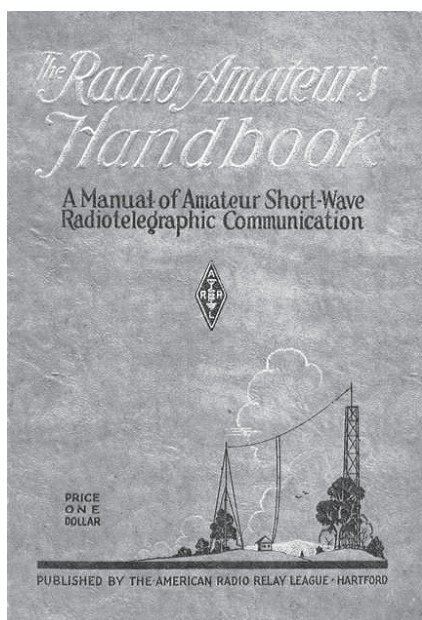


The ARRL *Radio Amateur's Handbook* — From Its Beginning

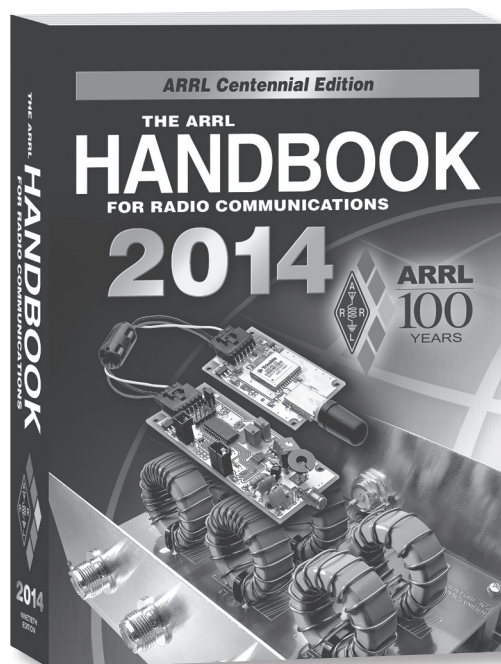
We will take a journey through time and space, looking over the ARRL *Handbooks* from their first edition to the modern era. After looking at the first offering, we will look in some detail at the changes on a decade by decade basis, highlighting the changes over each interval, with focus on the equipment in use and described in each volume. By the time of the first handbook, the art had already advanced from the days of spark and crystal sets to the use of vacuum tubes for both transmitting and receiving equipment.

In the early days of radio, before the ARRL published its first “handbook,” there were attempts by others to fill the space. Some were reviewed in *QST*, but most were found to be lacking in technical content or clarity.¹ This might explain why the League decided to enter the handbook business, although they didn’t get there until 1926. — Joel R. Hallas, *W1ZR*, *QST* Contributing Editor

¹S. Kruse, 10A, “Book Review — A. F. Collins, The Radio Amateur’s Handbook,” *QST*, Feb 1923, p 70.



1926 Edition



2014 Edition

ARRL Publishes the First *The Radio Amateur's Handbook* — The 1926 Edition

The first ARRL-published edition of *The Radio Amateur's Handbook* was announced by then *QST* Technical Editor Kenneth B. Warner, 1BHW, in *QST* of October 1926. Warner stated: "At last we have the honor of announcing *The Radio Amateur's Handbook*, the A.R.R.L. handbook we have been dreaming about for several years... The book has been written by Mr. F. E. Handy, A.R.R.L. Communication Manager, eminently qualified for the job not only because of his sound engineering

knowledge but perhaps more particularly because this business of actually operating amateur stations is the subject about which his department deals daily and he knows it inside and out..."²

This volume was quite comprehensive for its time, as shown in the table of

²K.B. Warner, 1BHW, "Our *Handbook* Announced," *QST*, Oct 1926, p 8.

contents (see Figure 1926-1), with the emphasis spread among underlying technology, building a station, operating a station and a bit about the ARRL's activities. A total of 5000 copies of the first edition of the *Handbook* were produced.

The book opens to a view of typical full-size stations of the era (see Figure 1926-2). Note the use of open construction without attention to operator safety (no safety rules back then) and no attempt at shielding (that would change with the popularity of

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Figure 1926-1 — The Table of Contents of the First Edition of ARRL's *Radio Amateur's Handbook*, circa 1926.

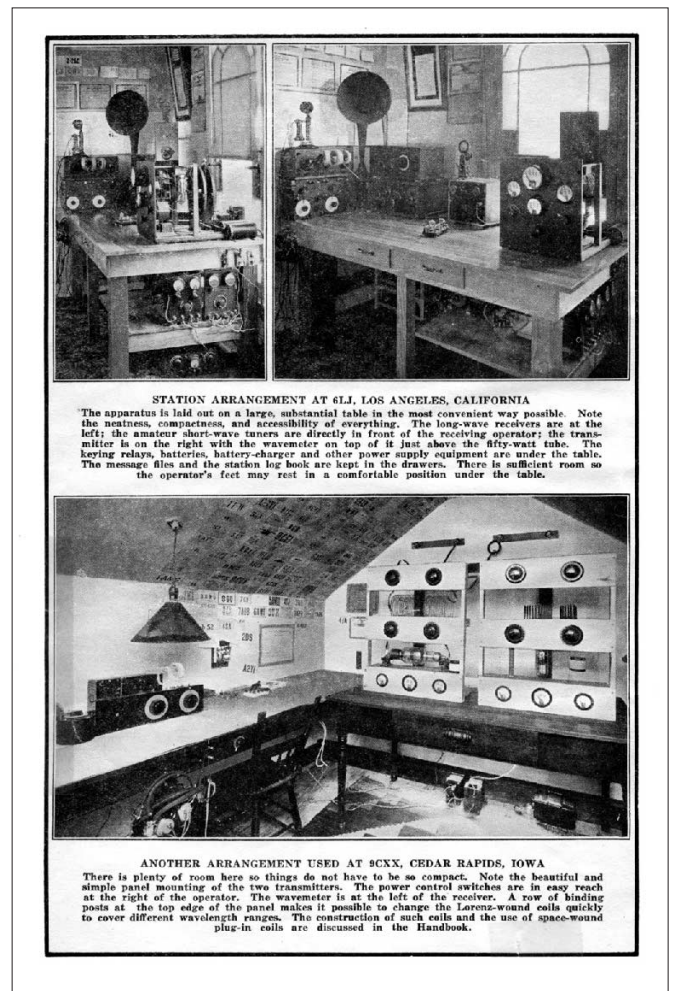


Figure 1926-2 — View of typical full size Amateur Radio stations of the era. From the inside cover of the 1926 ARRL *Handbook*.

over-the-air TV reception in the 1950s). The cover page (Figure 1926-3) is all business.

Construction projects included a bread-board long wave receiver (see Figure 1926-4), a shortwave regenerative receiver (Figure 1926-5) and both tuned (Figure 1926-6) and crystal controlled (Figure 1926-7) transmitters. At this time the regulations regarding exact frequency band allocations and technical standards were still a few years away with the consequence that many transmitters were shown operating in a "self rectifying" mode with raw ac on the plates. There was also attention given to

various wire antenna arrangements.

I found the advertisement section at the rear to be fascinating. While some manufacturers advertised over many years, others came and went quickly.

Interestingly, Vibroplex ads were in all handbooks that I examined, often with ads for the same equipment year after year (see Figure 1926-8). Of course, Horace Martin started making his famous speed keys before there was radio, and the company continues to this day.

Vibroplex was not the only key manufacturer in this edition — Bunnel, developer of

the famous sideswiper key, was also represented (see Figure 1926-9). Other common names included National, then making radio parts (see Figure 1926-10) with radio receivers some years away. While primarily focused on the amateur side of radio science, one ad stands out as a predecessor of many who would build on their interest in radio to move from amateur to professional status. Joseph E. Smith of The National Radio Institute (not related to National Radio) in their ad (see Figure 1926-11) even seems to promise salaries to be achieved through their studies.

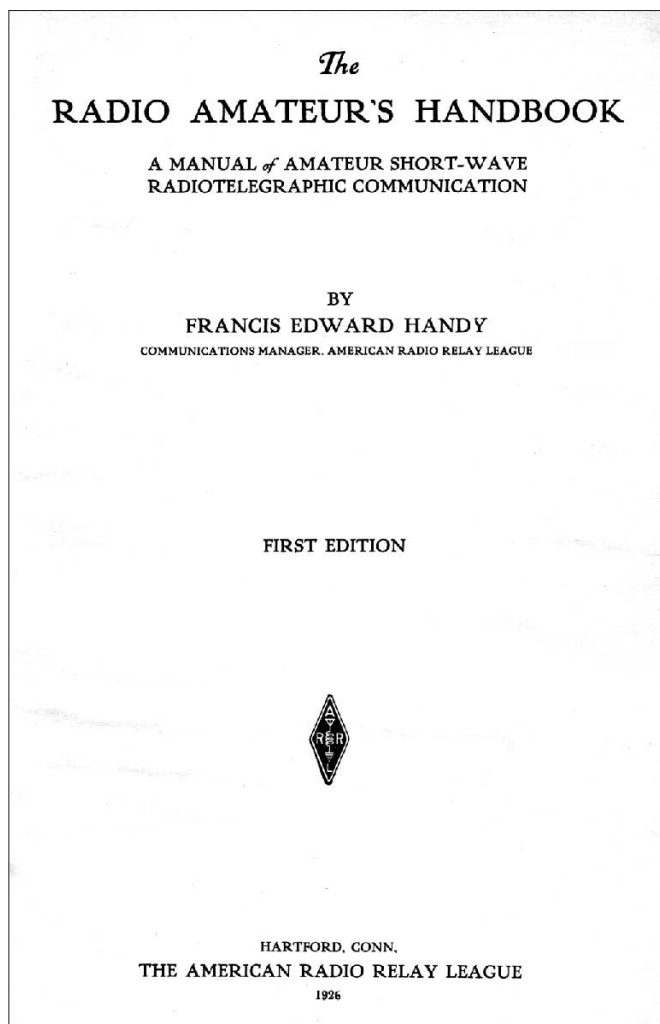


Figure 1926-3 — The 1926 ARRL *Handbook* title page — all business here.

