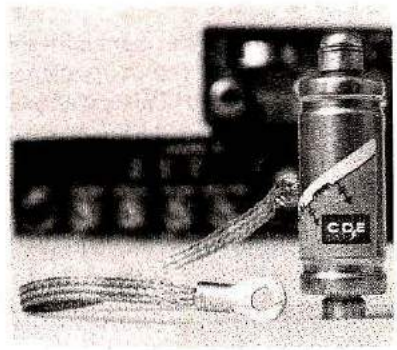
Additional operating and performance features built into Midland's Model 13-513 220-MHz mobile transceiver are lighted S/RFO meter, tone-burst jack and discriminator-meter jack, TX indicator light and an external-speaker jack.

Included with this Midland unit are mobile mounting bracket and hardware, an accessory bracket for desk-top use, and a high-performance microphone.

For further information contact Midland International Corporation, Communications Division, P.O. Box 1903, Kansas City, Missouri 64141, or use *ad check* on page 86.

Ingition-Noise Filter

Cornell-Dubilier Electronics has added a new noise filter, the CBFT315D, to its line. The filter's function is to correct the problem of transceiver noise interference by reducing both radiated and conducted noise originating from the ignition coil/point assembly.



Designated as an ignition coil/point filter, the unit mounts directly onto the ignition coil with no additional parts, nuts, or bolts. The installation is accomplished in three steps: the filter is threaded onto the coil terminal, ignition-switch wire is then attached to the filter screw, and the ground strap is connected to a good ground point.

A unique feature is the thread arrangement on the filter. It's metric on one end and standard on the other. Thus it can be used on either domestic or imported vehicles.

The CBFT315D filter is rated at 0.1μF, 20 amperes, and incorporates 600-volt construction to guard against damage from high voltage inductive spikes present at the coil terminal.

For further information contact Mr. Douglas W. Graham, Cornell-Dubilier Electronics, 150 Avenue L, Newark, New Jersey 07101, call (201) 589-7500, or use *ad check* on page 86.

Radio Shack Catalog

The new 1978 Radio Shack catalog, the company's 30th consecutive issue, is now available. The 164-page catalog includes 100 full-color pages describing the company's exclusive line of products for home entertainment, hobbyists, CBers, and experimenters.

An insert card in the catalog introduces Radio Shack's new TRS-80 Microcomputer System, which, according to Radio Shack president Lewis Kornfield, is "the most important product ever offered by Radio Shack."

Kornfield stated that "the TRS-80's importance goes far beyond the mere design, construction, and sale of a fine piece of electronic merchandise. Primarily, it signifies the dawn of the Microcomputer Age for ordinary people, schools,

and businesses everywhere."

The new catalog also includes coupons offering two Supertapes, either reel-to-reel, 8-track cartridge, or cassette, for the price of one, two P-Box kits for the price of one and any of the company's project boards for half-price.

Among the new items introduced in the catalog are 40-channel Realistic CB two-way radios, and a selection of electronic calculators ranging in price from $8.88 to $109.95 for a rechargeable printing calculator with full memory.

The new catalog also lists hundreds of specialized electronics items, parts and accessories, tools, tubes, semiconductors, wire and cable, intercoms, microphones, timers, batteries, and a complete library of Radio Shack's own books on electronics and related subjects.

Radio Shack's 1978 Catalog No. 289 is available free on request from Radio Shack stores and dealers, nationwide. If you do not know the address of your nearest Radio Shack dealer, write H. L. Siegel, National Publicity and Promotion manager, Radio Shack, 2617 West Seventh Street, Fort Worth, Texas 76107, or use *ad check* on page 86.

Quick-Disconnect Mobile Mount Bracket

Scientific Dimensions, manufacturer of the STOP-A-THIEF "Quick Disconnect" radio slide mount system, has just introduced a new unit to the line: the SDI-700. This slide mount provides easy removal of two-way radios and antitheft and/or convenience in transferring and interchanging radios from one vehicle to another. The new SDI-700, with its AMP *Coaxicon* contact will handle up to 500 MHz so it can be used for amateur and small business radios at the economical price of $19.95 each. It is the same high-quality mechanical design as the popular model SDI-1000 with its gold-plated AMP *Coaxicon* contact, which will handle up to 1000 MHz.

All models in the "Quick Disconnect" mobile radio slide-mount line feature the modified AMP *Dualatch* connector system which houses the AMP *Miniature Coaxicon* coaxial cable contact. This assures maximum performance and absolute contact for thousands of connections. The radio is easily removed by the operator when leaving his vehicle, to prevent theft of the radio and damage to the vehicle.

