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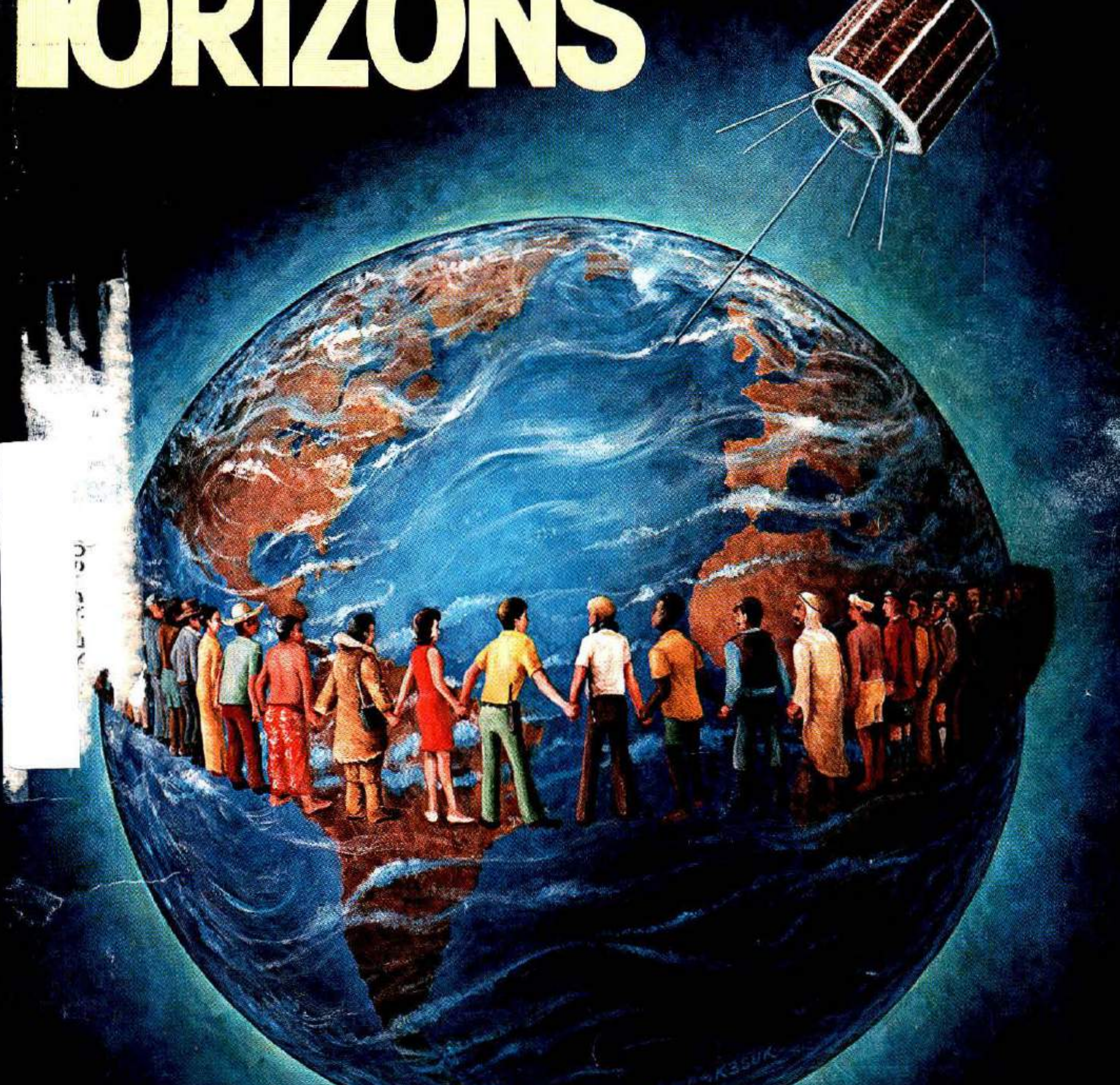
HAM RADIO HORIZONS



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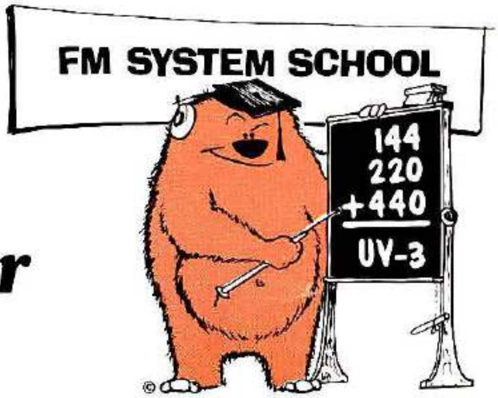

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2 Meters (Synthesized to 5 kHz)	$ 400.00
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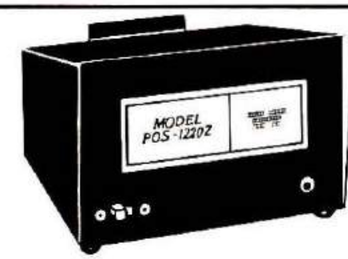

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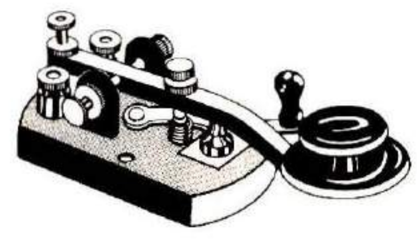

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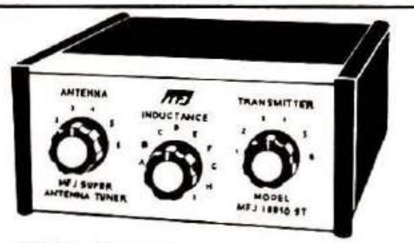

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THIS MONTHS HORIZONS

The Semiconductor Age

Ham Radio Horizons is proud to present an overall sketch of the birth of the semiconductor age by a fellow amateur who was interested enough to do considerable research so that others can benefit. You'll find a wealth of references to this interesting and vital subject in electronics as well as a short course in what makes it all happen.

Satellite Communication

Amateur satellites whirl around the globe several times a day, ready to help amateurs span great distances with their vhf signals. These orbiting repeaters have been planned so that you do not need a large and expensive Earth station to use their services. W1XU talks about the ordinary amateur equipment that you can put together to join the space age.

NN3SI — Smithsonian Institution Calling

Millions of people visit the exhibits at the Smithsonian Institution in our nation's capital every year. They have a chance to examine our history, our technology, our geology, and a multitude of other things that tell what America is all about. It is only natural that there should be an Amateur Radio station as part of the story. The station, NN3SI, is more than an exhibit — it's a living demonstration of the ability of amateurs to communicate with their fellow man anywhere in the world.

Questions? And Answers!

The end of the Rules and Regulations section is in sight, and a discussion of who is eligible for a license and what to do if you receive a notice of violation just about wraps it up. Operating signals and reporting systems are the next subject brought up under the Operating Practices part of the exam questions and Answers. Much of the information discussed in this part will be helpful when you get on the air, as well as when you take your Novice test.

Those Old Radio Mags

Many of today's amateurs do not remember the *real* old timers, and many have never even heard of them. There were people and products in the past that made radio, particularly Amateur Radio, what it is today. The key to who the people were, what they did, and how they thought, felt, and talked can be found in the old radio magazines. Pick one up, thumb through its pages, and learn what Amateur Radio was like in the old days.

War Surplus

Was war surplus radio gear a blessing or a curse? In some instances it helped put hams back on the air, but did it stifle the growth of ham-oriented business and products too? W6SAI tells us about the days when the magazines were full of advertisements for really low-priced stuff (some of which is still living in flea markets across the land).

Collinear Antenna

The inverted V dipole is well known for its simplicity, low cost, and ease of construction. It performs well as a DX antenna because of its low-angle radiation characteristics. The antenna described here by Alf Wilson, W6NIF, a modified inverted V, is based on recognized engineering principles.

Future

The year is 1999 and a couple of hams are rag chewing like they did in the good old days. Couldn't be much difference, you say? Well . . . in a way, you're right. Let's tune in and read the mail.

Our Cover

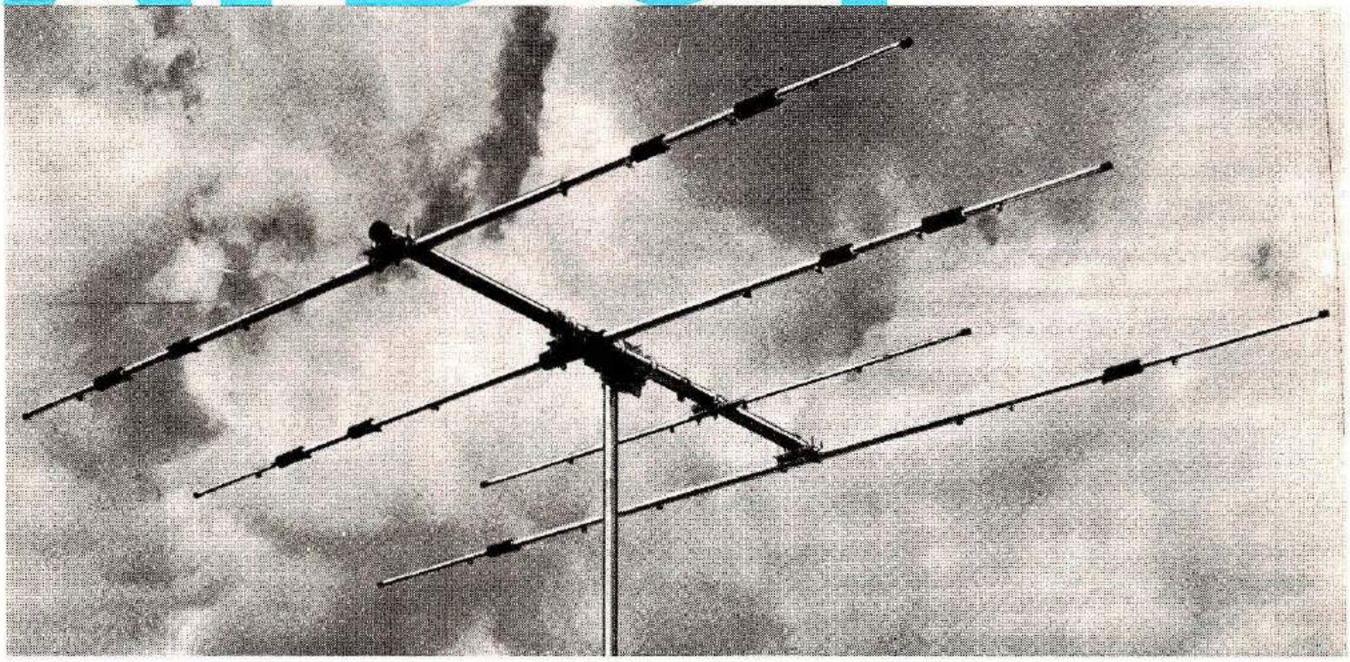
Amateur Radio is perhaps the only type of communications available to the average person on a world-wide basis. Amateurs share a common language, a common desire to communicate, and a great means of developing friendships. Our cover artist, Wayne Pierce, K3SUK, has expressed this bond of friendship through amateur radio by depicting people united through their hobby, encircling the globe as does their own satellite — a symbol of the amateur's ability to advance with technology.

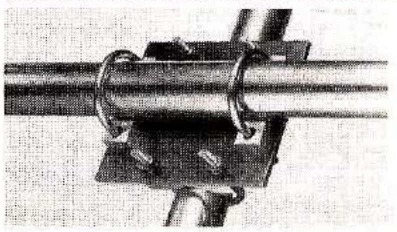
HAM RADIO HORIZONS December 31, 1977, Volume 1, No. 11. Published monthly by Communications Technology, Inc., Greenville, New Hampshire 03048. One-year subscription rate, $10.00; three-year subscription rate, $24.00. Second-class postage paid at Greenville, New Hampshire 03048 and additional offices.

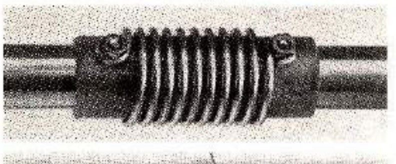
About This Issue

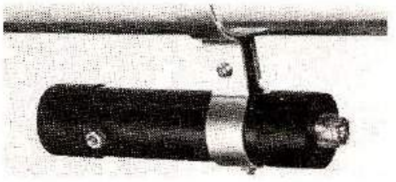
We're calling this the Wrap-Up 1977 issue of *Ham Radio Horizons*, and that is just what it will do. You'll notice the cover date is December 31, 1977. Why? Don't miss the complete and important details on page 74.

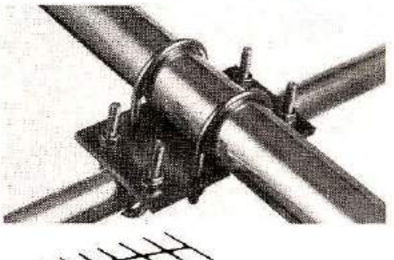
ATB-34











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HAM RADIO HORIZONS

December 31, 1977
Volume 1, Number 11

Ham Radio Horizons
is published monthly by
Communications Technology, Inc
Greenville, New Hampshire 03048
Telephone 603-878-1441

Subscription rates are
$10.00 per year, worldwide

Microfilm copies
are available from
University Microfilms, International
Ann Arbor, Michigan 48103

Cassette tapes of selected articles
from *Ham Radio Horizons* are available to
the blind and physically handicapped
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THE VIEW FROM HERE

During the past few months the FCC has been receiving an increasing number of inquiries concerning state and local laws which deal with radio and television. While many of the calls and letters are from CBers, amateurs have raised many of the same questions. Since all radio operations are licensed by the federal government, many amateurs feel that matters which have to do with their station and its operation are "beyond the reach" of local ordinances. When amateurs do run afoul of a local law that seems to infringe upon their radio activities, they often question that law's constitutionality. The FCC doesn't have the time nor the budget to investigate every complaint of this nature, so they have issued a Public Notice which lists some guidelines for amateurs and other FCC licensees who feel they have run into improper regulation of radio communications; some of the important points of that Public Notice are discussed here.

One important facet of the Communications Act passed by Congress in 1934 was the establishment of a Federal Communications Commission with authority to set up a system of regulation for the various radio services. If you read the fine print of the Act you'll see that it leaves little doubt as to the extent of this regulatory scheme — it indicates a clear intention by Congress that radio should be completely regulated by the federal government.

However, this does not necessarily mean that local statutes which deal with radio are illegal or unconstitutional. Under the Supremacy Clause of the United States Constitution, state and local statutes may be pre-empted when (1) a local law conflicts with a law enacted by Congress, or (2) when Congress has adopted pervasive legislation in a particular field with the intent that regulation in that area be conducted exclusively by the federal government. Furthermore, local ordinances which unreasonably burden interstate commerce may be invalidated.

Whether or not a particular local statute has been pre-empted by federal legislation is purely a legal question, and when a conflict between federal and state law arises, the courts are called upon to make the final decision. For proper resolution the specific local law in question must be reviewed, and each case must be carefully judged on its own facts.

In general it may be said that in matters involving purely local concerns, the courts have found that reasonable local statutes are not in conflict with the Communications Act; such things as local zoning ordinances limiting antenna heights, and the right of local authorities to make judgments on the property rights of an FCC licensee's station have all been upheld. On the other hand, when a local law conflicts with the FCC's regulations for radio services, the federal law prevails; state laws involving the censorship of material carried on broadcast stations, for example, and local laws requiring FCC licensees to refrain from activities required by the Communications Act have all been struck down.

Amateurs are usually aware of local legislative proceedings, and when it appears an improper law regarding radio is being brought up for debate, that's the time to make your local representative aware of the potential problems. In general, state legislators have better knowledge of federal authority than do the local county or city authorities, but in either case local lawmakers should be made aware that the FCC has issued extensive regulations governing radio. Therefore, local ordinances designed specifically to regulate amateur (or CB) transmissions may be invalid. If you run afoul of such a law, you have little choice but to seek legal counsel to raise federal pre-emption on your behalf.

Jim Fisk, W1HR
editor-in-chief

More details? Ad Check page 88.

FOCUS & COMMENT

It seems to be traditional to pause at the end of each calendar year and look back at what has happened, to take stock of the situation, or to evaluate your progress; I can't think of a better time to do so. A backwards look at 1977 is very interesting, especially from the viewpoint of someone in the business of putting together a magazine for radio amateurs. In fact, fascinating might be the more accurate term. One thing an editor can depend on is that the readers will let him know how they feel about things, and they do.

But, what a variety of comments! There were letters from those who thoroughly enjoyed the fiction pieces — and in the same mail delivery were some who asked, "Why clutter up the pages with such useless junk?" Other readers reacted strongly to our stories about CB (some see red immediately upon sight of the two letters, never mind what the story has to say), and, fortunately, this reaction was balanced by other readers who applauded our efforts to tell more than one side of the story. Some found our technical material too basic, too simple, and wanted something they could get their teeth into. The other side of that coin was filled by dozens of letters stating that the technical articles filled a need for them — gave them something at a level they found useful. This is a good sign, showing that our readers are involved in amateur radio, not sitting on the sidelines.

There are some other signposts visible as bright spots as you look back at 1977 — indicators that amateur radio is being brought to the attention of the general public in many ways: A recent issue of *Analog* (Science Fiction/Science Fact) magazine had a story that was well done (but too short), about a student who was into amateur radio, and his relationship with his professor. Although the theme was rather "far out," I could find no flaw in the presentation of amateur radio.

Another instance is the publication of the book "*The French Atlantic Affair*," written by Ernest Lehman, K6DXK, in which amateur radio plays a vital role in the lives of the characters portrayed in this contemporary novel.

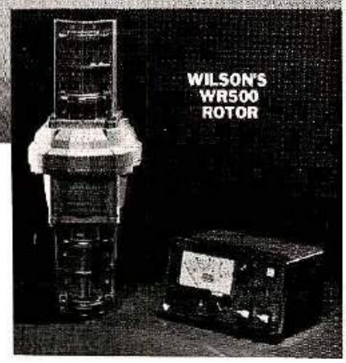
That's what we need more of — amateur radio told as it is, not inflated by impossible claims, not hidden in undecipherable (to the layman) jargon, but rather spoken of as a great hobby, pursued by everyday people who are just like the rest of the world. I'm glad to see that it is a growing trend. Some of the credentials sent in by many of our *Horizons* authors indicate that they have published articles about amateur radio in women's magazines, local and national newspapers, sporting magazines, and in those time-fillers that you find in the pocket of the seat on your favorite airline. Good stuff!

It's this variety of responses from our readers, the vast amount of territory to be covered, and the possibility of finding more signposts (perhaps even milestones) in the next year, that makes me look forward to 1978 with eagerness; I just know it will be anything but boring.

In the meantime, to all of you who took the time to express your feelings, I send a sincere "Thank You." And I wish each of you the very best for this holiday season, and throughout the coming year.

Tom McMullen, W1SL
Managing Editor

More details? Ad Check page 88.



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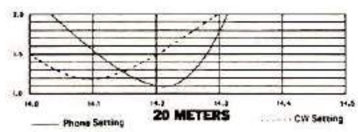
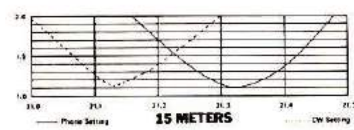
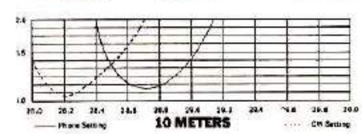
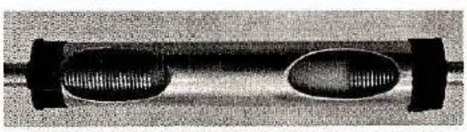
Maximum Power Input:	Legal Limit			Surface Area	7.3 sq. ft.
Gain	10 dB	No. of Elements	5	Windload Area	146 lbs.
VSWR (at Resonance)	1.5 to 1	Longest Element	26' 7"	Shipping Weight	50 lbs.
Impedance	50 ohms	Turning Radius	18' 6"		









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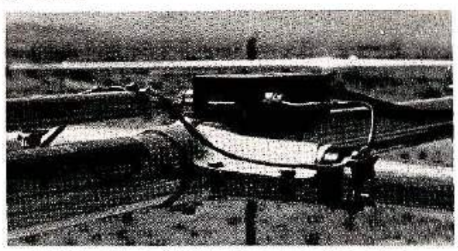

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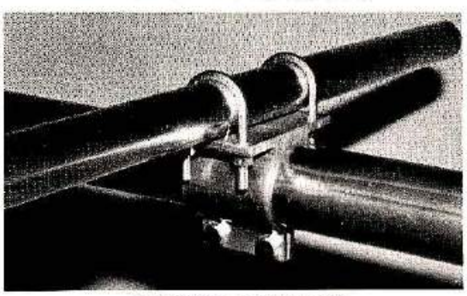

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NEWSLINE

SEPARATE REPEATER LICENSES will no longer be required and an Amateur operating a repeater will be able to do so simply by signing his regular call with the suffix "/RPT" on CW or "Repeater" on phone when in the repeat mode. This far-reaching deregulatory action came as a Report and Order on Docket 21033. Though agreement was universal throughout the Commission that separate repeater licenses were useful, it was felt they required more Commission investment in time and money than they were worth.

The Repeater Sub-bands were also expanded in the September 21 action, with an additional one MHz — 144.5-145.5 — now opened to repeaters on two meters. Additionally, all amateur frequencies above 220 MHz, with the exception of the 435-438 MHz space-communications slot, are now available for repeater use. The ten- and six-meter repeater limits remain unchanged.

Technicials Will Receive another 500 kHz, down to 144.5 MHz, so they'll be able to use the new two-meter repeater sub-band, which neatly avoids the OSCAR activity just below 146 and also manages to straddle (assuming 600 kHz input-output separation) existing ssb and a-m simplex operation between 145.0 and 145.2.

AMSAT WILL CONSTRUCT a building at the Goddard Space Flight Center to house both Phase III and AOD spacecraft integration and an office, according to an agreement tentatively approved by the Goddard authorities. It will be located next to the visitors' center, with windows permitting them to view the spacecraft construction efforts. Hiring a new full-time administrative assistant from the Washington area was also approved by AMSAT's Board.

OSCAR 7's Mode Schedule will be changed effective January 1 to two days in Mode B for every day in Mode A, and the new schedule will be shown in W6PAJ's orbital calendar coming out in December; see December Newsline. Ample Mode A operations will be provided by the Russian's "RS" spacecraft and AOD, and OSCAR 7 is considerably more sensitive in Mode B than it is in Mode A.

Increasing FM Operations just below 146 MHz are causing problems for OSCAR users. On Mode A 145.85-145.95 fm signals are being repeated to 10 meters, while Mode B users in major urban areas are having contacts broken up by local fm interference. A polite request usually suffices to move the fmers, but universal fm users' avoidance of 145.8 - 146.0 would be the best answer.

5139 Amateurs Throughout the world have used OSCAR 6 and 7, according to a compilation just completed by N3ES and WB2DNN. Just under 40 per cent are U.S. Amateurs, with the rest of the world's 60 per cent demonstrating the international importance of the Amateur space program. Recent word from South Africa has over 100 ZS stations active on Mode A and 20 on Mode B.

FLASHLIGHT "CW" SAVED EIGHT after the 37-foot yacht El Arca ran aground on Round Reef off the Virgin Islands shortly after dusk September 3. With no radio, the owner-captain aimed his flashlight toward shore and blinked a distress message that was spotted by KV4FZ. Herb alerted Civil Defense, Coast Guard, and REACT who immediately mounted a successful rescue effort.

"HAM'S" DETECTION of two policemen engaged in a restaurant burglary, widely reported in the press last summer, has some very unusual implications according to Florida Skip Editor W4IYT. By follow-up investigation, Andy found not only was the scanner-equipped "ham" not a ham, but the two policemen were using handheld units crystalled on 146.52, and neither of them was an Amateur!

Non-Amateur Use of Amateur transmitting equipment, this time for criminal purposes, is another powerful argument for point-of-sale controls — and a reminder that one never knows who is listening when you announce on the air you're leaving your home empty or parking your car in a vulnerable spot at the movie theater.

QUANTITIES OF FCC FORM 610s such as would be required for a large training class should be ordered from the Forms Distribution Center, Room B-10, 1919 M Street NW, Washington, D.C. 20554 rather than a local Field Office. A call or note to the nearest Field Office is quickest if you only need one or two.

KIWANIS MEMBERS may wish to check into a newly formed 20-meter net that meets Saturday mornings at 1700Z on 14275. There is also a Pacific Northwest net on 75 meters Tuesday and Sunday evenings on 3903 at 9:00 PM Pacific time.

HOT-AIR BALLOON ALTITUDE record was set by VS6DA on August 25 in Western Australia. VK6RU and VK6AO both assisted Geoff in the attempt, in which he reached 30,500 feet. Congratulations!

IMPORTANT WARNING TO FIBERGLASS USERS: The catalyst normally used to harden fiberglass resin can destroy eyesight if not washed from the eye within seconds after contamination. Always have a bowl of water at hand when working with resins.


DAWN
OF THE
SEMICONDUCTOR
AGE

Transistors — how we got them, what we're doing with them, and what they're doing to us

BY STEVEN E. KOMANIECKI, WB9SDN

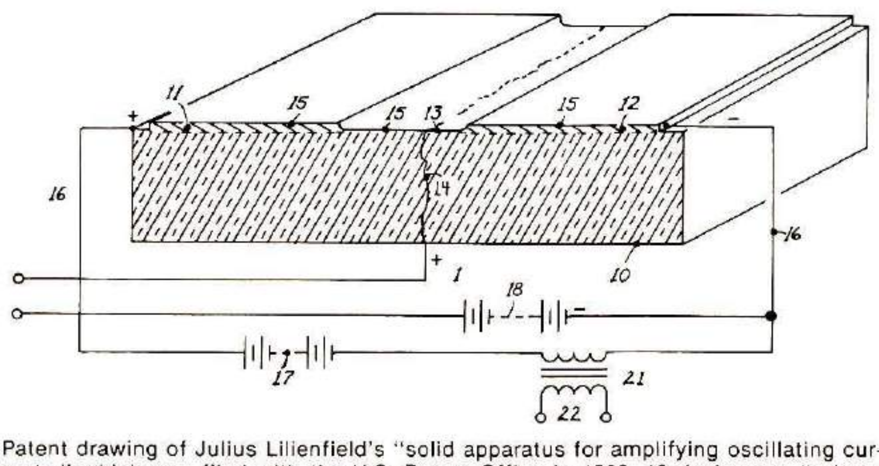
If a scientist discovers a great revelation or unlocks some secret of the universe, few people notice — unless, of course, he runs throughout the streets like Archimedes, shouting "Eureka! I have found it." — but then they only stare. But if someone invents a new device that makes life easier for an already indolent society — well, then everyone notices.

This is what happened to semiconductor electronics. Solid-state physics was the foundation for the building of an electronic society. Its first offspring, the transistor, will ultimately change the entire dimension of human existence. Solid-state technology helped send man to the moon, deep into the seas, and into his own body; it flies his aircraft, plays his music and favorite television shows, and may even replace defective bodies. Indeed, it's a rare occasion when there's not some item within sight that's transistor related.

Because these solid-state devices influence all our lives, we should have a general understanding of them. First we should know a little about the transistor's predecessor, the vacuum tube; then we can learn how the transistor was developed, how it works, and the impact it has had on society.

Prelude to the electronic age

The foundation of the transistor was really started well before its official birthday when, in 1883, Thomas Alva Edison was striving to improve his newly invented electric light. The principal flaw in his invention was the way in which the red-hot filament slowly evaporated with sustained use. Edison tried everything possible to slow down the evaporation process. In one test, Edison took a small metal wire and placed it near the filament, thinking perhaps the presence of the wire would affect the life of the filament.



Patent drawing of Julius Lilienfield's "solid apparatus for amplifying oscillating currents," which was filed with the U.S. Patent Office in 1926. 10 designates "a base member of suitable material, for example, glass." 11 and 12 are a pair of conducting members such as a coating of platinum or silver, and 13 is an aluminum foil electrode which "is secured in position by providing a transverse fracture (14) in the glass and then re-assembling the two pieces." Finally, superimposed over 11 and 12 is a thin film of "uni-directional conductivity" (such as copper sulphide, widely used as a rectifier before the availability of silicon or germanium diodes). Lilienfield's invention is perhaps the first recorded version of the field-effect transistor.

It didn't; but in testing this arrangement, Edison noted an unusual phenomenon: a distinct electric current could be detected in the metal wire, even though the wire was separated from the filament by a vacuum. Somehow current had jumped from the filament to the wire. This phenomenon, though unexplained, soon came to be called the Edison effect. An example is shown in **Fig. 1**.

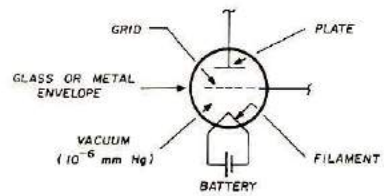
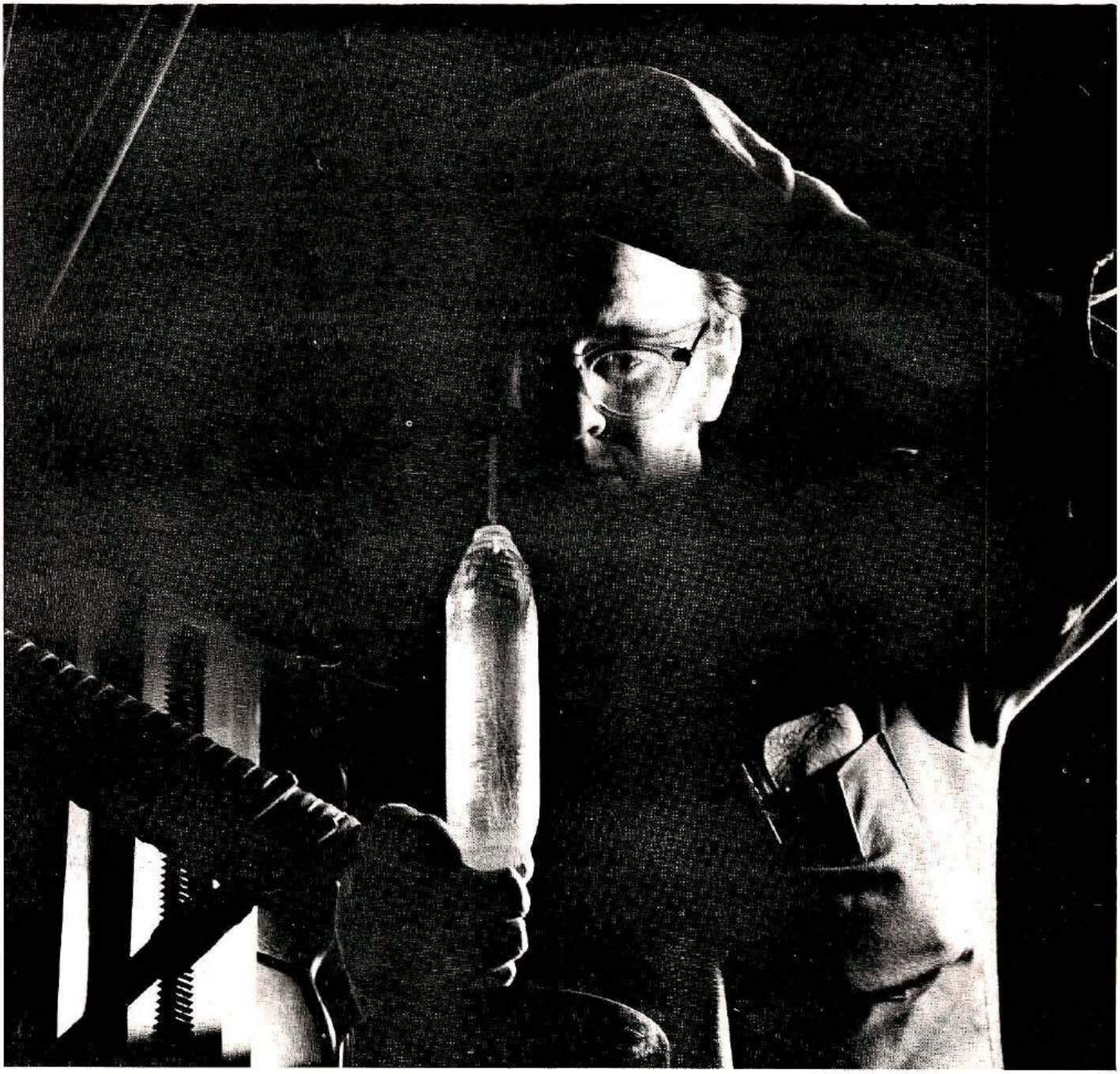


Fig. 1. Example of the Edison effect. Shown is a common triode vacuum tube (3 elements: filament, grid, and plate or anode). Electrons emanating from the heated filament cause an electric current to be induced into the nearby grid wire, even though the wire does not physically touch the filament. The phenomenon is also called "thermionic emission."