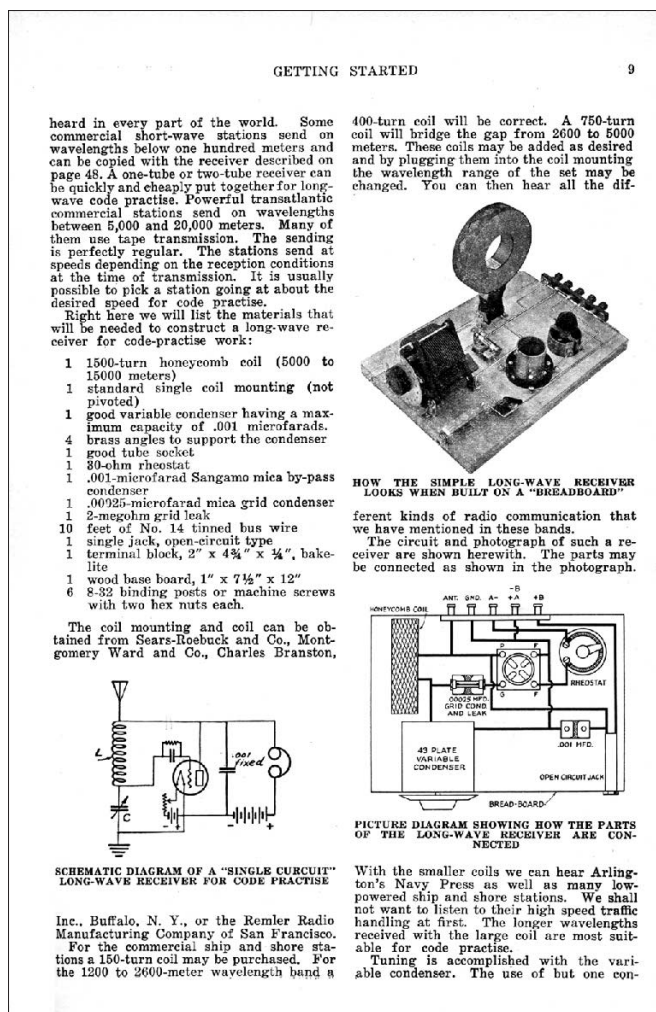


Figure 1926-4 — Construction projects were featured in even the first *Handbook*. Here is a one-tube regenerative long wave receiver you could build on a breadboard.

All distributed capacity in coils does not come from the capacity between turns. Running leads through the finished coil adds to the distributed capacitance, especially if the lead happens to be one of the coil leads itself. If a lead *must* be run through a coil by all means run it through the center as this adds least distributed capacitance. Running the lead near one side of the coil raises the effective resistance of the coil considerably especially at the shorter wavelengths.

A simple way of making quite good space-wound coils is to wind the wire on a cardboard form, spacing it with a thread, string, or another wire which is taken off after the winding is completed. Cardboard tubing should be first prepared by waterproofing with a celluloid varnish and binder. Wire should never be wound on the form until the varnish is dry. This prevents the varnish from soaking into the insulation which raises the dielectric constant making a poorer coil with higher effective resistance and distributed capacitance. A "Quaker Oats box" form is as good as they come electrically. Don't think that all coils must be of three inch diameter just because those mentioned here and all those you have seen are of that diameter. This is just a convenient size and good short-wave coils performing beautifully can be made 1½ and 2 inches in diameter. A thick form should be provided with longitudinal supporting strips to keep the wire off the form to reduce dielectric losses.

Here is a table showing the wavelength ranges that can be covered using 3½" diameter Lorenz coils of the following numbers of turns and a tuning condenser having the maximum and minimum capacity values specified. The wavelength ranges were determined by means of an oscillator (described in the appendix) and wavemeter (the next instrument we will build for the station after our receiver is in operation).

Tuning condenser capacity range: 20 to 380 micromicrofarads. A smaller maximum capacity (150 µµf) is recommended to give less crowding on the amateur ranges.

Turns	Wavelength meters
55	800 to 625
24	85 to 273
10	40 to 126
5	24 to 70
2	11 to 35

Some space wound coils checked by the writer were three inches in diameter, wound on skeleton forms, of No. 18 B. and S. wire spaced the width of the wire itself. The tuning condenser had a range of from 15 to 100 micromicrofarads.

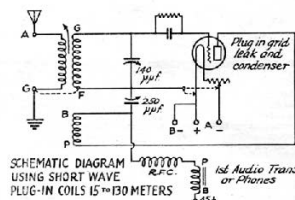
Turns	Wavelength (meters)
19	58 to 115
8	30 to 62
3	11 to 31

Although not allowing much overlap these ranges cover the three lower amateur bands nicely in the center of the dial. The confirmed traffic man will wish to use a still smaller condenser with a much larger number of coils (eight or ten) so that the tuning will not be critical and so that all stations will be spread out well over the dial.

BUILDING THE RECEIVER

A receiver built on a "breadboard" is very effective but picks up dust and dirt after a while and gets noisy. A panel-mounted set is about as cheap. The cabinet can be added later to protect the parts. Photographs show both "breadboard" and panel layouts. The sets can be wired from the photographs and the diagram.

Select every part carefully if you would make your receiver a permanent investment.



THE CIRCUIT

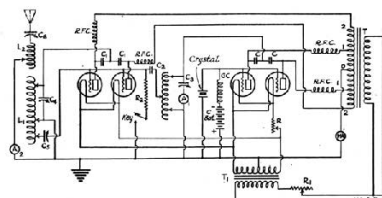
Chosen from the several possible circuits, a fixed tickler and a "throttle" condenser for regeneration control are used. Smooth regeneration control is effected with this arrangement, while at the same time the tuning is but slightly changed by movements of the regeneration condenser.

ment. Do not patronize the local cut price or "gyp" store if you are after the best results obtainable for your money. "Bootleg" parts are cheap it is true—but standard parts and tubes from reputable manufacturers are not so likely to prove defective after a few weeks of use. Buy well and your set will still be giving satisfaction when the friend who was taken in by a misguided idea of saving is paying for expensive replacements.

In putting the "breadboard" receiver together lay out the apparatus as it is shown

master oscillator is not shielded to keep the coupling between them low so that there will be little feedback to endanger the crystal. The chokes are wound on small dowels using fine wire. The sockets shown are provided for two UX210s and two UV203As. A good mounting for the crystal is shown in the photograph. When a set is shielded, it is important that the coils be

Electrical measurements are based on the use of one or more calibrated instruments especially made for their application. These instruments vary in construction depending on whether they are for use with direct current, alternating current at commercial frequencies (25 or 60 cycles), or for radio measurements where you are dealing with frequencies of millions of cycles.



COMPLETE CIRCUIT OF A 40-METER A.C. CRYSTAL-CONTROLLED SENDING SET

- T—Tapped plate transformer. 400 volts between 0 and 1. 1500 volts between 0 and 2.
- T1—250-watt filament transformer with a 12-volt secondary.
- R—2-ohm rheostat to adjust filaments of crystal tubes.
- R1—Primary rheostat to adjust all filaments to supply voltage conditions.
- RFC—200 turns No. 30 D.C.C. on half-inch wooden dowels.
- GC—140 turns No. 28 D.C.C. on half-inch dowel, tapped every 20th turn after the 80th so that the "best" adjustment can be used.
- C—2,000 µµf. Sangam blocking capacitors.
- C1—2,000 µµf. mica blocking capacitors (7500 volt breakdown).
- C2—400 µµf. fixed mica grid condenser (4,000 volt breakdown).
- C3—Double-spaced Cardwell receiving condenser, resultant max. capacity 250 µµf.
- C4, C5 and C6—National or Cardwell 100-µµf. transmitting condensers.
- C—BAT—40 volts.
- MA—0-500 milliamperes D.C. ammeter.
- ATA—0-50 amperes scale therm-ammeter.
- L1-L1—14 turns flatwire-wound ½" brass strip spaced ¼". Diameter 4½ inches.
- L2—6 turns No. 12 wire hinged on hard rubber form.

small to keep the magnetic field from spreading out and inducing heavy R.F. currents in the shielding. Such eddy currents will cause a serious power loss if the set is not very carefully planned and constructed. An un-neutralized set working on amplified harmonics of the crystal is best for the inexperienced builder to attempt.

ELECTRICAL MEASUREMENTS

The simple measurements of resistance (D.C.) and impedance (A.C.) have been described in the explanation of how to find the inductance of the filter choke. The proper use of voltmeter and ammeter followed by a substitution of the scale readings in Ohm's Law makes the determining of many circuit constants possible.

Two of the most important quantities to be measured are *current* and *voltage*. The instrument for measuring the rate of current flow is called an *ammeter* because the unit of current is taken as the "ampere". The unit of potential difference is the "volt" from which we name the instrument for measuring electrical pressure a *voltmeter*. Some instruments may be used for one kind of current only; others are suitable for both D.C. and A.C. Meters are built on various principles, each of which has a field of application and certain advantages and disadvantages. Most commercial instruments are built ruggedly and compactly. A pivoted movement carries a pointer moving over a scale which is calibrated directly in terms of volts, amperes, watts and so on, depending on the construction and circuit of

Figure 1926-5 — This shortwave regenerative receiver was another construction project in the 1926 *Handbook*.

Figure 1926-6 — Typical of its day, the 1926 *Handbook* featured a self-excited transmitter project.

capacitance (between turns) and no lumped capacity may be required. The trouble with this sort of thing is that when trying to adjust the set it is impossible to change one thing at a time as we desire—the controls are interlocking. The plate turns and the wavelength will be changed at the same time. Considerable inconvenience will result. Sometimes coils or parts of a circuit will give trouble by putting oscillations in the circuit at their natural period. Certain adjustments will appear to be stable but the tube later will "drop over" to another frequency of some particular part of the circuit. This emphasizes the desirability of using one tube rather than several in parallel on the short waves, as we thus get rid of troubles that may occur from "parasitic" oscillations between the different tubes and their leads. On the ultra-high frequencies we can make use of these oscillations in actual transmission but they are not well suited to practical communication and we will not spend any time on them.

PLANNING THE TRANSMITTER

To design and build a tube set for transmitting on short waves is quite simple. The choice of apparatus to fit the pocket-book is probably the most difficult task. Tube transmission and the use of shorter and shorter wavelengths have simplified this problem. The more powerful the set built, the more consistent the results obtained with least effort and care. The range of the transmitter in miles will not differ greatly with the power used. Low-powered transmitters using receiving tubes often give as good results in "DX" as more powerful sets. The atmospheric conditions, the wavelength used and the time of day all have greater effects on the "DX" worked than the power input.

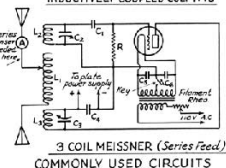
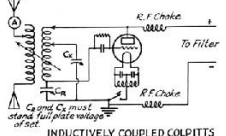
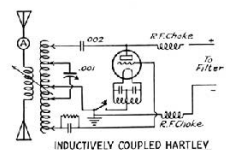
Our transmitter may be built "bread-board" style or the apparatus can be mounted on a panel. To keep the expense down, a wooden panel or baseboard should be used. Dry oak or maple are as good as anything else we can buy for this.

Contrary to the general superstition, a panel-mounted set with the parts spaced sensibly and wired correctly will give much superior results to the hit-or-miss layout frequently seen with leads running hither-skelter over everything in sight. The apparatus can be neatly arranged in either style of mounting.

CIRCUITS

The choice of a transmitting circuit is not of great importance. There is no excuse for most of the variations from the standard and simple circuits that are used. The principle of feeding back r.f. voltage

from the plate to the grid circuit to produce continuous oscillations is the same in all vacuum-tube oscillator circuits. The fundamental circuits are the Hartley and Colpitts circuits, named for the prominent investigators who first used them. In both circuits an inductance and capacitance determine the wavelength. In the Hartley circuit the filament of the tube is connected to the middle of the coil and the



COMMONLY USED CIRCUITS

plate and grid connections are made to the extreme ends of the coil. In the Colpitts circuit the filament of the tube is connected between two condensers and the plate and grid connections are made to the other condenser terminals. In one arrangement the tube gets its feedback inductively, in the other the capacitive voltage drops take care of the feedback.