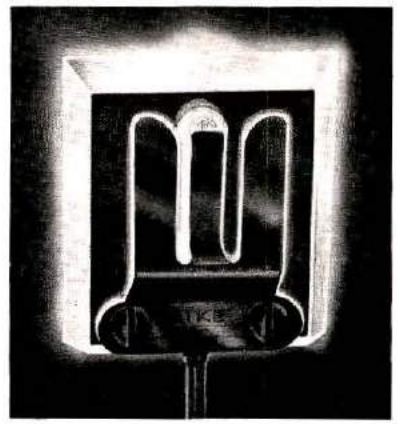
The SDI-700 unit, like the SDI-1000, is precision made of 16-gauge steel with durable chrome finish. It has a three-way spring lock to guarantee positive con-

nector contact every time and to eliminate rattles while the vehicle is in motion, yet the lock is designed to enable easy and quick removal of the radio from its mount in the vehicle with just a slight finger pressure on the release lever. All wire leads in the slide mount unit are securely clamped into place to prevent breakage. The no. 18 AWG stranded power and accessory leads have 10 ampere capacity, and the coaxial cable is RG-58C/U with UHF connectors attached.

To provide for easy transfer of the radio to another vehicle, Scientific Dimensions offers extra individual stationary mounts for each unit. The company has also designed and produced the universal TILT-N-TURN model SDI-500 mounting bracket for all its slide-mount units to provide easy visibility and operation of the radio. The SDI-500 unit is easily mounted on a vehicle's hump, floor, roof, or dash and similar locations on boats and farm equipment. It provides 50 degree tilting and turning flexibility, making head-on viewing possible from the driver's seat, thus reducing distraction of attention from operating the vehicle.

For more information on the complete line of Scientific Dimensions' products, use *ad check* page 86, or write to them at 309 McKnight NE, Albuquerque, New Mexico 87102.

Illuminated Microphone Holder



If you've ever fumbled in the dark for your microphone while driving at night along a twisting and unfamiliar road, you know how much easier it would be to be able to see your microphone — or at least its location — out of the corner of your eye.

A & S Electronics has just introduced a neat solution of this problem for the mobile operator. *Mike-A-Lite* is designed to enable Amateur, CB, and business-radio operators to locate their microphone holders in darkened vehicles. Emergency-vehicle operators have also shown interest in *Mike-A-Lite*, recognizing the benefit of enhanced safety through eyes-on-the-road driving. A bonus is the elimination of costly repair or replacement of dropped microphones, and many users

simply enjoy the holder's attractive appearance.

Mike-A-Lite uses a red LED light source that can be powered from any 12- to 14-volt dc supply, and can be easily mounted in the location of your choice by means of the screws or pressure sensitive tape provided. A standard two-prong clip and a five-foot (1.5m) cord for connection to the vehicle's electrical system are included. Current drain is only 20 milliamperes, so you needn't fear depletion of your battery, even if it's left permanently connected to the electrical system. Suggested retail price is $6.95, and further details may be obtained by writing A & S Electronics, Box 473, Belton, Missouri 64012.

Two-Meter Synthesized Transceiver

The American Communications Corporation, AMCOMM, has designed and developed a highly sophisticated, synthesized 2-meter mobile transceiver. The AMCOMM *S 2 25* features 800 frequencies in 5-kHz steps, four repeater splits — selectable from the front panel, fully multiplexed LED digital readout, and rf output power continuously variable from 2 to 25 watts.

All S 2 25 circuitry is constructed on Type G-10 fiberglass printed circuit board material, and these extremely stable boards are mounted on machined standoffs mechanically pressed into place. The entire mechanical chassis is iridited aluminum (including the cover) yielding maximum strength, high resistance to vibration and corrosion, and minimal weight. American technology and crafts-

manship are much in evidence throughout the S 2 25.

The receiver module incorporates an 8-pole crystal filter with a 2-pole crystal discriminator operating at a 21.4 MHz intermediate frequency. Dual-gate mosfets are employed in the receiver front end, resulting in a design which exhibits vastly enhanced sensitivity. The S 2 25 also features a large, easy-to-read, six digit, seven-segment LED frequency display, LEDs which indicate transmit and synthesizer lock, and a dual-function signal/power meter. Meter illumination and LED intensity is variable by a dimmer control on the front panel.

AMCOMM also offers an optional plug-in *Touch-Tone* encoder at $49.95. The S 2 25 sells for $499.95. For more information and specifications write to AMCOMM, 730 West McNab Road, Fort Lauderdale, Florida 33309, or use *ad check* on page 86.

New Heathkit Catalog

The Heath Company has just announced its new, 96-page catalog describing nearly 400 kits that will suit almost any interest. Product categories include Amateur Radio, Hi-Fi Components, Color TV, Test Instruments, Digital Clocks and Weather Instruments, Radio Control Equipment, Marine, Aircraft, and Auto Accessories, and much more.

New products introduced for the first ftime in the new catalog include a three-way bookshelf speaker system, a battery monitor device for radio-control modelers, and a complete selection of fully-assembled, name brand, 40-channel, Citizens' Band radios. Also shown are Heath's convenient two-way freezer alarm and a mount-anywhere touch-control light switch.

For additional information and a *free* copy of the new catalog, write to Heath Company, Benton Harbor, Michigan 49022.