Since its discoverer found no practical use for it, the Edison effect remained unexplained and unused for more than a decade. Near the turn of the century, however, subatomic particles were discovered (Milikin, Rutherford, Chadwicke, *et al*), and the Edison effect quickly ceased to be a mystery.[1] Researchers found that all the atoms that comprise matter contain electrons (negatively charged particles) and protons (positively charged particles).[2]

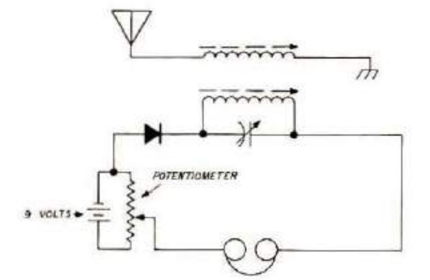
An electric current was found to be caused by the flow of electrons from one atom to another throughout the length of a conductor. During this same period the physicist, Owen Williams Richardson, explained that when metal filaments are heated in a vacuum, electrons "boil" out of the filament's atoms; the electrons then leap from the filament to the solitary wire. This subatomic evaporation explained the Edison effect.



C. David Brandle of Bell Labs in Murray Hill, New Jersey, examines a newly grown single crystal of garnet. Slices of this synthetic crystal are the basis for a new family of semiconductor memories being developed for computers (*photo courtesy Bell Labs*).

In 1904 the English electrical engineer, John Ambrose Fleming, put the Edison effect to use in an original manner. He placed a small metal cylinder around the filament and encased the entire system in an evacuated bulb. When alternating current (which changes direction many times per second) was applied to the terminals, Fleming found that current flowed mainly from the filament to the "plate" (or anode), which surrounded it. Fleming called his device a *valve* (the British still do today) because of its ability to turn the electric current on and off much like a water valve. This vacuum tube, which converts two-way motion into one-way motion, is now known as a rectifier[3] (**Fig. 2**).

The American inventor, Lee DeForest, carried electronic control a step further. In 1907, he inserted an element between the original plate and the filament. This added element was called a *grid* because it was perforated with holes; it was given a positive charge in relation to the cathode (an absence of electrons). Because it's positively charged and closer to the filament than the plate, the grid can intercept electrons



Did you ever hear of Dr. Pickard's oscillating crystal? It's one of the earliest examples of an operating semiconductor circuit, and was published in the March, 1920, issue of *QST*. The circuit was apparently widely duplicated by amateurs, but few, if any, could make it oscillate because their crystal material was not *exactly* the same as Dr. Pickard's!

from the filament, thus speeding the electron flow to the plate.

When the positive charge on the grid is made to increase slightly, the electrons come out of the filament in considerably greater quantities. A small increase or decrease in charge on the grid will impose a correspondingly large increase or decrease in the current passing from filament to plate. Furthermore, the pattern of change in current, or *signal* on the grid will be exactly duplicated by the current passing through the plate. This tube is now much more than a *valve*; it's an amplifier because of its ability to increase the amplitude or power level of a signal. **Fig. 3** shows a triode tube amplifier.

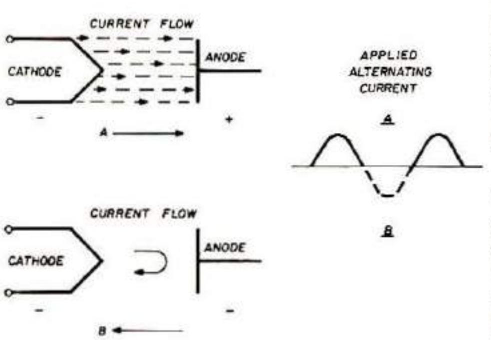


Fig. 2. Typical rectifier. Polarities (− and +) change during each half cycle of alternating current so that current can flow in direction A (sketch **A**) but not in direction B (sketch **B**).

In the United States, such amplifiers were commonly known as electron, or vacuum, tubes. Before the transistor, electron tubes were the mainstay of all electronics. Tubes were the only available means to amplify, modulate, and detect radio signals. As with all other man-made creations, the vacuum tube began to show deficiencies. The vacuum tube requires

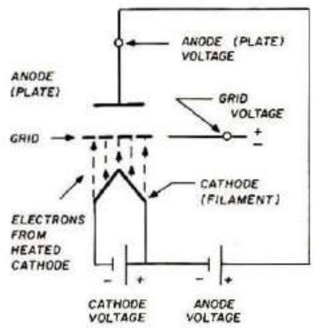


Fig. 3. A thermionic device, called a "triode" (3 elements: cathode, grid and anode) can amplify signals applied to its second element, the *grid*. The grid allows electrons from the cathode to pass through it. Variations in the grid voltage increase or decrease the electron charge from the cathode, which controls the density of the electron stream flowing between cathode (or filament) and anode. Thus, an *amplifier* is formed, which increases the applied signal.

large currents. More heat is developed, and the net effect is loss of efficiency, overheating, and shortened life span. Electron tubes also require a warm-up period. In radio circuits, tubes have an upper frequency limit beyond which they become unstable.[4] Moreover, electron tubes require a large amount of space.

Finally, because many tubes are made of glass, they lack sufficient strength to survive the rigors of field operation. Engineers and scientists recognized these limitations. They saw that no investment, manpower, or money could make the vacuum tube good enough to meet the future needs of innovations just

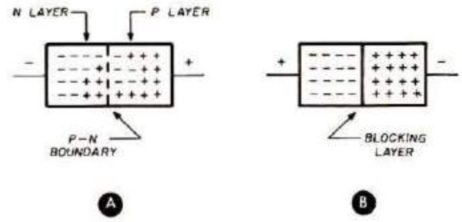


Fig. 4. The phenomenon of a semiconductor, which contains crystals contaminated by controlled addition of impurities. The type of impurity added to the crystal determines positive (P-layer) or negative (N-layer) conduction. In **A**, negative-charge carriers (N-layer) and positive-charge carriers (P-layer) migrate to the crystal center (dashed line), and current flows. If the applied voltage polarity is reversed (**B**), negative and positive charge carriers repel and migrate away from the boundary zone (blocking layer), thus no current flows.

beyond the horizon.[5] Researchers began to look in new directions: to semiconductors.

Birth of the transistor

Semiconductors were not new when transistors were first developed; in fact, they had been around since 1874 when they were first investigated by the Germans. A semiconductor is a substance with electrical properties midway between those of a conductor, such as silver or copper, and an insulator, such as porcelain. Semiconductors in one state may act as conductors, allowing current to flow, while in another state they are insulators, restricting the current flow.

Bell Telephone Laboratories became interested in these

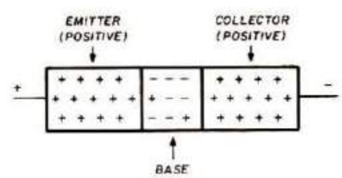
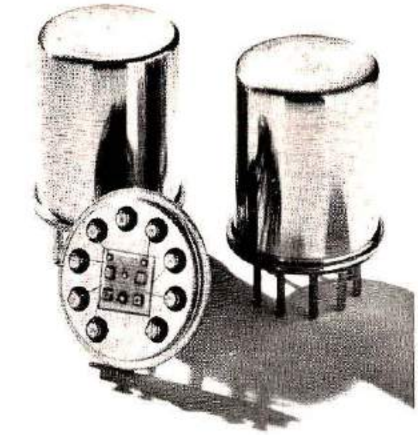


Fig. 5. How a transistor works. The current in the collector circuit is controlled by conduction in the base/emitter circuit. Thus the transistor can be used to amplify signals and to generate oscillations. Compare this action with that of "thermionic valves" or tubes (**Fig. 3**).

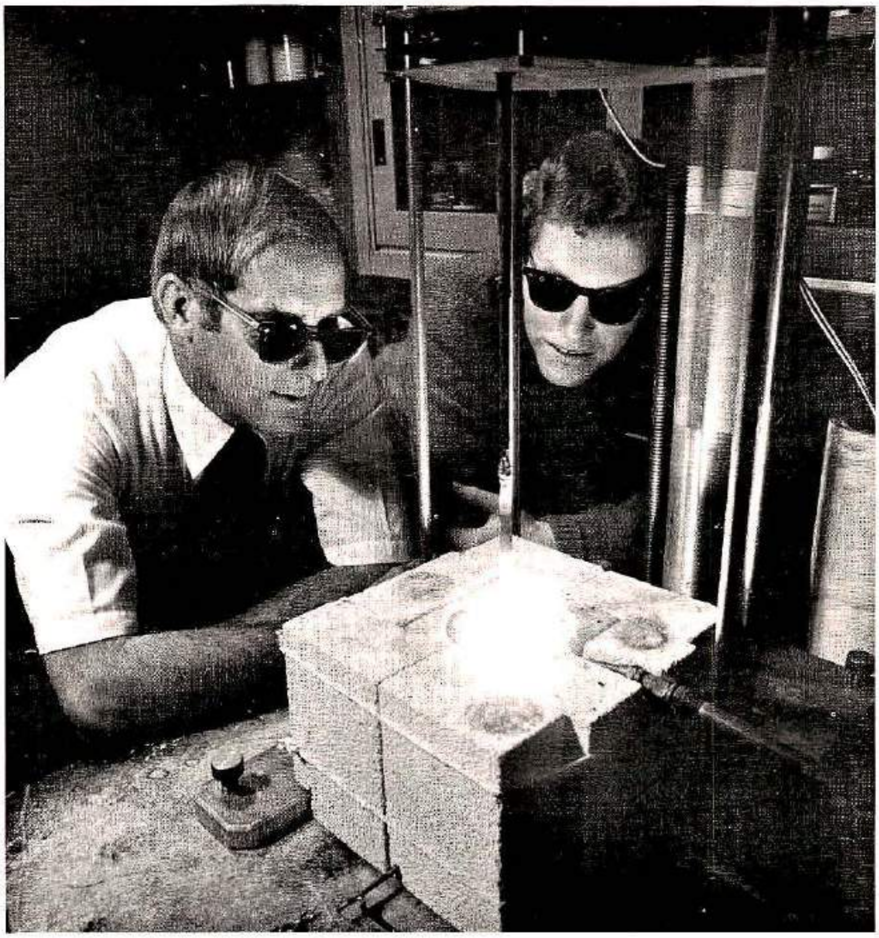


Field-effect transistor plug-in replacements for certain vacuum tubes, called Fetrons, are designed for use in electronic instruments (*photo courtesy Teledyne Semiconductor*).

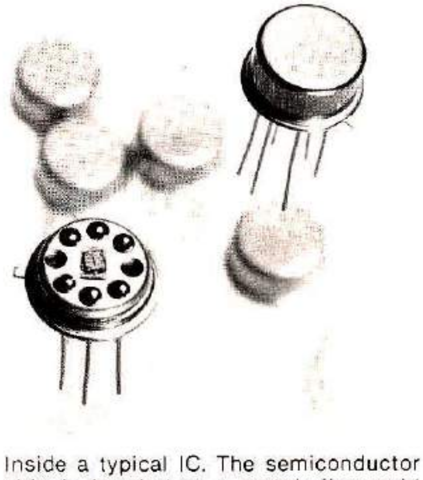
semiconductors in the early 1930s, when they sought to apply ultrahigh frequency radio waves to Bell-System communications. These frequencies were much higher than had ever been worked with before, and it was soon found that the electron tube, the conventional detector, could not detect such frequencies efficiently. Seeking another solution, the researchers thought back to the old cat-whisker detectors which had worked so well in Marconi's radio set.* The researchers found some old cat-whisker detectors in second-hand stores. The detectors made of silicon, a semi-conductor, worked best but were much too erratic to provide reliable detection. This erratic behavior later turned out to be a blessing in disguise.

The scientists melted down and pulled ingots from the purest specimens of silicon available and, in studying their behavior, noticed that there were actually two kinds of silicon: *P* and *N*, depending on the positive or negative direction in which current flowed. One day, using a different supply of silicon, the researchers accidentally produced an ingot that was not purely one type of silicon; it was *P* in one part of the block and *N* in another.

What intrigued the researchers most was the mysterious action that occurred at the *P-N* interface. Here, the dark silicon displayed an uncanny ability to convert light into electricity. A voltmeter was connected across the crystal, and when a flashlight was directed onto the silicon ingot, a definite potential difference was noted.



Researchers at Bell Labs watch the growth of lithium tantalate crystals which will be used in a filter for the Data Under Voice (DUV) microwave system produced in cooperation with Western Electric. Compared to quartz filters, the DUV filters have greater bandwidth and fewer components and cost less (*photo courtesy Bell Labs*).

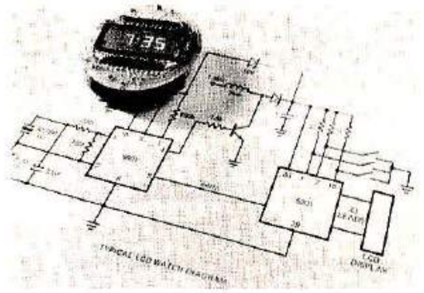


Inside a typical IC. The semiconductor chip is bonded to a metal; fine gold wires are used to connect the active device to the larger leads in the header which go to the outside world. The device is then hermetically sealed with a metal cover (*photo courtesy National Semiconductor*).

*Cat Whisker Detector — An early form of diode detector that consists of a needle point in contact with a base material of some type of semiconductor. Used in vintage radio equipment.

Even more important, the researchers discovered that the interface acted as a rectifier, permitting current to flow in one direction only, as in a vacuum tube rectifier; no wonder the cat whiskers worked so well in Marconi's radio!

Bell Lab scientists had discovered one of the most important phenomenons of the electronic age —*P-N* junction. No one knew it at the time, but the *P-N* junction just discovered held the key not only to the transistor but also to the Bell solar cell. Several years passed, though, before these discoveries were put into practice. **Fig. 4** gives a rough idea of how the *P-N* junction works in a semiconductor device.

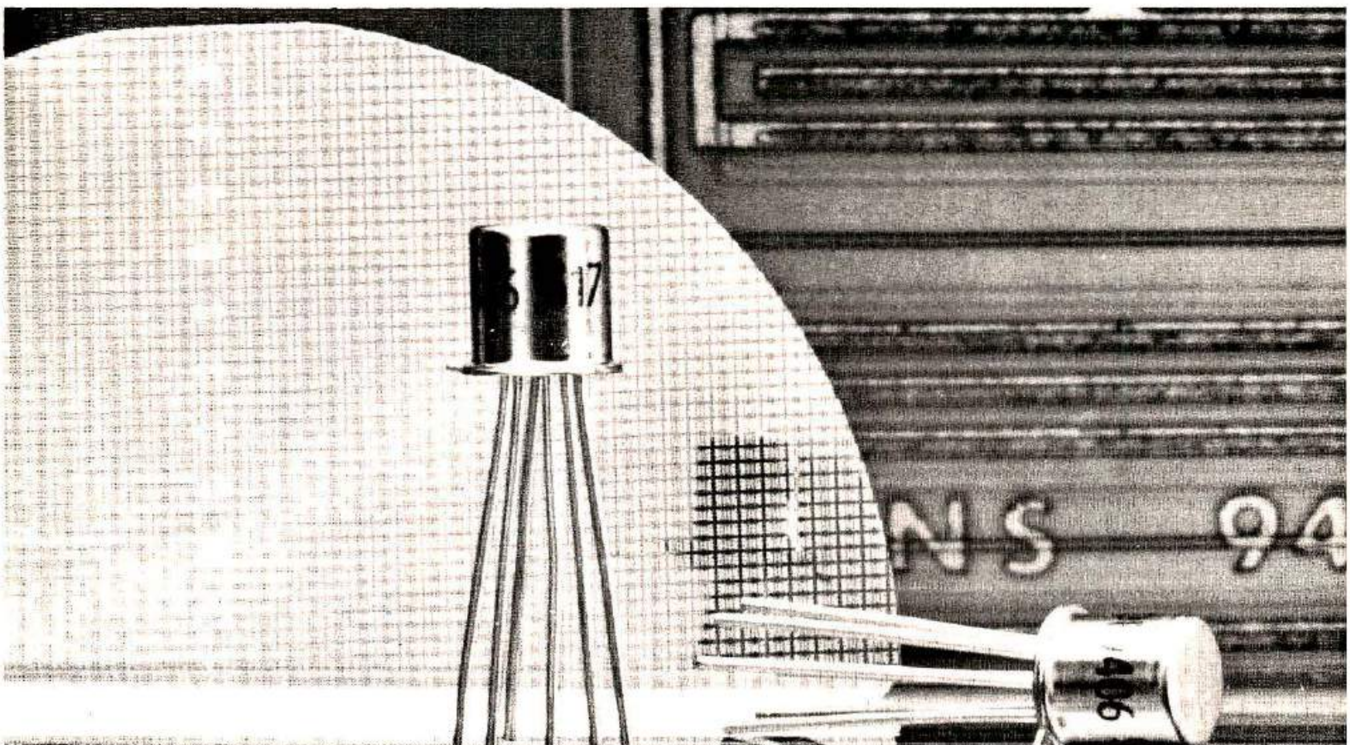


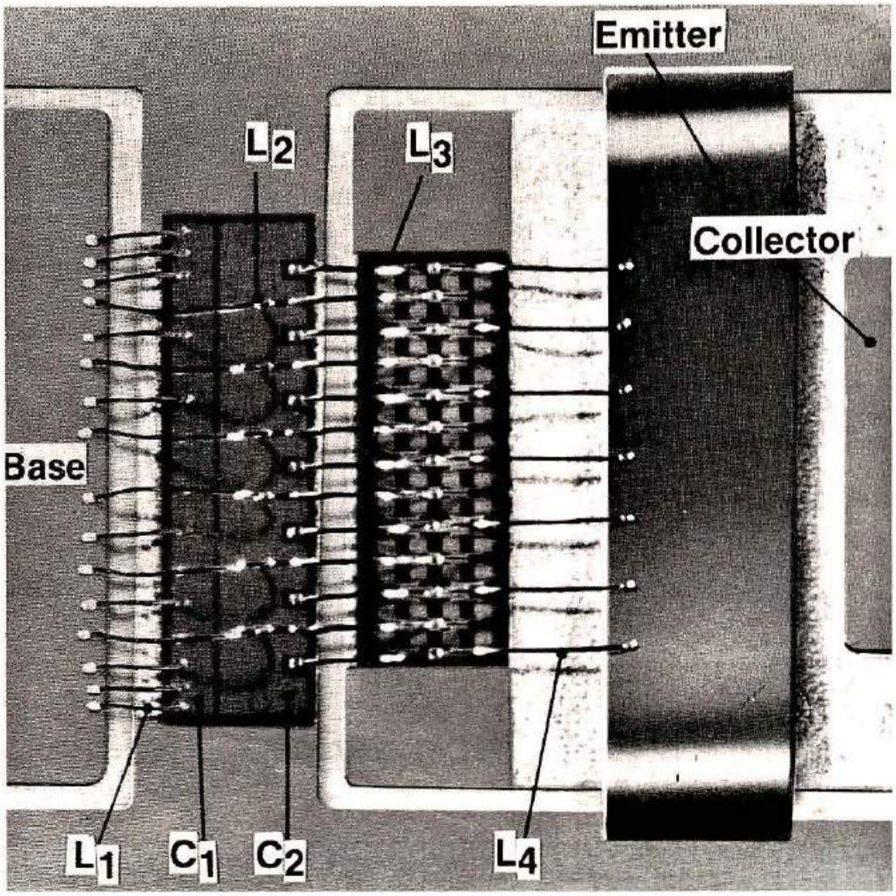
Modern digital watches would not be possible without semiconductors. This Liquid Crystal Display (LCD) watch uses two miniature ICs as well as a crystal and several external components (*photo courtesy Motorola Semiconductor*).

Meanwhile, during the 1930s, Bell engineers began to look for a substitute amplifier for the vacuum tube. Perhaps the answer could be found in semiconductor crystals. When used as detectors, the crystals involved only two electrodes, just like the filament and plate of an electron-tube rectifier. Why not introduce a third electrode that would act as a current-controller, as in the grid of a vacuum tube, to make it amplify? The answer was soon to be found.

With a return to peacetime operation after World War II, Bell Labs made an important decision: to begin an organized investigation. So in January, 1946, a research team was formed to investigate the prospect.[6] Among the many investigators who went to work was a notable trio: William Shockley, Walter H. Brattain, and John A. Bardeen. Shockley and Bardeen were pencil-and-paper physicists — theoreticians — and Brattain

Many electronic circuits require careful transistor matching for best results. The National LM194 pictured here consists of two carefully matched NPN transistors on a single chip. In the background is a microphotograph of the chip; to the left is a thin slice of silicon with hundreds of matched transistor pairs. This is cut up into single small chips which are installed in the metal packages, foreground (*photo courtesy National Semiconductor*).





Looking more like a hybrid integrated circuit than a discrete transistor, Motorola's newest line of uhf power amplifier devices features double tuned input matching networks to a multiple transistor to achieve broadband operation from 100 to 500 MHz with power outputs as high as 80 watts (*photo courtesy Motorola Semiconductor*).

was the lab man or experimenter.

Pooling their creativity, these three men evolved theories and tested them in the lab. From Shockley's calculations, Brattain tried to control the current flowing through a semiconductor crystal; no luck. Then Bardeen modified the theory and Brattain figured out a way to make it work by covering the crystal with an electrolyte. It worked, but feebly. So far, they had been using silicon crystals. Next they tried germanium, which is another semiconductor. Nearly a month later, mid December 1947, they observed that the crystal, which was in contact with two wires two-thousandths of an inch (0.05mm) apart, was behaving in a way never observed before: it was *amplifying;* it could in fact amplify a voice 40 times. This phenomenon came to be known as the *transistor effect* (see **Fig. 5**).

Transistor operation

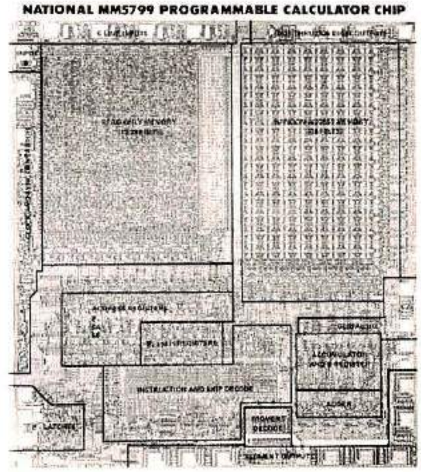
A transistor is basically a resistor that amplifies electrical signals as they are transferred through it from input to output terminals. The word *transistor* was actually derived from the words *transfer* and *resistor*. It was found that transistor action depends on the activity in the *P-N* barrier.

To understand what happens inside a transistor, we must know a few important things. In a conductor (*e.g.* a wire), there are really *two* types of current carriers: electrons and something slightly different called holes. The application of an electric field to a conductor will cause electrons to move to the positive terminal and the holes (which are really vacancies of electrons originally in the metal atom) to move in the opposite direction to the negative terminal. Like charges repel, unlike charges attract.

Next we must know a little about semiconductor chemistry. The semiconductors used in electronics are usually elements that have four valence electrons each. Valence electrons are those which are free to bond with other atoms. *Silicon* and *germanium* are elements of this type. Under laboratory conditions, their crystals can be grown to nearly any desired size and can be made almost perfectly pure. This type of *intrinsic* material is not of much use, though, because it is really only a high value resistor.[7]

Soon after the first transistor creation in 1947, Bell Lab scientists started work on practical models. In 1951, Morgan Sparks created the bipolar transistor. The birth of

NATIONAL MM5799 PROGRAMMABLE CALCULATOR CHIP



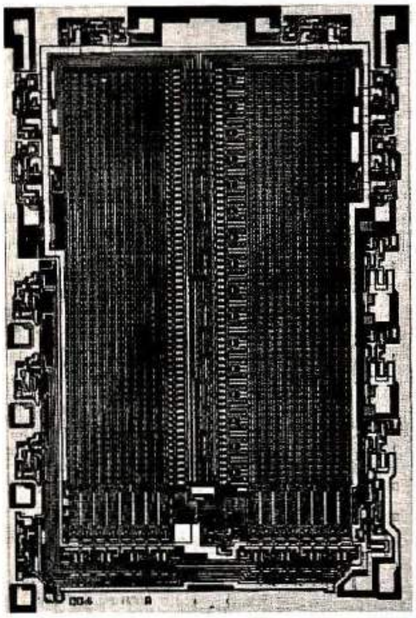
Photomicrograph of the National MM5799 programmable calculator chip, which contains all system timing, arithmetic, and logic, plus memory for more than 12000 bits. A chip such as this is called Very Large Scale Integration or VLSI (*photo courtesy National Semiconductor*).

the first point-contact transistor was announced in the laboratories' old building opposite the Hudson River docks; in the same building where, twenty-three years before, Davisson had discovered electron waves.

The auditorium was jammed with reporters, and on that day — June 30, 1948 — Shockley, Bardeen, and Brattain explained what they had done. They had samples of transistors so small that they could barely be picked up to show the curious onlookers. They also had built a working radio. It had a plastic case so that the public could see there were no tubes at all. For their work, the researchers later received the Nobel Prize in physics.

The impact of the transistor was tremendous. Why? — because Bell Telephone was determined not to keep the invention a secret. This step was radically different, because in most technical industries secrecy is the norm. Morgan Sparks, inventor of the bipolar transistor, wrote this[8] for the Bell *Record*: "Bell Lab's first important policy was not to keep transistor information secret. Not only was it not kept a secret, but we actively expounded the art as well as the science of practicing the technology. Several seminars were held in the early 1950s, where we told all we knew about transistor technology.

Nobel Prize winners Dr. William Shockley, Dr. Walter Brattain, and Dr. John Bardeen (left to right) discuss the crystal structure of semiconductors. The trio received the 1956 Nobel Physics award for their invention of the transistor, which was announced in 1948 (*photo courtesy Bell Labs*).



Photomicrograph of a Signetics 4096-bit read-only semiconductor memory. Actual size is approximately 0.1 by 0.16 inch (2.5x4mm); power dissipation is 125 microwatts per bit. This device can replace up to 144 other ICs (*photo courtesy Signetics*).

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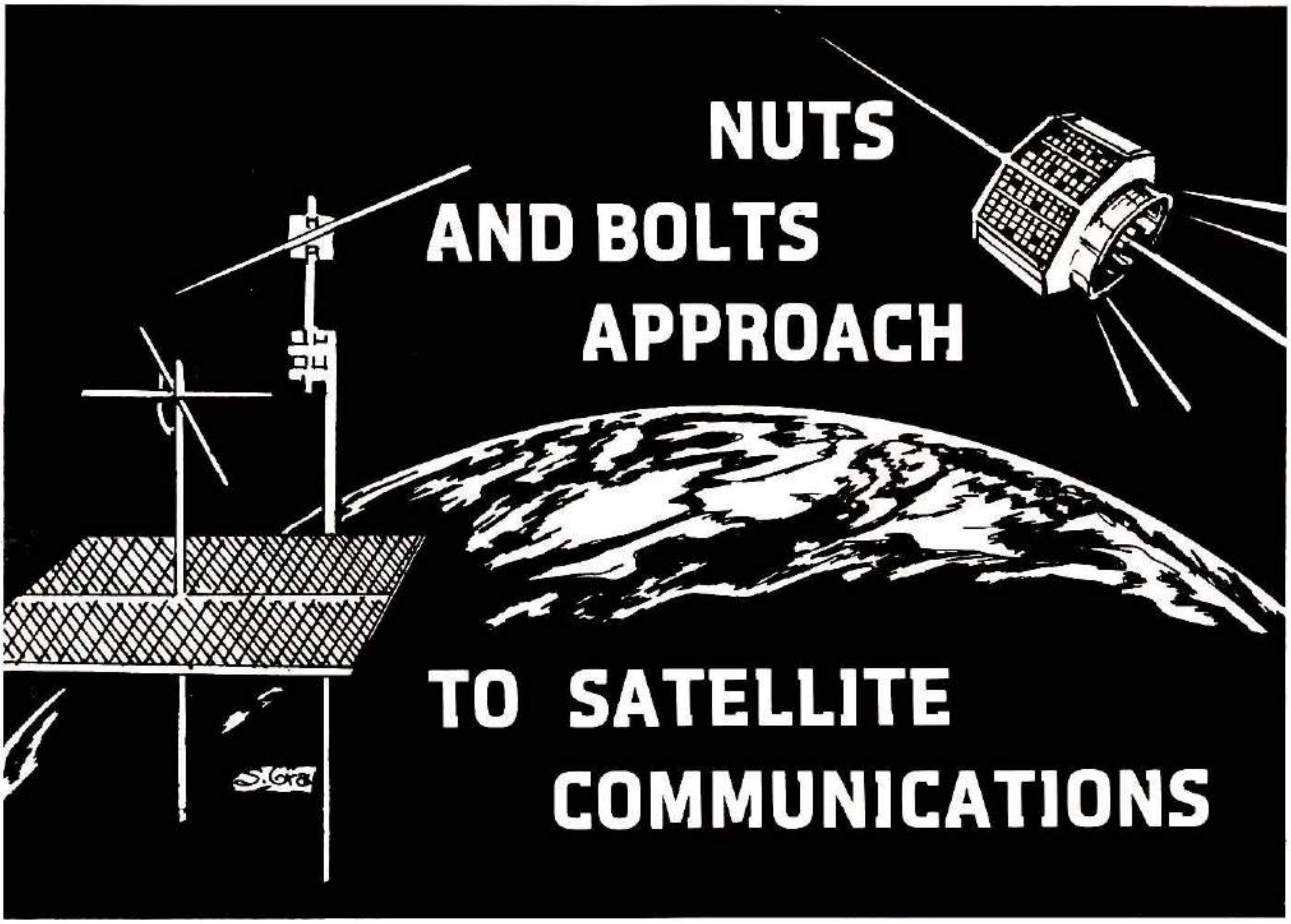
NUTS AND BOLTS APPROACH TO SATELLITE COMMUNICATIONS



JIM GRAY, W1XU

By now you've probably heard about AMSAT, the Amateur Satellite Corporation, and OSCARs 6 and 7, acronyms that stand for the sixth and seventh *O*rbital *S*atellites *C*arrying *A*mateur *R*adio, placed in orbit for the purpose of providing amateurs around the world with an opportunity to communicate with each other by satellite!*

Perhaps you've even heard amateur stations on the high end of the ten-meter band, and wondered if they could be signals relayed by satellite. If so, did you ever ask yourself, "I wonder if I could do that?" Okay, what did you *do* about it?

If you answered "nothing" to that question, you're not alone. Many hams who have never heard signals from the satellites have not done anything about trying to communicate through OSCAR because "I don't know where to start," or "I don't have the equipment," or "It's too complicated for me" and any one of a variety of similar excuses. Don't believe them! You *can* do it, you *don't* need much equipment and it's *not* at all complicated.

What you'll need

Really, it's very simple to put together a station capable of working through the satellites. You'll need a transmitter, a receiver, and an antenna system. That's right, antenna *system*, but don't be alarmed; two very simple and inexpensive antennas that you can build are all you'll need to start: one for your transmitter, and another for your receiver. In addition to this station equipment, you'll also want some data about when and where to look for the satellites — and that's easy to acquire, too. More about these things later.

*Anthony R. Curtis, K3RXK, "Riding High With OSCAR Satellites," *Ham Radio Horizons*, March, 1977, page 18.

Some background

December 12, 1976, marked the 15th anniversary of the launching of OSCAR 1, the first non-government satellite to be put into orbit. Four other OSCARs were launched between 1 and 6, but none remain functional — their battery systems were not designed for long life.

OSCAR 6 was launched on October 15, 1972, carrying a repeater, sometimes called a transponder or translator, that could receive amateur signals and retransmit them. The translator picked up signals on the amateur two-meter band (145 MHz) and sent them back in the 10-meter band (29 MHz).

OSCAR 7 was put in orbit on

November 15, 1974, and has two repeaters aboard. One receives signals on two meters, and repeats them on 10 meters, the same as OSCAR 6; the other picks up signals on the 70-cm (420 MHz) band and rebroadcasts them on two meters. Both OSCARs have transmitters that send information about the conditions within the satellite to help the control stations keep things running right. These are called telemetry channels or frequencies (*tele* = distant, *meter* = measure).

When OSCAR 7 is translating from two-to-ten meters, it is operating in Mode A, and when it is repeating from 432 to 145 MHz, it is in Mode B. The satellite alternates between Modes A and B on different days of the week, except for special days or experiments. For our purposes, we'll talk about OSCAR 7 in Mode A, because these are the easiest frequencies to reach with simple equipment.

Uplink and downlink

Signals that go from the ground station up to the satellite are called uplink signals or frequencies; those that return to earth from the satellite are called downlink signals, to borrow some terms from the space age. To talk through OSCAR 7, you must transmit in the uplink band of 145.85 to 145.95 MHz. The downlink signals will return to you between 29.4 and 29.5 MHz. **Table 1** shows this relationship between the frequencies. The general formula for finding the downlink signal on OSCAR 7 is:

F (downlink) =
F (uplink) minus 116.45

If I transmit on 145.93 MHz, and subtract 116.45, then I should hear my own signal on 29.58 MHz — and so will anyone else who listens there. You can use the chart of **Fig. 1** to find where your two-meter frequency will come back to you in the downlink for OSCAR 7.