The Hartley circuit has the tuning condenser across some of the turns both in the grid and in the plate part of the coil. When the condenser is entirely across plate turns, the circuit is a "tuned plate" circuit. When it is across the grid turns we have a "tuned grid" circuit.

Learn to Send the *Easy* Way

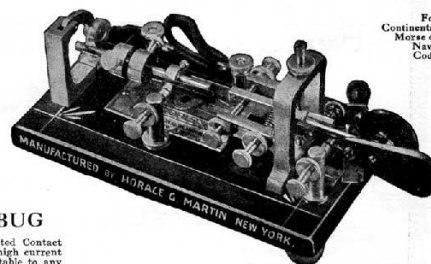
With the Genuine Martin

VIBROPLEX

Improved Radio Transmitter



Reg. Trade Marks
Vibroplex
BUG
Lightning Bug



For
Continental
Morse or
Navy
Code

Japanese Base,\$17
Nickel-Plated, 19
Carrying Case, 3

Improved Radio BUG

Equipped with Specially Constructed Contact Points 3/16" in diameter to break high current without the use of a relay. Adjustable to any desired speed. The choice of radio operators everywhere.

\$25

Simply Press the Lever—The Vibroplex Does the Rest

No operator—no matter how skilled can send Continental or Morse code on an ordinary key with the *EASE* and *PERFECTION* of the Vibroplex.

Signals that will be heard and easily read thousands of miles away are transmitted at any desired speed, simply by pressing the lever—the *Vibroplex does the rest*.

More than 100,000 Wireless and Morse operators use the Vibroplex in preference to the key, because the sending is more uniform, the signals easier to read and the effort of sending is reduced to the minimum.

Learn to send the *EASY* way—with the Improved Vibroplex. It saves the arm, prevents cramp and enables you to send with the skill of an expert.

Insist on the Genuine Martin Vibroplex. See that the *VIBROPLEX Nameplate* is on the *BUG* you buy. Accept no substitute. When you buy a Vibroplex you buy complete satisfaction. Sent anywhere on receipt of price. Money order or registered mail. Liberal allowance on your old Vibroplex—any model.

Write for Catalog

THE VIBROPLEX COMPANY, Inc., 825 Broadway, NEW YORK

J. E. Albright, President
Telephones: Stuyvesant 6091, 4828, 4829

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Figure 1926-7 — A fairly revolutionary transmitter project had its frequency set by a piezoelectric quartz crystal. The extra stability came at a price — a separate crystal was required for each frequency.

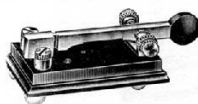
Figure 1926-8 — This 1926 ad from the Vibroplex Corporation was similar to those shown for 75 years.

BUNNELL Instruments



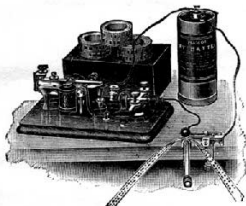
The "Gold" Bug

This Bunnell Transmitting Key, the standard of the largest telegraph companies, is known the world over for its simplicity of operation and ease of adjustments. Extra heavy contacts are supplied for ship work. It has fewer parts and better carrying qualities than any semi-automatic machine. Complete with wedge and cord, \$12.50. With extra heavy contacts, \$13.50. Carrying case, \$3.50 extra.



The Double Speed Wireless Key

Double your sending speed with this instrument. Half the motion does the work easily and thoroughly. No danger of cramp—brings back speed and style to operators affected by use of ordinary keys. Simple, attractive—sold on a money back basis. You can rely on a Bunnell Instrument. Only \$9.50.



Audible Transmitter

Instruct yourself with the Bunnell Learners' Outfit. It's easy to learn Morse Code, telegraphy, wireless signalling and heliography. Standard for both indoors and out. Complete with instructions for use, \$7.50.



The Blinko Buzzplex

Another Bunnell Instrument, ideal for learning wireless or radio signals. Gives both audible and visible signals. Complete with key, battery, lamp, telephone head set, instruction book and code chart, only \$7.75.

Bunnell Transmitting Instruments are known everywhere for their reliability and ease of operation. Sold and guaranteed on a money-back basis. You'll also be interested in a complete line of Jewell, Dublier, Thordarson, Hammarlund and other nationally known equipment.



J. H. BUNNELL & COMPANY, INC.

Headquarters for Transmitting Apparatus Since 1878

32 Park Place, New York

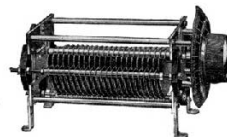
Phone: Whitehall 5970

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Figure 1926-9 — Bunnell, developer of the famous sideswiper key, also advertised in the 1926 edition.

NATIONAL

in name **NATIONAL** in fact



National Transmitting Condensers

used and approved by Lieut. Fred H. Schnell, Don. C. Wallace, A. A. Hebert, Gerald M. Best, L. W. Hatry, Lieut. Lowell Cooper, and countless other members of the A.R.R.L.

Supplied with 3/16 inch and 3/8 inch spacing on stator plates,—four sizes:— .0001—\$12.50 (3/8" spacing), .00023—\$11.50, .00045—\$16.50, .00015—\$7.50 (3/16" spacing), .00023—\$11.00, .00045—\$16.50

Price includes Type "A" Velvet-Vernier Dial. Type "B" supplied without extra charge. Add fifty cents for Type C Illuminated Dial.

If not stocked by your dealer, we will gladly ship orders for direct shipment on receipt of check or money order, plus transportation charges.



The new NATIONAL Velvet-Vernier, Type C ILLUMINATED Dial has over instant feature of the Type B, including variable radio with a one-coiled lamp added. Easily installed without special tools.

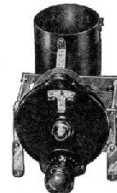
Price \$3.00



The NATIONAL Impedance Transformer, Type R, includes 12 sets of audio coils, 1 MFL. TOROID Condenser, mounted Laminar Reactor. Three to a set —for modern audio amplification. The first stage contains an R. F. Choke. Price \$5.50 each

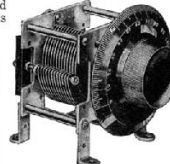
NATIONAL Radio products need no introduction to A.R.R.L. members. In proper combination they form a lasting foundation for modern broadcasting receiving sets, too. Literature covering any or all of these items gladly sent on request, —if A.R.R.L. ANNUAL is mentioned.

Be sure you get genuine NATIONAL products.



The NATIONAL Tuning Dial, HD-12, combines a Broadening-Brake space-wound inductance coil, 1000 NATIONAL "Egg-cylinder" Condenser in a four-inch, Type B NATIONAL Velvet-Vernier Dial.

Price \$10.25 Add fifty cents for Type C Dial.



NATIONAL "Equivalent" Condensers with Velvet-Vernier Type A Dial, specially adapted to shortwave receiving sets. In capacities from 5 to 1000 MFD.

Prices \$5.00 to \$5.00

NATIONAL COMPANY INCORPORATED

ENGINEERS AND MANUFACTURERS
110 BROOKLINE STREET

W. A. READY, President
CAMBRIDGE

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Figure 1926-10 — National Radio, then making radio parts, with complete radio receivers some years away, had an ad in the first edition of the Handbook.



RADIO NEEDS TRAINED MEN!

"I give you all this apparatus so you can learn quickly at home the Practical Way"

FREE OF EXTRA COST

I Will Train You At Home To Fill a Big Pay Radio Job



If you're earning a penny less than \$50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at \$25 or \$35 or \$45 a week, when you could earn \$50 to \$250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you?

Earn \$50 to \$250 a Week—Radio Experts in Big Demand

Radio needs trained men. Get into this new live-wire profession of quick success. It's the trained men, the Radio Expert, who gets the big jobs of this profession—paying \$75, \$100, \$200 a week and up. Every day N. R. I. trained men are taking good places in the Radio field—men just like you—their only advantage is TRAINING. You can prepare just as they did by new practical methods. Our tested clear training makes it easy for you. The Free Book contains all the proof.

You Learn Quickly In Spare Time

So sure am I that I can train you successfully for a better future in this new Big-Pay profession that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods enable you to start RIGHT AWAY toward one of the bigger Radio jobs paying \$50 to \$250 a week. No delay, no losing time from work—no scrimping or scraping to get your training.

Get This FREE BOOK

Most amazing book on Radio ever written—full of facts and figures—tells all about the great new Radio field, how we prepare you and help you start. You can do what others have done—GET THIS BOOK. Send coupon today—no obligation.

J. E. SMITH, President
NATIONAL RADIO INSTITUTE
Dept. #14 Washington, D. C.

You Get All of This

All instruments shown here and others sent to my students free of extra cost under short time special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship, and get added confidence in your ability.

World Famous Training That "Pays for Itself"

My Radio course World-Famous as the training that "pays for itself." Make more money QUICK when you take up this practical course. Work on millions of experience, receiving sets, offer you big chance to make spare time cash while you're learning. I'll show you how. My students don't wait a year to increase their income—they report QUICK INCREASES as a result of this course—often two or three weeks after starting. Howard Lach, Friedland, Pa., made \$300 in 4 weeks during spare time. D. H. Sutt, Newport, Ark., writes: "While taking the course I earned in spare time work about \$600. These records not unusual—these men a few of hundreds."

Your Satisfaction Guaranteed

We who know the results this practical tested training sets, stand behind it all the way with a signed guarantee bond that we give you when you enroll. Get started today! It's your big chance for one of the bigger Radio jobs—mail coupon NOW for my Big FREE BOOK and proof! No obligation.

Employment Service To All Graduates

Originators of Radio Home-Study Training



750 in one Day for T. M. Wilcox

"In business for myself—RECEIVING SETS—MAKING 750 in ONE DAY. I was an electrical and repair experience, occupying a splendid position as telephone superintendent when I enrolled with you, believing it would result in greater success. Result: Getting \$400 a month in spare time of thousands of dollars in 20 days. Wilcox, Radio Island, Newfoundland."

MAIL THE COUPON TODAY

J. E. Smith, President
NATIONAL RADIO INSTITUTE
Dept. #14 Washington, D. C.

Dear Mr. Smith—Without obligating me in any way, send me your free book, "Rich Rewards in Radio" and all information about your practical, home-study Radio Course.

Name.....Age.....
Street Address.....
Town.....State.....

Figure 1926-11 — Even in this first edition, there was interest in promoting Amateur Radio as a path to a career.

The ARRL Radio Amateur's Handbook — From Its Beginning 7

The Beginning of the Next Decade — The 1930 Edition

It's not obvious that the plan of the ARRL for the production of *The Radio Amateur's Handbook* was to make it an annual affair. The edition released in 1930 was, in fact, the seventh edition (see Figure 1930-1) — not the fifth, as would be the case if there were one per year. While the edition's lead photo (see Figure 1930-2) showed equipment at the ARRL headquarters station that looked somewhat similar to that of the first edition, in fact, there were many significant changes in Amateur Radio between these editions.