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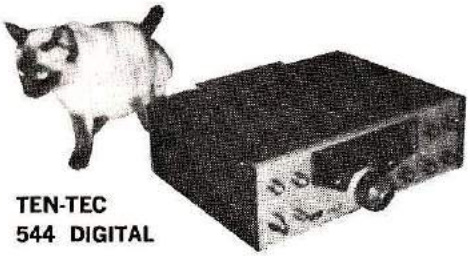

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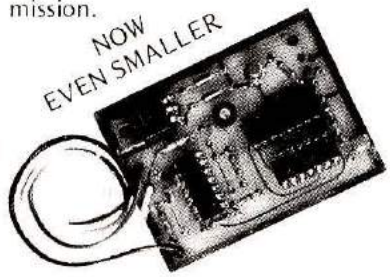

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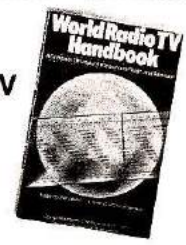

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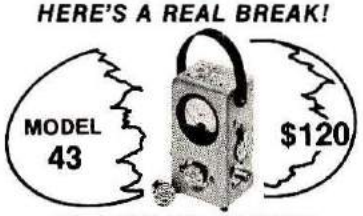

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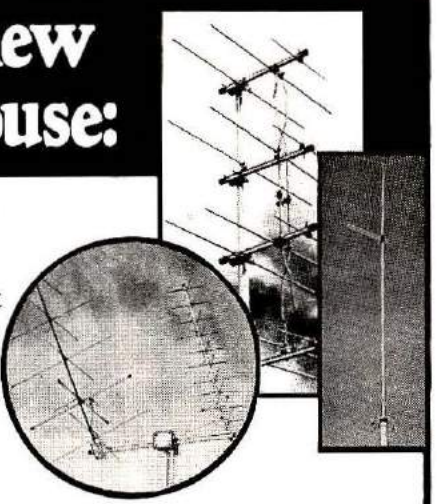

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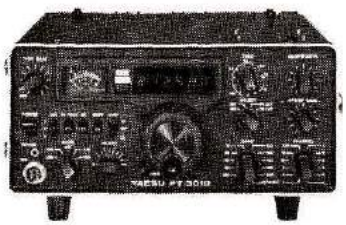

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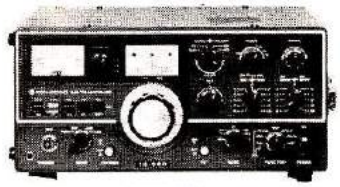

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More details? Ad Check page 86.

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The Tempo ONE is a highly reliable, excellent quality HF transceiver. It has proven itself in worldwide use by thousands of General and Advanced Class amateurs for more than six years. And now under the new FCC regulations the Tempo ONE has become the ideal rig for the Novice and Technician Class also. Study its specifications, talk to any of the thousands of owners, compare the Tempo ONE with other transceivers . . . and we know you can't beat the price. We're sure the Tempo ONE will prove itself to be the "value leader" for you also.

Frequency Range: 80 through 10 meters (28.5-29.0 10M. xtal supplied)
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HORIZONS ad-scan

RATES Regular classified is available at 50¢ per word. Display classified (1 inch deep x 2¼ inches wide) is $50, or at the 12x rate is $35. All Ad Scan payable in advance. No cash discounts or agency commissions allowed.

HAMFESTS Sponsored by non-profit organizations receive one free regular classified ad (subject to our editing). Repeat insertions of hamfest ads pay the standard rate.

COPY No special layout or arrangements available. Material should be typewritten or clearly printed (not all capitals) and must include full name and address. We reserve the right to reject unsuitable copy. *HORIZONS* cannot check each advertiser and thus cannot be held responsible for claims made. Liability for correctness of material limited to corrected ad in next available issue.

DEADLINE 15th of third preceding month.

SEND MATERIAL TO: Ad Scan, Ham Radio Horizons, Greenville, N. H. 03048.

ENGRAVED NAMETAGS 1½" x 2½" — $3.00. QTH added $0.50. Door plates, key tags available. Black, blue, red, walnut with white letters. Other colors available. Tag-it Co., Box 2062, Indianapolis, IN 46206.

21ST ANNUAL ABC HAMFEST, sponsored by the Six Meter Club of Chicago, Sunday, June 11, 1978, at Santa Fe Park, Willow Springs, Illinois, 91st and Wolf Road, Southwest of Chicago. Advance registration $1.50; $2. at gate. Large swap row, picnic grounds, plenty of parking, refreshments, AFMARS meeting. Talk in on 146.94 FM or 37/97 WR9ABC (PL2A). Contact K9ZWV, 3420 So. 60th Court, Cicero, IL 60650.

INDIANA: MIDWEST REPEATER ASSOCIATION First Annual Hamfest Sunday May 21, National Guard Armory, 2530 173rd St., Hammond, Indiana. Doors open 7 AM. Advance tickets $2.00, $2.50 at the door. Reserved flea market area $1.00 otherwise first come, first served. Door prizes, raffles, equipment displays. Talk in 146.31/91 and 146.52 simplex. Write to M.R.A. P.O. Box 342, Griffith, IN 46319.