In addition to repeating Amateur transmissions, OSCAR 7 also originates its own *telemetry* transmissions on 29.502 MHz, that tells ground stations all about battery voltages, temperatures, solar-cell charging rates, current consumption, and many other conditions on board the satellite. Ground-command stations can use this data to determine what, if anything, needs to be changed aboard the satellite, and can actually make changes — such as turning the repeaters on and off, changing power levels, and the like.

The telemetry data is sent in Morse code, and with a bit of practice, plus interpretation tables found in AMSAT's Orbital Predictions you can interpret on-board conditions on each pass of the satellite over your area. In fact, both AMSAT and its network of command stations welcome this information from you, and use it to be sure that all is going well. Write to AMSAT, Box 27, Washington, D.C. 20044.

The OSCARs were launched in sun-synchronous orbits; this means that they pass over the same *track* above the earth at about the same time each day. The orbits are roughly circular and at an altitude of about 900 miles (1400km). From this distance, each OSCAR "sees" an area about 5000

Table 1. OSCAR 7 operating frequencies.

Input (uplink) Frequency	
	145.85 to 145.95 MHz
	432.125 to 432.175 MHz
Output (downlink) Frequency	
	29.4 to 29.5 MHz
	145.975 to 145.925 MHz
	29.502 MHz beacon
	435.103 MHz beacon

Note: The uhf translator inverts the signals; USB on 432 MHz becomes LSB on 145 MHz. There is no signal inversion through the vhf translators.

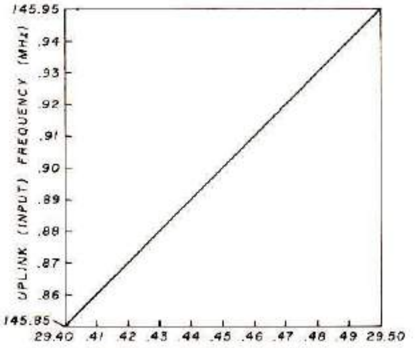


Fig. 1. The frequency translation of OSCAR 7, in Mode A, can be obtained by using this chart. Find your input frequency on the left, follow the line to the diagonal, and then down to the bottom. Read the output frequency between 28.4 and 29.5 MHz.

*Editor's Note:** When this article was written, both OSCAR 6 and 7 were in operation. Since that time, however, OCAR 6 has had battery problems and was shut down by command stations in an effort to prolong its life. It now refuses to respond to command signals, and must be presumed inoperational.

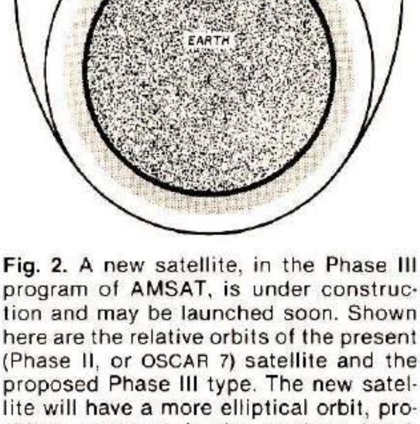


Fig. 2. A new satellite, in the Phase III program of AMSAT, is under construction and may be launched soon. Shown here are the relative orbits of the present (Phase II, or OSCAR 7) satellite and the proposed Phase III type. The new satellite will have a more elliptical orbit, providing amateurs in the northern hemisphere with communications capability nearly 60 per cent of the time.

miles (8000km) in diameter. Their period of revolution about the Earth is approximately 115 minutes; that is, one hour and fifty-five minutes. The orbital paths, however, do not cross the equator perpendicularly, but instead at a slight angle. Each pass is therefore in a generally northwest-southeast direction as it crosses the equator coming north, and is 28 degrees of longitude farther west, representing the distance the earth has turned beneath the orbital path in the last 115 minutes. For example, if one pass is about over Boston, the next one — 115 minutes later — will be approximately over Kansas City.

In the evening hours over the United States, both OSCARs make ascending-node orbits; that is, they head northwestward from the equator. In the morning hours over the United States, both make *decending-node* orbits, passing overhead in a generally northeast to southwest direction. Because of this, it is a bit easier to work stations in the Carribbean and South America in the evening, and in Europe and Africa in the morning, if you happen to live in the eastern part of the United States.

Doppler effect

Because the satellites move so fast (somewhere between 17 and 18 thousand miles (27 to 29 thousand kilometers) per hour,) the signals you will receive from them appear to change in frequency during each pass. Therefore, you'll have to tune your receiver slightly during the time you talk to another station. This effect, known as the Doppler shift, is similar to the change in pitch of a car horn as it approaches and passes you.

The OSCAR satellites tumble slowly in their orbits, so their antennas are constantly changing angle and perspective as seen from your location. This also means that the signals you receive will not be constant in strength. In addition to this, the signals will also vary in strength due to polarization effects caused by their passing through the ionosphere at an angle. Finally, the signal strength will change according to how close or far away the satellite may be from your station. All of these factors contribute to changing signal strength, but aren't meant to discourage you. They are only mentioned so you won't think you are doing something wrong when you find the signals getting stronger or weaker. Some stations use less power than others, too, and the effect of that variation will be noticeable.

The satellites have only so much transmitter power

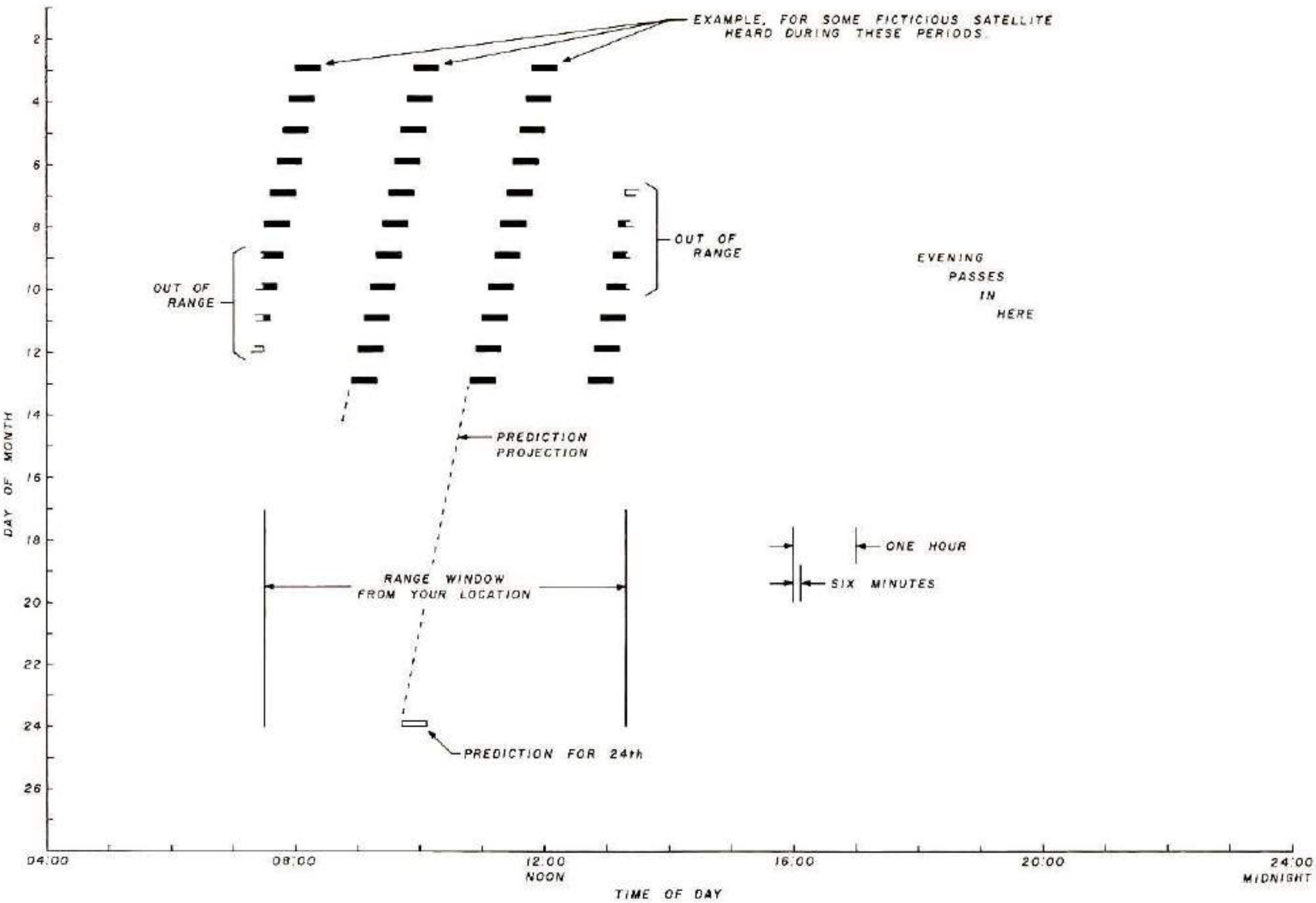


Fig. 3. Here is an example of an orbital prediction chart that you can make for your location if you do some listening and plot the times that you first hear and last hear the satellites. Morning passes are on the left side, evening on the right. Days of the month are designated along the left margin. See text for explanation of how each mark corresponds to a satellite pass.

available; therefore, the amount of power devoted to each repeated signal is proportional to the strength of the received signal. For this reason, it would not be fair for one user to "hit" the satellite with 1000 watts, when another user can only muster 25 watts. OSCAR users are requested to use only about 100 watts effective radiated power. This means the output power of your transmitter multiplied by the gain of your transmitting antenna should be no more than 100 watts.

As an example, suppose your output power is 25 watts and your antenna power gain is 4 (6dB). Four times twenty-five gives you the suggested ERP (Effective Radiated Power).

Finally, you ought to know that OSCAR 7 sometimes reduces its total transmitter power and go into what is known as a low-power, or QRP, mode. For an entire day the signals may seem weaker to you than they should; one explanation might be that a QRP day is in effect. On these days, Earth stations are asked to reduce their power to a maximum of ten watts ERP. It is surprising how little signal it takes to communicate by satellite, and QRP users have been amazed at results.

Where and when

This is one of the questions that you're going to have to answer before you can transmit signals to, or receive signals from the satellites. Fortunately, the answer is very simple. Some very helpful people have developed satellite locators. One of these is called a *Satellabe*; it is an orbital plotter in the form of a hand-held device having several concentric, movable rings of paper and plastic. The rings contain information about time and longitude, a map or chart, several overlays, and an orbital track. If you know the *beginning* orbit for any day, for either satellite, the calculator-plotter will permit you actually to see the path of that orbit and all other orbits for that day, merely by moving the tracking grid.

You may also want to invest in the publication, *1977 Orbital Predictions for AMSAT OSCAR 6 and AMSAT OSCAR 7*.† This booklet gives all of the data about equatorial crossing times and longitudes for every orbit of the entire year, and is almost indispensable for the serious OSCAR user.

Fig. 3 shows a simple graph developed by G3BVU, that you can construct for your particular location, and it will hold good for a very long time. Best of all, it costs nothing except a little time and effort, plus a fair amount of listening. That's what you plan to do anyway — so it's time well spent.

To make the graph, lay out the days of the month on the

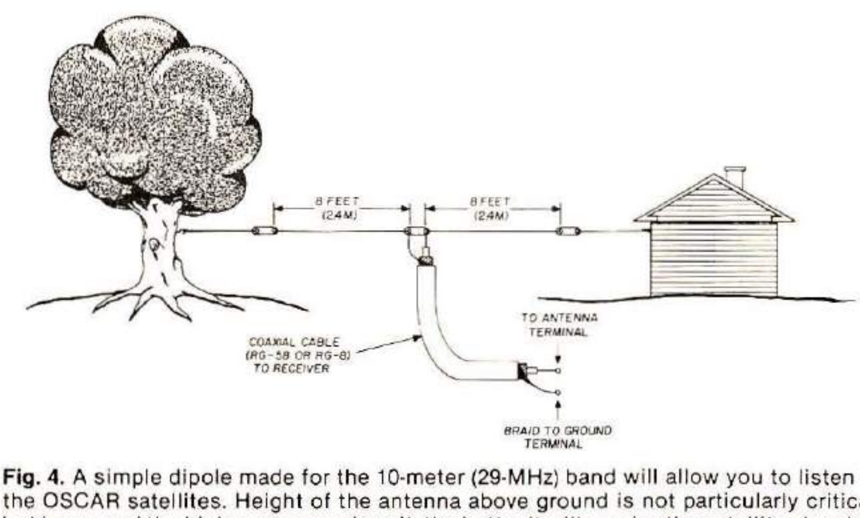
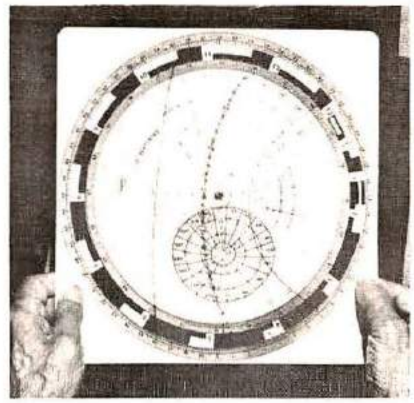


Fig. 4. A simple dipole made for the 10-meter (29-MHz) band will allow you to listen to the OSCAR satellites. Height of the antenna above ground is not particularly critical, but in general the higher you can place it, the better it will receive the satellite signals.



The position and orbital track of OSCAR can be found for each pass near your location by using this Satellabe. It is available from *ham radio's* Communications Bookstore, Greenville, New Hampshire 03048, for $7.95 postpaid.

vertical margin (ordinate) and the time of day on the horizontal margin (abscissa) of your paper. Use the 24-hour clock system. Now, begin listening. Every time you hear one of the satellites, mark in the time of day you first hear signals, and the last time you hear signals on that pass. The result will look like a short, horizontal dashmark. By listening to several successive passes on several different days, you'll begin to develop a plot of times for AOS (Acquisition Of Signal) and LOS (Loss Of Signal). By extending the plots as shown, you can develop a prediction system. The range *window* will begin to make itself apparent, too; that is, the easternmost and westernmost orbits that you can hear from your location.

Transmitters

You don't need a fancy transceiver, capable of doing everything but the dishes, to hear and work OSCAR. At first, you will only need CW, so don't go out and buy a vhf ssb transceiver until you're sure that you want to become a permanent OSCAR user. Many serviceable two-meter CW transmitters are available in the used market for well under

†Available for $5 from Skip Reymann, W6PAJ, Box 374, San Dimas, California 91773.

$100. You might even find one for less than $50! A very good one is the discontinued Ameco TX-62, with accessory vfo. Another might be the old Johnson 6N2, or one of the older Heathkit rigs that covered two meters. A vfo is desirable, but not absolutely necessary. Just be sure that everything works okay, puts out a decent, stable signal, and has an output power of about 50 watts or so — up to 100 watts, if you don't plan to use a beam antenna. That's it for transmitters.

Receivers

Here is where you may already be in good shape. Almost everyone has a receiver that will cover the entire ten-meter band. If not, many can be made to do so merely by adding a crystal to extend the coverage. Some older receivers covered the whole band, but weren't too sensitive. A good way to check the sensitivity of your receiver is to tune it to the ten-meter band, near 29.5 MHz, with the antenna disconnected. When you connect the antenna you should hear an increase in hiss or background noise. If you do not hear such a change, the receiver needs help in the form of a preamplifier,* they'll do wonders to pep up an old dog. Just make sure that the combination covers 29.4 to 29.55 MHz. That's about it for receivers. I told you that it was simple!

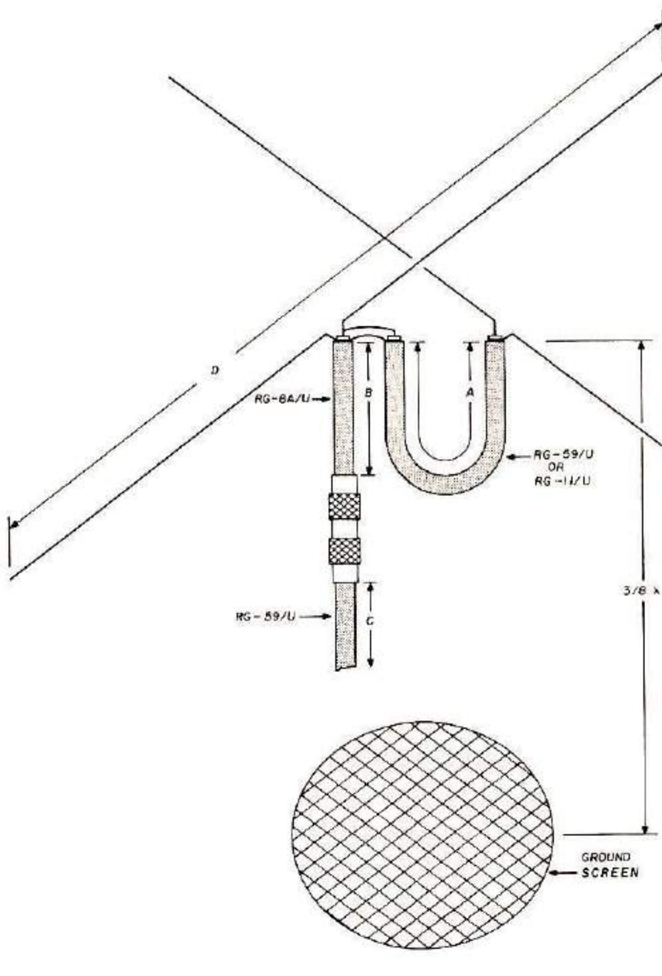
Antennas

You'll need two antennas, as I said before. One can be a simple dipole, sixteen feet (4.9m) in length and fed with coaxial cable, for your receiving antenna **(Fig. 4)**. Put it as high and in the clear as possible, but don't worry if you can't. I've seen excellent OSCAR receiving antennas inside buildings (although not steel buildings). You may want to try different directions for your dipole, but most users recommend putting it up with the legs running north and south.

The transmitting antenna is somewhat more important. You could use a beam, but that creates still other problems and complications. One of the common antennas for use with OSCAR is a simple *turnstile,* **Fig. 5**, consisting of crossed dipoles above a reflector screen. Dimensions for both bands are given in the table with **Fig. 5**.

What about beams?

As long as you asked, let's just say that it is possible to use multi-element arrays on azimuth and elevation mounts that provide tilt and rotation for your antennas. Usually, the two beams (for 2 and 10 meters) are mounted on the same support and rotate together. A very sophisticated arrangement would include a drive mechanism — perhaps computer-fed — that automatically tracks the satellite for you during its pass. You could



DIMENSION	10 METERS	2 METERS
A	56 INCHES (142cm)	13 INCHES (33cm)
B	54 INCHES (137cm)	13 INCHES (33cm)
C	NEEDED LENGTH TO TRANSMITTER	
D	16 FEET (488cm)	39.5 INCHES (100cm)

Fig. 5. A turnstile antenna can be made for either 29 MHz or 145 MHz, and is an excellent transmitting and receiving system for use with OSCAR. Dimensions are given for the element length and coaxial cable sections for both bands. For best results the crossed dipoles should be placed over a metal screen that is one wavelength on each side (32 feet, or 10 meters, for receiving; 80 inches, or 2 meters, for transmitting). The distance from the screen to the dipoles in each case should be approximately 3/8 of the wavelength dimension for that band.

*Some suppliers of preamplifiers and converters are: Janel Laboratories, 3312 S.E. Van Buren Blvd., Corvallis, Oregon 97330; Ameco Equipment Company, 275 Hillside Avenue, Williston Park, New York 11596; and Hamtronics, Inc., 182 Belmont Avenue, Rochester, New York 14612. Write for current models available and prices.

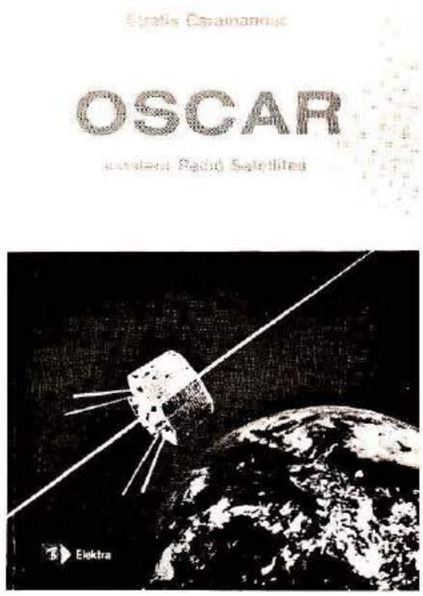
even have a choice of helical antennas with right- or left-handed polarization, switchable at will. The fact is you don't *need* them, but if money is no object, go ahead. Remember that with a beam, however, you're going to have to follow OSCAR across the sky; otherwise, it will pass through your narrow beam pattern too quickly.

If you must use a beam, be sure to use only a three- or four-element job. You can tilt it up about 20 or 30 degrees and fix it at that angle. Use two beams, if you must, but don't blame me if your buddy does better with dipoles.

You could use something like a two-meter ssb, CW, and fm transceiver. Lots of good ones are being made in Japan and elsewhere. They will cost you the better part of a $700 bill before you're through, and they won't do any better on CW than the Ameco TX-62 with vfo, for example. You might also buy a transverter for your existing CW-ssb transceiver. That's okay, too, and transverters work well. Simplest is best for the beginner — and much less expensive.

Assuming you've built the simple antennas, have acquired the transmitter and receiver, obtained an orbit calendar and plotter, and have done lots of listening, you're ready to *access* the satellite. Pick an overhead pass for your first try. Let's say you find OSCAR 7, mode A, suitable. Okay, pick a frequency from the chart of **Fig. 1**. You chose 145.93? Good. Now, tune your receiver to 29.49 MHz. Here it comes! Send a series of Vs, or a series of dits, while tuning around your chosen spot. Soon, you should hear them coming back to you. Now rap out a CQ and listen near your frequency. Be patient, because other stations are going to have to hear you, zero beat, and answer. Also, they may have to follow the signal through its Doppler shift. Got an answer? Great! Now don't rag chew; a simple RST report, name, and location are fine. If you're nervous like I was the first time, it will take you the whole 20-minute pass to get set, have a QSO, and then sit back long enough to let it all sink in and quit shaking. By the way, you'll find that the conversation is fully *duplex*, meaning that you can talk and listen at the same time — like a telephone — and, what's more, hear your own signal.

What a thrill — you've worked through a satellite that was built for and by amateurs, and you've done it with a system that you assembled, and an antenna that you constructed. No wonder you're proud; you have every right to be. Enjoy OSCAR, and look for me. **HRH**



If you would like to know more about satellites and how they work, what makes them stay up there, and what can be done with them, here is a book that has all the answers. It's an excellent English translation of the original German edition. The price is $8.50; order RS-O from *ham radio's* Communications Bookstore, Greenville, New Hampshire 03048.

Do you speak OSCAR?
From AMSAT Newsletter, March 1976

Orbit is the satellite's "highway in the sky", a fixed path in space.

Period is the time taken for the satellite to travel once around the earth.

Equatorial Decrement is the amount that the satellite's orbit moves west or east where it crosses the equator, due to the earth rotating on its axis. The satellite orbit also makes an angle with the equator.

Inclination is the angle of the orbit with respect to the equator.

AOS is the acquisition of signal, as the satellite comes within range of a listening station. AOS time is the time that the signal is first heard.

LOS is the loss of signal, as the satellite moves out of range of a listening station. LOS time is the time that the signal disappears.

Pass is the period of time for each station between AOS and LOS, when the satellite is within range.

Downlink is signals being transmitted by the satellite toward earth.

Uplink is signals being transmitted by an earth station toward the satellite.

Passband is the range of frequencies available in the satellite for uplinks or downlinks. Example, OSCAR 7; Uplink passband 145.85 to 145.95 MHz; downlink passband 29.4 to 29.5 MHz.

Doppler is the slow frequency drift of signals from the satellite as it completes a pass. Similar to the change in pitch of a siren on a speeding vehicle as it moves away from you or toward you.

Azimuth is the horizontal direction of rotation of your antenna as it follows the satellite during a pass.

Elevation is the vertical rotation of your antenna as it follows the satellite during a pass.

Beacon is the transmitter aboard the satellite sending signals about its condition (spacecraft status).

Telemetry is the status signals from the beacon transmitter.

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- High power output — 25 watts on 144 MHz 10 watts on 220 and 440 MHz. Programmable low power is switch-selected.
- Four diode-programmable fixed channels on each band in addition to the synthesizer.
- Scanner continuously monitors synthesizer frequency when using fixed channels or vice versa.
- Standard offsets or simplex on each band, plus a total of three diode-programmable offsets for special repeaters.
- Remote operation with optional trunk-mount kit.
- Complete 3-band model available or begin with basic configuration and add on other band modules later. Standard band models are:

Model 1346 Drake UV-3 (144-220-440)	$995.00
Model 1344 Drake UV-3 (144-440)	$795.00
Model 1343 Drake UV-3 (144-220)	$795.00
Model 1345 Drake UV-3 (220-440)	$795.00
Model 1340 Drake UV-3 (144)	$595.00

(Prices above include factory installed modules for bands as listed, standard dynamic mike, and mobile mounting bracket.)

*144 Add-on Module	$250.00
*220 Add-on Module	$250.00
*440 Add-on Module	$250.00
Model 1504 Drake PS-3 AC Power Supply	$ 89.95
Model 1525 Drake 1525 EM Encoding Mike	$ 49.95
Model 1330 Drake UMK-3 Remote Trunk-Mount Kit	$ 69.95

*Add-on modules expand band coverage of models which may have been purchased in a single band or two band configuration. Prices include factory installation which is necessary to meet FCC Receiver Certification requirements.

For the discerning FM enthusiast who wishes to reach above and beyond 2 meters we are proud to introduce the...

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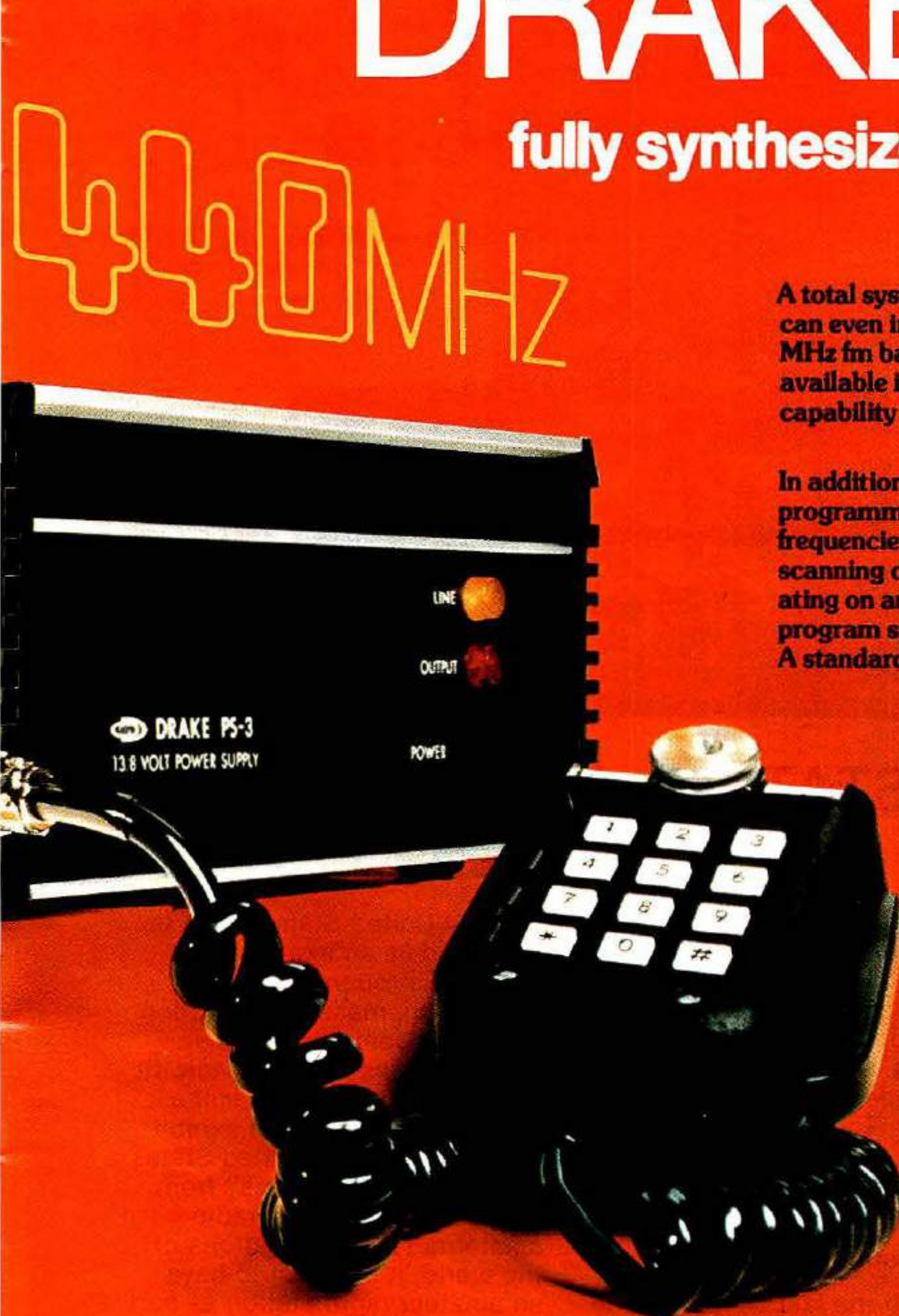
440MHz



A total system, the UV-3 does not stop with 144 MHz, but can even include full synthesis on the entire 220 and 440 MHz fm bands as well. All of this coverage is now available in a single, bandswitched unit with add-on band capability for your convenience.

In addition to a synthesizer, fixed channels are diode-programmable for quick selection of your favorite frequencies. A built-in scan feature permits continuous scanning of dialed or programmed channels while operating on another channel. The UV-3 even lets you diode-program special offsets for those non-standard repeaters. A standard dynamic mike is included with the UV-3.

An optional remote trunk-mount kit (cable included) adds remote operation and security. The PS-3 AC Power Supply and 1525EM Encoding Mike (Shown in photo) are available as options for further expanding the capabilities of the UV-3 system.

Write for a fully illustrated brochure on the Drake UV-3 System.

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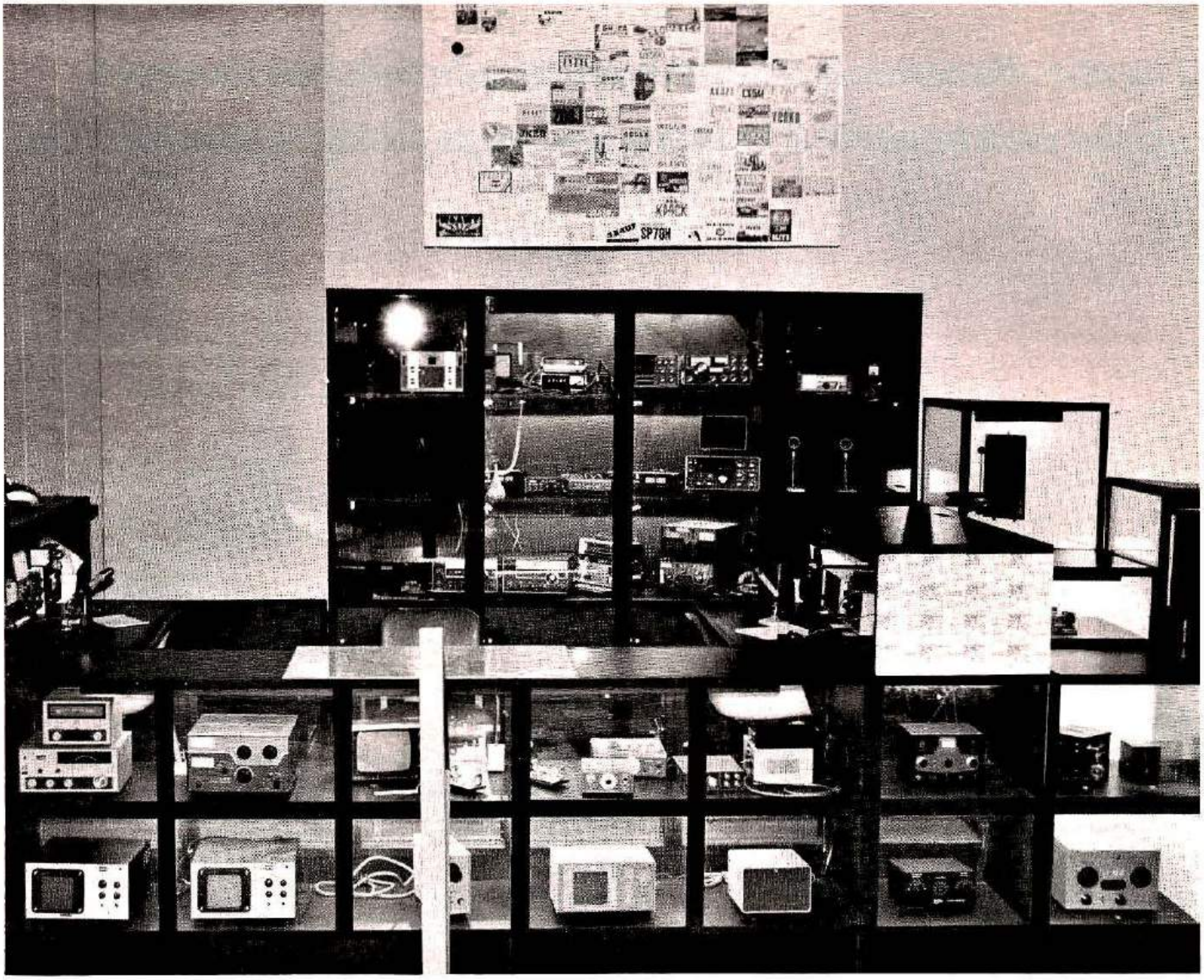


AMATEUR RADIO STATION NN3SI *CALLING*

BY JOE FINCUTTER, W3IK

The Smithsonian Institution's *Nation of Nations* exhibition in its Museum of History and Technology was not only a significant bicentennial display for 1976, but was intended as a sight to see for at least several more years. This exhibition covers the entire west end of the second floor of the building. The main theme of the exhibition is to depict that the United States is a Nation of Peoples who emigrated to North America from the many nations of the world, seeking a new life and a new life style. This new life style is a mixture of the many cultures these people brought with them and is a distinctive influence on the modern-day world.