The changes in the late 1920s were driven more by regulatory actions than by technology. In 1926, radio was rather loosely regulated by the US Department of Commerce. Most "regulations" were in the form of loose understandings between various commercial and amateur operating groups. This included frequency allocations (amateurs were then permitted to use any frequency above 1500 kilocycles [now kHz]) as well as technical standards, which were not yet well defined.

The US Federal Radio Commission (FRC), the forerunner of today's more general FCC, was established by congress and signed into law by President Calvin Coolidge on February 23, 1927. Over a few years, the FRC defined strict frequency allocations for different services, including the Amateur Radio Service. The new allocations established bands with a similarity to today's bands, except that they were just those harmonically related as shown in Table 1. The original order described the bands in terms of the actual wavelength, as well as

Table 1
Amateur Radio Bands Established by the FRC in 1928

<i>Band (meters)</i>	<i>Meters</i>	<i>Kilocycles (Frequency in KHz)</i>
160	150.0 to 200.0	2000 to 1500
80	75.0 to 85.7	4000 – 3500
40	37.5 to 42.8	8000 – 7000
20	18.7 to 21.4	16,000 – 14,000
10	9.99 to 10.71	30,000 – 28,000
5	4.69 to 5.35	64,000 – 56,000
0.75	0.7477 to 0.7496	400,000 – 401,000

Table 2
Amateur Radio Bands for Voice Established by the FRC in 1928

<i>Band (meters)</i>	<i>Meters</i>	<i>Kilocycles (Frequency in KHz)</i>
160	150.0 to 175.0	2000 to 1715
80	84.5 to 85.7	3500 – 3550
5	4.69 to 5.35	64,000 – 56,000

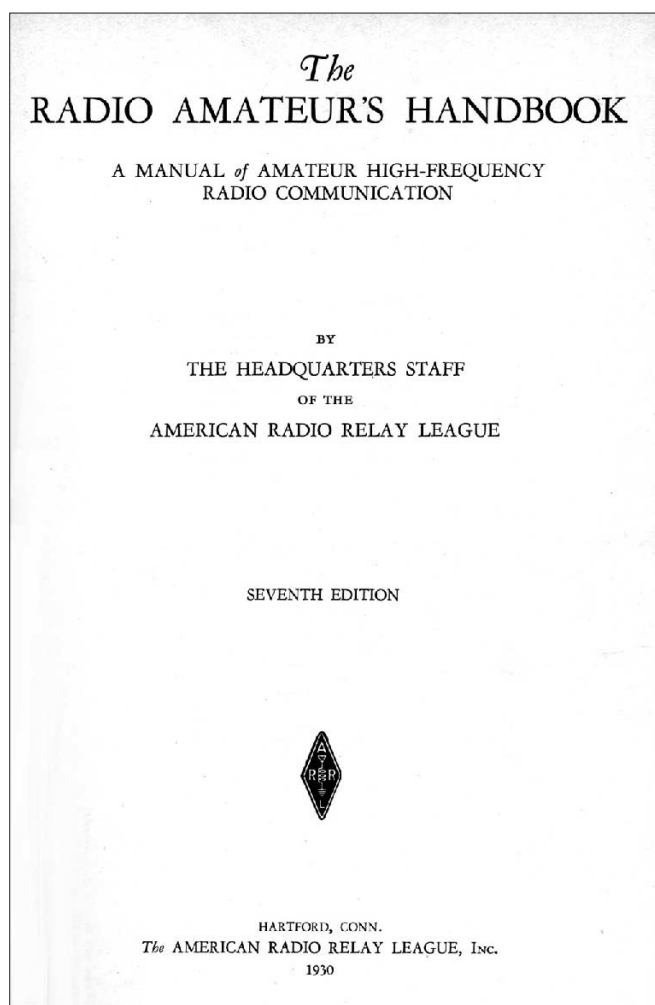


Figure 1930-1 — Title sheet of the seventh edition of *The Radio Amateur's Handbook*.

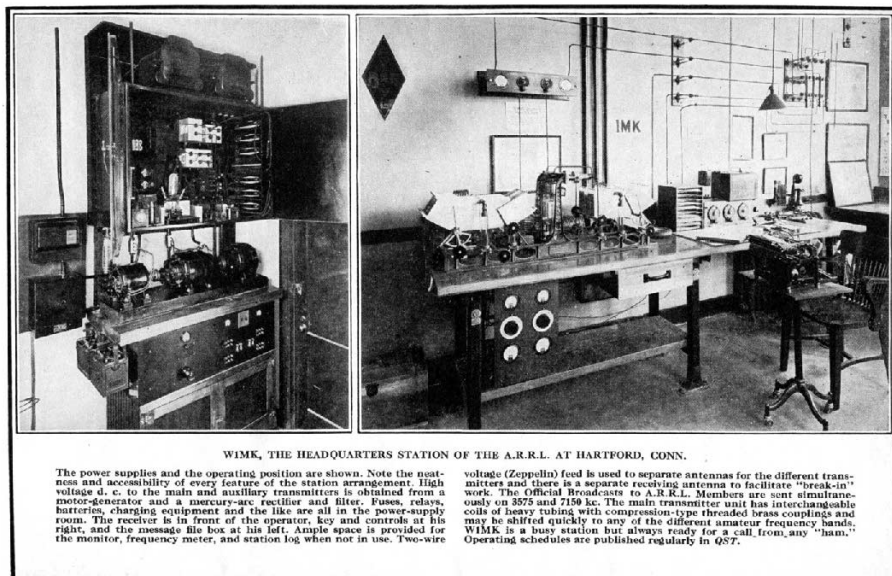


Figure 1930-2 — The headquarters station of the ARRL, then in Hartford, Connecticut, was shown on the cover page of the seventh edition.



NATIONAL CO. engineers designed this new High-Frequency Receiver in collaboration with Robert S. Kraus.

Write today for new Bulletin 143-A on NATIONAL Amateur-Equipment.

High Quality Phone Reception

Full A. C. Operation—No Hum—Push-Pull Audio
NATIONAL A.C. SW 5 THRILL-BOX

A true A.C. Amateur Instrument; tunes and logs as easily as a broadcast receiver. Actual single control; — set and forget the antenna trimmer. There are 1080 dial degrees available between 21.2 m.c. and 2.61 m.c. Easily adapted for still wider spreading of the amateur bands if desired. Very smooth control of sensitivity either on c.w. or phone. No grunting or backlash — no hand capacity. Double screen-grid, with 224 grid-leak detection. Equipped with push-pull audio, and special phone-jack after first stage. Made also in new battery-model, using the new UX 230, 231 and 232 tubes.

Easily assembled with genuine NATIONAL Radio Parts

 <p>R. F. TRANSFORMERS Standard set of four pairs covering from 21.2 to 2.61 m.c. Special coils also available for 35-21.2 m.c. and the 2.61-1.5 m.c. ranges. Forms are moulded developed by Radio Frequency Laboratories. Blank forms also available for winding experimental coils.</p>	 <p>SE AND ST VARIABLE CONDENSERS Model SE, a special high-frequency design, not a cut-down broadcast job. Insulated main bearing and constant impedance piston. 270 degree straight-line frequency plates. Model ST has 180 degree capacitance plates. Either model available in capacities up to 150 mmf.</p>	 <p>PRECISION VELVET-VERNIER DIALS, Type N A four inch Solid German Silver Dial, for use in amateur and experimental equipment requiring maximum accuracy in logging. Equipped with real vernier, reading to 1/10 division. Easy and simple to mount.</p>
 <p>LEVER-TYPE INDICATOR Type J For transmitter-panel use. Bakelite knob and handle. Nickel plated brass pointer. 6" diameter etched scale can also be furnished. Available for 1/4" and 3/8" shafts. Details on request.</p>	 <p>Transmitting CONDENSERS—Model TM Widely used by the U. S. Government, Broadcasting Stations and amateur transmitters the world over. Made in 500 and 1000 volt ratings and capacities from .000015 to .00015 mfd. Other voltage and capacities made to special order. Now supplied with Cratone insulation.</p>	 <p>THE POWER UNIT A separate unit with cable and soft rubber covered connecting plug, especially designed for harmless operation of high-frequency receivers. 180 Volt B, 2.5 Volt filament supply. Licensed under R.C.A. Patents.</p>

NATIONAL

Precision-Built RADIO—PARTS

NATIONAL COMPANY INC., SHERMAN, ABBOTT & JACKSON STS., MALDEN, MASS.

xix

Figure 1930-3 — The National Radio ad still shows a sample of their fine parts, but now ads a complete receiver, the SW-5.

the frequency (radios of the day were more likely to be calibrated in wavelength than frequency). I have also shown the usual band descriptor that we use today. Table 2 shows the frequencies on which radiotelephony was allowed — not very many, at least initially.³

In addition to the frequency allocations, the FRC 1928 announcement included new technical standards. These now required amateur stations to use "loose coupling to the antenna system," typically inductive rather than conductive coupling, to reduce harmonic output and "key impacts." Additionally, plate supply modulation (self rectifying circuits) and spark transmitters were no longer allowed (interestingly, some ship transmitters continued to use spark for many years).

The new regulations were reflected in the details of the *Handbook* construction projects, although a cursory look might not have revealed the difference, since most of the technology did not change a lot. Even the 1926 edition did not include any spark transmitters, since most amateurs now realized the benefits and additional efficiency of CW transmitters made with vacuum tubes.

Again, the ads in the back of the 1930 edition provided a glimpse of what amateurs were buying. By this time, National Radio had moved from being a parts supplier to being a manufacturer of receivers for amateur use, including the SW-5 "thrill box," highlighted in their ad (see Figure 1930-3).

³K. B. Warner, 1BHW, "Recent Changes in Radio Law and Regulations," *QST*, May 1928, pp 14-15.