THE 4TH ANNUAL NORTHWESTERN PENNSYLVANIA Hamfest, May 6th, Crawford County Fairgrounds, Meadville, PA. Gates open at 8:00. $2 prize ticket required for admission — $1 to display. Children FREE. Hourly door prizes, refreshments, commercial displays welcome. Indoors if rain. Talk-in 04/64 and 52. Details CARS, P.O. Box 653, Meadville, PA 16335.

TOROIDS 88 or 44 mH. Same day shipment. 5 for $3.50 postpaid. Gull Electronics, 12690 Rt. 30, N. Huntington, PA 15642.

23RD ANNUAL WEST COAST VHF CONFERENCE, May 12-14, 1978 at the Stardust Hotel, Las Vegas, Nevada. Technical program, hospitality room, noise-figure measurements, antenna-gain measurements, prizes, entertainment. Advance registration fee $4.00 per person; make checks payable to: West Coast VHF Conference, 510 South Rose Street, Las Vegas, Nevada 89106.

CODE PRACTICE OSCILLATOR! Your gateway to the exciting world of ham radio. Complete with key, speaker and assembled circuit board. All you need is a 9v battery to start developing your "fist." By K5YEF. At only $8.99 you can't afford to put off ham radio any longer. Send today! Harding Electronics, P.O. Box 1627, Plano, TX 75074.

WARMINSTER AMATEUR RADIO Club's Fourth Annual "HAMMART", Flea Market and Auction Sunday, May 14, 9 to 4, at William Tennent Senior High School, Street Road (Route 132) 2 miles East of York Road (Route 263), Warminster, Bucks County, Pa. Registration $1.00, Tailgating $2.00 additional. No indoor selling, bring your own tables. Talk-in on 146.16-76 and 146.52. For further information write Horace Carter, K3KT. 38 Hickory Lane, Doylestown, PA 18901 or call 215-345-6816.

DIRECTORY OF STATESIDE QSL MANAGERS. Computerized cross-reference listing. Updated weekly. Most accurate and comprehensive source available. $1.00 with 24-cent business-size s.a.s.e. Gary Yarus, WBØMSZ, 921 N. Clay, St. Louis, Missouri 63122.

MARYLAND: FOURTH ANNUAL EASTON ARS HAMFEST, May 14th, 10 AM to 4 PM, at Talbot County Agricultural Center, 5 miles north of Easton, Maryland on Route 50. Talk-in on 52 simplex or 146.445/147.045 repeater in Cambridge. Some inside and outside tables available at $2, also $2 for tailgaters, in addition to $2 donation. Write K3ONU, Box 781, Easton, MD 21601. Telephone (301) 882-0943 after 6 PM.

WEST COAST BULLETIN edited and transmitted by W6ZF, 9 PM PDT (8 PM PST) (0400 UTC) 3450 kHz, A-1, 22 WPM, FIRST AND THIRD MONDAYS each month. Ten to fifteen items of latest current events of interest to Amateurs, with final few minutes at 25 WPM to help build code speed.

CODE PRACTICE OSCILLATORS, hand keys, electronics keyers, other products. Free catalog. Globalman Products, Box 246, El Toro, CA 92630. 714-533-4400.

KENTUCKY HAM-O-RAMA — Sunday, May 28 (Memorial Day Weekend). 7 minutes south of Cincinnati. Erlanger Lions Park, Erlanger, Kentucky. Donaldson Road exit, I-75 South. Prizes, exhibits, flea market. NKARC, Box 31, Ft. Mitchell, Kentucky 41017.

"THE CADILLAC" of QSL's! — New! Samples: $1.00 (Refundable) — MAC'S SHACK, Box #1171-G, Garland, Texas 75040.

UPGRADE NOW — to Ham Radio Magazine, the technical journal for all radio amateurs that brings you the latest ideas, construction projects, new circuits, and state-of-the-art advances in electronic communication. You can't afford to miss it at only $12 per year. Ham Radio, Greenville, New Hampshire 03048.

AWARD CERTIFICATES
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QSL's with class! Unbeatable quality, reasonable price. Samples, 50¢. QSL's Unlimited, Box 27553H, Atlanta, GA 30327.

MOBILE IGNITION SHIELDING provides more range with no noise. Bonding strap sale less than 50¢ each. Literature. Estes Engineering, 930 Marine Drive, Port Angeles, Wash. 98362.

ADVANCED MICROCOMPUTER INTERFACING AND PROGRAMMING WORKSHOP. On board the TSS Carnivale in the Carribean June 17-24, 1978. This five-day workshop will be based on a hands-on course using the popular 8080 and 8085 microprocessors. The use of programmable interface chips, data acquisition modules, programming techniques as well as future trends will be some of the topics covered. For more information contact Dr. Norris Bell, V.P.I. and S.U., Continuing Education Center, Blacksburg, Virginia, 24061, (703) 951-6208.

ATTENTION CERTIFICATE HUNTERS. Free information on beautiful operating awards. SASE to HAROAA, P.O. Box 341, Hinckley, Ohio 44233.