The *Nation of Nations* exhibition is divided into four sections, suitably marked as you wander through the displays. These sections are:

1. People for a New Nation.
2. Old Ways in a New World.
3. Shared Experiences.
4. A Nation Among Nations.

Although the last section is the location of amateur station NN3SI, I highly recommend a visit to the Smithsonian and the Nation of Nations exhibit. This last section typifies the role the United States plays in the world as an exporter and importer through its mass production, mass consumption and mass communications.

Where does amateur radio fit into this exhibit? Well, since the basic theme of the exhibit indicates that the United States is a "Nation of Peoples" from all nations, and since radio amateurs talk to all nations of the world, it's logical to have an amateur radio station as part of the exhibit. The station operators do their best to talk to all nations of the world.

The amateur station has rug-covered stairs directly in front of the exhibit, which is a fine place for the leg-weary to sit and rest while amateur radio is explained and demonstrated.

Station NN3SI

Let's get down to the real purpose of this article, amateur station NN3SI. The *Nation of Nations* exhibit was opened to the public on the evening of June 8, 1976. The first transmission of NN3SI (which was the special callsign assigned by the FCC to the Smithsonian Amateur Radio Club — Vic Clark, W4KFC, trustee) was made at 2130 (9:30 PM local time).

I was fortunate enough to be the chief operator that evening. The official opening ceremonies consisted of transmissions by Harry Dannals, W2HD, president of ARRL; S. Dillon Ripley, secretary of the Smithsonian Institution; and Vic Clark, W4KFC, first vice president of ARRL.

The first QSO, although in the form of an Official Bulletin, was with VE3JW, W1AW, and W2AN. Vic Clark transmitted a short poem by Walt Whitman that depicted the theme of the exhibit. He used a straight key that was once used by David Sarnoff (RCA) when communicating with the *Carpathia* on April 15, 1915, to obtain detailed information about the survivors of the sunken liner, *Titanic*.

Once the official ceremonies were over and we had loggers ready, it was

QRZ NN3SI? — 3865 kHz

What a pileup! But it was fun! We did our best to work those we heard until sign-off time. I know we missed many callers, but I must say that the decorum of all the operators calling was *excellent*! I'm sure that most of them knew what it must have sounded like at NN3SI and they were compassionate.

Station features

One very nice feature of amateur station NN3SI is that it's open to the public and not behind a glass enclosure. The flat portion of the display case between the two operating consoles (see photo) is about chest high for the average adult. This allows the public close access to operating equipment and the operators. The display also serves as a storage area for equipment not in use.

Antennas

Nine antennas are installed on top of the building (six floors above ground). The coaxial cables from the station to the antennas are more than 200 feet (61m) long. The antennas include a 20/40 meter beam, two verticals, a log periodic for 10, 15, and 20 meters, and beams for 2-meter and OSCAR communications. Also included are dipoles for 80 and 40, and the 11.7 meter swl band.

Each antenna is terminated on a patch panel in a cabinet under the back display case. Each console can be connected to any antenna by three coaxial patch cables. Normally the 40- and 11.7-meter dipoles and one vertical are used for the shortwave listening post, leaving the other antennas for use in the two consoles at the operator's discretion.

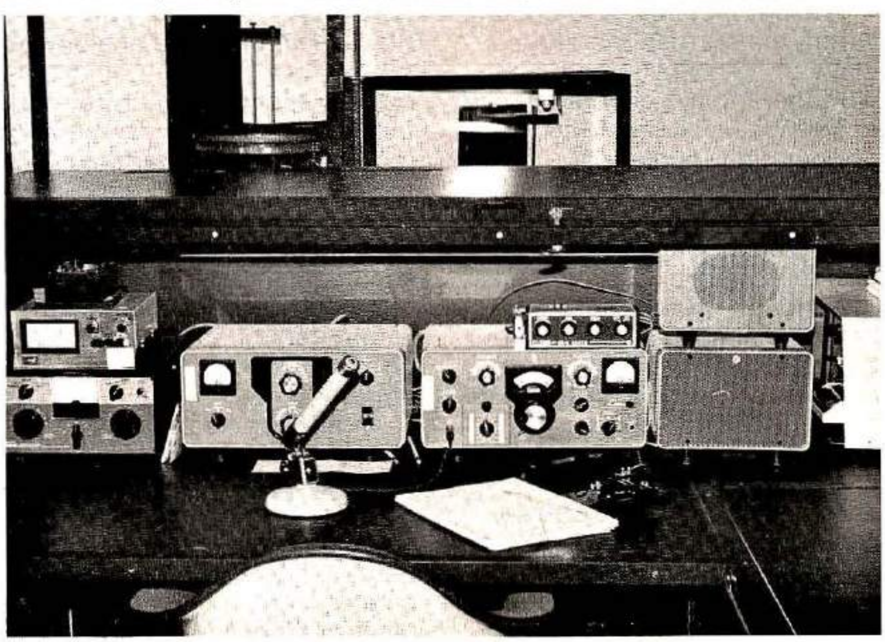
With the equipment available and the frequencies that can be used, the majority of operation has been on the 20- and 15-meter bands. In keeping with the theme "talking with the nations of the world," DXing has been mostly on 20 and 15 meters.

We've done considerable work on 10, 40, and 75 meters; some on 2-meter fm; and the equipment has been set up several times for OSCAR. RTTY and SSTV will be set up and operated during the summer months. At present there's no set schedule for times and frequencies, but the museum is open from 10 AM to 9 PM in the summer months. For the most part, operators are available during that time.

QSLs

Although the QSL cards displayed on the board above the exhibit indicate some good DX contacts, these cards were already there the night the station first was operated. The displayed QSL cards were donated by ARRL and the Smithsonian's Division of Electricity. The station's own card collection, now representing well over *100 countries*, will be added with the addition

One of the two operating consoles of NN3SI showing the amateur radio equipment in use.



of special drop-down panels.

The NN3SI QSL card is a commemorative card, and with the special prefix, is a collector's item. So, when you work the station the operator will provide you with details for obtaining a card for the contact.

Visiting operators

The station is staffed by operators through the Smithsonian Associates Volunteer Program and the Smithsonian Amateur Radio Club. Duty operators are W4HU, K3BV, W3STG, W3FYJ, W4KFC, K3KWJ, N3DF, WB3BRF, K3NCB, W4ZM, N8II, WB3FTB, and myself, W3IK. Station managers are K3RJA and WA4CLQ from the Smithsonian staff.

Amateurs who would like to operate as a visiting operator should write to: Smithsonian Institution, Division of Electricity, Room 5025, Museum of History and Technology, Washington, D.C. 20560. Indicate when you will be available and your license class. Each of the duty operators is responsible for the proper operation of the station and assists the visiting operators. I have used WAYLARCS W3CDQ, W3RXJ, WA3IWK, WA3GZT, and K4SHE, and these gals have been a big help.

Present practice is to operate within the restrictions of the class of license you hold and with the original of your license in your possession at the time of operating. Additional operators are being added to keep the station in operation during the normal open hours of the museum.

Although one operator can keep the station in operation, it's better to have two, so that one can converse with the people who stop by to ask questions about amateur radio, or who want to know the difference between shortwave radio, amateur radio, and CB radio. So, really, it takes two operators to keep things going, but three is the ideal number. With three operators, two can keep operating while the third can sit in the middle, so to speak, and field the many questions that come from the visitors. This provides for maximum use of equipment and allows amateurs in the United States and abroad additional opportunities to work NN3SI.

CB and amateur radio

Those of us who have been in amateur radio for some time seem to forget the impact that CB radio has made on the younger people in particular and, to some extent, on older people. It's amazing how many people, when they hear the term "communications" or see a small transceiver, immediately think of CB. Also, they're amazed to find that there's a form of communications *other* than CB. For example: "It sure looks and sounds like CB!" — "Well, that sure looks like the same equipment my friend uses on CB." So we explain amateur radio and the big differences between it and CB radio. How well we've succeeded in explaining both we'll never know, but we deserve an E for effort.

When we ask people if they've ever considered becoming an amateur, a standard answer is, "It costs too much!" or "I can't afford it!" So I've used the analogy of the first car I bought. I didn't order it especially built for me. I bought a used car, worked on it, fixed it, then either sold it or traded up to a better car. I explain that it's the same way with amateur radio: you buy used equipment within the affordable price range, use it within its limitations, and later on trade up to something better.

Another standard answer is, "I could never pass the tests!" So we explain how easy it is to get a Novice license at the present time because of all the training being offered by amateur radio clubs, recreation departments, and schools.

So we stress the beneficial facets of amateur radio and try to show that CB is a means of *communications over short distances*, while amateur radio is a *hobby* with unlimited possibilities for learning about electronics as well as for providing communications around the world.

We pass out literature made available by the ARRL. We have people fill out a small card with their name and address, which we forward to ARRL, so that the good word of amateur radio may be passed onto them.

One question that invariably comes up is, "How far can you talk?" and we always answer, "Around the world!" To prove our point, each operator on each day lists the DX stations worked during the day in a log book, so that we can show the inquirers the book and let them peruse the pages to see the countries we've worked. We also have a log of the amateurs from around the world who have visited the station. These include operators from SM5, G3, G8, F3, OA4, F6, J11, LX1, LU3, DL2, HP1, KV4, JR3, PY2, VK5, HC1, SM6, VE1, VK2, 6W8, JY9, PAØ, PJ8, SM7, VE5, G4, YN1, PEØ, SMØ, and VE3.

Amusing incidents

Each of us has, at one time or another, been involved in trying to separate a signal out of a number of other signals. We have one or two fingers on the dial, and our head is cocked at a precarious angle to make sure that the acoustics are exactly right to hear the proper signal. In this position we're absolutely motionless, with a blank stare in our eyes. Or perhaps we're copying Morse code wearing a pair of headphones — not writing down the message, but just looking straight ahead.

Well, this happened to two of us recently. From out in front of the exhibit came a voice which said, "Those are the two most natural looking dummies I've ever seen!" Since I was not working anyone, but was

The second operation position of NN3SI. Many familiar pieces of amateur gear are evident.

looking for a DX station, I immediately stood up, stating that we were indeed alive, but may be *dummies*. A little girl standing there almost jumped out of her shoes — she was sure we were mannequins!

It wasn't until that little incident occurred that we realized NN3SI was the only exhibit that had "live" people in it.

One evening, as I was searching for DX on 20 meters, I heard YO3AC in Romania and was waiting for him to finish his QSO so I could call him. There were several people standing at the station. Along came a young woman, dressed in the latest fashion, with two lady friends. She immediately tried to show her knowledge of radio communications, and was explaining to her two friends how CB worked, and that the operator was a licensed CB operator.

I was just about to correct her knowledge when she asked, "Where is that station?" I informed her that this was an amateur station, and that the station being heard was in Bucharest, Romania. She replied, "Fine, you amateurs can hear Romania; why don't you try for someone else?" I explained that I wanted to talk to this particular station. At that, YO3AC finished with his QSO and I gave him a call; he came right back to the special call but wasn't sure he had it correct. As I was talking to him, the young lady departed the scene, telling her friends that I was operating illegally since CBers were limited to 150 miles (240km). Oh well, you can't win them all!

Shortly after New Year's Day, 1977, I was calling CQ on the low end of 20 meters when a station called me and informed me that I was using an illegal call; he told me that bicentennial calls were not to be used after December 31, 1976, and that I could be cited for using an illegal call. I informed him that NN3SI was a special event call and that it was good for some time to come. I have also been told on several occasions that the call is N3SI because no double-N calls had been issued yet.

Acknowledgements

It's a rewarding experience to operate a special event station such as NN3SI. We've met some wonderful people who are interested in museums and thereby have furthered their education. I've made some new friends and hope I've been able to increase the interests of many in amateur radio as a hobby and to extend friendship through amateur radio.

In particular, I want to acknowledge the help provided to all the operators of NN3SI by Bernard Finn, Elliott Sivowitch, and Ray Hutt — all members of the Smithsonian's Division of Electricity staff. **HRH**

QUESTIONS & ANSWERS

Eligibility, Addresses, and Violation Notices; Q-Signals and RST-Systems

BY THOMAS McMULLEN, W1SL

This is it! We're at the last of the Rules and Regulations segment of the FCC Study Guide material. I'll bet you thought it would never end, didn't you! Well, just go through the following sections about License Eligibility and Notices of Violation and you've earned the right to breathe a sigh of relief.

When it comes to who is eligible for an amateur license, you'll find that there are very few people who cannot obtain one. A *representative* of a foreign government is one category that is denied an amateur operator license, but that's about all. Notice that there are no restrictions about age, sex, religion, or almost anything else. As far as station licenses go, corporations (companies, business organizations, etc.) are not eligible either, and if you'll think about the necessity of keeping amateur radio and commercial radio separated, that makes sense too. It just wouldn't do for XYZ Oil Company to outfit its fleet of delivery trucks with two-meter rigs and use the local repeater to keep in touch with home base. But if the *employees* of that oil company decided that they wanted a club station, and formed a club, elected officers, and appointed a station trustee that's great. They can have their club amateur station, complete with its own call and everything. They'd just better not try to use that station to shuffle a truckload of oil over to 327 Maple Boulevard, or there will be trouble with a capital T!

Before I get carried away, here is the FCC text regarding Station and Operator License eligibility:

97.9 Eligibility for new operator license.

Anyone except a representative of a foreign government is eligible for an amateur operator license.

97.37 General eligibility for station license.

An amateur radio station license will be issued only to a licensed amateur radio operator, except that a military recreation station license may also be issued to an individual not licensed as an amateur radio operator (other than a representative of a foreign government), who is in charge of a proposed military recreation station not operated by the U.S. Government but which is to be located in approved public quarters.

97.39 Eligibility of corporations or organizations to hold station license.

An amateur station license will not be issued to a school, company, corporation, association, or other organization, except that in case of a bona fide amateur radio organization or society meeting the criteria set forth in Section 97.3, a station license may be issued to a licensed amateur operator, other than the holder of a Novice Class license, as trustee for such society.

97.42 Mailing address furnished by licensee.

Except for applications submitted by Canadian citizens pursuant to agreement between the United States and Canada (TIAS No. 2508 and No. 6931), each application shall set forth and each licensee shall furnish the Commission with an address in the United States to be used by the Commission in serving documents or directing correspondence to that licensee. Unless any licensee advises the Commission to the contrary, the address contained in the licensee's most recent application will be used by the Commission for this purpose.

97.43 Location of station.

Every amateur station must have one land location, the address of which is designated on the station license. Every amateur radio station must have at least one control point. If the control point location is not the same as the station location, authority to operate the station by remote control is required.

Notice that the restriction is against a *representative* of a foreign government, which is not the same thing as being a non-citizen (alien) of the United States. There are provisions under which an alien can obtain a permit to operate an amateur station, spelled out in sections **97.301** through **97.311**. This is often referred to as reciprocal licensing. Many countries do not have an equivalent of the Novice license, however. The new FCC form 610 (application for Individual Amateur Station and/or Operator License) no longer has a Declaration of Citizenship as one of the questions to be completed, so an alien who intends to live in the United States can get his amateur license just the same as anyone else.

I included the section dealing with a station location and mailing address because it ties in with the next part: Notice of Violation. One thing that the FCC takes a very dim view of is failure to respond to a Notice of Violation or other correspondence. It would be a shame to have them take drastic action (like suspending your license) just because their mail did not reach you for whatever reason. That's why it is a good idea to use a form of traceable mail (Registered, Return-receipt, etc.), whenever you answer a notice, or have other vital communication with the FCC. Here's the text concerning notice of violation:

97.137 Answers to notices of violations.

Any licensee receiving official notice of a violation of the terms of the Communications Act of 1934, as amended, any legislative act, Executive order, treaty to which the United States is a party, or the rules and regulations of the Federal Communications Commission, shall, within 10 days from such receipt, send a written answer direct to the office of the Commission originating the official notice: Provided, however, that if an answer cannot be sent or an acknowledgment made within such 10-day period by reason of illness or other unavoidable circumstances, acknowledgement and answer shall be made at the earliest practicable date with a satisfactory explanation of the delay. The answer to each notice shall be complete in itself and shall not be abbreviated by reference to other communications or answers to other notices. If the notice relates to some violation that may be due to the physical or electrical characteristics of transmitting apparatus, the answer shall state fully what steps, if any, are taken to prevent future violations, and if any new apparatus is to be installed, the date such apparatus was ordered, the name of the manufacturer, and promised date of delivery. If the notice of violation relates to some lack of attention or improper operation of the transmitter, the name of the operator in charge shall be given.

97.49 Commission modification of station license.

(a) Whenever the Commission shall determine that public interest, convenience, and necessity would be served, or any treaty ratified by the United States will be more fully complied with, by the modifications of any radio station license either for a limited time, or for the duration of the term thereof, it shall issue an order for such licensee to show cause why such license should not be modified.

(b) Such order to show cause shall contain a statement of the grounds and reasons for such proposed modification, and shall specify wherein the said license is required to be modified. It shall require the licensee against whom it is directed to appear at a place and time therein named, in no event to be less than 30 days from the date of receipt of the order, to show cause why the proposed modification should not be made and the order of modification issued.

(c) If the licensee against whom the order to show cause is directed does not appear at the time and place provided in said order, a final order of modification shall issue forthwith.

97.131 Restricted operation.

(a) If the operation of an amateur station causes general interference to the reception of transmissions from stations operating in the domestic broadcast service when receivers of good engineering design including adequate selectivity characteristics are used to receive such transmissions and this fact is made known to the amateur station licensee, the amateur station shall not be operated during the hours from 8 pm to 10:30 pm, local time, and on Sunday for the additional period from 10:30 am until 1 pm, local time, upon the frequency or frequencies used when the interference is created.

(b) In general, such steps as may be necessary to minimize interference to stations operating in other services may be required after investigation by the Commission.

Many amateurs live in dread of receiving that "pink ticket" from the FCC, notifying them that they have violated some part of the Rules. Well, it's a serious business, all right, and not to be taken lightly. But, neither is it reason to take a long walk into the ocean. People make mistakes, equipment malfunctions, and they realize this. That's why they give you a chance to explain what happened.

In almost all cases, if you find out what went wrong, and give the FCC a rational explanation of what happened, along with assurances and a description of what steps are being taken to prevent its happening again, that is all that is necessary. For instance; you just received a notice that you were transmitting a "spurious signal" at 21,315 kHz. You didn't think you had been on that band (15 meters) at that time, so you checked in your log. Sure enough, you were on 40 meters that night. (There's another good reason for keeping a log.) How come you were transmitting a signal on 15? Well, a moment's thought clears up the mystery; you had been using a 40-meter dipole but on the day in question you changed to the new tri-band antenna that you just put up. This antenna doesn't discriminate against harmonics like the dipole did, so it radiated your third harmonic in great quantities. The cure? Easy! Just place a tuned matching network, or a filter, between your rig and the antenna. This should attenuate your harmonic to such a degree that it will not radiate. All you have to do is tell the FCC all of this, and you are off the hook. What they really want is some assurance that you are a responsible individual and are really trying to run a clean station.

End of a section

Congratulations, you have stayed with me through the Rules and Regulations portion of the series. But, don't file them away and forget them. Keep going back now and then to refresh your memory on a point or two. Sometimes things will seem a bit more clear when you read them a second or third time. If you would like to have your own set of the complete Amateur Rules, you can obtain them from your nearest Government Printing office outlet. Ask for the new edition of the Amateur Radio Rules, (Part 97), stock number

004-000-00338-1. The price is $1.30 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Several major cities have GPO outlets, so it may be worthwhile to look in your telephone book to see if they have one near you. Look in the section under United States Government.

Now, let's get back to the operating practices that I started to talk about last month. The next subject on my list was operating signals, which you'll need to know about when you get on the air the first time; you'll also find some questions about them on the Novice exam. These signals apply to telegraphy (CW) because when you are using voice you should "say it with words," just the same as you speak to each other. The same reasoning applies to the signal-strength reports which I'll talk about shortly; why say, "Your signal is R-5, S-9," when "Your signal is very clear and strong," sounds more friendly and tells the same story?

Telegraphy

Radiotelegraphy (CW) is the basic language of the radio amateur, and as a beginner it is only natural that you will find the language difficult for a while. You can make life on the air a bit easier, and speed up

Table 1. A list of the most common Q-signals used by amateur radio operators.

QRG	Will you tell me my exact frequency (or that of . . .)? Your exact frequency (or that of . . .) is . . . kHz.
QRH	Does my frequency vary? Your frequency varies.
QRI	How is the tone of my transmission? The tone of your transmission is . . . (1. Good; 2. Variable; 3. Bad).
QRK	What is the intelligibility of my signal (or those of . . .)? The intelligibility of your signal (or those of . . .) is . . . (1. Bad; 2. Poor; 3. Fair; 4. Good; 5. Excellent).
QRL	Are you busy? I am busy (or I am busy with . . .) Please do not interfere.
QRM	Is my transmission being interfered with? Your transmission is being interfered with . . . (1. Nil; 2. Slightly; 3. Moderately; 4. Severely; 5. Extremely).
QRN	Are you troubled by static? I am troubled by static . . . (1-5 as under QRM).
QRO	Shall I increase power? Increase power.
QRP	Shall I decrease power? Decrease power.
QRQ	Shall I send faster? Send faster (. . . wpm).
QRS	Shall I send more slowly? Send more slowly (. . . wpm).
QRT	Shall I stop sending? Stop sending.
QRU	Have you anything for me? I have nothing for you.
QRV	Are you ready? I am ready.
QRW	Shall I inform . . . that you are calling him on . . . kHz? Please inform . . . that I am calling on . . . kHz.
QRX	When will you call me again? I will call you again at . . . hours (on . . . kHz).
QRY	What is my turn? Your turn is number . . .
QRZ	Who is calling me? You are being called by . . . (on . . . kHz).
QSA	What the strength of my signals (or those of . . .)? The strength of your signals (or those of . . .) is . . . (1. Scarcely perceptible; 2. Weak; 3. Fairly good; 4. Good; 5. Very good).
QSB	Are my signals fading? Your signals are fading.
QSD	Are my signals garbled? Your signals are garbled.
QSG	Shall I send . . . messages at a time? Send . . . messages at a time.
QSK	Can you hear me between your signals and if so can I break in on your transmission? I can hear you between my signals; break in on my transmission.
QSL	Can you acknowledge receipt? I am acknowledging receipt.
QSM	Shall I repeat that last message which I sent you, or some previous message? Repeat the last message which you sent me (or message (s) number(s) . . .).
QSN	Did you hear me (or . . .) on . . . kHz? I did hear you (or . . .) on . . . kHz.
QSO	Can you communicate with . . . direct or by relay? I can communicate with . . . direct (or by relay through . . .)
QSP	Will you relay to . . . ? I will relay to . . . .
QSU	Shall I send or reply on this frequency (or on . . . kHz)? Send or reply on this frequency (or . . . kHz).
QSV	Shall I send a series of Vs on this frequency (or . . . kHz)? Send a series of Vs on this frequency (or . . . kHz).
QSW	Will you send on this frequency (or on . . . kHz)? I am going to send on this frequency (or on . . . kHz).
QSX	Will you listen . . . on . . . kHz? I am listening to . . . on . . . kHz).
QSY	Shall I change to transmission on another frequency? Change to transmission on another frequency (or on . . . kHz).
QSZ	Shall I send each word or group more than once? Send each word or group twice (or . . . times).
QTA	Shall I cancel message number . . . ?
QTB	Do you agree with my counting of words? I do not agree with your counting of words. I will repeat the first letter or digit of each word or group.
QTC	How many messages have you to send? I have . . . messages for you (or for . . .).
QTH	What is your location? My location is . . . .
QTR	What is the correct time? The time is . . .

The Q-signal takes the form of a question when it is followed by a question mark: QRV? means "Are you ready?" and the reply, QRV, means "Yes, I am ready."

your contacts, if your learn a few commonly accepted abbreviations and signals to use in your contacts.

A group of signals called "Q-signals" will convey a lot of common information in just a fraction of the time that it would take to spell it all out. You should learn the proper meaning and use. For instance, the signals "QRM" and "QRN" are often mistakenly switched. They should be easy to remember — QRM relates to interference from another station (M = manmade interference), and QRN refers to the static from storms and the like (N = natural interference).

The proper use of Q-signals involves simply placing a question mark after one if you are asking a question. As an example, a very much abused signal is QRZ. If someone just pops up on a frequency and sends QRZ, you don't know whether he was telling you someone was calling you, or what he had in mind. You'll hear this signal misused on both CW and voice operation. Properly used, the signal should have a question mark after it — QRZ? — meaning "Who is calling me on this frequency?" A proper reply would be "QRZ WB7XXX," meaning, "you are being called by WB7XXX," but the signal is so grossly misused that a reply would likely confuse everyone.

If you think about the voice version of that signal, you can see the absurdity of using Q-signals when you are speaking. To use the signal properly, "QRZ question the frequency," or as most operators misuse it, "QRZed question" would sound ridiculous, to say the least!

In spite of their occasional misuse, Q-signals are a handy thing to know and use in your operating. Certainly a snappy "QSY PSE" on CW is much faster than a couple of sentences explaining that the new station on frequency is interfering with a contact already in progress, and would he please move away. Q-signals were invented by commercial operators for just this purpose — saving time on the air. You'll hear old-timers speak of other codes, such as "Z-codes," Philips codes, and the like.

"Must QRT, QRN is getting unbearable."

These also were used to speed up CW transmissions in the early days of radio, but the Q-code that is shown here is universally accepted by amateurs worldwide, and understood by most of them. A list of the most commonly used Q-signals is given in **Table 1**.

Operating abbreviations

The same need for speed and brevity that led to the use of Q-signals also brought about some operating signals or abbreviations. Most of these are to inform the other station of what you intend to do, or what you would like him to do. Two of the most often used are **DE** and **K**; instead of sending "this is," you send the two simple letters **DE**. An invitation to another station to transmit is simply **K**, and the voice equivalent is "go ahead", or, "over." When you are in contact with a specific station and you do not care to have another station call either of you, you can modify the invitation to transmit by sending **KN**, which means, "Only the station I am in contact with go ahead." **Table 2** has a list of operating signs that you will need to know.

Signal reporting

Radio operators recognized the need for a signal-strength and readability system very early in the history of radio. Without knowing how well your signal was being copied by the operator at the other end, you might send your entire message only to find out that he had missed half of it because of poor conditions, interference, fading, and the like. At first the reporting system that they devised concerned only strength and readability; later, when signal quality became important (because of FCC purity-of-emissions rules), a tone reporting system was added. Thus the system called RST means *Readability Strength*, and *Tone*. Readability means just that — how well can you read (copy) the other guy. It is possible for his signal to be very strong, but not very readable — perhaps because of his sending, or because

Table 2. Some operating signals and abbreviations often used by radio amateurs.

$\overline{AR}$	End of message
$\overline{BT}$	Pause, or long dash in message text
CL	Closing station, leaving air
CQ	General call, any station please answer
DE	From, this is
$\overline{DN}$	Slant bar, often used to indicate that station is portable or mobile
$\overline{IMI}$	Question mark, query
K	Go ahead, any station
KN	Go ahead, only the station called

The line above the letters indicates that they are to be sent as one character, with no spacing between the letters.

someone else is on the frequency, or whatever. Strength has to do with your *estimate* of his signal strength. When it was first put into use, a scale of 1 to 9, weakest to strongest, was sufficient, and most operators were realistic in their reporting of signal strength. Later, when receiver manufacturers began to compete with one another for the amateur dollar, someone calibrated a signal-strength meter to indicate dB-levels above the so-called "S9." Then all receivers had to follow suit, with the result that today most meters give readings that are almost unrelated to the original S-scale.

The tone, or purity, report of a signal is a means of letting the other operator know that there may be something wrong with his transmitter. Below 144 MHz all amateur transmitters must have a well filtered power supply. If they do not, the output from the transmitter will have hum, ripple, or a low-frequency tone on it, causing it to take up more room on the band than necessary. In addition, improper tuning, defective parts, or operator error (leaving the microphone turned on while sending CW) can cause the note to be impure. **Table 3** shows the RST system that amateurs use today. Never be afraid to tell another ham that his signal is not T9; you might save him the embarrassment of receiving a notice of violation from the FCC. Some are not gentlemanly enough to accept your report in good grace, but most will thank you for it and start looking for the problem.

Code speed

You can use any code speed you like for your contacts with another station, but you should be sure that you can handle what he sends back to you. Most amateurs can send faster than they receive, and some make the mistake of buzzing off a CQ or an answer to a CQ at a pretty good rate of speed. The operator at the other end thinks "Oh, boy, this guy is a hot operator," and blasts right back at the same, or higher, speed. Therefore, you should always call at a speed that is comfortable for you because most operators will reply near that same speed. Never be afraid to ask the other amateur to slow down (QRS). It is far less annoying to get it right the first time than to ask for several repeats.

This is a good place for a sample question about this section, and the FCC study guide contains one that is as good as any:

Table 3. Quality and strength of signals associated with the RST reporting system.

Readability

1 Unreadable
2 Barely readable, occasional words distinguishable.
3 Readable with considerable difficulty.
4 Readable with practically no difficulty.
5 Perfectly readable.

Signal Strength

1 Faint signals barely perceptible.
2 Very weak signals.
3 Weak signals.
4 Fair signals.
5 Fairly good signals.
6 Good signals.
7 Moderately strong signals.
8 Strong signals.
9 Extremely strong signals.

Tone

1 Sixty-cycle ac or less, very rough and broad.
2 Very rough ac, very harsh and broad.
3 Rough ac tone, rectified but not filtered.
4 Rough note, some trace of filtering.
5 Filtered rectified ac but strongly ripple-modulated.
6 Filtered tone, definite trace of ripple modulation.
7 Near pure tone, trace of ripple modulation.
8 Near perfect tone, slight trace of modulation.
9 Perfect tone, no trace of ripple or modulation of any kind.

The Q-signal "QRM" generally means

(a) a transmission is experiencing interference
(b) a frequency is varying
(c) a reply is requested on a certain frequency
(d) the sending speed is too fast
(e) the previous message is to be repeated

Your answer should be (a), of course. As a further exercise, look at **Table 1** and see how many of the other choices given can be covered by a Q-signal.

Public Service Operating is the next subject on the list, but I'll let that wait until next month. It's one of the ways that amateurs earn their "place in the sun," but, more than that, a great number of people really enjoy "giving" in this manner.

Meanwhile, here's another sample question to close this segment with:

An amateur station calling CQ should end his transmission with

(a) KN
(b) CL
(c) K
(d) ARK

I'm tempted to make you wait for the answer in the next issue, but that wouldn't be right. The correct answer is (c).

HRH

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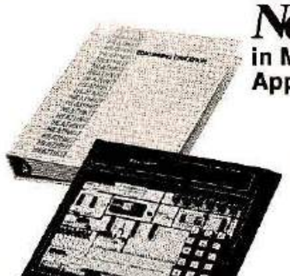

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those GOOD OL' RADIO magazines

BY JOHN J. NAGLE, K4KJ

Nostalgia buffs fondly recall the "Good Old Days"

Memories . . . memories . . . Dusty mountains of surplus "one flight up" on radio row; once-familiar names: Gonsett, Jones, Windom, Reinartz, Meissner, Lamb, McMurdo Silver; the sights and sounds of an HRO, an MB-29, a HQ-120, a Super Skyrider; crisp pages in the latest copy of *Radio, Amateur Radio Review*, and *The Transmitter* ; share these, and more, on a nostalgic ramble through the pages of . . . those old radio mags.

Last weekend I was repainting the family room and needed to move the children's old train table out of the corner. At first I could not budge it, but, looking under the table, I saw the problem was several very heavy boxes. "What," I wondered, "has my wife stashed away here?" So I opened them up and was I surprised: they contained *my* collection of old radio magazines!