A Decade of Advancement — The 1940 Edition

Incremental advancement in technology occurred broadly in the decade preceding the 1940 edition. While the basic underlying physics remained the same, circuitry using vacuum tubes moved forward in large steps. By 1940, advanced amateur stations had moved from regenerative receivers on breadboards to bandswitching commercial superhets. Transmitters advanced from one or two tube self-excited transmitters on planks or breadboards to high power equipment in professional

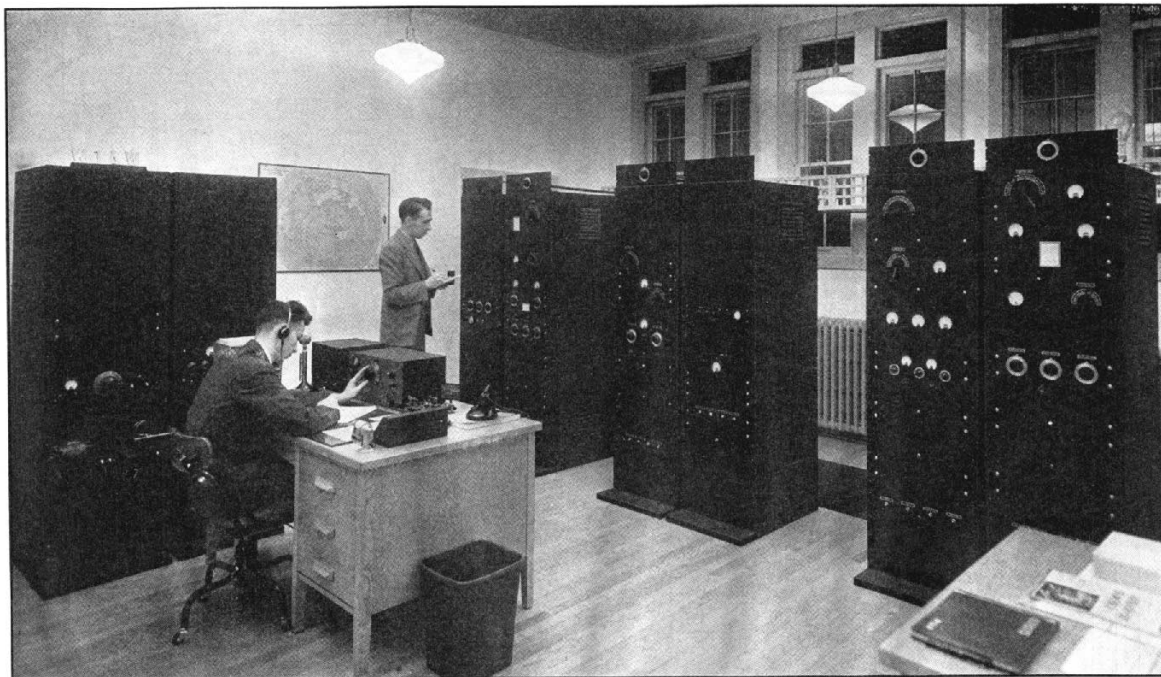
racks. This is perhaps best illustrated by comparing the cover leaf photos of the 1930 version of the ARRL headquarters station to that shown in the 1940 edition (see Figure 1940-1). This station, now the “Maxim Memorial Station, W1AW” was located at its present site in Newington, Connecticut, looking a lot like it would when I first visited it in 1956.

The cover page (Figure 1940-2) of the 1940 edition looks much like the previous ones, again, not identifying the publication

year, but the edition — this one the 17th. Note that there was exactly one edition per year between 1930 and 1940, now firmly making the *Handbook* an annual affair.

By 1940, voice operation had been expanded into all HF bands, except 40 meters. Amateurs were allowed to operate on all frequencies above 110 Mc (MHz) and gravitated to the harmonics of lower frequency bands with operation on 2½ meters (112 MHz) and 1¼ meters (224 MHz).

Equipment projects were considerably



THE OPERATING ROOM AT THE MAXIM MEMORIAL STATION, W1AW, A.R.R.L. HEADQUARTERS

Separate 1-kw. transmitters are installed for each band. Voice transmissions on 1806, 3950, 14,237 kc. and 28,600 follow simultaneous telegraph messages to all amateurs sent on 1762.5, 3825, 7280, 14,254 kc. and 28,600 kc. at 7.30 and 11 p.m. CST. Operators “Hal” Bubb (seated) and “Geo” Hart (standing) are always ready for a call from any amateur.

Figure 1940-1 — The ARRL headquarters Maxim Memorial Station, W1AW, was located at the site of the present ARRL headquarters (and station) in Newington, Connecticut. It is interesting to compare 1940’s equipment to that of the 1930 headquarters station.

advanced over the decade. A snapshot of a receiver (see Figure 1940-3) shows a six-tube superhet that provides a significant improvement in performance over the regenerative receivers of the previous decade. As with most *Handbook* receivers, this set used plug-in coils, rather than bandswitching, in order to minimize construction complexity. While performance didn't suffer, operating convenience did. Most commercial superhet receivers described in the ad section (see Figure 1940-4) went a step beyond, with the exception of the famous National HRO (see Figure 1940-5), and

provided single switch bandswitching.

HF transmitters moved forward in a similar manner, many making use of metal chassis and panels and crystal frequency control. Bandswitching was not yet feasible in transmitter power stages due to the large tank inductors employed. Some used switching in low-level stages, but for many the marginal benefit was not worth the complexity. Figures 1940-6 and -7 illustrate one transmitter project, a medium power HF rig, from this edition. The ad from Hallicrafters (Figure 1940-8) not only showed a commercial bandswitching

receiver, but also a companion desktop transmitter.

With the additional VHF bands, operation on the (then called) "ultrahighs" gained in popularity. Early equipment for 2½ and 1¼ meters tended to be of the modulated oscillator variety and were described in their own chapter of the 1940 *Handbook* (see Figure 1940-9).

Ads from many manufacturers for complete radios, parts, instruction and accessories (see Figure 1940-10) continued to provide a window into what could be accomplished with enough resources.

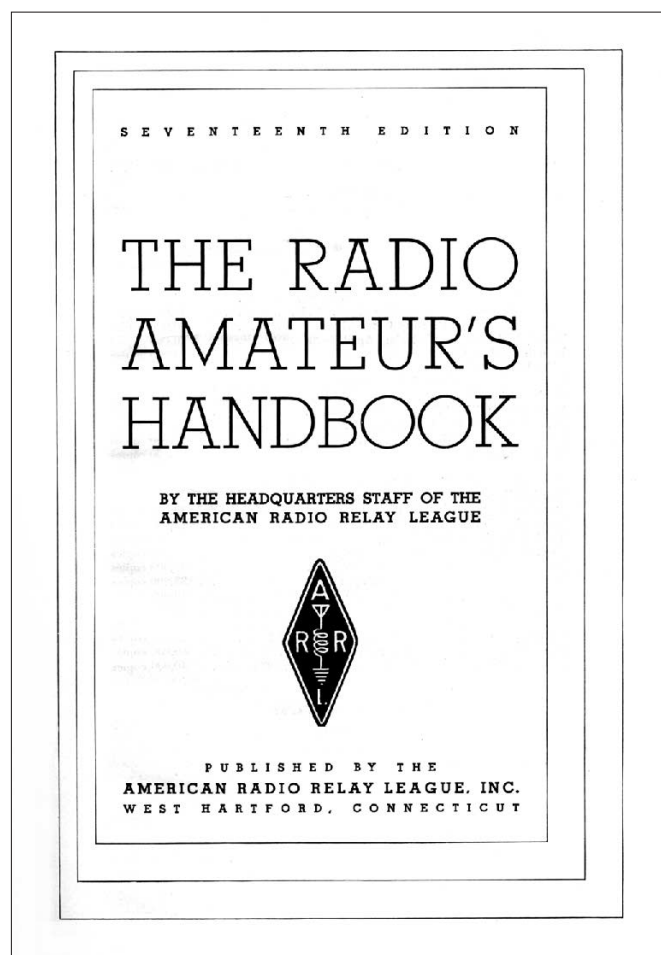


Figure 1940-2 — The cover page of the 1940 edition looks much like the previous ones, again, not identifying the publication year, but the edition — this one the 17th.

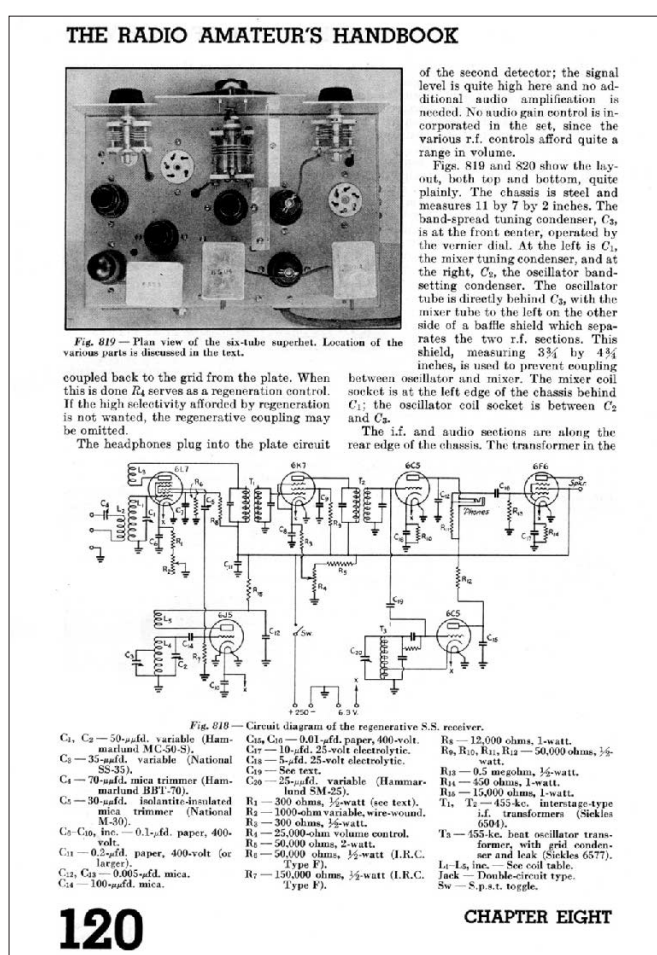


Figure 1940-3 — This 1940 *Handbook* construction project resulted in a modern HF ham band superhet using plug-in coils to change bands.



HAMMARLUND



NEW

"HQ-120-X"

AMATEUR RECEIVER

THE NEW HAMMARLUND "HQ-120-X" meets the most critical demands of amateur and professional operators. Hammarlund engineers have gone beyond ordinary practice in designing this new and outstanding receiver. This ultra-modern 19-tube super-heterodyne covers a continuous range of from 31 to 54 mc. (9.7 to 555 meters) in six bands, taking in all important amateur, communication, and broadcast channels. The "HQ-120-X" is not to be confused with modified broadcast sets. Two years were required to develop it. This is a special receiver with special parts throughout. Every wave range is individual—that is, each range has its own individual coil and a tuning condenser of proper value for maximum efficiency. This includes the broadcast band, does not decrease efficiency at high frequencies. Besides having all the necessary features for perfect short wave reception, such as A.V.C., beat oscillator, send-receive switch, phone jack and relay terminals, the "HQ-120-X" also includes a new and outstanding crystal filter circuit which is variable in 6 steps from full



band-width to razor edge selectivity. This permits the use of the crystal filter for the reception of both voice and music. It is no longer necessary to contend with serious heterodyne interference. These annoying disturbances can be phased out with the phasing control on the panel. Other features include a new and accurate "50" meter circuit for precise tuning (incoming signal strength), antenna compensator to compensate for various antennas, and 310 degrees band spread for each amateur band from 60 to 10 meters. The band spread dial is calibrated in megacycles for each of these amateur bands. The main tuning dial is calibrated in megacycles throughout the entire range of the receiver. Rack adapter, \$6.00 extra.