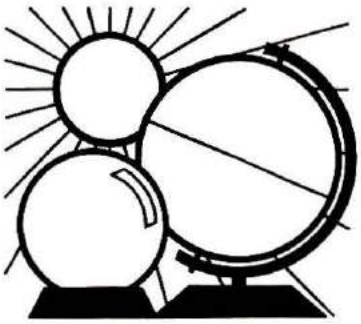
SAVE $$$. Build your own: LINEAR AMPLIFIERS, 50-100 watt solid state. FREQUENCY COUNTER, 300 MHz, 7 digit, crystal accuracy, portable/mobile, memory! BASE ANTENNA, omnipolarized! Omnidirectional! VOX-COMPRESSOR AND MORE! Construction plans $3.00 each, 3 up/$2.50 each. Specify desired band. PANAXIS, Box 5516-AS5, Walnut Creek, CA 94596.

ROME HAM FAMILY DAY will be held on June 4, 1978. For information write Rome Radio Club, P.O. Box 721, Rome, NY 13440. (Dealer inquiries invited).

VACATIONLAND HAMFEST — Sunday, May 21, 1978 Sandusky, Ohio. Info write P.O. Box 2037, Sandusky, Ohio 44870.

SOUTH CAROLINA: COLUMBIA HAMFEST sponsored by the Carolina Repeater Society, May 20th and 21st, at the Jamil Temple Shrine on I-26, one mile west of I-20. Free on-site parking, air-conditioned building, flea market, dealers, activities, talk-in on 34/94. Combined admission/drawing tickets for $3 advance or $3.50 at door. Write or call WA4VOJ, 1520 Atlantic Drive, Columbia, South Carolina 29210. Telephone: (803) 772-7984 or 788-1308.

THE WEXAUKEE A.R.A. will hold their 18th Annual Swap and Shop on Saturday, May 20th from 9:00 AM until 4:00 PM at the National Guard Armory, 415 Haynes St., Cadillac, Michigan. Tickets $2.00. Free parking, lunches available. Talk-in on 146-37/97.



DX FORECASTER

Once again, the only unchanging aspect of the ionosphere is that it changes! Spring DX has been better than ever, with opportunities on ten and fifteen meters that we haven't seen in years. The May ionosphere is slowly giving way to the summertime conditions of high atmospheric noise (QRN) from thunderstorm activity, and increasing solar absorption. Except on rare occasions, 80 and 40 meter DX will be rather poor, but twenty, fifteen and ten will be much, much better than last year at this time.

28 MHz will provide many openings between the United States and Central/South America during afternoon and early evening hours. Short skip will become increasingly active out to distances of 750 and 1500 miles (1200 to 2400 kilometers). The chart will show you the best times to turn your beam, and in which direction, to enjoy DX. Don't be surprised to hear both short skip and DX signals blending in your receiver.

21 MHz will be open on the North-South path during most days of this month, and QSOs with Latin America will be commonplace. The regular path between Africa or the Pacific and the United States will be open frequently, so keep your ears open for rare DX, and your beams pointed in the direction shown by the chart at the appointed hours. Short skip out to distances of between 600 and 2400 miles (1000 and 4000 kilometers) will provide excellent, strong, signals that may tend to mask the DX coming through. As always, you may have to dig a bit for the weak ones but, in general, DX stations will be strong!

14 MHz will open to DX areas shortly after sunrise local time, and will stay open to some area of the world most of the day and on into the evening hours. Because of the vastly improved solar flux, expect 20 to stay open until midnight on some days! Short skip distances of between 400 and 2400 miles will be commonplace (650 and 4000 kilometers) during the afternoon.

7 MHz and 3.5 MHz can still provide an occasional DX tidbit worth waiting for, but you're going to have to be tolerant of static crashes. However, the fact that most of the United States will be on Daylight Saving Time means that the time discrepancy between here and Europe will be one hour less. Therefore, you will find DX stations still up and working, well before it's time to turn in for the night. Keep your ears honed between 8PM and the "wee" hours, and — if you're an early riser — look for Pacific stations at daybreak!

Propagation special

Look for unusual ionospheric activity between May 3rd and May 10th, and again between May 21st and 28th. New moon is on May 6th. Full moon occurs on the 22nd, and perigee on the 24th. The *Eta Aquarid* meteor shower will take place on May 5th, with a peak rate of about 20 per hour, and will last for about three days, tapering off to about four or five per hour. **HRH**