I couldn't resist a peek. I reached into the nearest box and hauled out old *QSTs*, some with red covers, some with plain covers, and some with picture covers; a large assortment of *Radio* magazines, also known as the "West Coast QST;" and all-too-few issues of *Amateur Radio Defense*. There was a copy of *CQ* dated April, 1931 (no connection with the present *CQ*) published for commercial radio operators.

Did you realize that there were two different *73s*, neither of which was any relation to the present *73*? One issue, dated May, 1932, was published by the United Radio Operator's Association in Portland, Oregon; a commercial operator's magazine. Another *73* was the official publication of the Federation of Radio Clubs of the Southwest ARRL. Seems kind of strange to read an issue of *73* that wholeheartedly supports the League, like a Hatfield going to bat for a McCoy.

I turned up another magazine called *The Transmitter* dated October, 1926, and two issues of *Amateur Radio Review* from the early 1930s, both with the NRA eagle on the front cover: "We do our part."

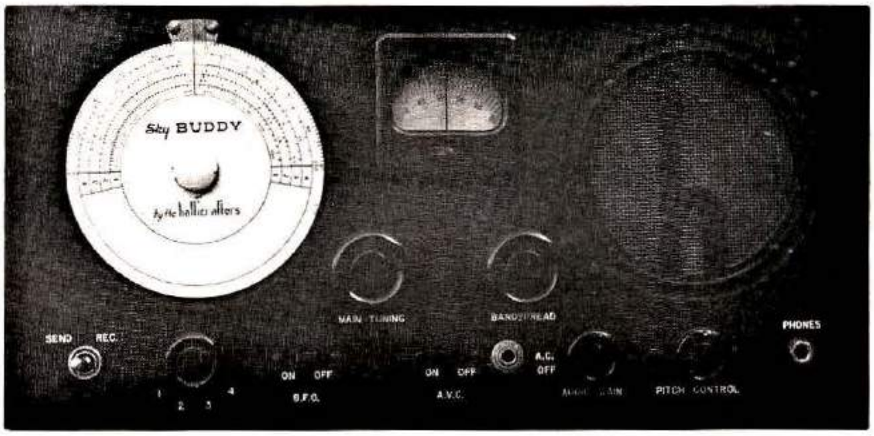
And here were a few *R/9s*. *R/9* was always a first-rate technical magazine. When *R/9* and *Radio* merged in 1936, the result was a really top-notch product, and a worthy competitor in the field.

There was an swl magazine called *RADEX* (stands for *RA*dio In*DEX*). In it, my eye fell on one item sent in by a reader that KNHI, Alcatraz Island, tests every morning on 2160 kc with the U. S. Coast Guard! Verification was signed by the Warden. Apparently it was easier to get a QSL card out of Alcatraz than a weekend pass.

The next box held some early handbooks, some pamphlets by James Millen and some by Frank Jones. I couldn't help myself: I forgot the paint brush, lit up my pipe, sat down on the floor, and, as I leafed through these old treasures, returned to my boyhood . . .

In skimming through the old

In addition to the well-known, nationally distributed amateur magazines like *QST* and *RADIO*, there were numerous publications intended for a local audience. *Amateur Radio* was published in New York in the 1920s; it combined with *Radio Relays*, a Boston magazine, in June, 1924. William Halligan, who later founded Hallicrafters, was the editor of *Radio Relays*. *Ye Brass Pounder* (opposite page) was a four-page newspaper style publication produced in New York around 1930. *Midwest Radio* was published in St. Louis in the 1920s for amateurs in the ninth call area (now the tenth call area). *Modern Radio* was published in Connecticut in the early 1930s; *R/9* was published in Southern California between 1933 and 1936 — both were eventually absorbed by *RADIO*.



Hallicrafters Sky Buddy receiver from about 1940. This receiver had no rf amplifier, only one stage of i-f, a built-in speaker, and electrical bandspread, but for $29.50 it was a lot of radio. As a junior high school student K4KJ worked in the school cafeteria almost a full semester to buy one! (*photo by K4KJ*).

magazines, I gleaned several bits of miscellaneous information that in my 37 years in radio I hadn't known before. I feel the urge to pass these on to the unwary in the form of questions, lest this information become lost to posterity forever.

1. In the late 1920s and early 1930s the National Company made a couple of models of receivers called the MB-29 and the MB-30. What does "MB" stand for?

2. Over the years Hammarlund manufactured a series of receivers known as the HQ-120, HQ-129, HQ-170, HQ-180, etc. What does "HQ" stand for?

3. What is the difference between a heterodyne type receiver and a superheterodyne type receiver? Hint: What is the difference between an autodyne and heterodyne type receiver?

Watch for the answers to these important questions which I will try to work in during the course of the article.

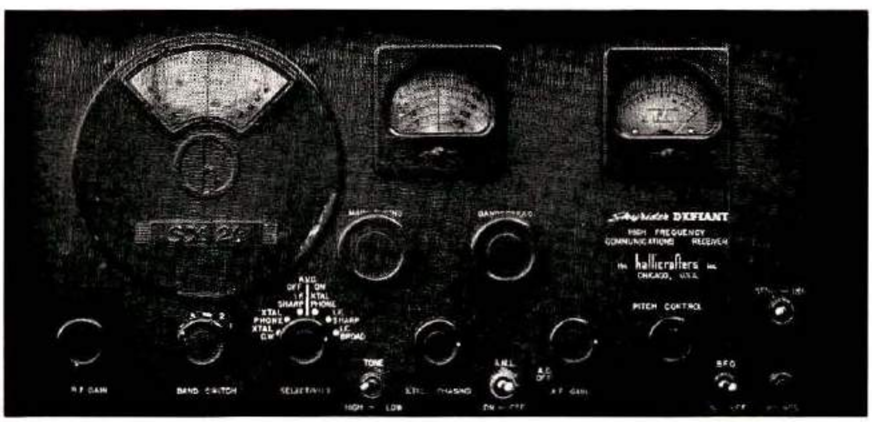
Authors

I was interested to read the tables of contents of these magazines and note the authors: names like W. W. Smith, Ray Dawley, and Frank Jones; John Kraus, also Faust Gonsett (later shortened to "Gonset"), Herb Becker; E. H. Conklin who, with his wife, Josephine, always seemed to be going somewhere; Charles Perrine, John Griggs, Dawkins Espey, J. N. A. Hawkins (who also wrote as "Jayenay"), and Clayton Bane, F. D. Wells, Robert Kruse, Boyd Phelps, McMurdo Silver, George Grammer, James Lamb, Don Mix, John Reinartz, and Byron Goodman — all these names and many more.

I can't resist philosophizing a little about these names. The tremendous expansion in electronics in the last 30 years or so really began with the intensive use of electronics during World War II. Outside of the telephone and broadcasting industries, there were very few people trained in electronics except for Amateur Radio operators; and most Amateurs, in those days, learned their electronics by reading these authors. I believe that the electronics industry today owes a lot more to these men than it can ever repay . . . or is even aware of.

In the Small World Department, while this is being written, the May, 1976, issue of *ham radio* arrived with an article by the same E. H. Conklin in which he makes a very flattering comment about a previous article I had written. I can't help but return the compliment, for Conklin's article proves that the early radio writers can also compete in today's market place. They certainly have a wealth of background that would be helpful to the modern generation.

One of the most prolific technical writers of the time was Frank Jones. The earliest article of his of which I am aware appeared in the May, 1929, *Radio* on "Detector Circuit Design Problems," although it may not have been his first article. I visited Frank two or three years ago, and he took me out to his radio room. What a sight! I wish my wife could have seen it; she would appreciate my own modest



Hallicrafters Skyrider Defiant was also known as the SX-24. It had one rf stage, two i-f stages, a crystal filter, S-meter, and sold for $69.50 (plus external speaker). One of the features of the receiver was its *Frequency Meter Tuning* system — when the main tuning dial was set to an appropriate index, the bandspread dial was accurately calibrated and could be used as a frequency meter. K4KJ claims that the one he owned was "dead accurate" (*photo by K4KJ*).

shack. It was a homebrewer's delight. Outside of some commercial test equipment, *everything* was homemade! Gear was spread over the operating table, over a side table, and up the walls. Frank had to rearrange a lot of stuff just to find me an empty chair. I think it should be preserved in its present state in some radio museum. No hurry, though, Frank!

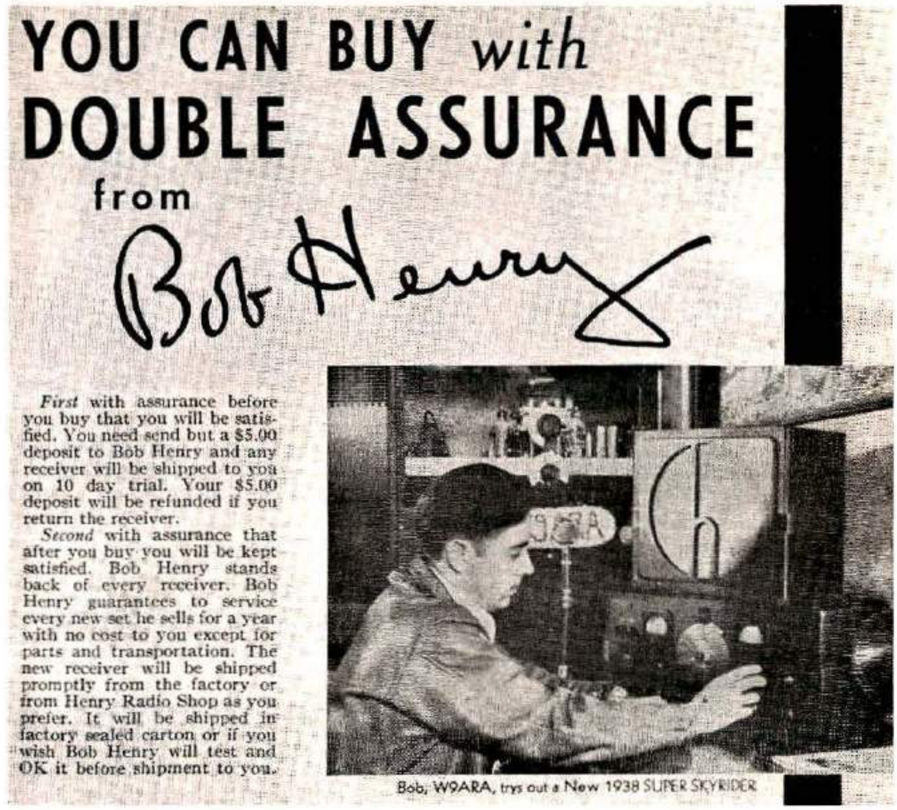
Interestingly, much of his equipment appeared to be transistorized. Apparently, Frank is one of the few oldtimers who has made the transition from vacuum tubes to solid state. I hope we will have some more articles from him, soon.

Goodies For Sale

After reviewing the tables of contents, I moved into an easy chair and turned to the advertisements . . . which proved equally fascinating. The first ad to catch my eye was a small two-inch ad in, the May, 1934 *QST* that announced that one Robert Henry, W9ARA, of Butler, Missouri, a graduate of the Massachusetts Institute of Technology in electrical engineering, offers to sell the latest factory-made short-wave receivers — on easy terms, too. He was doing business as Henry's Radio Shop then.

I often wondered how a graduate in electrical engineering from MIT could find happiness selling short-wave receivers by mail order on easy terms from a small town in western Missouri. I hope he did, for he's been doing it now for over 40 years, and doing very well at it. In May, 1935, Bob advertised the new Hallicrafters S-9 receiver, which tuned from 550 to 18,000 kcs (they didn't use Hz in those days). It featured a built-in speaker and nine all-metal tubes, the latest thing, then, in the tube business. It was only $69.50 on easy terms. If you have any left, Bob, I'll pay the full cash price, and not trade-in either!

Another ad that caught my eye was by Bill Harrison, W2AVA, in the December, 1935, issue of *Radio*. Bill was offering genuine Western Electric 211Ds for $4.90 (regular price, $17.50) brand new. How many amateurs today use Western Electric tubes in their transmitters? How many even know what a 211D is? If you have any left, Bill, I'll bet you can sell them to the collectors without any trouble at all.

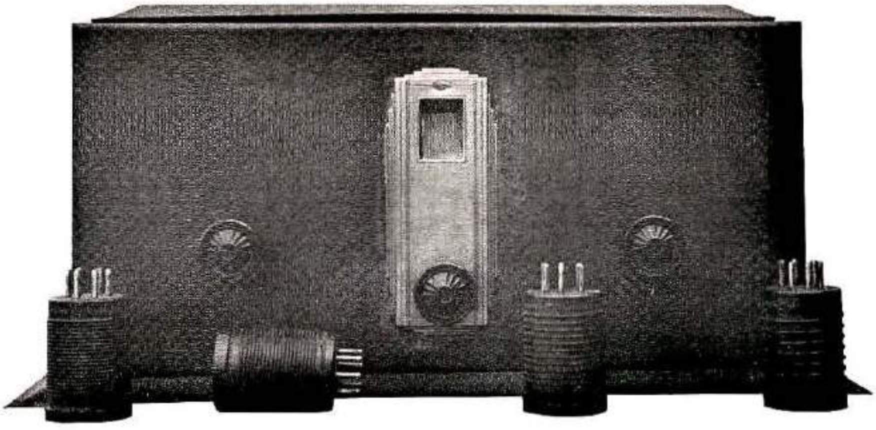


Bob Henry must be as good an operator as he is a businessman — he won the DX phone contest in 1937. This photograph was featured extensively in Hallicrafters advertising for their 1938 Super Skyrider in late 1937.

I always enjoyed visiting Harrison Radio, both before the war as a boy and also later on during my annual pilgrimage to New York for the IRE Convention in March. Harrison always had the largest displays of secondhand equipment I have ever seen. It would take me the best part of an hour just to twist all the knobs. That stuff would go like hot cakes at an Antique Wireless Association convention today.

Thinking of Bill Harrison brings back other pleasant memories, too. His old store on West Broadway was just a few blocks from that "radio heaven" known as Cortlandt Street. On school holidays I would take the Liberty Street ferry from New Jersey, walk down a block, and then work my way up the east side of Heaven, visiting the stores one by one. By the time I got to the end of radio row, I was usually broke; so I would continue on up to Broadway where my father had his office. I could generally talk the OM out of an advance on the next lawn mowing or car washing job. Then I'd proceed down the *west* side of Heaven.

Cortlandt Street radio stores were real radio stores, too. A big pile of odds and ends in front of a store advertised as "Today's Special," had probably been Today's Special for the last six months. Some of it looked as if it was also Tonight's Special; (they didn't bother to take it in at night either). Often there'd be several bushel baskets of old glass-type tubes piled in front,



The National SW-5 was one of the first ac powered all-band shortwave receivers. It preceded the famous SW-3 and was designed for shortwave listening, which was very popular in the early 1930s. The SW-5 used plug-in coils and required an external power supply and loudspeaker; the receiver had one stage of rf amplification, a regenerative detector, and three stages of audio with a push-pull output stage to drive the loudspeaker (*photo by K4KJ*).

"Guaranteed to light, 5 cents each." No guarantee on the emission capabilities; just guaranteed to light. You wouldn't have to look very far to find the tube type you needed; the older the type, the easier it was to find. I could really use a store like that today: I'm trying to restore an old National AGS and am having trouble with numbers like 35, 37 and 89 . . . among others.

Inside the store there was inevitably a bargain table right by the front door; around the walls, and in the back of the store, the stuff was piled to the ceiling. There were some stores where it was handy to bring a flashlight. The wooden floor creaked and groaned when you walked, and they hadn't been swept in months, or maybe even years. Dust was everywhere, but you could usually find whatever you wanted, old or new; and that's a lot more than you can do today. I wonder if any of those stores relocated, and if so, where?

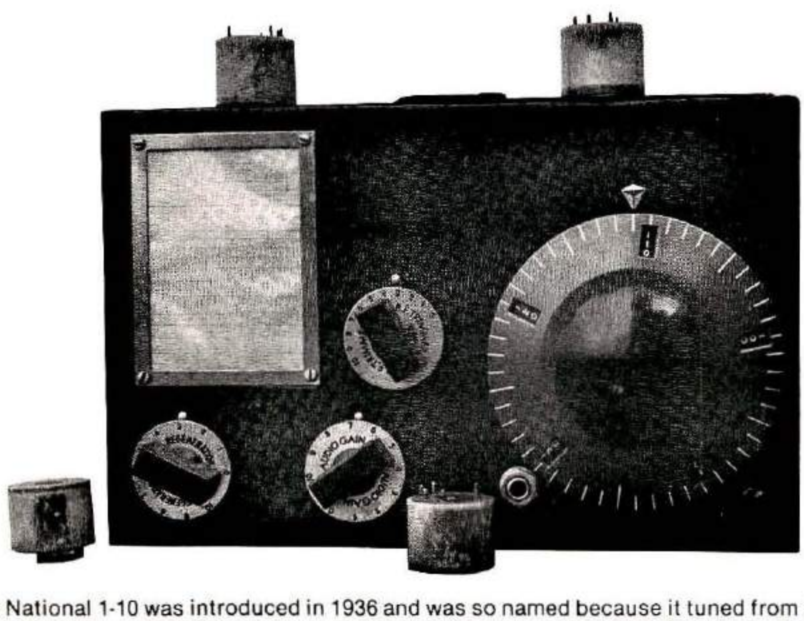
Some stores were at the tops of stairs one flight up. In many cases the light bulb at the head of the stairs was burned out, so the stairs were dark as well as creaking and rickety. I doubt that I could have gotten my mother inside some of those places, and I think if she had seen them, she might not have been so willing to let me visit them either.

In spite of the appearance of the stores, or whether they were one flight up or down, you could generally count on a friendly greeting once you got inside. The clerk, who was usually the owner, would say, "Look around, and if you don't see what you want, call me." And then he'd go about his business leaving you to browse. I had the contents of some of the smaller shops memorized and could almost always spot when he had sold something or, perish forbid, gotten in something new.

Theory and Practice

The technical articles of those times are absorbing, too. In late 1933 and early 1934, *R/9* ran a three-part series on single sideband transmission by Robert M. Moore. The series concludes with a schematic diagram of a rig that tunes 3900-4000 kHz. Moore's rig is almost identical in block diagram-form to that of A. H. Nichols in the January 1948 *QST* at the start of the current sideband activity. Moore uses translation frequencies of 10 kHz, 200 kHz, and 4150 kHz to reach 75 meters. Nichols used 9 kHz, 550 kHz, and 13.665 MHz to reach 20 meters. Both were filter-type rigs with the carrier filter in the high audio region. Moore used type 56 tubes with a 210 output stage; Nichols used mostly 6SN7s with an 807 output stage.

Looking back, I am sorry that ssb was not pushed harder at the time, but a start was made. James Lamb, then Technical



The National 1-10 was introduced in 1936 and was so named because it tuned from 1 to 10 meters (30 to 300 MHz) — this was quite a feat in those days. Note the short pins on the plug-in coils. K4KJ used this receiver in his War Emergency Radio Station (WERS) on the old 2½-meter amateur band during World War II, and reports he had "one of the hottest receivers on the net." This set had an rf amplifier stage followed by a superregenerative detector (both using acorn tubes), and two stages of audio; the set required an external power supply and speaker (*photo by K4KJ*).

Editor of *QST*, started what was to have been a series of articles of SSB, but only the first saw the light of day. This article appeared in the October, 1935, issue of *QST*, but was not listed in the magazine index or in the annual index either, so you just have to know where to look (try page 33).

An editorial preface to Lamb's article says, in part, that in 1933 the ARRL Board of Directors instructed the technical staff to investigate the feasibility of single-sideband "carrierless" phone transmission on amateur frequencies. Accordingly, J. J. Lamb investigated both the theoretical and practical aspects and a report was rendered to the Board in 1934. Lamb's October, 1935, article and the articles that were expected to follow were taken from that report. Unfortunately, no articles followed. The October article is mostly an introductory type article. One of his concluding comments was especially interesting.

In explaining the difference between what is now known as ssb and dsb, he states that "With the carrier suppressed and both sidebands transmitted, it is practically impossible to supply a locally generated replacement carrier in the precise phase relationship needed for undistorted reception. For this reason (dsb) is hardly practicable." This information did not appear in *QST* nor the prestigious *Proceedings of the IRE* until the early 1950s, nearly 20 years later.

Lamb also designed an ssb transceiver using an improvement of his original crystal filter and incorporating a crystal oscillator-frequency multiplier chain which provided not only the transmitting carrier but also the receiver heterodyne frequencies from the same source. Remember, this was back in 1935, but it sounds like what is common practice today.

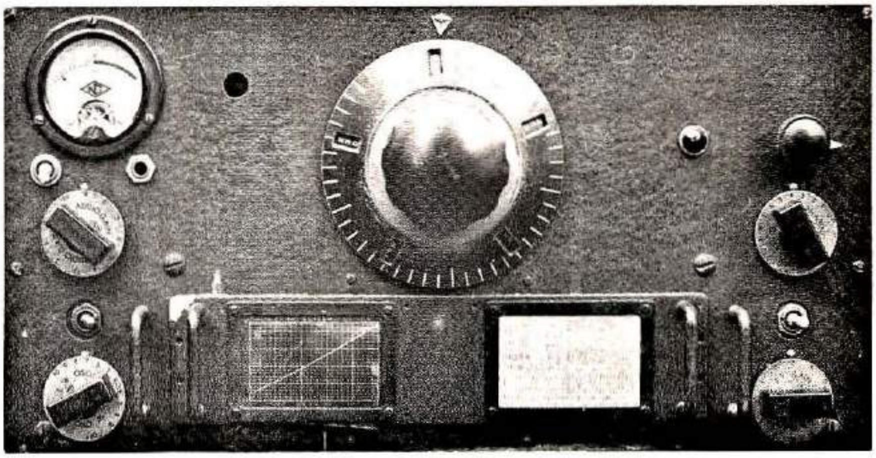
It's fascinating, too, to follow the development of the single-signal super-heterodyne receiver through James Lamb's articles in *QST*, including the development of the crystal filter and the noise limiter; in fact, several forms of the noise limiter are described. The Dichart, as well as Lamb's, circuits, seem to be still in use today.

The electron-coupled oscillator (eco) and its offspring, the tri-tet oscillator, are both described in an article by Dow and several by Lamb. Both of these circuits were very popular up until the development of transistors.

Speaking of transistors, I'll bet you thought they were a recent development. In the July, 1925, (that's right, 1925) *QST*, an "oscillating crystal" (galena type) is described. That was over 50 years ago. Today the oscillating crystal would be called a point-contact transistor.

Aside from historical interest, many of the early articles have a lot of good, useful technical information that has fallen down through the cracks. Windom's article in the September, 1929, *QST*, describing the single-wire feeder system that bears his name, explains how to adjust the antenna. This information has not appeared in any handbook or antenna manual since that time, to the best of my knowledge. The procedure is simple and straightforward and required only two rf ammeters. The charts and graphs that are in the books now are fine for a first approximation, but Windom's procedure must be used if a really *good* match is desired. A companion article in *The Proceedings of the IRE*, by Windom's associates, gives more detail on why the antenna works.

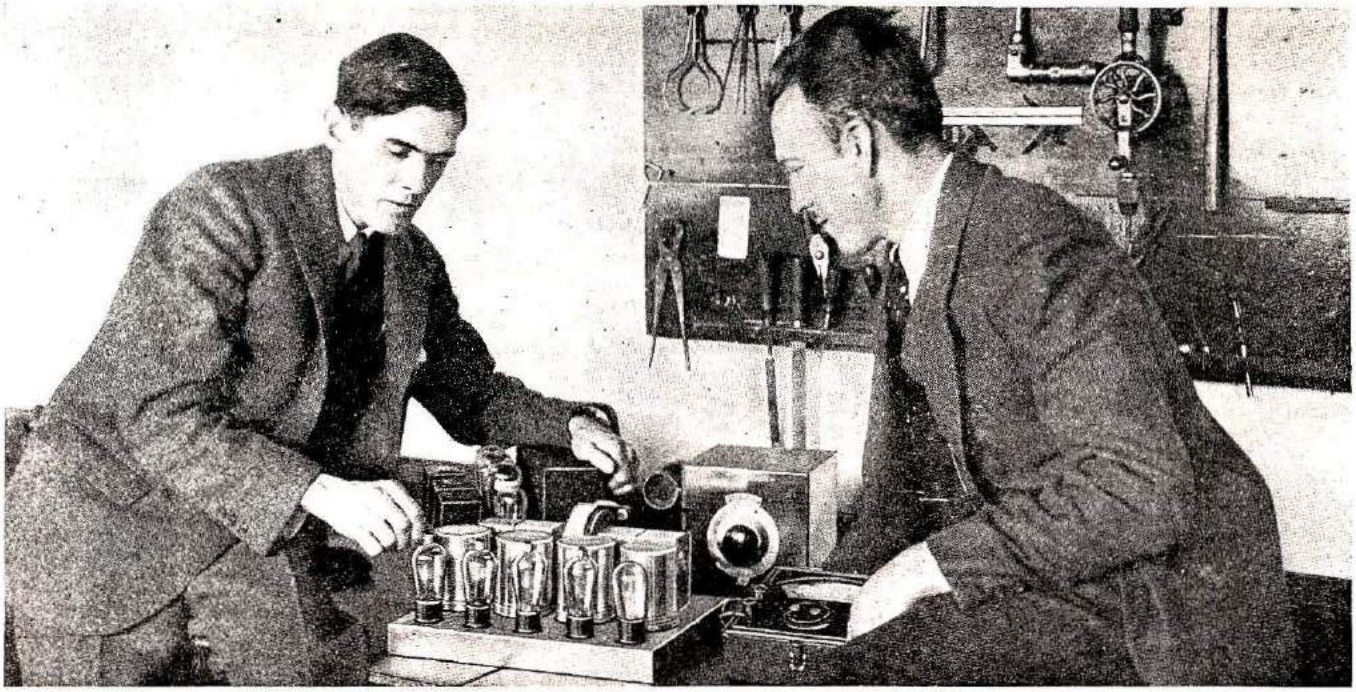
As another example, we think of the balun for coupling a balanced antenna to an unbalanced transmission line as a relatively new device. *Radio* for December, 1933, describes a "shielded transformer" to do the same thing. Furthermore, the 1933 article describes some of the problems that one runs into in using such a device; problems that have been generally ignored by all of the recent writers on the subject.



An early National HRO receiver. A previous owner cut a hole in the front panel which considerably reduces its value to collectors of old radio sets (*photo by K4KJ*).

Engineering Practice

Beginning in *QST* for March, 1934, and continuing well into the 1960s, the National Company ran what was probably the most useful and successful series of advertisements in the history of radio publishing. These were one-page articles appearing as the first advertising page in *QST* and were usually written by James Millen (until he left National to form his own company). When I first began



James Millen (left) and Dr. Glenn Browning (right) look over the National Velvetone-29, a five-tube ac screen grid tuner with exceptional signal reception for its day. It was designed for operation with the Velvetone amplifier, the latest thing in high fidelity for 1929. Dr. Browning, who was co-inventor of the famous Browning-Drake circuit used in amateur receivers in the 1920s, went on to form his own company which still manufactures CB equipment. James Millen also formed his own company, and Millen capacitors, inductors, and precision mechanical parts are still used by amateurs who want the very best in their homebrew equipment (*photo courtesy National Radio*).

reading these ads as a boy, I was impressed by the good tips they gave on design problems of a modern receiver and on how to make things work better. As I reread them years later through the eyes of a professional engineer, I find they contain much more than hot tips: they also exemplify an engineering philosophy that is sorely lacking in many of the electronic products on today's market, for professional and consumers as well as amateurs, namely, attention to engineering detail throughout the product. How many times have you bought a product which has a good basic design, but was sloppily assembled? Or assembled using cheap and underrated components? Or how many times have you found a product that is well fabricated, but with sloppy design engineering?

I have long felt that one of the finest examples of attention to engineering detail was the HRO receiver, which appeared first in 1934 and stayed on the market with the same basic design well into the 1960s, almost 30 years. When it was taken off the market, it was not so much due to technical obsolescence, but to those damnable plug-in coils. Storing the coil set I *am* using isn't any problem because it goes in the receiver, but I have never yet found any good way to store the coil sets I am *not* using. In a field that changes as rapidly as electronics, a design that is accepted by the market place for almost 30 years is truly a good basic design. I have tried to use Millen's "attention to engineering detail" in my own designs, but will probably never be as successful as he was.

A pair of National receivers that were very popular in their day were the MB-29 and MB-30. The MB presumably stands for Millen/Browning. Glenn H. Browning later established Browning Laboratories and made amateur and commercial equipment until relatively recent times.

Early TV

Numerous articles on television appeared in early radio magazines. *Radio News*, in May, 1931, published a list of ten active TV stations along with the number of holes, revolutions of their disks, and their frequencies which were around the present 160 meter band. That's right: mechanical scanning. One of the stations ran 5 kW; a minor headline under the list was: "Television Programs Improving." That was 35 years ago, but you would never know it today!

All-electronic TV systems were also in evidence. One of *QST*'s most popular technical editors, Ross Hull, was accidentally electrocuted while experimenting with amateur TV in the middle 1930s. In 1940 *QST* published a three-article series describing a camera chain, TV transmitter and a receiver for the 2½-meter band. Amateur TV is just now catching on. Today we have slow-scan television in the hf ham bands. A fast-scan TV repeater is operating in the Washington, D.C. area on the 450-MHz band.

People

It is interesting, too, to go back and read the early work of some of the people who have become common names in the ham magazines. One always associates longtime *QST* assistant technical editor, Byron Goodman, with ARRL. However, in the February, 1935, *Radio* he wrote the lead article on "The Noise-Free Autodyne." In *Radio*? How could you, Byron?

Osockme, Japan.
September 23, 1935.

Hon. Friend Editor of
RADIO, dear pal Ed.:—

Scratchi sit down for square meal at round table and make questions with self and answers for such that it seem appropop to open retale radio parts store here in Japan for purpose of making quick fortune from radio amateur trade.

All other radio dealer friends seem to ride in alleged automobiles, whereas Scratchi still find himself on foot travel basis. Prosperity are a state of the mind and into such I herewith make formal entry.

Another person usually thought of as an ARRL stalwart is the late Phil Gildersleeve, whose cartoons were enjoyed by the amateur community for so many years. "Gil's" cartoons are always associated with *QST*, but the December, 1934, *Radio* has three "Gil" cartoons. Gil had not yet fully developed the quiet, subtle humor that made his "Jeeves" monthly cartoons and his annual Podunk Hollow ARC Field Day *QST* covers such classics, but the lines and style are definitely "Gilean"; you wouldn't have any trouble recognizing them even if they hadn't been signed.

I also suspect that Gil was the originator of the Hashafisti Scratchi cartoon caricature that still appears on and off in *CQ* magazine. Most old-timers remember Scratchi as that mischievous ham from Osockme, Japan. In the 1934 *Radio*, the first drawing of Scratchi appears, which is the same as, but with much more detail than, the present *CQ* cut. (Or maybe *CQ*'s cut is worn out after all these years.) The early cut is signed with what appears to be Gil's "signature." The cut was obviously reduced from a much larger original, so I can't be sure and don't want to stick my neck out too far.

However, as I mentioned before, Gil did draw for *Radio* at about that time, and even under a magnifying glass the signature appears to have the same form as Gil's. I don't know when the cut was first used as my collection of *Radio* is not very complete prior to 1934 and I imagine the original drawing is long gone, too! It would be ironic if ARRL's most famous cartoonist originated the trademark for *CQ*'s longest running newsletter. If true, it is certainly a tribute to Gil's ability to have a symbol still in use after 40 years.

Speaking of Scratchi, do you realize how far back this magazine feature goes? Scratchi has been published on and off in *CQ* since its inception in 1945, and prior to that in *Radio*. Actually Scratchi goes back to at least April, 1922, when "Scratchi Starts Business Careering" by David P. Gibbons appeared in *Radio*. I don't know if even this was the first Scratchi or not, but it's the earliest of which I have a record.

The October, 1933, *Radio* has a letter from Osockme, Japan, after a 10-year absence, and promises a letter every month from then on, but gives no indication of the author. April, 1934, *Radio* has a photograph of a person identified as the originator of Scratchi, but gives no name. A box of "assorted Japanese wavelengths" is offered to anyone who can identify him; it says that he started in radio 20 years ago (20 years before 1934, that is).

At the 1975 ARRL Convention at Reston, Virginia, I asked *CQ*'s editor, "Who is writing Scratchi these days?" He changed the subject, and in a way I'm glad he did. It's much more fun to imagine that on the first of each month a special messenger from the Japanese Embassy appears at *CQ*'s editorial office with the latest missive which had just arrived in the diplomatic pouch from Osockme.

I would like to know about Scratchi's early heritage, though, say, prior to World War II. It would also be interesting to learn what happened to David Gibbons, who, I assume, created Scratchi, to the best of my knowledge, the oldest feature in any amateur magazine.