Prices Include Speaker and Tubes				
Code	Type	Tuning Range	Speaker	Net Price
HQ-120-X	Crystal	31 — 54 mc.	10" P.M. Dyn.	\$138.00
Speaker cabinet (metal) 15 1/2" x 15 1/2" x 7 inches				3.90

Special model finished in navy.....\$110.00 Net
Speaker Cabinet, gray to match.....4.50 Net

Send for Descriptive Booklet!

NEW

"SUPER-PRO"

THIS new 18 tube "SUPER-PRO" includes all the outstanding features which have made the "Super-Pro" famous, and in addition many recent developments have been added. The new "Super-Pro" has a variable selective crystal filter. This crystal filter has five positions of selectivity—3 for phone and 9 for CW. The variable crystal filter, in addition to the variable band width (LF), provides a selectivity range of from less than 100 cycles to approximately 10 kc. The new "Super-Pro" also has an improved noise limiter designed to minimize interference caused by automobile ignition systems and disturbances of similar nature. Maximum image suppression is obtained with two stages of high selectivity, tuned RF ahead of the first detector. Three stages of 1F are employed and there are three stages of high fidelity audio amplification resulting in an output of approximately 14 watts. A new and improved "50" meter has been installed in the "Super-Pro" for accurately reporting relative signal strength. Other features include full band spread on all bands, beat oscillator, send-receive switch, relay connections, phone connectivity, connection for phone pickup, beautifully finished modernistic cabinet. The sensitivity of the "Super-Pro" is better than 1 microvolt. Available in rack mounting type at \$10.50 extra.

Code	Type	Spkr.	Tuning Range	Net Price
SP-110-X	Crystal	10"	15 — 560 meters	\$279.00
SP-110-SX	Crystal	10"	7 1/2 — 240 meters	\$79.00
SP-120-X	Crystal	12"	15 — 560 meters	\$94.00
SP-120-SX	Crystal	12"	7 1/2 — 240 meters	\$94.00

PSC 10" speaker cabinet to match receiver 5.10

Special Models Covering Other Wave Ranges Available On Order
HAMMARLUND MANUFACTURING CO., INC., 424-438 West 33rd Street, New York City

Write or Cabled

Figure 1940-4 — These receivers, advertised by Hammarlund, set the standard for modern receiver technology of the day — the architecture remaining popular for decades to come.



HRO



NC-100A



NC-101X



NC-44



ONE-TEN



NHU



SW-3



NTX-30



SPEAKER

NATIONAL RECEIVERS

HRO. A professional receiver, designed for maximum performance. Features include two high-gain preselector stages giving exceptional signal to noise ratio; crystal filter, micrometer dial, 5 meter, AVC, Beat Oscillator.

NC-100 SERIES. Fine Communication Receivers with splendid tone quality. These 11 tube super-heterodynes are self contained except for the speaker. The NC-100A series is ideal for broadcast reception as well as communication work. Special amateur models, NC-101X and NC-101XA, cover only the amateur bands. Features include one stage of preselection, an effective noise limiter, as well as complete communication equipment.

NC-44. For capable performance at a very low price. A seven tube superheterodyne with continuous coverage from 550 KC to 30 MC. A CW Oscillator is provided.

ONE-TEN. A specialized receiver for the range from 1 to 10 meters. The ONE-TEN Receiver is intended primarily for the Experimenter. It is a thoroughly satisfactory receiver for the ultra-high frequencies. Four tubes are used; RF, Super-regenerative Detector, 1st Audio, and Output Audio.


NHU. A specialized communication receiver covering the range from 27 to 62 MC. The NHU is a high performance superheterodyne, provided with all features and controls commonly needed in communication work, including a wide range crystal filter.

SW-3. A dependable regenerative receiver. The SW-3's eight year reputation for performance and dependability give it preference for many classes of work. It uses three tubes in a highly developed circuit that provides maximum sensitivity and flexibility.

NATIONAL TRANSMITTING EQUIPMENT

NTX-30. National makes a complete line of transmitting equipment ranging from a complete 600-watt transmitter to speech amplifiers and exciters. The NTX-30 illustrated above is a compact and convenient transmitter for CW or Phone, having an output of 30 watts on 10, 20, 40 and 80 meters. In addition to being a transmitter in itself, it makes an ideal exciter-buffer combination whenever higher power is desired.

Separate Power Packs available for all requirements



NATIONAL COMPANY, INC.

MALDEN, MASS., U.S.A.

Figure 1940-5 — National Radio had expanded its receiver line to include bandswitching and plug-in coil superhets, but still offered the popular SW-3 regenerative receiver from years past.

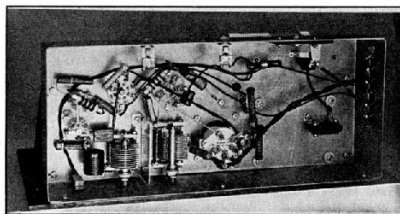


Fig. 1021—Bottom view. The cathode-circuit coil may be seen to the left of its tuning condenser. C_2 is insulated from the chassis by four button-type insulators and the shaft provided with an insulating flexible shaft coupling. The 5-prong amplifier-tube socket is lowered an inch or so below the chassis on brackets. A small baffle shield is placed between the two small variable condensers.

No output-coupling arrangement is indicated in the diagram, this being left to the preference of the constructor. There is ample room on the forms for a link. (8th. 3).

● 100-TO-175-WATT TRANSMITTER OR EXCITER

The circuit of this unit is shown in Fig. 1023. The tube line-up consists of a 6L6 tetrode crystal oscillator, a 6L6 frequency doubler and a final amplifier which, in this case, employs a type HY51Z. The arrangement is suitable, however, for almost any triode-amplifier tube operating at plate voltages between 750 and 1000 volts in which the plate connection is at the top of the tube and the grid terminal is in the base.

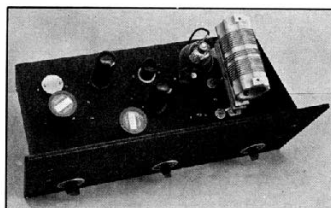
Output at either the crystal frequency or the second harmonic is readily obtainable. The complication of neutralizing the second stage when operating at the crystal frequency is eliminated by cutting this stage out of use. This is accomplished by means of a "dummy" plug-in form which serves as a low-loss switch. Capacitors suitable for coupling the final-amplifier grid to the output of either the oscillator or the doubler are mounted inside the

"dummy" plug-in forms and connected as shown in the insert in the circuit diagram.

Most of the constructional details will be evident from an inspection of the photographs of Figs. 1022 and 1024. The coils for the oscillator and frequency doubler are wound on Hammarlund 1½-inch diameter plug-in forms, while those for the final amplifier are wound on National XR-10A ceramic forms which plug into the XR-15 jack base mounted on the chassis. All tank condensers are mounted underneath the chassis. The final-amplifier tank condenser C_4 is mounted by means of angle brackets on four ½-inch cone insulators which bring the shaft 1¼ inches above the lower edge of the chassis and level with the shafts of the other two tank condensers which are shaft-hole mounted on the front edge of the chassis. The shaft of C_4 is fitted with an insulated flexible coupling and a bearing is set in the front edge of the chassis for the extension. Large clearance holes are cut in the panel for the shaft bushing of C_4 and the mounting nuts of the other two condensers. The dial plates are held in place by cementing them to the panel with Duco cement.

The socket of the final-amplifier tube is set

Fig. 1022—The 100-175-watt transmitter-exciter. Controls from left to right are for the oscillator, doubler and final amplifier. The chassis is 17 in. by 9 in. by 3 in. and the Preswood panel 19 in. by 8½ in. The controls are 1½ in. above the bottom of the panel and the two outer controls 2 in. in from the edges of the chassis or 3 in. from the panel edges. The crystal-oscillator tube and plate coil are to the left, the doubler plate coil to the left of the 6L6 doubler and the change-over plug-in form at the rear.



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CHAPTER TEN

Figure 1940-6 — A 1940 edition medium power transmitter construction project.

TRANSMITTER CONSTRUCTION

about an inch below the surface of the chassis on long machine screws to bring the plate terminal down closer to the tank-coil terminal. A pair of fibre lug strips supports the voltage-divider resistances for oscillator and doubler screen voltages. Other resistances and chokes are self-supported.

Connections between the final tank coil and condenser are made through feed-through insulators set in the chassis. The neutralizing condenser, which may be seen in front of the final tube socket, is mounted on spacers. A clearance hole in the chassis permits the shaft

to protrude a half-inch or so above the chassis so that it may be adjusted with a screw driver.

All terminals for external connections, excepting that for the positive 1000-volt connection, are of the pin-jack type. The strips are mounted on small angle pieces behind a slot cut in the rear edge of the chassis. Insulated pin jacks are used to make connections and leave no exposed metal contacts. Separate connections are provided for meter and key connections as shown in the diagram.

When working at the crystal frequency, the "dummy" unit with connections shown in the

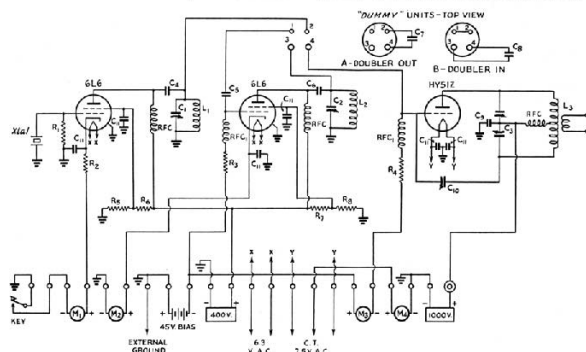


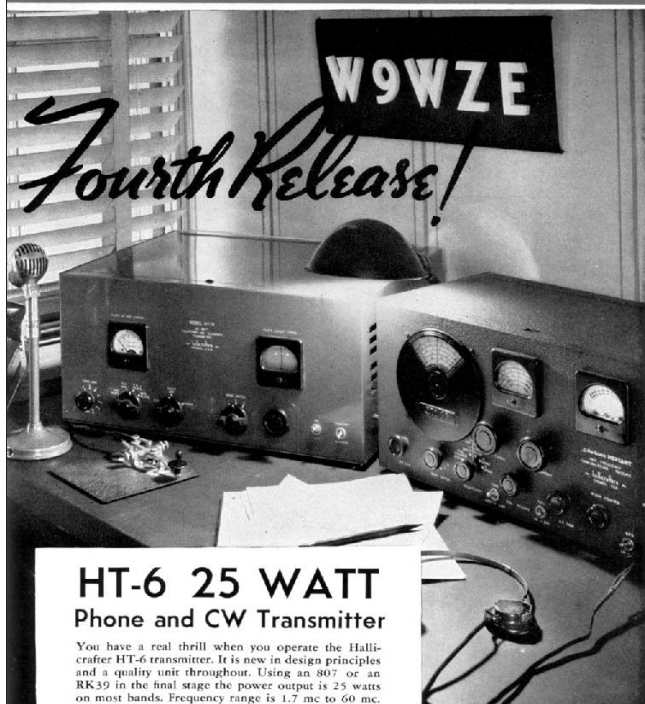
Fig. 1023—Circuit diagram of 100- to 175-watt transmitter.