GMT	PDT	WESTERN USA N	NE	E	SE	S	SW	W	NW	MDT	MID USA N	NE	E	SE	S	SW	W	NW	CDT	EDT	EASTERN USA N	NE	E	SE	S	SW	W	NW
0000	5:00	20	—	20	15	—	15	15	—	6:00	20	20	20	15	—	15	15	20	7:00	8:00	15	20	—	—	15	15	15	15
0100	6:00	20	—	20	15	20	15	15	—	7:00	20	20	20	15	20	15	15	20	8:00	9:00	20	20	40	40	15	15	15	15
0200	7:00	20	—	20	15	20	15	10	15	8:00	15	20	20	15	20	15	15	20	9:00	10:00	20	40	40	40	15	15	15	15
0300	8:00	15	—	—	15	20	15*	10	15	9:00	20	—	—	20	20	15	15	20	10:00	11:00	20	40	40	—	20	20	20	20
0400	9:00	15	—	—	15	20	15*	10	20	10:00	20	80*	—	20	20	15	15	20	11:00	12:00	20	40	—	—	20	20	20	20
0500	10:00	20	20	20	15	20	15	10	20	11:00	20	40	40	20	20	15	15	20	12:00	1:00	20	80	—	—	20	20	20	20
0600	11:00	20	20	20	20	20	15	10	20	12:00	—	40	40	20	—	15	15	20	1:00	2:00	40	80	—	—	20	20	20	20
0700	12:00	20	20	20	20	20	20	20	20	1:00	—	20	40	40	—	20	20	20	2:00	3:00	40	80	—	—	20	20	—	—
0800	1:00	20	20	20	20	—	20	20	20	2:00	—	20	20	—	—	20	20	20	3:00	4:00	40	—	—	—	40	—	40	40
0900	2:00	—	20	—	—	—	40*	20	20	3:00	—	20	20	—	—	40*	40*	20	4:00	5:00	20	20	20	—	40	—	40	40
1000	3:00	—	20	—	—	—	80*	20	20	4:00	—	20	20	20	—	40*	40*	20	5:00	6:00	20	20	20	20	20	—	40	40
1100	4:00	—	—	—	—	—	80*	20	20	5:00	20	20	20	20	—	80*	40	20	6:00	7:00	20	20	20	20	20	20	40	40
1200	5:00	—	—	20	20	—	80*	20	20	6:00	20	20	20	20	—	80*	40	40*	7:00	8:00	20	20	20	20	20	20	20	20
1300	6:00	20	20	20	20	—	40	40	40	7:00	20	20	20	20	—	20	40	40*	8:00	9:00	15	20	20	20	20	20	20	20
1400	7:00	20	20	20	20	—	20	40	20	8:00	20	20*	20	15	—	20	40	20	9:00	10:00	15	20*	20	20	20	20	20	20
1500	8:00	20	20	15	15	—	20	20	20	9:00	20	20*	20	15	—	20	20	20	10:00	11:00	20	20	15	15	15	20	20	20
1600	9:00	20	20	15	15	—	20	15	20	10:00	20	20*	20	15	—	20	20	20	11:00	12:00	20	20	15	15	15	20*	20	20
1700	10:00	20	20	15	15	—	20	15	20	11:00	20	20*	20	15	—	20	20	—	12:00	1:00	20	20	15	15	15	20*	20	20
1800	11:00	20	20	15	15	—	20	15	20	12:00	20	15	15	15	—	20	20	—	1:00	2:00	20	20*	15	15	15	15	20	20
1900	12:00	20	20	20	15	—	20	15	20	1:00	20	15	15	15	—	15	15	—	2:00	3:00	20	20*	20*	20*	15	15	20	20
2000	1:00	20	20	20	15	—	20	15	20	2:00	20	20	—	15	—	15	15	20	3:00	4:00	20	20*	20	20	15*	15	20	20
2100	2:00	20	20	20	15*	—	15	15	15	3:00	20	20	40*	15	—	15	15	15	4:00	5:00	20	20*	20	20	15*	20	20*	20*
2200	3:00	20	20	20	15*	—	15	15	15	4:00	20	20*	40*	15	—	15	15	15	5:00	6:00	20	20*	40	20	20*	20	20*	20*
2300	4:00	20	20	20	15*	—	15	15	—	5:00	20	20	20	15	—	15*	15	15	6:00	7:00	15	20	40	20	20	20	20*	20*
	MAY	CENTRAL ASIA	EUROPE	S. AFRICA	S. AMERICA	ANTARCTICA	NEW ZEALAND	W. AUSTRALIA OCEANIA	FAR EAST		CENTRAL ASIA	EUROPE	S. AFRICA	S. AMERICA	ANTARCTICA	NEW ZEALAND	AUSTRALIA	FAR EAST			FAR EAST	EUROPE	CENTRAL AFRICA	S. AFRICA	S. AMERICA	OCEANIA	W. AUSTRALIA NEW ZEALAND	AUSTRALIA