Receivers

The multitude and variety of equipment that was advertised in those old mags was equally

Rare Hallicrafters Skyrider Diversity receiver, which was marketed in the middle of the depression with a price tag of $425 — about six months pay for those who were employed. Only about a dozen of these sets were made. The receiver is about 3 feet (1 meter) long. In spite of its impressive size two additional chassis were used which were installed on either side of the receiver (*photo by K4KJ*).

absorbing — receivers, transmitters, antennas, accessories. At the top of the list were the dream receivers, the Hammarlund Super-Pro and the National HRO, probably the two most wanted receivers of the day. Incidentally, "HQ" stands for "Hi Q," an early trade name used by Hammarlund.

In the affordable price range, the receiver that caught my fancy was the RME 69 or 70. For some reason RME did not put labels on the knobs, so you just had to know what knob did what. As a young teenager, I was very impressed watching a skilled, experienced operator handle a 69 or 70. He would tune in a signal, then tweak a knob here and twiddle another there to make a cluttered signal R-9 just by knowing how, while I couldn't even turn on the ac power without assistance.

In addition to the 69/70, RME made a preselector, the DB-20, available as a separate item. They also made a combined preselector/receiver combination available as a single item. This model, I think, impressed me as a teenager the most. It had more dials and knobs than any other amateur model. I have had my eye open for one since boyhood, but have never seen one. I'm beginning to wonder if they existed only in the ads.

Of all the receivers, commercial or homemade, past, present, and probably future, the most impressive one of all must be the Hallicrafters Skyrider Diversity (Model DD-1). It looked like a real piece of equipment, for sheer size if nothing else. If you could tune in a signal with one, any layman could not help but be impressed by your skill as a radio operator.

I'll never forget when that receiver hit the street either. Hallicrafters took a two-page spread in *QST*; and it took two pages, too, in order to do justice to the thing. They sure don't build them like that any more, and it's probably just as well: the way they build houses today, the average ham wouldn't have room to keep one. On the other hand, an advantage of today's society is that there are usually one or two pick-up trucks in every neighborhood, so you wouldn't have too much trouble moving one — if you ever had to. This is another item I wonder if they really made, for I have never actually seen one, nor have I ever talked to anyone who has ever seen one.

By way of transmitters, National sold a rack and panel job; 600 watts, a-m or CW, in an open rack at that. There was no TVI to worry about. The model owned by a local amateur used Taylor TW-150's in the final. Remember those bottles? TW stood for "thin wall." Hallicrafters made the HT-4 for ham use. This equipment did yeoman duty in World War II as the BC-610. Either of those two transmitters was acceptable in my boyhood dreams: I wasn't prejudiced in my youth and would have been happy to have one of each!

For antennas you could have a Mims Signal Squirter on ten or twenty, or both, which was the first commercially available Yagi beam. It featured inductive coupling between feed line and antenna, for continuous rotation in either direction without slip rings, which you don't see any more. I believe the Mims name, trade mark and patents were bought out by Amphenol, but I have never seen them push the product. I don't know what happened, but they certainly had the jump on Telrex.

For the lower frequency bands, you could use EO-1 cable. This was a rubber-insulated 72-ohm impedance balanced line for direct connection to the antenna. It worked fine in dry weather, but was a dead short after a rain storm. I still have a length of it around someplace for old times' sake. If you wanted all-weather operation, there were Johnson Q-bars to match a 72-ohm antenna to 600-ohm open wire line. Or, why bother to match anyway? Coaxial line was only used by the higher class stations on 5 or 2½ meters, and was always homemade. It was made from copper water pipe; plastic beads, made by Amphenol, separated the inner conductor from the pipe. Since the line was mostly air-insulated, the losses were lower than the commercial flexible cable available today.

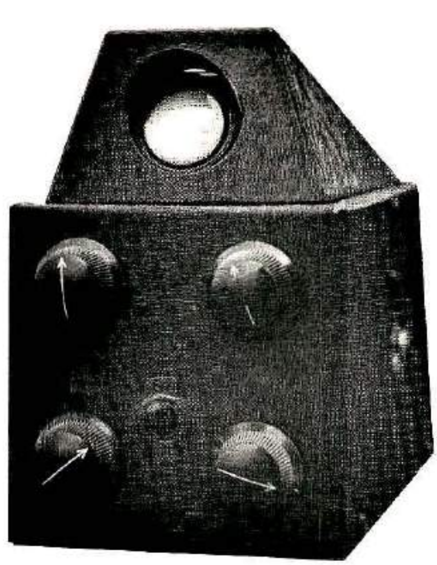
October, 1939, *Radio* has an article by F. R. Gonsett entitled "Ten-Meter Auto-Radio Converter." Except for the tube type, this converter appears almost identical to the famous Gonsett Converters of the late 1940s that helped establish mobile operation as a viable means of hamming. An earlier article by Gonsett in October, 1938, *Radio* discusses mobile radio equipment in the 30-41 MHz band. These articles may have laid the ground work for the contribution Gonsett made to mobile communication following World War II.

For operating accessories, my dream station included an Edwin Guthman direct reading frequency meter, a Triplett model 1639 modulator monitor and a National 1- or 3-inch cathode-ray modulation monitor. After about 1932, you were expected to know what frequency you were on, and after about 1936, your modulation percentage, too.

Here's the answer to my final question: A heterodyne receiver has a separate local oscillator and mixer, as does a super heterodyne, but the output frequency of the mixer is in the audio range for the heterodyne receiver. In a super heterodyne receiver the output frequency of the mixer is at a *super*sonic frequency, usually called "the intermediate frequency."

An interesting series of three articles began in the January, 1935, *Radio* on "How Telegraphers are Made" by Ted McElroy, who at the time was the "world's fastest telegrapher." McElroy gives tips on sending and receiving and on how to run a code speed contest, well worth reading today. His comments on operating conditions at the time would be of interest to the history buffs and maybe to *Playboy* as well. The articles are very interestingly written, for his sense of humor is as good as his ear drums and fist.

While on the subject of code, Walter H. Candler has an article on "Code Technique" in the March, 1934, *R/9* and another in September, 1934. As I recall, the Candler System was still advertising in *QST* up until recently, so he must have had some good advice. Good CW men (and women) seem to be becoming a thing of the past, so that I think his article would be useful reading today.

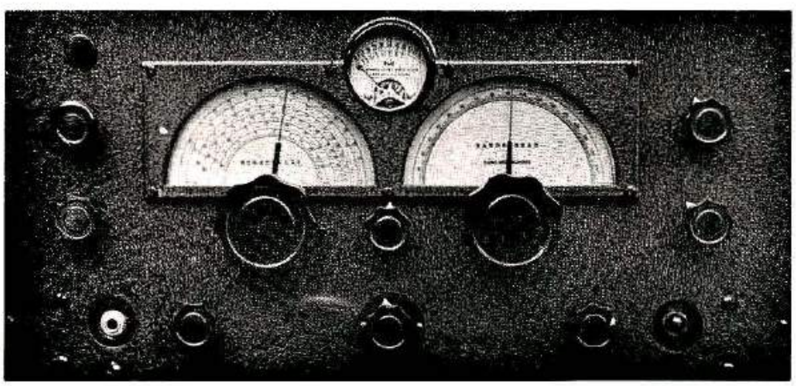


National 1-inch oscilloscope from the late 1930s. After about 1936 all amateurs were expected to know their modulation percentage. The National CRO used a 913 cathode-ray tube; a trapezoidal pattern was normally used because no linear sweep was provided (*photo by K4KJ*).

In the midst of my reverie, the XYL walked in and looked. She didn't say anything, she just looked. Sitting in the easy chair with magazines scattered all around me, while the paint brush had hardened and the paint can had been pushed back in the corner, I had been all too quiet.

From the dreams of my boyhood, a jolt to the realities of the present. Our youngest offspring is bringing her fiance home from college next weekend, so it's back to the woodwork.

The Lamb single-signal supers, the Jones 5-meter transmitters, the Nationals, the Hallicrafters and RMEs, all fade away into the background like DX stations on 20 meters. Never to be built, many of them, but never to be forgotten either. The schematics, the tube lineups, the panel layouts, even the parts lists are as indelibly impressed in my memory as they are on the pages of . . . those old radio mags . . . **HRH**



The Radio Manufacturing Engineers' RME-69 was a favorite with many amateurs in the late 1930s. Notice that there are no labels on any of the controls — the operator just had to know which ones were which. Accessories which were available for the RME-69 included a high-frequency preselector and a tunable vhf converter. Amateurs with that lineup on their table had a very impressive looking station (*photo by K4KJ*).

DenTron Radios... Built by Americans for the whole world.

One of the greatest pleasures ham radio brings is contact with distant lands. What other organization can boast of daily communication among its members throughout the world?

It's a great hobby and we want to make it more fun for you!

DenTron antenna tuners do just that. Our Super Tuners are the only tuners on the market capable of matching everything between 160 and 10 meters, plus handling 1-3 KW PEP.

A. The Original Super Tuner 1KW PEP $129.50. If you're new at ham radio you'll find it's invaluable.

B. Super Super Tuner 3KW $229.50. If you've added more power to your station it's a must. Both the Super Tuner and the Super Super Tuner match balanced feed, coax, random or long wire. Both transfer maximum power from the transmitter to the antenna.

C. NEW! The MT-3000A $349.50. The MT-3000A was designed for the serious ham interested in professionalizing his station. It is a rugged antenna tuner that easily handles 3KW PEP. It has built-in dual watt meters, and a built-in dummy load. The antenna selector switch: (a) enables you to by-pass the tuner direct; (b) select the dummy load or 5 other antenna systems.

D. 80-10 Wire Tuner $59.50. Our random wire tuner handles 500 watts and is ideal for the ham on the move.

E. W-2 Watt meter $99.50. DenTron's dual in-line Wattmeter allows you to read forward and reflected watts simultaneously.

F. SuperAmp $574.50. The SuperAmp is one of the best amplifier values currently on the market. It covers 160-10 meters, and features four 572B triodes in grounded grid. With it add 2000 watts PEP SSB and 1KW CW power. No other amplifier delivers so much at such a reasonable price.

G. NEW! MLA-2500 $799.50. The MLA-2500 is one of the world's finest high performance military amateur amplifiers. It was designed for the discriminating buyer who knows and appreciates precision plus power. Coast along with a full 2000 watts PEP input on SSB, 1000 watts DC input on CW, RTTY, or SSTV. The heart of the MLA-2500 is a heavy duty, self contained power supply, and it features 2 Eimac 8875's.

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THE WAR SURPLUS STORY

BY BILL ORR, W6SAI

To thousands of equipment-starved amateurs the warehouses full of surplus equipment was a blessing, and the BC-348 series of receivers, left center, and the command sets, upper right, were rulers of the ham shack. To manufacturers of new equipment, such as the futuristic console, left, and the advanced receiver, above, the horn-of-plenty surplus was a curse that marked the end of the road for many of them. Profits were made, amateurs stayed on the air, but what happened to progress?

Two weeks after the end of World War II, one of the largest assembly buildings on earth hummed with purposeful activity. As far as I could see down its half-mile length, the building was filled with just-completed, four engine, heavy bombers. The aircraft, gleaming with Air Force insignia, were surrounded by mechanics and technicians.

One-by-one, the planes were rolled out the door of the building where a tank truck gave each one a few gallons of high-octane fuel. With a cough, then a roar, and belching blue exhaust flames, the engines were started. After a few minutes, the engines were turned off, the remaining gasoline was siphoned from the tanks, and the bomber was officially turned over to the government.

After a pause, a tractor was hooked to the nosewheel of each aircraft and it was towed slowly to the end of an ever-growing line of similar planes. At the front of the line, another tractor pulled a bomber into position under a crane which supported a two-ton lead ball, swinging at the end of a cable. After a second flurry of paper work, the technicians and mechanics moved away from the doomed aircraft.

The lead ball was hoisted high into the air and let fall with a thunderous crash amidships of the bomber. Its spine was broken, the wings collapsed, and the landing gear was crushed. Again and again the lead ball was dropped until the new bomber was a mass of wreckage. A puffing bulldozer then swept the corpse into a huge pile of rubble and the next plane was brought into position under the crane.*

The foreman in charge of demolition, wearing a yellow hard hat, approached me. "You a radio ham?" he yelled above the din. Before I could answer, he said, "Why don't you go down the line and take some of the radio equipment out of the planes? Anything you can remove without a screwdriver is yours. A pity to waste all this surplus radio gear. There's tons of it in the warehouse, too, and the taxpayers will never see it; that's for sure!"

The foreman was wrong

At the end of World War II, amateurs were allowed back on the air, but, for most of them, it was a slow start back to normality. Many hams were still overseas in the armed forces, and those at home had little equipment. In many cases their receivers had been sold to the Government during the war, and several war-production drives for panel meters had stripped the erstwhile hamshacks of indicating devices. Although new receivers were becoming available, they were selling for about twice the price of comparable pre-war receivers. Yes, amateur radio seemed to be getting off to a slow start, indeed.

Unknown to most radio amateurs, a vast fortune in communications equipment belonging to the War Assets Administration and the Defense Supply Corporation, agencies of the United States Government, was stored in bulging supply depots scattered across the United States and abroad. This is the story of some of that equipment, and the impact it had on amateur radio.

It all began quietly enough. In mid-August, 1945, the

*Similar scrapping of aircraft and radio equipment was reported in the newspapers for Guam, Japan, and England.

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Collins ART-13 Transmitters
APS-13's
SCR-269F or G Fairchild or Bendix ADF's
Headphones in quantity lots
Microphones in quantity lots
Field telephones
Sound-powered telephones

wartime system of priority allocations was scrapped, permitting sale of communications equipment to the general public without a "show of necessity."

In the November, 1945, issue of *QST*, the Hallicrafters Company announced that it was offering "government radio and electronic supplies" for general distribution, under contract SIA-3-24 with the Reconstruction Finance Corporation. A coupon was included with the full-page advertisement, soliciting inquiries about bidding for the various items.

But, the red tape prevailed.

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Although large businesses seemed able to buy some choice items, little material appeared in the ham market-place.* Then, in early 1946, a trickle of war surplus equipment began to show up at the larger radio distributors, such as Harrison Radio in New York. By midsummer, the trickle had become a stream as more and more radio distributors obtained government surplus radio equipment.

*In 1946, a letter to the Sales Agency of the Reconstruction Finance Corporation brought a reply to contact the manufacturer of the equipment. A follow-up letter to selected manufacturers brought an answer that told me to contact the RFC Sales Agency! War veterans could apply through the Smaller War Plant Corporation office for a certificate to buy surplus radio equipment directly from the RFC, *provided* that the applicant was in the radio repair, test, sales, manufacturing, or similar electronics business. The certificate could not be issued to amateurs, or to the public at large. By late 1946, the RFC had been severely cut back, the Smaller War Plant Corporation was defunct, and the military began direct, sealed-bid sales to the public. The system had collapsed of its own red tape!

The coming of "Surplus Sam"

I don't think anyone, including the government, was really aware of the great quantity of communications equipment that had been built during the waning years of the war.

By mid-1946, the Reconstruction Finance Corporation had gone out of the surplus business, and the military, frantic to unload their stocks of equipment, began to sell it at closed bid — by the pound — to any and all bidders. Most radio distributors, unwilling to get into the junk business, stood aside while a new breed of entrepreneurs stepped into the picture: The surplus dealers who handled nothing but government surplus equipment.

Within just a few months the price of surplus equipment dropped sharply, and the flood reached full tide. For only pennies on the dollar, a radio amateur could outfit himself with a station that looked like a military communications post! Overnight, unknown surplus dealers sprang up, and the heretofore obscure Esse Radio Company of Indianapolis, Indiana, ran four-page advertisements in *CQ* magazine, showing their surplus stocks and a photograph of their three-story warehouse! In the same issues

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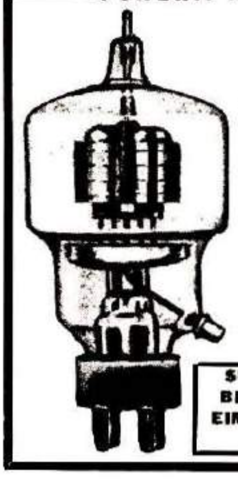

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of *CQ*, R & M RADIO ran two-page advertisements featuring more war surplus goodies. By February, 1948, as more and more equipment reached the market, some of the ham magazines resembled war surplus catalogs!

The manufacturers

Needless to say, the flood of surplus radio equipment knocked the new-equipment market into a cocked hat! Who would buy a $275 receiver when it was possible to buy an acceptable war-surplus receiver for only $49? Why buy a $45 transmitting tube when you could get the same tube — surplus — for only 49 *cents*!

Of course, under these circumstances, many manufacturers went out of business. Some of them introduced new products, many of which didn't even get off the ground. TAYLOR TUBE COMPANY closed its doors and EIMAC, one of the largest independent tube manufacturers, survived only because it brought out a new line of high-gain tetrodes that tended to make obsolete the flood of old-style, war-surplus triodes.

Meanwhile, the character of war surplus equipment slowly began to change in a subtle way. Some pieces of equipment, not necessarily the best, had disappeared from the market. The cumbersome and unstable BC-375 aircraft transmitter, bought by hams mostly for parts, became unavailable; and the BC-654A transmitter-receiver combination that covered the frequency range between 3.7 and 5.8 MHz had disappeared. Where did they go, who bought them, and why?

Looking back on those days, it appears that Nationalist China had bought enormous stocks of surplus radio equipment which eventually fell into the hands of the Chinese Communists. By the mid-1950s, West Coast Amateurs were cursing those old BC-375 transmitters which had showed up on the 80-meter band, chirping and blurping their coded radio messages over point-to-point communications networks on the mainland of China.

The BC-654A transmitter-receiver, and other good items of communications equipment, had been purchased by Israel in the early years of that country. In addition, during the Korean War, the United States Government bought back certain choice items of equipment that it needed, but were in short supply.

In 1950, a prominent war-surplus junkie confided to me that he had made a quick $60,000 in two days by buying war-surplus transmitting tubes from the United States Army at *fourteen cents a pound*, and selling them to the United States Navy at *$35 apiece*!

The deadline

By 1951, the huge stocks of good war-surplus material had been virtually depleted and the equipment left for sale, such as oxygen bottles, tuning boxes, dynamotors, and out-of-band crystals, was mostly junk. The party was over, and on the horizon appeared a small cloud — no bigger than a man's hand: television interference, TVI.

Since 1948 the number of television sets had increased sharply and, by 1950, many amateurs were in serious trouble with television interference. The surplus equipment, designed over a decade before and hastily pressed into operation by eager amateurs after the war, was simply not *clean* enough to meet modern operating standards.

To top it all off, ESSE RADIO COMPANY and other surplus stores were running magazine advertisements offering to *buy back* the surplus equipment sold to hams only a short time before! Overseas buyers were looking for good war-surplus radio gear, and many amateurs were at last willing to unload all of the military equipment in favor of communications equipment that better fitted their needs and the changing state of the art.

The popularity of single sideband finally signalled the doom of the surplus market. True, even today, bits and pieces of World War II radio gear are for sale: It looks as if the popular *Command* receivers will go on forever. But, the days when an up-to-date Amateur station boasted a BC-348 communications receiver, a 500-watt BC-610 transmitter, a BC-221 frequency meter, and a modified SCR-522 for two-meter work are probably gone forever.

The grand old radio equipment of World War II, rendered obsolete at last by the combination of age, TVI, ssb, and solid-state devices, is now only a collector's item, bringing back memories to old-time hams who served their country well in the greatest of all wars.

HRH

The photographs of equipment and the advertisements used as illustrations are from *CQ* and *QST* magazines of the war-surplus era, and are reproduced here with their permission.

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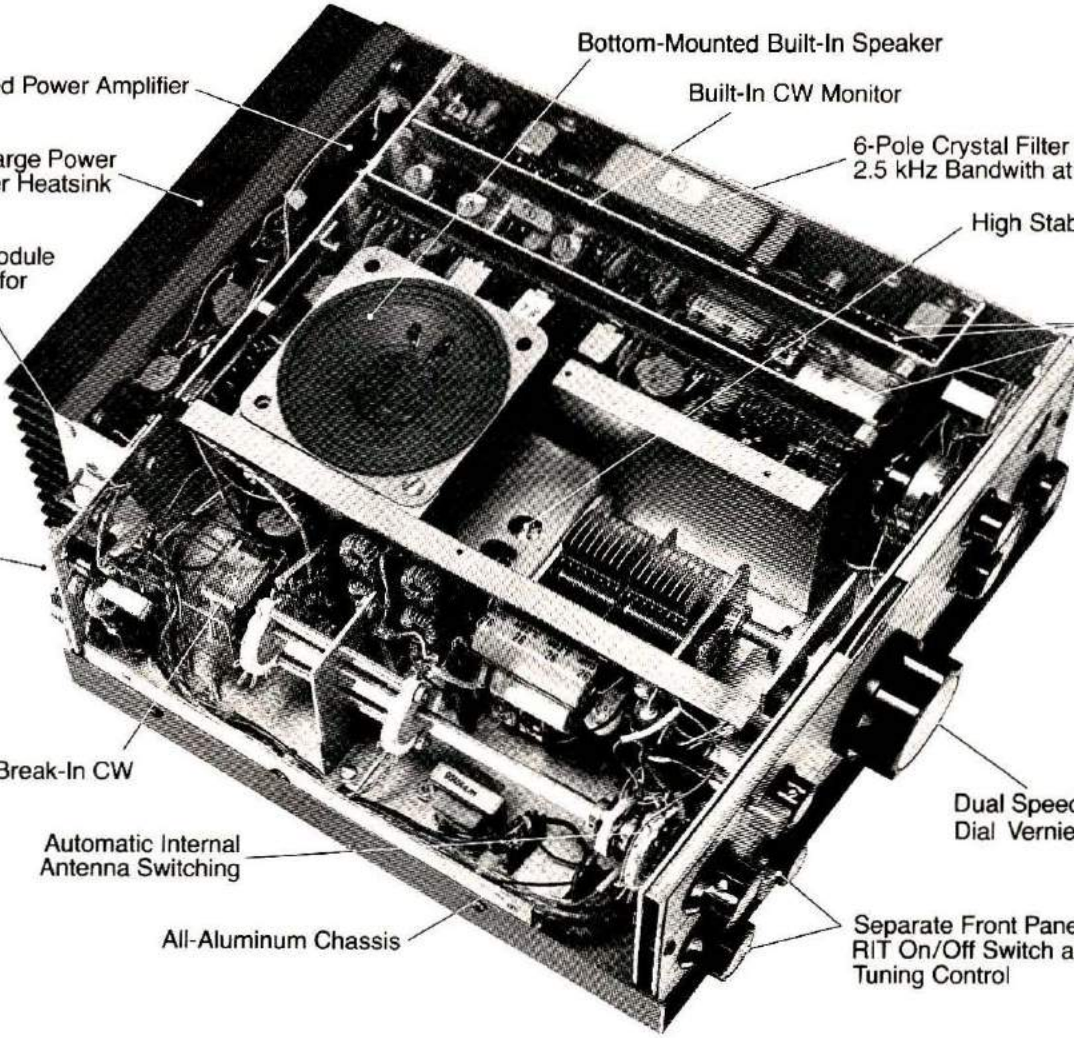

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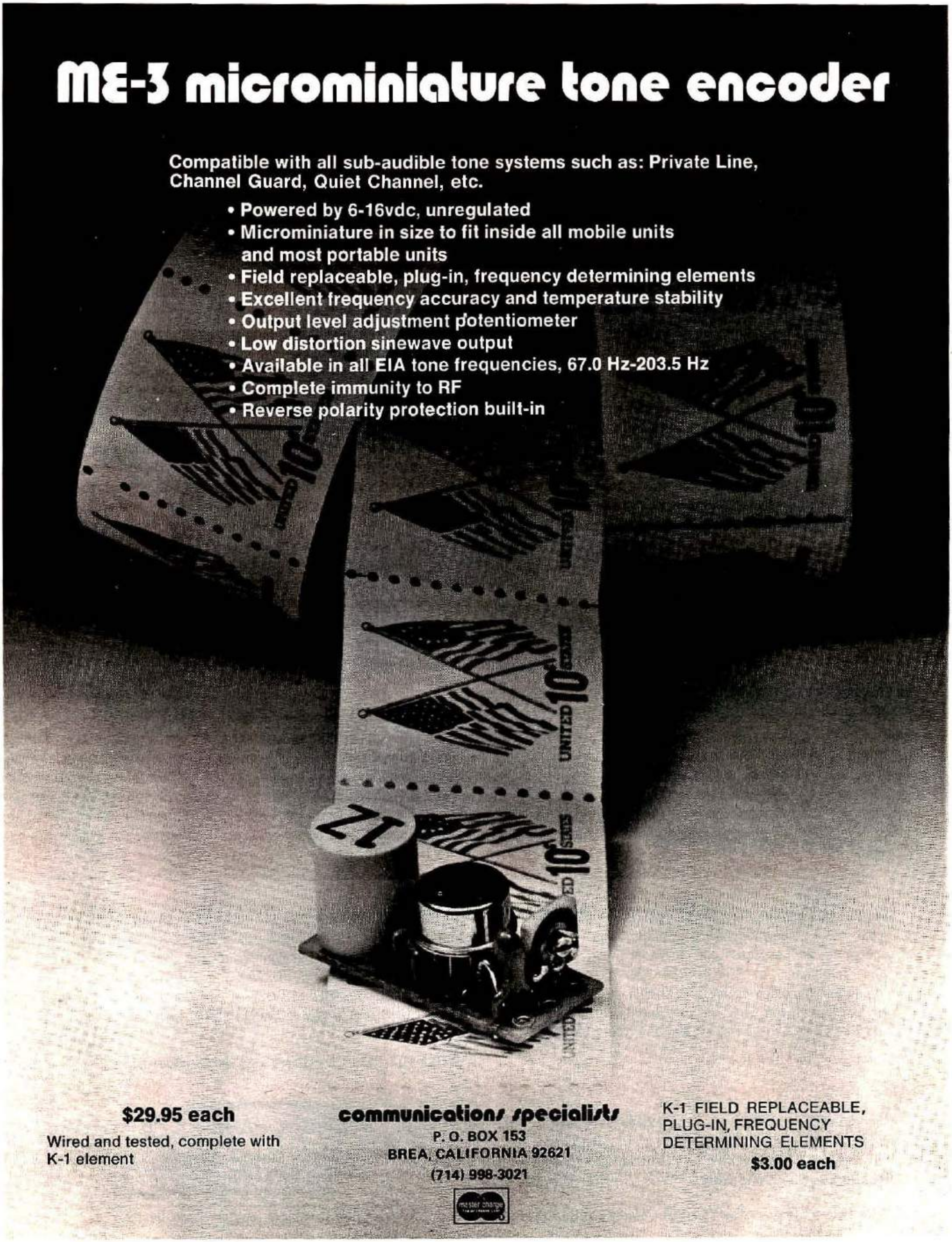

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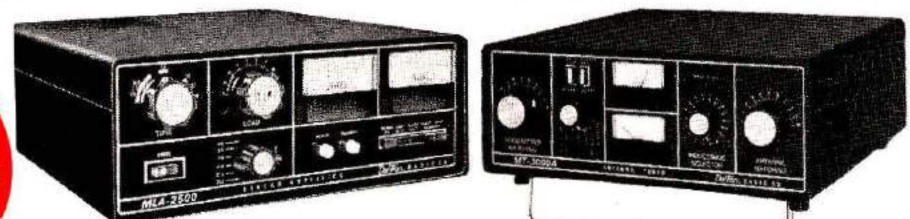

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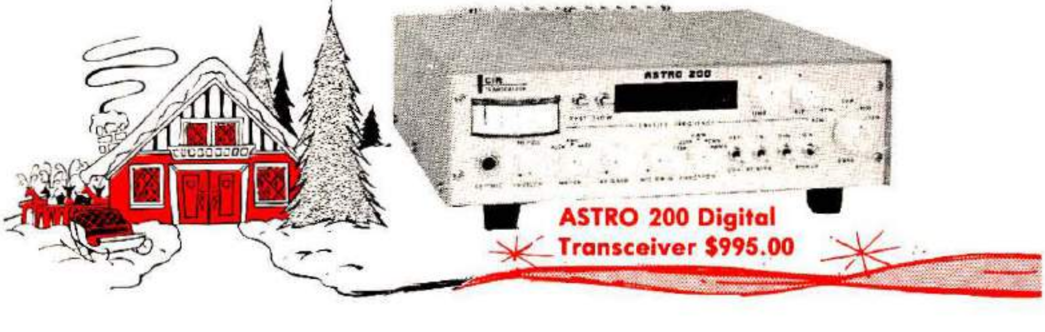

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INVERTED... Antenna

BY ALFRED WILSON, W6NIF

The popular inverted-V dipole can be improved to provide some directivity by adding a little more wire and a couple of home-made phasing stubs

The inverted V, or sloping dipole antenna, which was described in Jim Fisk's article, "Antennas for the High-Frequency Amateur Bands" in the June, 1977 issue of *Ham Radio Horizons*, is one of the simplest arrangements you can use for working DX stations. Only a single support (tree or mast) is needed to hold the antenna above ground. The inverted V is really a dipole antenna with sloping elements, or legs. The angle between the legs isn't too critical; however, it should be somewhere between 90 and 120 degrees. If the angle is much less than 90 degrees, you can expect feed problems and high standing-wave ratio.

The inverted V has characteristics of both horizontal and vertically polarized antennas. The inverted V doesn't perform as a true vertical antenna; nevertheless it seems to have a low radiation angle in the vertical plane. Furthermore, an elaborate ground radial system, which is characteristic of vertical radiators, isn't necessary.

Energy radiated from a half-wave (dipole) antenna oriented horizontally looks like the pattern of **Fig. 1A**. The radio-frequency energy leaves the antenna in two broad lobes in opposite directions, **A** and **B**. If two dipoles arranged in a straight line are connected so that they operate in the *same phase*, the currents in each element will appear as shown in **Fig. 1B**. Such an arrangement is known as a *driven array*.

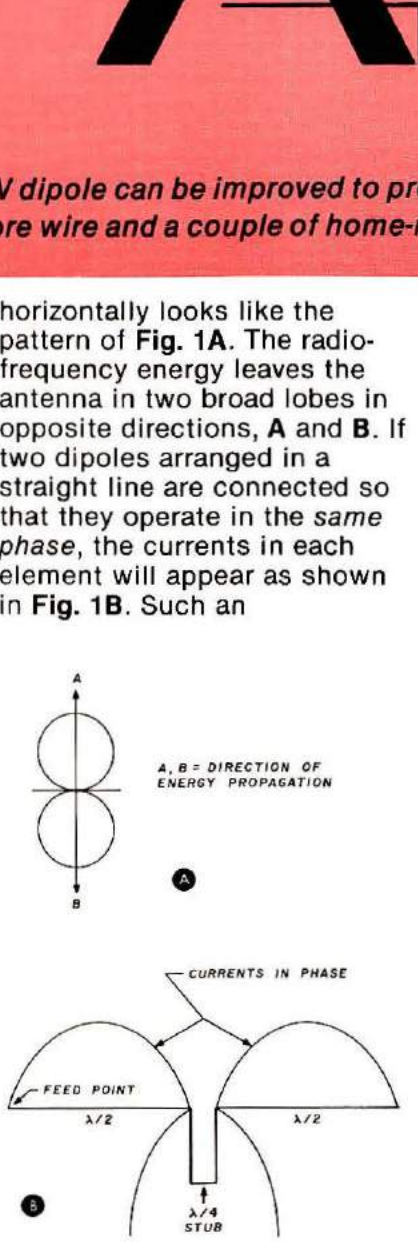

Fig. 1. Radiation pattern for a simple horizontal dipole antenna, **A**, and current distribution of two dipoles driven in phase, **B**.

The radiation pattern of the antenna of **Fig. 1B** will be similar to that of **Fig. 1A**. However, because two half-wave elements are used, which are fed in phase, the radiation pattern will be intensified and will look somewhat like that shown in **Fig. 2A**. This radiation pattern is sharper and more directive, which is the same as saying that the antenna producing such a pattern has *gain* along the line of maximum energy propagation. Also, the antenna beamwidth is reduced. This is the same feature provided by expensive Yagi beams, which use aluminum tubing for elements and must be mounted on a tower or other high support for maximum effectiveness.

If all the elements in a driven array are in a straight line, the arrangement is called a *collinear array*. The current in each element must always be in the *same phase*. This phase relationship is maintained by connecting each element with sections of transmission line, called "stubs," of the correct length and impedance.

When two collinear half-wave antenna elements are connected directly, the effect is that of a full-wave antenna, **Fig. 2B**. The current in the first half-wavelength element is exactly 180 degrees out of phase with that in the second half-wavelength element.

When the elements are connected by a quarter-wavelength stub, as in **Fig. 1B**, the current travels down one side of the stub and up the other. The current travels a distance of one-half wavelength in the stub; thus the current travels through *one-half cycle* of change. When the current reaches the next element, it's in the desired phase. Since the current in one side of the stub is equal and opposite to the current on the other side, the fields produced by the stub cancel, and no radiation is produced from the stub. Thus, the two half-wave elements are said to be *driven in phase*.