- C_1 —100 μ fds. (National ST-100.)
- C_2 —100 μ fds. (National ST-100.)
- C_3 —180 μ fds. per section, 0.05-in. spacing (Cardwell MO-180-HD.)
- C_4 —0.001 μ fd. mica, 600 v.
- C_5 —500 μ fds. mica, 600 v.
- C_6 —0.001 μ fd. mica, 600 v.
- C_7 —50 μ fds. mica, 600 v.
- C_8 —150 μ fds. mica, 600 v.
- C_9 —0.002 μ fd. mica, 5000 v., Cornell-Dubilier.
- C_{10} —Neutralizing condenser, 0.07-in. spacing, Cardwell Trim-Air ZT-15-AS.
- C_{11} —0.01 μ fd. paper, 600 v.
- R_1 —0.1 meg., 1-watt.
- R_2 —400 ohms, 1-watt.
- R_3 —0.1 meg., 1-watt.
- R_4 —2500 ohms, 10-watt.
- R_5 —50,000 ohms, 2-watt.
- R_6 —10,000 ohms, 10-watt.
- R_7 —6000 ohms, 10-watt.
- R_8 —50,000 ohms, 2-watt.
- RFC₁—National R-100 r.f. chokes, 2.5 mh.
- RFC₂—National R-154U r.f. choke, 1 mh.
- M₁—Oscillator cathode milliammeter.
- M₂—Doubler cathode milliammeter.
- M₃—Final-amplifier grid milliammeter.
- M₄—Final-amplifier cathode milliammeter.
- L₁—L₂ (Coils interchangeable).
- 1.7 Mc.—60 turns No. 22 enam., 1½-in. diam., close wound.
- 3.5 Mc.—30 turns No. 22 enam., 1½-in. diam., 1½-in. long.
- 7 Mc.—15 turns No. 22 enam., 1½-in. diam., 1½-in. long.
- 14 Mc.—8 turns No. 16 enam., 1½-in. diam., 1½-in. long.
- 28 Mc.—3 turns No. 12 wire, 1½-in. diam., self-supporting mounted on small banana-type plugs. Adjust spacing to tune to resonance near minimum of C_2 .
- L₃—1.7 Mc.—50 turns No. 18 2½-in. diameter wound on bakelite tubing form to fit mounting.
- 3.5 Mc.—30 turns No. 14, 2½-in. diam., 3½-in. long wound on form to fit mounting.
- 7 Mc.—16 turns No. 14 bare, 2½-in. diam., 3-in. long with 1-in. space at center (National XR-10A form, start each half of winding one hole from end).
- 14 Mc.—12 turns No. 14 bare, 2½-in. diam., 3½-in. long (National XR-10A form, turns wound in alternate grooves).
- 28 Mc.—6 turns No. 14 bare, 2½-in. diam., 3½-in. long (National XR-10A form, turns wound every 4th turn).

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Figure 1940-7 — The second page of the project in Figure 1940-6, showing the schematic diagram.



HT-6 25 WATT Phone and CW Transmitter

You have a real thrill when you operate the Hallicrafter HT-6 transmitter. It is new in design principles and a quality unit throughout. Using an 807 or an RK39 in the final stage the power output is 25 watts on most bands. Frequency range is 1.7 mc to 60 mc.

Coils for any three bands may be plugged in, prewound, and then switched at will by a control on the front panel, which properly connects all circuits from crystal to antenna. It is only necessary to retune the final amplifier plate. Coils are available for any amateur band, 5 to 160 meters with crystal control; or with ECO on the 160, 80, 40, 20 meter amateur bands.

A special form of oscillator keying gives a clean chirpless signal, providing for break-in operation on CW.

Any high level high impedance mike may be used, such as an Asaric type D-104 or Shure 706 SA. Excellent voice quality with 100% modulation is assured. Output circuit is adjustable to match any type of resistive load of from 10 to 600 ohms.

Tube complement: 1-6L6 Osc. dble., 1-RK 39 or 807 final R.F. amplifier, 1-6J5 microphone amplifier, 1-6J5 Audio amplifier, 2-6BE6 modulators and 2-5Z3 rectifiers. Power drain about 120 watts CW and 225 watts phone. Size — 20" long, 9" high, 4 1/2" deep. For operation on 110 volt 50-60 cycle AC.

MODEL HT-6 Transmitter with tubes, less coils and crystals. Shipping weight 6 1/2 lbs. (TRANO).....**\$99.00**

Coils for 160, 80, 40, or 20 meter operation — Each Set.....**\$4.95**

E. C. O. unit for 160, 80, 40 or 20 meter operation for corresponding coils listed above. Each.....**\$3.65**

Set of coils for 5 or 10 meter operation on twice crystal frequency. Each Set.....**\$6.95**

Random Free. Crystal for 160, 80 and 40 meters. Each.....**\$4.80**

Random Free. Crystal for 20, 10 and 5 meters. Each.....**\$5.75**

Extra for 220 volt 50-60 cycle operation.....**\$7.50**

Available in U. S. A. on Hallicrafter's Factory-Sponsored Time Payment Plan

Figure 1940-8 — Hallicrafters not only provided receivers, but also had a matching desktop transmitter.

RECEIVING EQUIPMENT FOR 56- AND 28-MC.

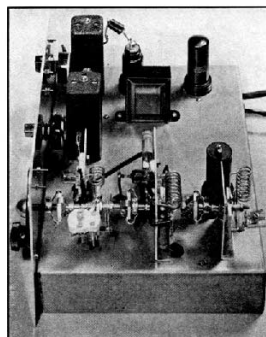


Fig. 2712 — An end view of the 56-Mc. superhet. Details of the construction of the r.f. end of the receiver are apparent from this photograph.

bly will not be enough, and suppressors should be installed at each spark plug. Generator "whine" can be eliminated by winding up a choke consisting of a few turns of heavy wire and connecting it in series with the hot lead at the generator with a 1/2- μ f. condenser between the far side of the choke and the frame, in addition to the usual condenser directly across the generator terminals (Bib. 1).

• A COMPLETE 56-MC. SUPERHET

If a communications receiver or all-wave broadcast receiver is not available to be used as an i.f. amplifier for a 56-Mc. converter, a relatively-simple complete superhet may be constructed according to Fig. 2713. Photographs of a receiver using the circuit are shown in Figs. 2712 and 2714. The circuit includes an 18S1 r.f. stage, 954 mixer, 955 high-frequency oscillator, a 1000-ke. i.f. amplifier, regenerative second detector, and a pentode audio output. The regenerative second detector may be operated in the oscillating condition for the reception of c.w. signals, or just below oscillation for 'phone reception of weak signals when maximum amplification is needed.

The receiver is constructed on a chassis

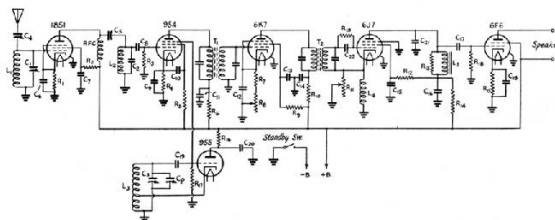


Fig. 2713 — 56-Mc. superhet circuit diagram.

- | | | |
|--|--|---|
| C ₁ , C ₂ — 10- μ f. (Cardwell ZR-10-AS). | C ₂₁ — 0.002- μ f., 400-volt tubular. | L ₁ — 8 turns No. 14, 1/2" diameter, winding length 1 1/2". |
| C ₃ — 15- μ f. (Cardwell ZR-15-AS). | R ₁ — 100 ohms, 1/2-watt. | L ₂ — 9 turns No. 14, 1/2" diameter, winding length 1 1/2". |
| C ₄ , C ₅ — 3-35- μ f. (Isolantite) powders. | R ₂ — 60,000 ohms, 1/2-watt. | L ₃ — 1 meg., 1/2-watt. |
| C ₆ — 50- μ f. air padder (Hammarlund APC-50). | R ₃ , R ₄ — 2000 ohms, 1/2-watt. | L ₄ — 4 turns No. 14, 1/2" diameter, winding length 1/2" (cathode tap 1/2 turn from ground end). |
| C ₇ , C ₈ , C ₉ — 0.01- μ f., 400-volt tubular. | R ₅ , R ₆ , R ₇ — 100,000 ohms, 1/2-watt. | L ₅ — 30 turns No. 24, close-wound on 1/2" form. |
| C ₁₀ , C ₁₁ , C ₁₂ — 100- μ f. midget mica. | R ₈ — 300 ohms, 1/2-watt. | L ₆ — 1089-henry plate impedance (Thoradon 1-29C27). |
| C ₁₃ , C ₁₄ — 0.05- μ f., 400-volt tubular. | R ₉ , R ₁₀ — 50,000-ohm potentiometer. | RFC — 2 1/2-mh. r.f. choke (National R100). |
| C ₁₅ , C ₁₆ , C ₁₇ , C ₁₈ — 0.1- μ f., 400-volt tubular. | R ₁₁ — 1000-ohm potentiometer. | T ₁ — 1600-ke. iron core i.f. (Meisner No. 16-8991). |
| C ₁₉ — 0.02- μ f., 400-volt tubular. | R ₁₂ — 250,000 ohms, 1/2-watt. | T ₂ — 1600-ke. iron core i.f. (Meisner No. 16-8991). |
| C ₂₀ — 10- μ f., 25-volt tubular. | R ₁₃ — 450 ohms, 10-watt. | |
| C ₂₂ — 0.001- μ f. midget mica. | R ₁₄ — 500,000 ohms, 1/2-watt. | |
| | R ₁₅ — 5 meg., 1/2-watt. | |

CHAPTER TWENTY-SEVEN

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Figure 1940-9 — The 1940 edition described VHF construction projects as well as those for HF.

SUPERIOR KEYS FOR SUPERIOR WORK

STANDARD OF THE WORLD FOR CLARITY . . . SPEED . . . SENDING EASE

Demand
the Genuine

VIBROPLEX

SEMI-
AUTOMATIC
KEY

The "CHAMPION"

The new "CHAMPION" is an inexpensive key having exceptional sending qualities—clarity . . . speed . . . sending ease, which will appeal alike to amateurs and professional operators. Chrome and cadmium plated and mounted on black base. Standard size and equipped with standard contact points same as the more expensive models. Practically rust-proof. This model is not equipped with screw closer or cord and wedge. If your dealer cannot supply you write us for full particulars.



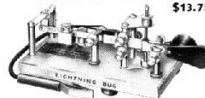
ONLY
\$9.95

IMPROVED ORIGINAL VIBROPLEX
\$13.75



Needs no introduction being known the world over for its smooth, easy, rhythmic sending. In high favor with experienced operators everywhere. Polished finish bright parts.

A Winner "LIGHTNING BUG"
\$13.75



This is the same Great New Easy-action Vibroplex which formerly sold for \$17.00 — the same fine instrument that is preferred for its ease of handling, fine quality signal and all 'round superior performance. Polished finish bright parts.

CARRYING CASE
\$3.00



Handsome black morocco. Reinforced corners. Flexible leather handle. Keeps bug free of dirt and moisture. Patent lock and key.