HAM CALENDAR

May 1978

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
*All international events such as contests are shown on the GMT days on which they take place even though they may actually begin on the evening of the preceding day in North America.	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB WEST COAST BULLETIN Edited & transmitted by W6ZF 9PM PDST 3540 kHz, A-1, 22 WPM **1**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **2**	West Coast Qualifying Run **3**	Society of Wireless Pioneers QSO Party — CW — Full Zulu Period — 4-5 **4**	Hampden County RA Inc. Flearnarket — Feeding Hills Congregational Church — Feeding Hills, MA — K1BE **5**	Georgia QSO Party — 6-7 Northwestern Pennsylvania Hamfest — Crawford County Fairgrounds — Meadville, PA — WA3YXJ Baton Rouge ARC Hamfest — Riverside Centroplex — Baton Rouge, LA — WA5IBT — 6-7 Russian Contest (CQM) — 6-7 Vermont QSO Party — 6-7 **6**
Cass County ARC Hamfest — 4-H Fairgrounds — Logansport, IN — K9DVL Potomac Area VHF Society Hamfest — Howard County Fairgrounds, approximately 25 miles N. of Washington DC or 15 miles W. of Baltimore, MD, at the intersection of I70 and Maryland Rt. 32 Terry County ARC Swapfest — National Guard Armory — Brownfield, TX — W5FBM Tri-County ARC Hamfest — Youth Center just off Valley Rd. — Stirling, NJ **7**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB **8**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **9**	**10**	**11**	West Coast VHF Conference Stardust Hotel — Las Vegas Strip at Convention Center Drive — Las Vegas, NV — 12-14 **12**	ARRL Alabama State Convention — Birmingham, AL — 13-14 Clark County ARC Ft. Vancouver Hamfair — Clark County Fairgrounds, off Interstate 5 — N. of Vancouver, WA — 13-14 Frequency Measuring Test Hosstraders Net Tailgate Swapfest — Deerfield Fairgrounds — Deerfield, NH — Info: SASE to Joe Demase, K1ROG, Star Rt., Box 56, Bucksport, ME 04416 or Norm Blake, WA1IVB, P.O. Box 32, Cornish, ME 04020 or check Hosstraders net on Sundays 4PM 3940 kHz **13**
Champaign Logan ARC Inc. Hamfest — West Liberty Lions Pk. — W Liberty, OH — WBHFK Warminster ARC "Hammart" Flearnarket/Auction — William Tennent Senior High School — Warminster, Bucks County, PA — K3KT **14**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB WEST COAST BULLETIN Edited & transmitted by W6ZF 9PM PDST 3540 kHz, A-1, 22 WPM W1AW Qualifying Run **15**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **16**	**17**	**18**	Rochester HAMFEST Rochester Hamfest — Monroe County Fairgrounds and the Marriott Inn — Rochester, NY — WA2KND — 19-21 **19**	ARRL Wisconsin State Convention — Lake Delton, WI **20**
Breeze Shooters Hamfest — White Swan Park, Parkway West (Rt. 60) near the Greater Pittsburgh International Airport — Pittsburgh, PA — WA3LUM Carolina Repeater Society Columbia Hamfest — Jamil Shrine Temple located 1 mile west of I-20 on I-26 — Columbia, SC — WA4VOJ EME Contest (second part) Humboldt ARC Hamfest — Shady Acres City Park — Trenton, TN — W4IGW Wabash County ARC Hamfest — Wabash County 4-H Fairgrounds — Wabash, IN — WD9BDZ Vacationland Hamfest — Sandusky, OH — Info: Erie Amateur Radio Society, P.O. Box 2037, Sandusky, OH 44870 **21**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB **22**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) W1AW Qualifying Run **23**	**24**	**25**	**26**	**27**
Kentucky Ham-O-Rama — Erlanger Lions Park — Erlanger, KY **28**	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB **29**	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) **30**	**31**		 See May 1, 3, 4, 6, 15, 16, 23	