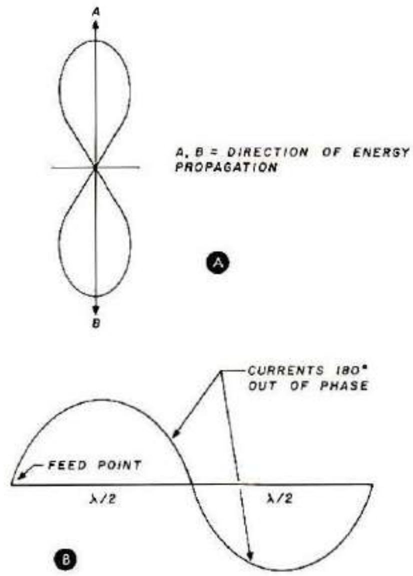

Fig. 2. Radiation pattern of an antenna with two half-wave elements driven in phase, **A**. The pattern is sharper than that of an ordinary dipole and gives increased signal strength in the directions shown. Sketch **B** shows the current distribution in two half-wavelength antenna elements connected directly together; that is, the system operates as a full-wavelength antenna.

Let's build one

Enough of the theoretical stuff. Here's how to put up an inverted V with collinear elements for increased directivity. A sketch of the modified inverted V is shown in **Fig. 3**. Dimensions are in terms of wavelengths for the radiating elements and the phasing stubs. Also shown are suggested angles for separating the antenna legs (angle α), the angle between the antenna legs and the phasing stubs (angle β), and the angle between the mast and antenna legs when the antenna is looked at from the side (angle γ). The reason for showing angle γ is that I've obtained better results with the inverted V when the plane of the element legs is sloped out of the plane of the supporting structure. See **Reference 1** for further details.

Assuming you're now using the naked inverted V and want to add another half-wavelength section to each leg for improved performance, all you need is a little more wire for the additional elements and a couple pieces of coax cable for the phasing stubs. I've shown type RG-8/U coaxial cable for the stubs and transmission line in **Fig. 3**; however, if you're

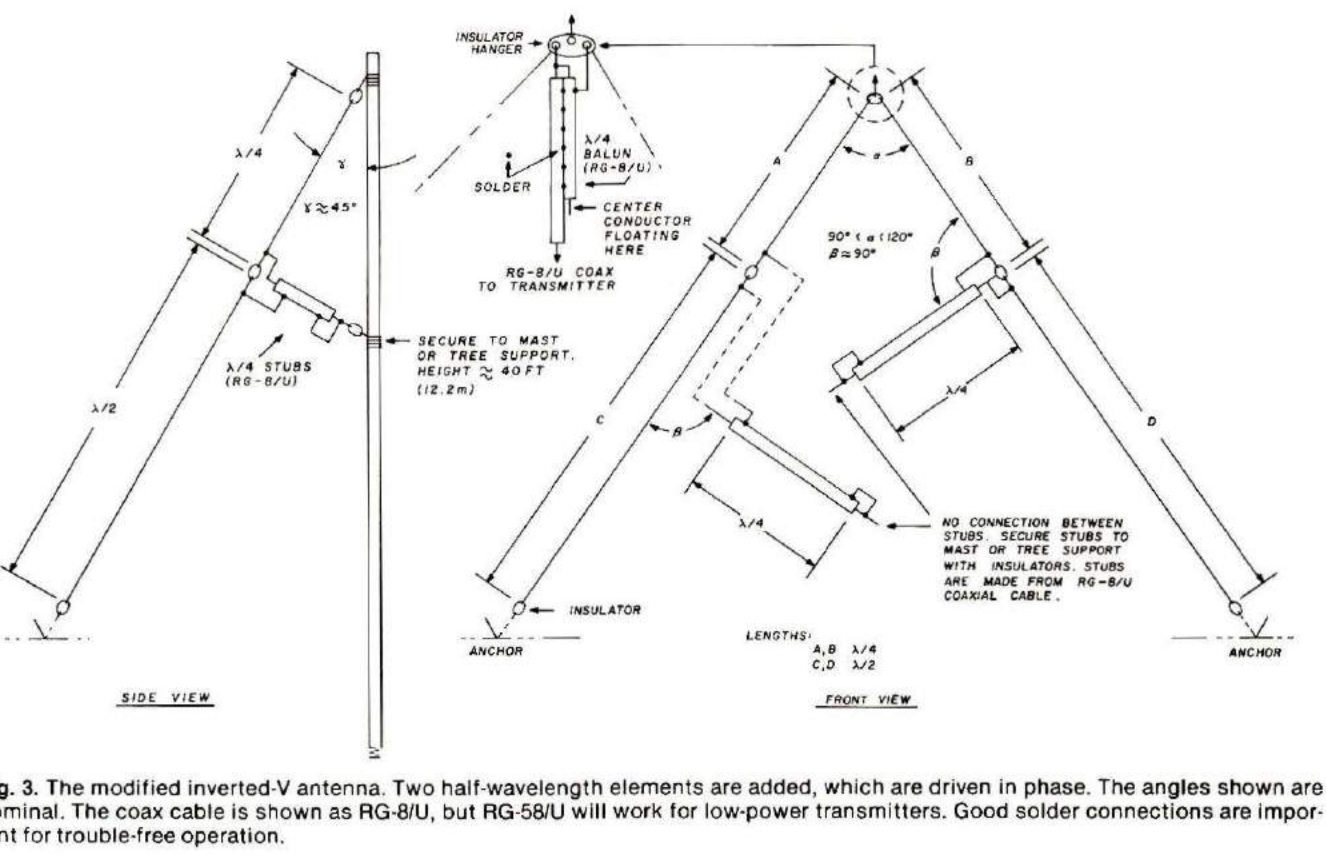

Fig. 3. The modified inverted-V antenna. Two half-wavelength elements are added, which are driven in phase. The angles shown are nominal. The coax cable is shown as RG-8/U, but RG-58/U will work for low-power transmitters. Good solder connections are important for trouble-free operation.

using low power (say, under 200 watts input), then type RG-58/U cable will be okay. The main thing to remember is that the added elements must be connected in the *proper phase*; adding the stubs will maintain this relationship.

Here's an example for a collinear inverted V antenna for 15 meters. Dimensions **A** and **B** (**Fig. 3**) are one-quarter wavelength, which means each of these legs will be 11 feet (3.4m) long. The two phasing stubs, also one-quarter wavelength, will also be the same electrical length. The added elements, **C** and **D**, are one-half wavelength long, which is 22 feet (6.7m). (All these dimensions are nominal for the 15-meter band).

So this means that each antenna leg will be of the order of $11 + 22 = 33$ feet (10m) long. A 40-foot (12.2m) mast would be a good choice as a support. If the antenna apex angle is 90 degrees (angle α in **Fig. 3**), the insulators at the end of each leg will be about 16 feet (5m) above ground.

When you make the phasing stubs, remember that the coax center conductor is connected to the antenna elements and the coax-cable shield braid is connected with a *good* solder joint as shown. The solder joints should be wrapped with PVC tape then coated with silicone compound to avoid long-term corrosion problems.

The far end of the phasing stubs should be insulated from each other. A low-loss antenna insulator can be used here. The stubs should (ideally) drop at a 90-degree angle from the antenna elements, (angle β) although this doesn't seem to affect antenna performance. Secure the phasing stubs to the mast or other support through insulators. If the coax shields of the stubs are correctly soldered and coated with some kind of protective material, you won't have any problems with corrosion for a long time.

Ordinary "egg" insulators can be used for the setup shown if low power is used, or you can use pieces of thick plastic salvaged from discarded containers from household detergents. The choice is yours: you can be elegant and use expensive materials for insulators or use materials that would otherwise end up in the trash can. Either way, the antenna won't know the difference. You can save money by using your ingenuity.

Final remarks

During the next few years propagation conditions on the high-frequency amateur bands are expected to improve. The antenna described here won't provide a quantum jump in signal strength over your horizontal dipole or vertical antenna. Also it won't give results that a beam antenna will provide, but you'll find that the improvement obtained in received and transmitted signal strength will be well worth the construction effort.

Acknowledgement

My thanks to Joe Saugier, K6CD, for reviewing the manuscript and for much helpful engineering advice.

Reference

1. A. Wilson, W6NIF, "Dipole Sloping Inverted Vee," *ham radio*, February, 1969, page 48.

HRH

"This is K9ARF apologizing to the FCC and all other listeners for the comment made when my desk drawer fell on my foot."

More details? Ad Check page 88.

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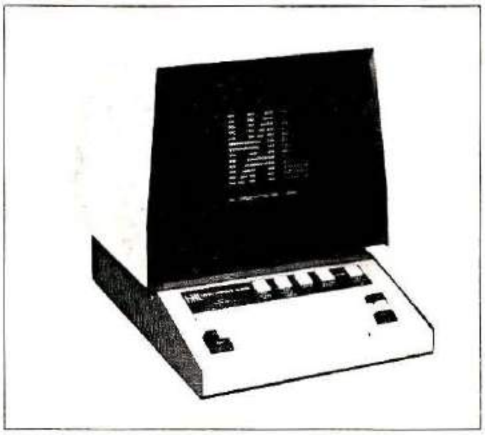

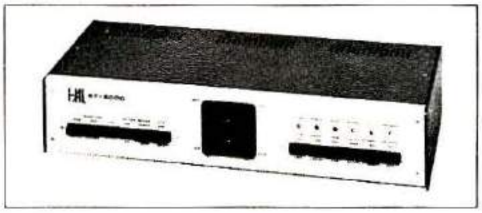

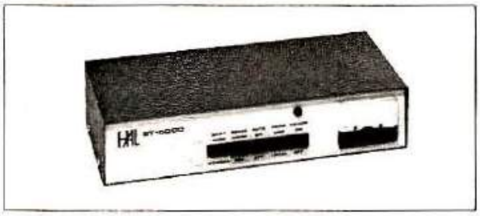

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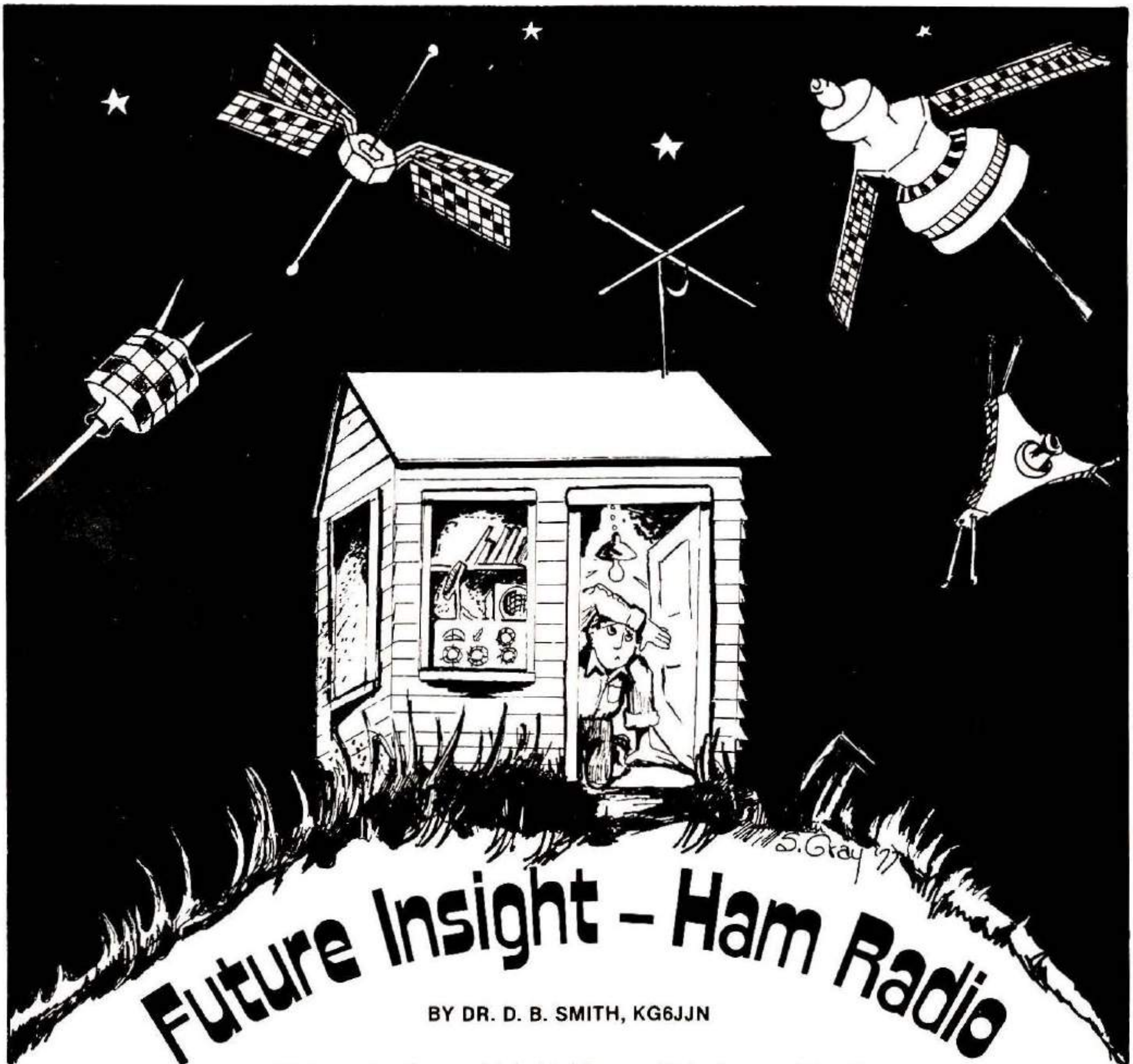

Future Insight – Ham Radio

BY DR. D. B. SMITH, KG6JJN

With apologies to Alvin Toffler and his Future Shock

You say you wonder what ham radio is coming to these days? Repeaters, slow-scan television, all kinds of nets taking up the 75-meter band, programmed DX from exotic places . . . Are these changes getting to you? How about taking a look at what it could grow into many years from now. Come over here and listen to this new converter circuit that I've been haywiring together; it's a new gadget and I'm not too sure I got it working right, but I heard something the other night. Mind you — the dial calibration is not too good yet, so I'm not sure what year I've tuned in, but here goes . . .

"Breaker — breaker DX, from WZ2ABC . . ."

"WZ2ABC, your call has been sked to me by the SatCom Scan Searcher; this is KG6XYZ."

"Roger dodger; got you on Visual, KG . . . I see we got Channel 8899. I got that channel assigned to me last year and won a bundle on it in the Random Sked Raffle. How about that, Old Person?"

"That's a roger. You're pegging my meter at the 10-4 mark, and you get one little green light, to boot. Nice signal through the bird."

"Thanks good buddy. I notice

we were assigned satellite No. 765; real interesting. You got two green lights at this end, and my processor indicates we have four hours of use before losing it."

That's a big roger dodger. Say, WZ, notice on the soft copy that your handle is Heat Sink."

"Roger dodger . . . like to make up some homebrew from time to time. Got me a new snap-it-together CW simulator kit the other day. All you gotta do is snap ten pieces together, and you can produce good old-fashioned Charlie William right off the processor keyboard!"

"Well . . . can't see the advantage of that over the built-in. What else can it do?"

"Makes CW from 'phone . . . but you have to watch your accent, though; gets most of it spelled okay in NewPhonics. Another few green stamps and you can add a conversion to Old American. Say, KG, how come you aren't using the long wire?"

"Aw . . . got sick of it after the first few years out here; just too easy. Besides, it's only hooked up to about 95 per cent of the licensed hams. Have to hit a bird to get the rest, anyway, so thought I'd do some real hamming tonight by wireless."

"Yeh, know what you mean, but I sure like it, though. Don't know what I did before the cable went in. Used to hear noise and hiss on so many of the signals; takes all of the fun out of the hobby when you hear some noise on a signal, ya know? Some of the signals used to fade out just like they had equipment trouble when I used to work the old terrestrial repeaters."

"Yeh, WZ, I know . . . but seems to me that there's more challenge in it. After all, you have to wait for one of the satellites to be assigned to you by the Scanner, and you can only get ten kW from most of 'em, anyway! Heard there's gonna be a new series up with 100 kW . . . what say, WZ?"

"News to me. Will they let the CB Extras work it, KG?"

"Roger dodger. They get all the Tech privileges when they pass the 60-wpm typing test. Sure was a good thing when The Lobby got incentive licensing for CB, WZ. Know what I mean?"

"Yeh, but as I remember, they took away half of the 500 channels, and then gave 'em back to only those who could pass the typing test. Beats me why they didn't use technical exams, instead."

"Roger dodger that, WZ . . . just like the days before guys started implanting CW converters under their scalps; you had to pass higher-speed *CW* to use additional *'phone* channels."

"Hey, that's right! Think they used to call 'em straps, or bands, or something like that, before everything got channelized, Old Person."

"Roger dodger. With this twenty-step Am-Cit incentive program, I guess a lot of terminology has been changed. Say . . . what did 'break' used to mean in the Old Days? I note by the print-out you have 5 years in, and are a certified *Old Timer*."

"Yeh, KG; and I'm working on my next five to make me an *Ancient*. 'Break used to mean that you were passing the cable over to the other station. Then it was adopted in place of a Q-call . . . *QRZ*, I think it was.

"Gee, WZ, wonder if they had any way of starting a chat before that?"

"Yeh, KG, my old *Almanac for Ancients* shows something called *CQ* as predating *QRZ*; and a note here states that in rare instances it was used to interrupt a visit, but almost never used to indicate an emergency."

"Roger dodger. Very interesting to get that background. Say . . . I heard they used to do some 'bare-wire' work back then . . . had some luck, too."

"Right, KG, but haven't tried it lately myself, though; too much hassle. Weak signals, noise, all that. It's done by beaming your raw rf straight at the other station, if you happen to know where one might be that has the same capability."

"Roger dodger, WZ; probably by sked. How did the other station pick up the rf?"

"Had to have his own antenna, rather than use the short wire into the local antenna co-op."

"Roger dodgeroodle, Old Person. Boy, that must have looked like a mess around the ol' high-rise; and I'll bet it was a hassle trying to get SatCom Scan to assign a channel . . . oops, forgot. They would be working direct. Really ancient, eh what?"

"Right, KG, and to make it worse, they used to modulate by amplitude, before it was outlawed. No advantage to it at all. Well, your video is getting a bit hazy on my screen, so I'll sign. Have punched in a 925 to give you a QSL entry into your *pross*; 10-73, Old Buddy."

"10-73, Old Person." . . . Bleep . . .

"Breaker-breaker, WZ2ABC, this is an automatic recording from your friendly Amateur Cable Company. How would you like the hiss-free, loud-signal advantage of world-wide cable communications just for a small monthly billing to your compu-account? Well, all you have to do is punch a #$10-4 into your keyboard, and . . ."

"Bleep; cancel message, de WZ2ABC clear."

"Bleep; WZ2ABC from AmCabCom. Won't you reconsider? Think of the fine signal reports, and . . ."

"Bleep, AmCabCom from WZ2ABC . . . discontinue sales routine #324. This is not a live station you're working, but a synthesized compu-station."

"AmCabCom here. Say, just wanted to tell you, fella, what a good deal you're missing. How would you like to have a fine business chat with a station just like mine, anytime you want? Well, I'm not a real person, but a computer . . . and it's mightly fine to subscribe to our service so that you can have a chat anytime you want, even when the channel doesn't answer. Think how impressed the other hams will be when they hear you getting all those DX contacts, when they can't even get a clear channel assigned.
And, with our new generation of conversation — Conver IV — they will never know whether you're talking to a real ham, or being answered by your service. Just punch #$73 into your pross, and . . ."

"Bleep. Synthetic compu-station clear by command."

"Bleep. This is KG6XYZ closing the SynCompStat. For all interested hams and CB Extras on channel, you, too, can work KG6 by subscribing to the CEEBAM DX Bureau. Your calls will receive guaranteed DX via our fine Radio Buoys and Long Wire Beacons. Just punch a ##$ into your processor for more information." . . . Bleep . . .

"Attention all holders of licenses in the Senior Citizens' Bands: These bands once were issued to another class of license, and if you would like to save these channels for your own use, just punch a 457$%& into your pross and join the 'Fight to Save 220 Megs, Inc.'' . . . Bleep . . .

"Attention all holders of Youth Band equipment: Say, gang, did you know that six meters once belonged to adults? Well . . . let us tell you what you can do to have some real fun with your 1-kW model-controlled equipment and help save the band, too . . ."

Bleep. Bleep. **HRH**

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STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

1. TITLE OF PUBLICATION: HAM RADIO HORIZONS — DATE OF FILING: 10/1/77

FREQUENCY OF ISSUE: MONTHLY — NO. OF ISSUES PUBLISHED ANNUALLY: 12 — ANNUAL SUBSCRIPTION PRICE: $10.00

LOCATION OF KNOWN OFFICE OF PUBLICATION: MAIN ST., GREENVILLE, N.H. 03048

LOCATION OF THE HEADQUARTERS OR GENERAL BUSINESS OFFICES OF THE PUBLISHERS: MAIN ST., GREENVILLE, N.H. 03048

PUBLISHER: T.H. TENNEY, MAIN ST., GREENVILLE, N.H. 03048

EDITOR: J.R. FISK, MAIN ST., GREENVILLE, N.H. 03048

OWNER:

NAME	ADDRESS
COMMUNICATIONS TECHNOLOGY INC.	MAIN ST., GREENVILLE, N.H. 03048
T.H. TENNEY JR.	MAIN ST., GREENVILLE, N.H. 03048

KNOWN BONDHOLDERS, MORTGAGEES, AND OTHER SECURITY HOLDERS:

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T.H. TENNEY JR.	MAIN ST., GREENVILLE, N.H. 03048

EXTENT AND NATURE OF CIRCULATION	AVERAGE NO. COPIES EACH ISSUE DURING PRECEDING 12 MONTHS	ACTUAL NO. COPIES OF SINGLE ISSUE PUBLISHED NEAREST TO FILING DATE
TOTAL NO. COPIES PRINTED	38,937	41,500
PAID CIRCULATION: SALES THROUGH DEALERS AND CARRIERS, STREET VENDORS AND COUNTER SALES	10,398	11,339
MAIL SUBSCRIPTIONS	18,555	25,626
TOTAL PAID CIRCULATION	28,953	36,965
FREE DISTRIBUTION BY MAIL, CARRIER OR OTHER MEANS: SAMPLES, COMPLIMENTARY, AND OTHER FREE COPIES	3,565	2,626
TOTAL DISTRIBUTION	32,518	39,591
COPIES NOT DISTRIBUTED: OFFICE USE, LEFT OVER, UNACCOUNTED, SPOILED AFTER PRINTING	5,801	1,700
RETURNS FROM NEWS AGENTS	538	209
TOTAL	38,937	41,500

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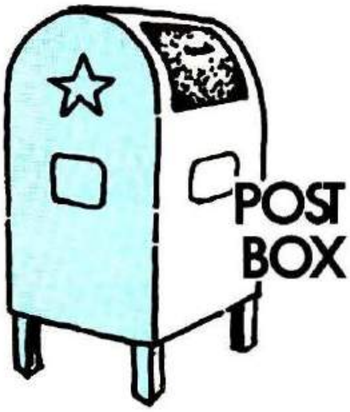

Dear Horizons:

I found your article on CB radio (October, 1977) quite interesting. Although the article was accurate, it totally overlooked the almost total disregard for FCC rules that many CBers seem to exhibit. Forget the INTENT of the service — look what's happening in actual use.

So called "amateur" linears are being manufactured and distributed for the exclusive use of bootleg CBers. Amateur transceivers seem to have a larger market among the CBers than the amateur. CB signals are heard en masse up to 27.65 MHz and occasionally will even get up into the bottom of the 10-meter amateur band. CB operators have been heard operating on 10 meters as hams with fictitious calls. CB DXing is common (forget the 150-mile limit). Overpowered CB stations have been causing tremendous interference on the 10 meter band — I have personally had QSOs cut short by CB splatter. Probably the most frustrating thing is the apparent inability of the FCC to enforce its own rules and bring the CB service back under control. As far as I'm concerned, the 11-meter CB service should be phased out, 11 meters given back to the amateurs, and a new CB service should be established in the uhf spectrum, far away from any other radio service. Maybe then it would in fact be a service, rather than the Citizens Band Dis-service it is now.

Stanley A. Holz, WA1SFN
Whitefield, New Hampshire

Unfortunately, Stan, everything you say about the abuse of CB is true. Equally unfortunate is the fact that I could match you point for point with wrongdoings in the Amateur Service, so we (as a service) cannot afford a holier-than-thou stance. But neither of these arguments addresses itself to the main point of our publishing articles about CB and Amateur Radio. In order to understand the real point, you have to first face and understand a couple of realities: 1. The Amateur Radio Service must show a need for the space it occupies. We have been given less than subtle warnings about this from the people who will represent us at the World Administrative Radio Conference; 2. Good deeds and technical achievements are no longer enough to warrant the many MHz that we hold exclusive rights to. In today's world, people *are what count, therefore we must grow — or die.*

Horizons *is not here to solve the FCC's problem with CB; we are here to help people become hams. There are millions of individuals who have been exposed to the thrill of communicating within the limited possibilities of CB. If we can instill in a small percentage of them the same pride in Amateur Radio, pride in accomplishment, that most of us have developed, then we have helped a lot of good people. There is indeed a gap of prejudice and stubbornness to be bridged here, but you cannot build a bridge on one shore only — you must have a foundation on the other side too. A foundation based on the "you-guys-are-all-bad-and-I'm-going-to-save-you" theory is set in quicksand. If you would read some of the CB publications of recent date, you'll see that they, too, are becoming increasingly concerned with the actions of their "bad apples," and are casting about for ways to handle the situation. That's a good sign.*

The solution that will work for CB is one that they themselves come up with, not one that is imposed by Amateurs. In the meantime, let's not be afraid to show the "good apples" what our good life is all about, and let's make sure that we keep our service worthy of being a goal. ***Editor***

Dear Horizons:

I am enclosing a check for a subscription to *Horizons*. You are doing a fine job of informing that group of people who are looking past CB toward Ham Radio.

When you get to writing about Novices or old timers getting into CW traffic handling, please tell them about the "Hit and Bounce Slow Net." It is a young offspring of the very old and respected independent "Hit and Bounce Net." The HBSN meets Friday, Saturday, Sunday, and Monday at 7:30 AM EST on 3714 kHz, and at 8:00 AM EST on 7140 kHz. We try to keep the speed down to 10 wpm, and welcome Novices and newcomers.

This is a chance for a Novice to learn a little about CW traffic handling and work the rare state of Delaware as a bonus.

Dan Bucher, WA3WPY
Wilmington, Delaware

Thanks for writing Dan, and I hope many beginners see this reminder of your Net. We cannot publish a Net Directory here, but if our readers know of other nets that are tailored to the Novice or beginning traffic handler, perhaps we can mention them from time to time. ***Editor***

Dear Horizons:

I just wanted to drop you a quick line to let you know that the first issue of your magazine is just great! I hope you manage to keep the quality as high in the future. Most magazines designed with the beginner in mind are cheaply done and boring, but you manage to avoid all that. As a beginner just starting to study for my Novice license I want to get *Horizons* each month.

Edward Hall
Fort Lauderdale, Florida

Dear Horizons:

Spend a tropical isle vacation (April, 1977) talking to Americans? Unthinkable!

Mary M. Steffens, WB7OSH
Pullman, Washington

But you forget, Mary, that some people will do almost anything to escape from New England winter weather! ***Editor***

Dear Horizons:

I would like to congratulate you on your great magazine. It lives up to everything you said it would be. I enjoyed my first two issues greatly, and anxiously await the next ones. It is not too complicated, but loaded with information. Keep up the good work.

Daniel Baker, WB3AYC
Hanover, Maryland

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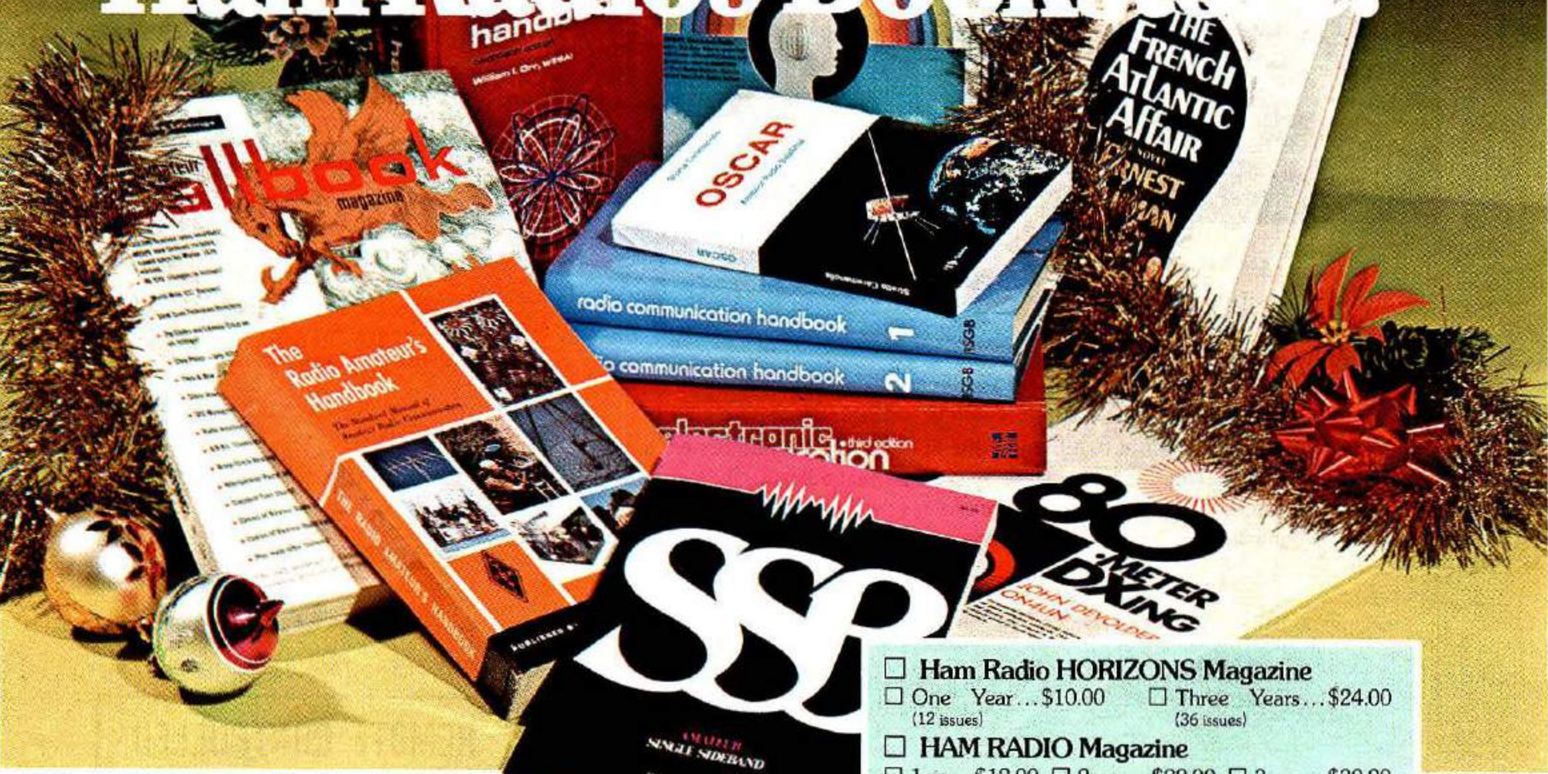

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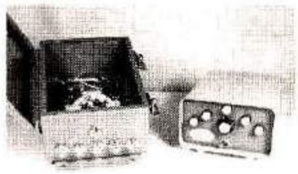

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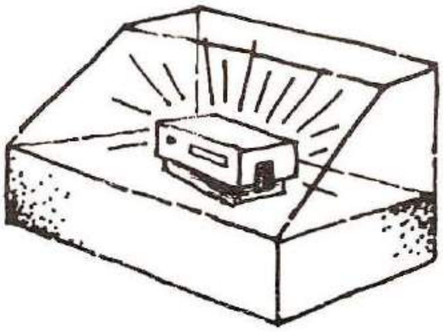

SHOWCASE

Daytronics Iambic Keyer

Daytronics Company, of Selden, New York, has recently announced a new Iambic Electronic Keyer designed to be used by any amateur radio operator, Novice to Extra class. The *IK-1 Iambic Keyer* is a fully automatic keyer which greatly reduces operator fatigue by enabling the operator to send perfect code with little effort. Features included are both DIT and DAH paddle memories, self-completing characters, automatic spacing, automatic weighting, and a built-in sidetone speaker for monitoring. The transistorized keying circuit will accommodate either grid-block (negative grounding) or cathode-keyed (positive grounding) transmitters. The IK-1 is able to send at speeds from below 5 wpm to over 40 wpm. Sturdy paddles are also available which come mounted on a beautifully finished wood base. The paddles can be set for wide, medium, or narrow grip spacing.