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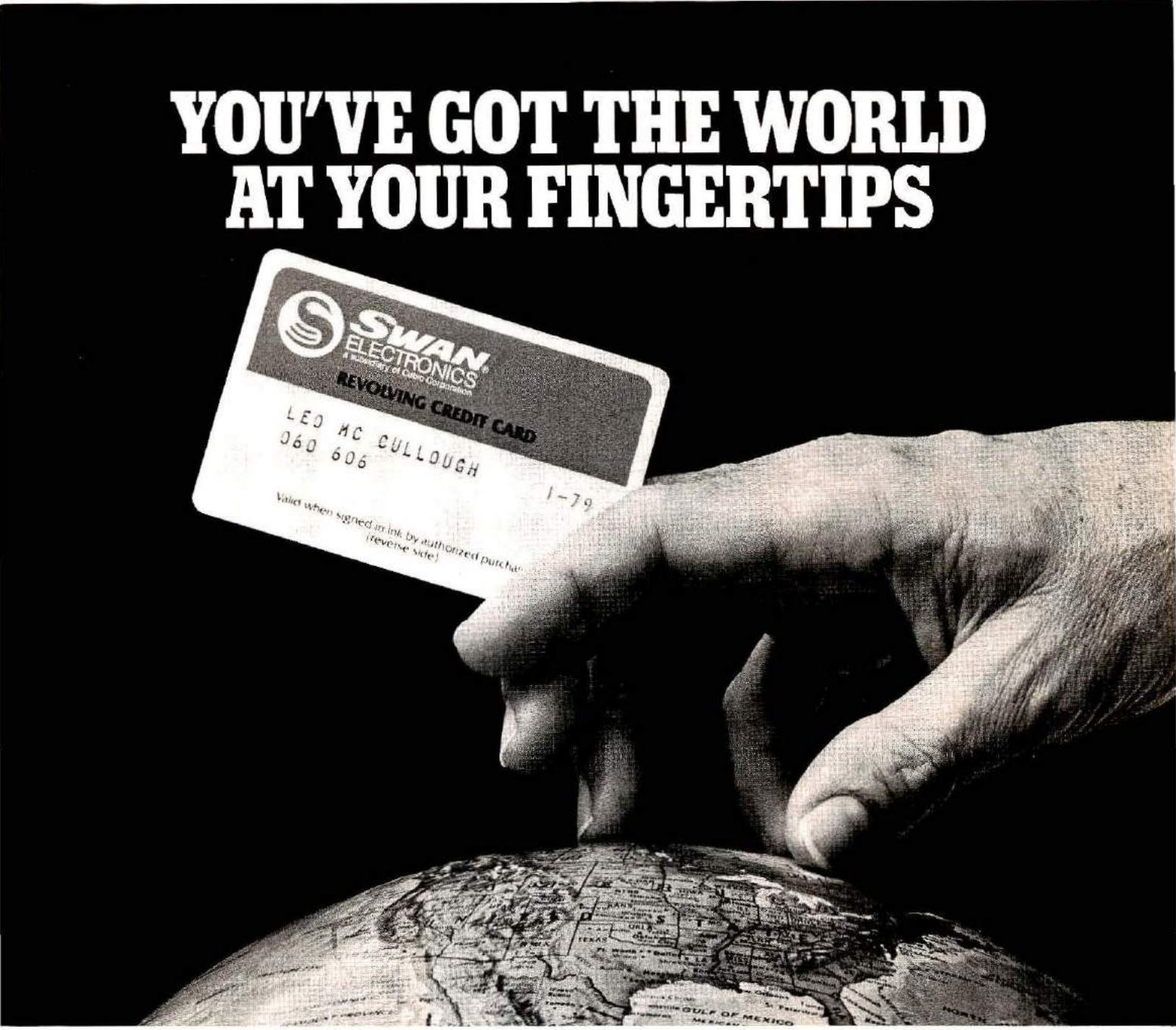

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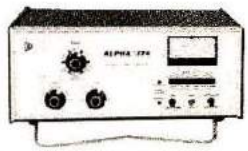

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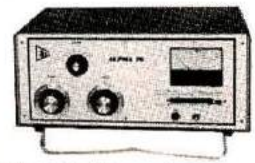

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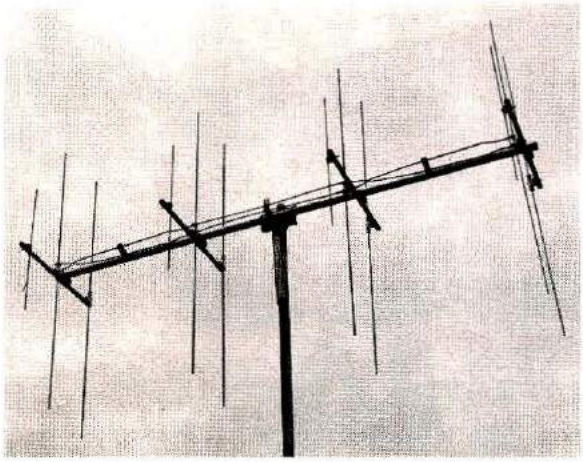

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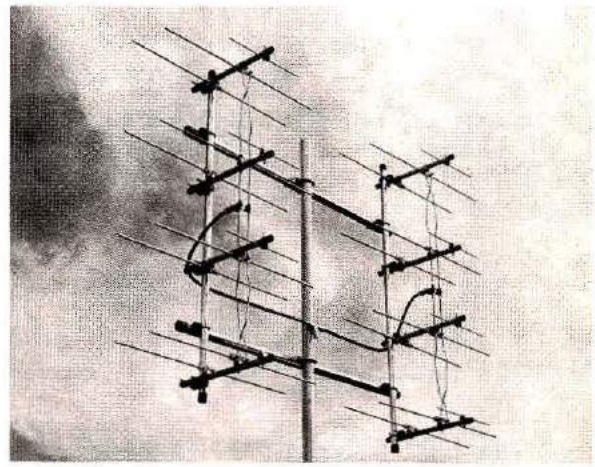

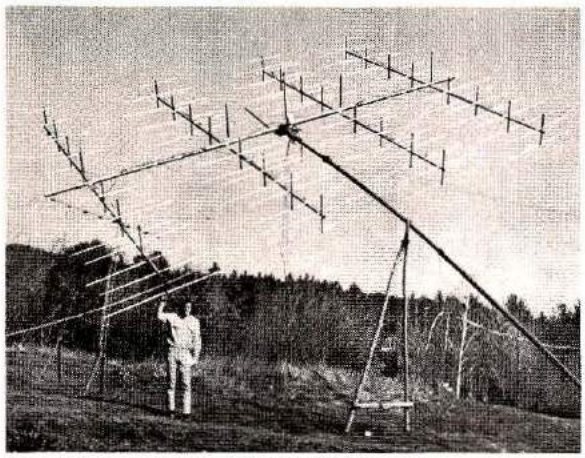

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AM-362

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