The IK-1 is attractively priced at $39.75 for the kit version; $65.00 with a set of paddles. The factory assembled version is $56.95; $80.00 with paddles. Write to Daytronics company, 12 Oakdale Ave., Post Office Box 426, Selden, New York 11784, or use *ad check* page 88.

OSCAR Amateur Radio Satellites

For most amateurs, obtaining information about any of the Oscar satellites has been somewhat of a piecemeal process. Almost every area of interest was covered in a separate publication or source, and some information just did not seem to be available at all.

Author and engineer Stratis Caramanolis has written a very useful book, *OSCAR AMATEUR RADIO SATELLITES*, that ties it all together in one place. The original was published in German, and now an English-language version is being distributed by the Radio Society of Great Britain, and by Ham Radio's Communications Bookstore.

Almost any question that you may have about amateur radio satellites can be answered by consulting *OSCAR Amateur Radio Satellites*. It shows a high degree of competence in presenting the technical and theoretical facts of satellite operation, but at the same time these facts are covered in language that the non-engineer can understand and work with. The author uses just enough mathematics to prove whatever theory or point is being discussed, but not so much as to scare away

WHY WRAP-UP 1977

A word of explanation

During the past year you've probably wondered at one time or another why the cover date on *Horizons* was so far ahead — why you were receiving the August issue in early June, or the December issue in early October.

The original idea was to give adequate time for newsdealers and retailers to distribute *Horizons* to each of their various locations. However, experience has shown that this is not really necessary; at the same time this postdating has proved difficult to most all of us, including subscribers and advertisers. We are correcting this problem with this *Wrap-Up 1977* issue.

This issue would normally have been dated January, 1978; by calling it Wrap-Up 1977, December 31, 1977, we have been able to move future cover dates back one month, thus putting them more in line with customary dating practices.

To provide each subscriber with the proper number of issues we will subtract one month from your expiration date on the label — **you will still receive the appropriate number of issues.** To clarify even more: if your scheduled expiration was 0378 (March 1978) it will now be 0278 (February 1978). As you'll recall, according to our old method of dating, you would have received the March issue in early January but now that issue will be the February issue.

There will be *no* changes in subscription terms, number of issues, or mailing schedules. You will still receive 12 issues per year (one per month).

It may sound mixed up, but it's really very simple. No one's subscription has been changed. The only change has been in the cover-dating procedure. Perhaps it's confusing for now, but it should become much simpler in the future.

More details? Ad Check page 88.

any neophyte to amateur radio or satellite communications.

The book starts out with a discussion of the solar system from the first misconceptions that placed the earth at the center of the universe, and brings you right through the changes in scientific thinking into the current period of knowledge, which was started by Johannes Kepler. The first three laws formulated by Kepler are essential in understanding the mechanics of orbiting bodies, no matter what size they are. The book uses this Keplerian foundation to build a subsequent discussion of satellite orbital mechanics starting with a simple explanation of the trajectory of a projectile and then developing this into a trajectory that has no terminus, thus being an orbit.

Once the essential mechanics of orbits and satellite theory are taken care of, the author gets into a good explanation of satellite types, systems, control, power requirements, and structures. This is followed by a chapter on the fundamentals of telecommunications by means of satellites, which includes such areas as free-space loss (of signal strength) and receiver sensitivity — both important considerations if you plan to use a satellite system.

All of this groundwork material takes up a good portion of the book, but it is interesting and essential reading if you are to really understand what makes any satellite behave the way it does. Chapter seven is the first one that is devoted entirely to amateur radio satellites, and it starts with the background of amateur work in planning, building, and launching the first OSCAR. It continues with a history of each amateur satellite right through to the current OSCARs 6 and 7.

This chapter is followed by one that, logically, devotes many pages to detailed descriptions of all the systems that go to make up an OSCAR satellite package — transponders, telemetry, antennas, receivers, modes, decoding, and much more. It explains how you can calculate orbital information, how you can interpret the telemetry data that indicates the condition of the spacecraft systems, and what you need at your home (ground) station to work with satellites.

The last chapter is devoted to the subject of learning with satellites. It is a section designed to acquaint educators with the possibilities of classroom use of amateur satellite signals and experiments. The author points out some of the uses that have been made of this material, and provides names and addresses where those interested can obtain more information. Some samples of techniques useful in classrooms are given, such as

More details? Ad Check page 88.

measurement and explanation of Doppler effects, orbital data, and transmission of amateur television and weather satellite pictures through the OSCAR spacecraft. Future satellites are discussed, but because of the many variables in timing of launch vehicles, satellite construction, and the like, this coverage can be only tentative at best.

All-in-all, the book is recommended as an excellent reference for the amateur (or anyone else) who is curious about any phase of satellites, or who is seriously contemplating the use of OSCAR for communication or educational purposes. *OSCAR Amateur Radio Satellites*, by Stratis Caramanolis, is 194 pages, paperback, and is $8.50 postpaid from Ham Radio's Communications Bookstore, Greenville, New Hampshire 03048; order RS-O.

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The MA1003 Digital Clock Module for vehicular or portable applications is priced at $24.95. If there are no Radio Shack stores near you, write H. L. Siegel, National Publicity and Promotion Manager, 2617 West Seventh Street, Fort Worth, Texas 76017, or Phone (817) 390-3272, or use *ad check* on page 88.

Erratic Errors

Things do go wrong at times when getting an article into print. We are indeed fortunate when a reader calls a mistake to our attention. Then the problem becomes one of advising our readership so they will know too. Take a moment to check the items below; it could clear up something that has been puzzling you.

Happy birthday

A *Newsline* item in the March, 1977, issue of *Horizons*, indicating the age of the earth as 20 billion years, was questioned by several of our readers. We checked with our source for that bit of information, and, to the embarrassment of both of us, found it to be in error. The 20-billion year figure refers to the *Universe*, with the earth still pegged at just over the 4-billion year mark. Either way, that's a lot of birthday candles!

Integrated-circuit keyer

The following should help the builders of the integrated circuit keyer by WA5TRS, in the May, 1977, issue of *Horizons*. The circuit shown in Figs. 2, 4, and 6, when combined, is the recommended keyer. The printed-circuit board is shown twice actual size, but can be purchased for $3.50 from G. R. Whitehouse, 15 Newbury Dr., Amherst, New Hampshire 03031. Also, a complete kit that includes the PC board, sidetone generator, and electrical components, is available for $19.95 from Whitehouse.

The reed relay is available for $2.10 by writing to Electronics Application Co., Attn: Annie Williams, 4918 Santa Anita Ave., El Monte, California 91734.

Sunspots

We regret that the following list of sources of material was inadvertently omitted from the article, "The Strange World of Sunspots," by William I. Orr, W6SAI, in the July, 1977, issue of *Ham Radio Horizons*.

* *Ionospheric Radio Propagation*, Superintendent of Documents, Government Printing Office, Washington, DC 20402.

* G. Jacobs and S. Leinwoll, "Cycle 20: The Declining Years," *CQ*, November, 1969, page 44.

* T. Cohen and G. Jacobs, "Solar Activity Update: The Transition Years," *CQ*, January, 1976, page 18.

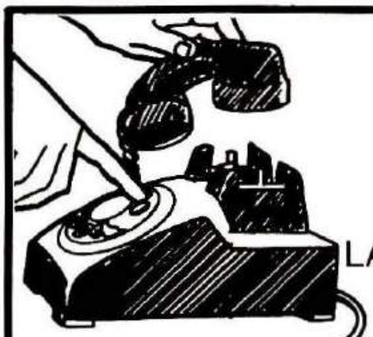
* E. Schultz, "Don't Be Afraid of the Big Bad Blackout," *CQ*, November, 1969, page 31.

* E. Tilton, "The DXer's Crystal Ball," *QST*, June, July, August, September, 1975.

* G. Jacobs, "Sunspots and the Solar Influence Upon High Frequency Radio Communications," unpublished thesis, University of Maryland.

* T. Cohen and P. Lintz, "The Sunspot Cycle Analysis and Prediction," *CQ*, March, 1974, page 24.

* G. Jacobs and E. Martin, "The Dwindling High-Frequency Spectrum," *IRE Transactions of the Professional Group on Communications Systems*, Volume CS-9-4, December, 1961.



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DEADLINE 15th of fourth preceding month.

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

STOLEN EQUIPMENT: DRAKE ML-2, SN 11546, with 34/94, 94/94, 16/76, 07/67, 22/82, and 25/85 crystals installed. Stolen from Tom Fraser, WAØQQT, Colorado Springs, Colorado. Call (303) 635-8911, Ext. 3874. Anyone desiring to list stolen Amateur radio equipment please send information to Colorado Council of Amateur Radio Clubs C/O Charles E. Myers WØRNT, 1120 Yosemite Drive, Colorado Springs, CO 80910. Please include as much identification information as possible. Free distribution will be made to all Amateur radio magazines and Colo. Amateur radio clubs. Funds for postage and printing will be greatly appreciated.

NORTH CAROLINA QSO PARTY — from 1900Z Dec. 2 through 0100Z Dec. 4. Suggested frequencies are plus/minus 10 kHz: cw, 3560 7060 14060 21060 28060; Novice, 3720 7120 21120 28120; ssb, 3900 7270 14290 21390 28590. Out-of-state stations transmit RS(T) and state, province or country. NC stations send RS(T) and NC county. Logs must be postmarked no later than Jan. 10, 1978 and sent to: Alamance ARC Inc., 2822 Westchester Dr., Burlington, NC 27215. For additional information write K4EG.

SECOND ANNUAL WELLESLEY AMATEUR RADIO Society QSO Party from 0100Z November 19th to 1900Z November 20th. Exchange RS(T) and ARRL Section or Country with W1TKZ on 3.950, 7.250, 14.310, 21.400, 28.600, and 146.52 (phone) or 3.720, 7.120, 21.120, and 28.120 (CW). QSL and long SASE to W.A.R.S., 324 Washington St., Wellesley, MA 02181.

SOCIETY OF WIRELESS PIONEERS second annual membership on-the-air CW QSO Party, December 17th & 18th for the full GMT period. All members with Amateur licenses are encouraged to call CQ SOWP 55 kHz up from the low end of each Amateur band. Information from Bill Wilmot, K4TF, 1630 Venus Street, Merritt Island, FL 32952.

MICROCOMPUTER INTERFACING WORKSHOP, December 8 - 10, 1977. A three-day workshop based on the 8080 and 8085 microprocessors, with over 20 microcomputers available for participant use; and . . .

DIGITAL ELECTRONICS FOR AUTOMATION WORKSHOP, December 6 & 7, 1977. A two-day workshop based on small-scale and medium-scale TTL integrated circuits, with in-depth lectures and individual breadboarding stations. For more information on these workshops, write Dr. Norris Bell, V.P.I. and S.U. Continuing Education Center, Blacksburg, VA 24061, or call (703) 951-6328.

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.

THE OAK PARK HIGH SCHOOL Electronics Club presents a Swap and Shop on Thanksgiving Sunday, Nov. 27, 1977 at Oak Park High School, Oak Park, Michigan, 48237. Refreshments and Door Prizes. Donation $1.00. Table $1.00.

LaPORTE ARC'S WINTER HAMFEST, Sunday, February 26, 1978 at the LaPorte Civic Auditorium, 50 miles southeast of Chicago. Plenty of room, free tables, good food. Donation $2 at gate. Talk in on 01/61 and 52 simplex. LPARC, Box 30, LaPorte, IN 46350.

HAM RADIO HORIZONS

Index to Volume I — 1977

This index covers all articles published in *Ham Radio Horizons* during 1977. The articles are listed alphabetically under each category along with the author, page number and month. Categories are: Antennas; Construction; Features; Fiction; Fm and Repeaters; License Preparation; Miscellaneous Technical; Operating; Old-Time Radio; Propagation; Receivers; Regulations and FCC; Satellites; and Station Equipment.

ANTENNAS

CONSTRUCTION

FEATURES

FICTION

FM AND REPEATERS

LICENSE PREPARATION

MISCELLANEOUS TECHNICAL

OLD-TIME RADIO

OPERATING

PROPAGATION

RECEIVERS

REGULATIONS AND FCC

SATELLITES

STATION EQUIPMENT

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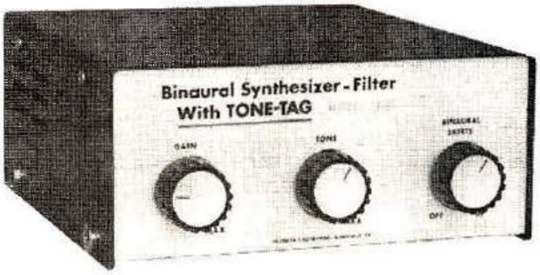

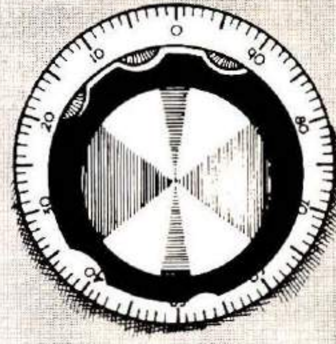

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KENWOOD

...pacesetter in amateur radio

TS-520S

AND DG-5 DIGITAL FREQUENCY DISPLAY

The TS-520S combines all of the fine, field-proven characteristics of the original TS-520 together with many of the ideas and suggestions for improvement from amateurs worldwide.

FULL COVERAGE TRANSCEIVER

The TS-520S provides full coverage on all amateur bands from 1.8 to 29.7 MHz. Kenwood gives you 160 meter capability, WWV on 15.000 MHz., and an auxiliary band position for maximum flexibility. And with the addition of the TV-506 transverter, your TS-520S can cover 160 meters to 6 meters on SSB and CW.

DIGITAL DISPLAY DG-5 (option)

The Kenwood DG-5 provides easy, accurate readout of your operating frequency while transmitting *and* receiving.

OUTSTANDING RECEIVER SENSITIVITY AND MINIMUM CROSS MODULATION

The TS-520S incorporates a 3SK35 dual gate MOSFET for outstanding cross modulation and spurious response characteristics. The 3SK35 has a low noise figure (3.5 dB typ.) and high gain (18 dB typ.) for excellent sensitivity.

NEW IMPROVED SPEECH PROCESSOR

An audio compression amplifier gives you extra punch in the pile ups and when the going gets rough.

VERNIER TUNING FOR FINAL PLATE CONTROL

A vernier tuning mechanism allows easy and accurate adjustment of the plate control during tune-up.

FINAL AMPLIFIER

The TS-520S is completely solid state except for the driver (12BY7A) and the final tubes. Rather than subsitute TV sweep tubes as final amplifier tubes in a state of the arc amateur transceiver, Kenwood has employed two husky S-2001A (equivalent to 6146B) tubes. These rugged, time-proven tubes are known for their long life and superb linearity.

HIGHLY EFFECTIVE NOISE BLANKER

An effective noise blanking cricuit developed by Kenwood that virtually eliminates ignition noise is built into the TS-520S.

RF ATTENUATOR

The TS-520S has a built-in 20 dB attentuator that can be activated by a push button swich conveniently located on the front panel.

PROVISION FOR EXTERNAL RECEIVER

A special jack on the rear panel of the TS-520S provides receiver signals to an external receiver for increased station versitility. A switch on the rear panel determines the signal path . . . the receiver in the TS-820 or any external receiver.

VFO-520 — NEW REMOTE VFO

The VFO-520 remote VFO matches the styling of the TS-520S and provides maximum operating flexibility on the band selected on your TS-520S.

AC POWER SUPPLY

The TS-520S is completely self-contained with a rugged AC power supply built-in. The addition of the DS-1A DC-DC converter (optional) allows for mobile operation of the TS-520S.

EASY PHONE PATCH CONNECTION

The TS-520S has 2 convenient RCA phono jacks on the rear panel for PHONE PATCH IN and PHONE PATCH OUT.

CW-520 — CW FILTER (OPTION)

The CW-520-500 Hz filter can be easilly installed and will provide improved operation on CW.

AMPLIFIED TYPE AGC CIRCUIT

The AGC circuit has 3 positions (OFF, FAST, SLOW) to enable the TS-520S to be operated in the optimum condition at all times whether operating CW or SSB.

The TS-520S retains all of the features of the original TS-520 that made it tops in its class: RIT control • 8-pole crystal filter • Built-in 25 KHz calibrator • Front panel carrier level control • Semi-break-in CW with sidetone • VOX/PTT/MOX • TUNE position for low power tune up • Built-in speaker • Built-in Cooling Fan • Provisions for 4 fixed frequency channels • Heater switch.

TS-520 Specifications

Amateur Bands: 160-10 meters plus WWV (receive only)
Modes: USB, LSB, CW
Antenna Impedance: 50-75 Ohms
Frequency Stability: Within ±1 kHz during one hour after one minute of warm-up, and within 100 Hz during any 30 minute period thereafter
Tubes & Semiconductors:
Tubes 3
(S2001A x 2, 12BY7A)
Transistors 52
FETs 19
Diodes 101
Power Requirements: 120/220 V AC, 50/60 Hz, 13.8 V DC (with optional DS-1A)
Power Consumption: Transmit: 280 Watts Receive: 26 Watts (with heater off)
Dimension: 333(13⅛) W x 153 (6-0) H x 335(13- (13-3/16) D mm(inch)
Weight: 16.0 kg(35.2 lbs)

TRANSMITTER
RF Input Power: SSB: 200 Watts PEP CW: 160 Watts DC
Carrier Suppression: Better than -40 dB
Sideband Suppression: Better than -50 dB
Spurious Radiation: Better than -40 dB
Microphone Impedance: 50k Ohms
AF Response: 400 to 2,600 Hz

RECEIVER
Sensitivity: 0.25 uV for 10 dB (S+N)/N
Selectivity: SSB:2.4 kHz/-6 dB, 4.4 kHz/-60 dB
Selectivity: CW: 0.5 kHz/-6 dB, 1.5 kHz/-60 dB (with optional CW-520 filter)
Image Ratio: Better than 50 dB
IF Rejection: Better than 50 dB
AF Output Power: 1.0 Watt (8 Ohm load, with less than 10% distortion)
AF Output Impedance: 4 to 16 Ohms

DG-5
SPECIFICATIONS
Measuring Range: 100 Hz to 40 MHz
Input Impedance: 5 k Ohms
Gate Time: 0.1 Sec.
Input Sensitivity: 100 Hz to 40 MHz . . . 200 mV rms or over, 10 kHz to 10 MHz . . 50 mV or over
Measuring Accuracy: Internal time base accuracy ±0.1 count
Time Base: 10 MHz
Operating Temperature: -10° to 50° C/14° 122° F
Power Requirement: Supplied from TS-520S or 12 to 16 VDC (nominal 13.8 VDC)
Dimensions: 167(6-9/16) W x 43(1-11/16) H x 268(10-9/16) D mm(inch)
Weight: 1.3 kg(2.9 lbs)

DG-5

The luxury of digital readout is available on the TS-520S by connecting the DG-5 readout (option). More than just the average readout circuit, this counter mixes the carrier, VFO, and heterodyne frequencies to give you your exact frequency. This handsomely-styled accessory can be set almost anyplace in your shack for easy to read operation . . . or set it on the dash-board during mobile operation for safety and convenience. Six bold digits display your operating frequency while you transmit and receive. Complete with DH (display hold) switch for frequency memory and 2 position intensity selector. The DG-5 can also be used as a normal frequency counter up to 40 MHz at the touch of a switch. (Input cable provided.)
NOTE: TS-520 owners can use the DG-5 with a DK-520 adapter kit.

KENWOOD

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TS-820S

WITH DIGITAL FREQUENCY DISPLAY

We told you that the TS-820 would be best. In little more than a year our promise has become a fact. Now, in response to hundreds of requests from amateurs, Kenwood offers the TS-820S* . . . the same superb transceiver, but with the digital readout factory installed. As an owner of this beautiful rig, you will have at your fingertips the combination of controls and features that even under the toughest operating conditions make the *TS-820S the Pacesetter that it is.*

Following are a few of the TS-820S' many exciting features.

PLL • The TS-820S employs the latest phase lock loop circuitry. The single conversion receiver section performance offers superb protection against unwanted cross-modulation. And now PLL allows the frequency to remain the same when switching sidebands (USB, LSB, CW) and eliminates having to recalibrate each time.

DIGITAL READOUT • The digital counter display is employed as an integral part of the VFO readout system. Counter mixes the carrier VFO, and first heterodyne frequencies to give *exact* frequency. Figures the frequency down to 10 Hz and digital display reads out to 100 Hz. Both receive and transmit frequencies are displayed in easy to read, Kenwood Blue digits.

SPEECH PROCESSOR • An RF circuit provides quick time constant compression using a true RF compressor as opposed to an AF clipper. Amount of compression is adjustable to the desired level by a convenient front panel control.

IF SHIFT • The IF SHIFT control varies the IF passband without changing the receive frequency. Enables the operator to eliminate unwanted signals by moving them out of the passband of the receiver. This feature alone makes the TS-820S a pacesetter.

*The TS-820 and DG-1 are still available separately.

TS-600

TV-506

An easy way to get on the 6 meter band with your TS-520/520S, TS-820/820S and most other transceivers. Simply plug it in and you're on . . . full band coverage with 10 watts output on SSB and CW.

Experience the excitement of 6 meters. The TS-600 all mode transceiver lets you experience the fun of 6 meter band openings.

This 10 watt, solid state rig covers 50.0-54.0 MHz. The VFO tunes the band in 1 MHz segments. It also has provisions for fixed frequency operation on NETS or to listen for beacons. State of the art features such as an effective noise blanker and the RIT (Receiver Incremental Tuning) circuit make the TS-600 another Kenwood "Pacesetter".

TR-8300

Experience the luxury of 450 MHz at an economical price.

The TR-8300 offers high quality and superb performance as a result of many years of improving VHF/UHF design techniques. The transceiver is capable of F_3 emission on 23 crystal-controlled channels (3 supplied). The transmitter output is 10 watts.

The TR-8300 incorporates a 5 section helical resonator and a two-pole crystal filter in the IF section of the receiver for improved intermodulation characteristics. Receiver sensitivity, spurious response, and temperature characteristics are excellent.

KENWOOD
...pacesetter in amateur radio

TS-700S
WITH DIGITAL FREQUENCY DISPLAY

Check out the new "built-ins": digital readout, receiver pre-amp, VOX, semi-break in, and CW sidetone! Of course, it's still all mode, 144-148 MHz and VFO controlled.

Features: Digital readout with "Kenwood Blue" digits • High gain receiver pre-amp • 1 watt lower power switch • Built in VOX • Semi-break in on CW • CW sidetone • Operates all modes: SSB (upper & lower), FM, AM and CW • Completely solid state circuitry provides stable, long lasting, trouble-free operation • AC and DC capability (operate from your car, boat, or as a base station through its built-in power supply) • 4 MHz band coverage (144 to 148 MHz) • Automatically switches transmit frequency 600 KHz for repeater operation. Simply dial in your receive frequency and the radio does the rest... simplex, repeater, reverse • Or accomplish the same by plugging a single crystal into one of the 11 crystal positions for your favorite channel • Transmit/Receive capability on 44 channels with 11 crystals.

VFO-700S

Handsomely styled and a perfect companion to the TS-700S. This unit provides you with the extra versatility and the luxury of having a second VFO in your shack. Great for split frequency operation and for tuning off frequency to check the band. The function switch on the VFO-700S selects the VFO in use and the appropriate frequency is displayed on the digital readout in the TS-700S. In addition a momentary contact "frequency check" switch allows you to spot check the frequency of the VFO not in use.

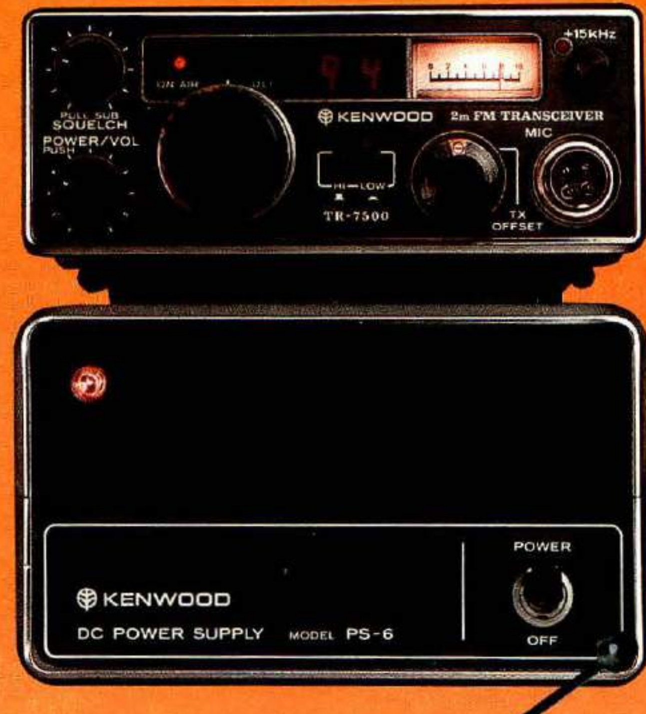
TR-7400A

Features Kenwood's unique Continuous Tone Coded Squelch system, 4 MHz band coverage, 25 watt output and fully synthesized 800 channel operation. This compact package gives you the kind of performance specifications you've always wanted in a 2-meter amateur rig.

Outstanding sensitivity, large-sized helical resonators with High Q to minimize undesirable out-of-band interferance, and give a 2-pole 10.7 MHz monolithic crystal filter combine to give your TR-7400A outstanding receiver performance. Intermodulation characteristics (Better than 66dB), spurious (Better than −60dB), image rejection (Better than −70dB), and a versatile squelch system make the TR-7400A tops in its class.

Shown with the PS-8 power supply

(Active filters and Tone Burst Modules optional)



TR-7500

This 100 channel PLL synthesized 146-148 MHz transceiver comes with 88 pre-programmed channels for use on all standard repeater frequencies (as per ARRL Band Plan) and most simplex channels. For added flexibility, there are 6 diode-programmable switch positions. The 15 KHz shift function makes these 6 positions into 12 channels. 10 watt output, ±600 KHz offset and LED digital frequency display are just a few of the many fine features of the TR-7500.

The PS-6 is the handsomely styled, matching power supply for the TR-7500. Its 3.5 amp current capacity and built-in speaker make it the perfect companion for home use of the TR-7500.

TR-2200A

The high performance portable 2-meter FM transceiver. 146-148 MHz, 12 channels (6 supplied), 2 watts or 400 mW RF output. Everything you need is included: Ni-Cad battery pack, charger, carrying case and microphone.

KENWOOD

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Kenwood developed the T-599D transmitter and R-599D receiver for the most discriminating amateur.

The R-599D is the most complete receiver ever offered. It is entirely solid-state, superbly reliable and compact. It covers the full amateur band, 10 through 160 meters, CW, LSB, USB, AM and FM.

The T-599D is solid-state with the exception of only three tubes, has built-in power supply and full metering. It operates CW, LSB, USB and AM and, of course, is a perfect match to the R-599D receiver.

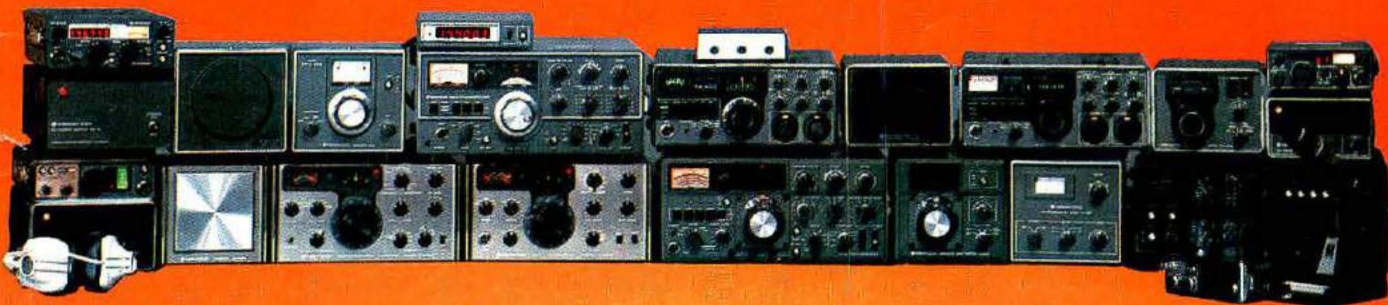
If you have never considered the advantages of operating a receiver/transmitter combination . . .maybe you should. Because of the larger number of controls and dual VFOs the combination offers flexibility impossible to duplicate with a transceiver.

Compare the specs of the R-599D and the T-599D with any other brand. Remember, the R-599D is all solid state (and includes four filters). Your choice will obviously be the Kenwood.

R-599D T-599D

R-300

Dependable operation, superior specifications and excellent features make the R-300 an unexcelled value for the shortwave listener. It offers full band coverage with a frequency range of 170 KHz to 30.0 MHz • Receives AM, SSB and CW • Features large, easy to read drum dials with fast smooth dial action • Band spread is calibrated for the 10 foreign broadcast bands, easily tuned with the use of a built-in 500 KHz calibrator • Automatic noise limiter • 3-way power supply system (AC/Batteries/External DC) . . . take it anyplace • Automatically switches to battery power in the event of AC power failure.



Fine equipment that belongs in every well equipped station

HF LINES

820 Series

- TS-820S . . . TS-820 with Digital Installed
- TS-820 . . . . 10-160 M Deluxe Transceiver
- DG-1 . . . . . . Digital Frequency Display for TS-820
- VFO-820 . . . Deluxe Remote VFO for for TS-820/820S
- CW-820 . . . 500 Hz CW Filter for TS-820/820S
- DS-1A . . . . . DC-DC Converter for 520/820 Series

520 Series

- TS-520S . . . 160-10 M Transceiver
- DG-5 . . . . . . Digital Frequency Display for TS-520 Series
- VFO-520 . . . Remote VFO for TS-520 and TS-520S
- SP-520 . . . . External Speaker for 520/820 Series
- CW-520 . . . 500 Hz CW Filter for TS-520/520S
- DK-520 . . . . Digital Adaptor Kit for TS-520

599D Series

- R-599D . . . . 160-10 M Solid State Receiver
- T-599D . . . . 80-10 M Matching Transmitter
- S-599 . . . . . External Speaker for 599D Series
- CC-29A . . . . 2 Meter Converter for R-599D
- CC-69 . . . . . 6 Meter Converter for R-599D
- FM-599A . . FM Filter for R-599D

SHORT WAVE LISTENING

R-300 General Coverage SWL Receiver

VHF LINES

- TS-600 . . . . 6 M All Mode Transceiver
- TS-700S . . . 2 M All Mode Digital Transceiver
- VFO-700S . . Remote VFO for TS-700S
- SP-70 . . . . . . Matching Speaker for TS-600/700 Series
- TR-2200A . 2 M Portable FM Transceiver
- TR-7400A . 2 M Synthesized Deluxe FM Transceiver
- TR-7500 . . . 100 Channel Synthesized 2 M FM Transceiver
- TR-8300 . . . 70 CM FM Transceiver (450 MHz)
- TV-506 . . . . 6 M Transverter for 520/820/599 Series

POPULAR STATION ACCESSORIES

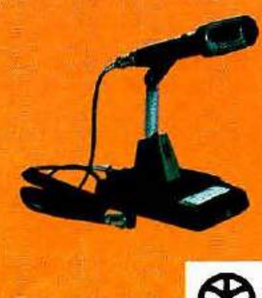
- HS-4 . . . . . . Headphone Set
- MB-1A . . . . . Mounting Bracket for TR-2200A
- MC-50 . . . . Desk Microphone
- PS-5 . . . . . . Power Supply for TR-8300
- PS-6 . . . . . . Power Supply for TR-7500
- PS-8 . . . . . . Power Supply for TR-7400A
- VOX-3 . . . . VOX for TS-600/700A

Trio-Kenwood stocks a complete line of replacement parts, accessories, and manuals for all Kenwood models.

MORE ACCESSORIES:

Description	Model #	For use with
Rubber Helical Antenna	RA-1	TR-2200A
Telescoping Whip Antenna	T90-0082-05	TR-2200A
Ni-Cad Battery Pack (set)	PB-15	TR-2200A
4 Pin Mic. Connector	E07-0403-05	All Models
Active Filter Elements	See Service Manual	TR-7400A
Tone Burst Modules	See Service Manual	TS-700A; TR-7400A
AC Cables	Specify Model	All Models
DC Cables	Specify Model	All Models

The Kenwood HS-4 headphone set adds versatility to any Kenwood station. For extended periods of wear, the HS-4 is comfortably padded and is completely adjustable. The frequency response of the HS-4 is tailored specifically for amateur communication use. (300 to 3000 Hz, 8 ohms).



The MC-50 dynamic microphone has been designed expressly for amateur radio operation as a splendid addition to any Kenwood shack. Complete with PTT and LOCK switches, and a microphone plug for instant hook-up to any Kenwood rig. Easily converted to high or low impedance. (600 or 50k ohm).

TRIO-KENWOOD COMMUNICATIONS INC.
1111 WEST WALNUT/COMPTON, CA 90220

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