Approved by Over
100,000 Operators

Experienced operators — over 100,000 of them, have put their stamp of approval on VIBROPLEX keys for clarity, speed and sending ease. They have learned from actual experience that the Vibroplex really does make sending a lot easier and better, and that it develops a higher degree of sending skill than the average hand sender can hope to attain.



The BUG trade mark identifies the Genuine Vibroplex.

Press Lever — Vibroplex Does the Rest

If you can send on the regulation key — you can send better, faster and with half the effort with a Vibroplex. Its simplicity, mechanical perfection, machine speed and sending ease enables any operator with a little practice, to send with the skill of an expert. Simply press lever — Vibroplex does the rest. Heed the advice of experienced operators and demand the Genuine Vibroplex. Accept no substitute. Only the Genuine has "THE BUG" trade mark. Look for it on the bug you buy. You will always be glad you did. Money order or registered mail. Write for FREE illustrated catalog.

THE VIBROPLEX CO., Inc.

832 Broadway New York, N. Y.

J. E. Albright, President

Figure 1940-10 — Vibroplex continued to advertise its popular "Bugs."

A Decade of Turmoil and Recovery — The 1950 Edition

The big news between the 1940 and 1950 editions was, of course, World War II, which was declared on December 7, 1941. All Amateur Radio operation was suspended “until further notice.” While there were some exceptions for specific amateurs operating in support of local security and Civil Defense, including a special War

Emergency Radio Service that mainly used the 2½ meter band, hams were essentially off the air until bands were gradually brought back starting after the end of hostilities.

One might have expected that this would have resulted in a suspension of *Handbook* publication, but that was not the case. *QST*

and *The Radio Amateur’s Handbook* continued unabated throughout the period, in fact there was even an extra edition published in 1942 for the war effort. This “Special Defense Edition” (see Figure 1950-1) was designed as a training manual for use by various military technical schools. At 288 pages, it was about one third the size of the

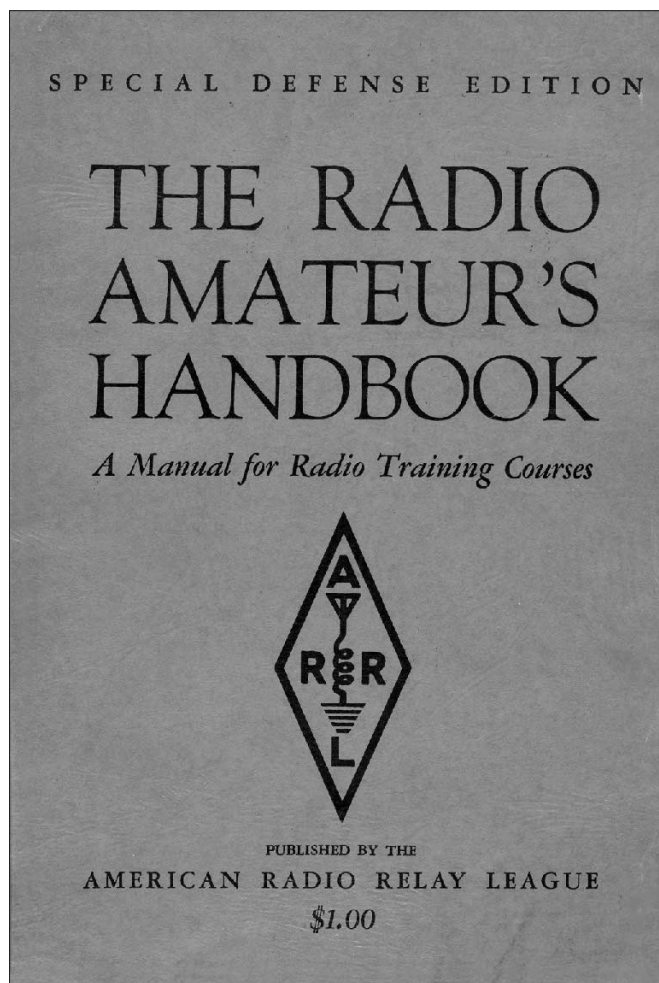


Figure 1950-1 — The cover of the 1942 Special Defense Edition of *The Radio Amateur’s Handbook*.

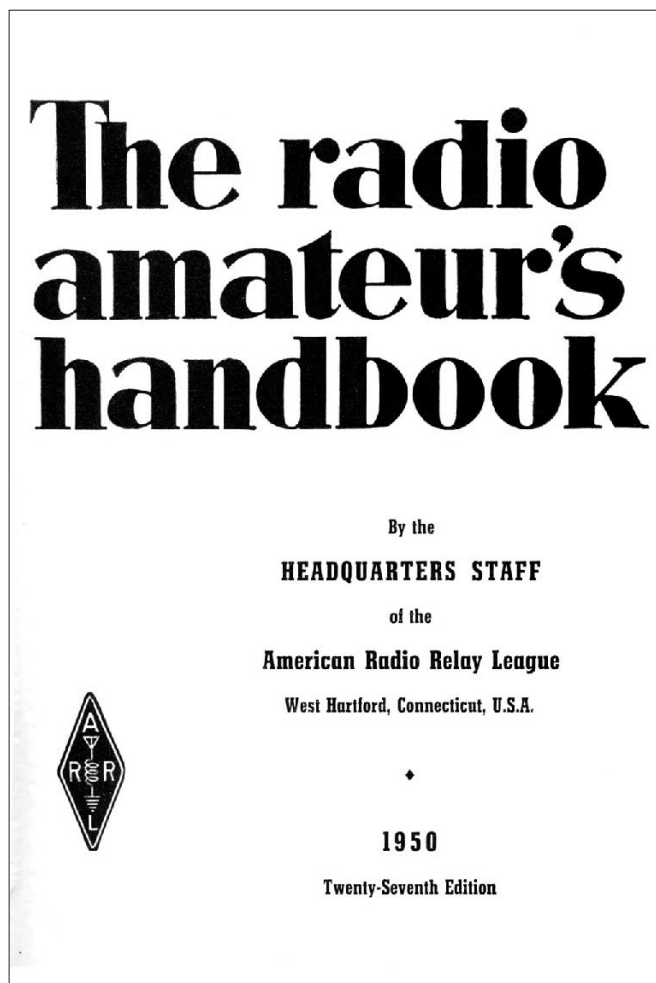


Figure 1950-2 — The cover page of the 1950 edition looks much like the previous ones, but a bit more modern and note that the year is explicitly shown.

regular editions, accomplished by eliminating most construction projects, the advertising section and material very specific to Amateur Radio.

The latter half of the 1940s found the amateur bands gradually returned to amateur use, but with some changes. Perhaps the most significant was the change in VHF allocations to accommodate the newly defined VHF television service. The 2½ and 5 meter

bands were within the TV allocation, resulting in the shift to our current 2 and 6 meter bands.

The 1950 edition cover page (see Figure 1950-2) sported a new more modern look and now firmly indicated the year of publication, in addition to the edition identifier. Changes in the approach to technology employed reflected two different changes in the environment:

◇ The rapid development of radio science during the war years was reflected in Amateur Radio. The single signal effect, described by Lamb in the previous decade, has been improved by coupling it with the high selectivity of single crystal IF filters as shown in Figure 1950-3, a figure that will remain in *Handbooks* for decades. In addition to the adaptation of technology, the years following the war included an

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varies with signal strength, being less on strong signals, and the selectivity varies.

Crystal Filters

The most satisfactory method of obtaining high selectivity is by the use of a piezoelectric quartz crystal as a selective filter in the i.f. amplifier. Compared to a good tuned circuit, the Q of such a crystal is extremely high. The dimensions of the crystal are made such that it is resonant at the desired intermediate frequency. It is then used as a selective coupler between i.f. stages.

Fig. 5-23 gives a typical crystal-filter resonance curve. For single-signal reception, the audio-frequency image can be reduced by a factor of 1000 or more. Besides practically eliminating the a.f. image, the high selectivity of the crystal filter provides great discrimination against signals very close to the desired signal and, by reducing the band-width, reduces the response of the receiver to noise.

Crystal-Filter Circuits; Phasing

Several crystal-filter circuits are shown in Fig. 5-24. Those at A and B are practically identical in performance, although differing in details. The crystal is connected in a bridge circuit, with the secondary side of T_1 , the input transformer, balanced to ground either through a pair of condensers, $C-C'$ (A), or by a center-tap on the secondary, L_2 (B). The bridge is completed by the crystal and the phasing condenser, C_2 , which has a maximum capacity somewhat higher than the capacity of the crystal in its holder. When C_2 is set to balance the crystal-holder capacity, the resonance curve of the crystal circuit is practically symmetrical; the crystal acts as a series-resonant

circuit of very high Q and thus allows signals of the desired frequency to be fed through C_1 to L_2L_3 , the output transformer. Without C_2 , the holder capacity (with the crystal acting as a dielectric) would pass undesired signals.

The phasing control has an additional function besides neutralization of the crystal-holder capacity. The holder capacity becomes a part of the crystal circuit and causes it to act as a parallel-tuned resonant circuit at a frequency slightly higher than its series-resonant frequency. Signals at the parallel-resonant frequency thus are prevented from reaching the output circuit. The phasing control, by varying the effect of the holder capacity, permits shifting the parallel-resonant frequency over a considerable range, providing adjustable rejection of interfering signals. The effect of rejection is illustrated in Fig. 5-23.

Additional I.F. Selectivity

Most commercial communications receivers do not have sufficient selectivity for amateur use, and their performance can be greatly improved by adding additional selectivity. One popular method is to couple a BC-453 aircraft receiver (war surplus, tuning range 190 to 550 kc.) to the tail end of the 465-kc. i.f. amplifier in the communications receiver and use the resultant output of the BC-453. The aircraft receiver uses an 85-kc. i.f. amplifier that is quite sharp — 6.5 kc. wide at —60 db. — and it helps tremendously in separating 'phone signals and in backing up crystal filters for improved c.w. reception. (See *QST*, January, 1948, page 40.)

If a BC-453 is not available, it is still a simple matter to enjoy the benefits of improved selectivity. It is only necessary to heterodyne to a lower frequency the 465-kc. signal existing in the receiver i.f. amplifier and then rectify it after passing it through the sharp low-frequency amplifier. The Hammarlund Company and the J. W. Miller Company both offer 50-kc. transformers for this application.

QST references on high i.f. selectivity include: McLaughlin, "Selectable Single Sideband," April, 1948; Githens, "C.W. Receiver," Aug., 1948.

RADIO-FREQUENCY AMPLIFIERS

While selectivity to reduce audio-frequency images can be built into the i.f. amplifier, discrimination against radio-frequency images can only be obtained in circuits ahead of the first detector. These tuned circuits and their associated vacuum tubes are called radio-frequency amplifiers. For top performance of a communications receiver on frequencies above 7 Mc., it is mandatory that it have one or two stages of r.f. amplification, for image rejection and improved sensitivity.

Receivers with an i.f. of 455 kc. can be expected to have some r.f. image response at a signal frequency of 14 Mc. and higher if only one stage of r.f. amplification is used. (Regen-

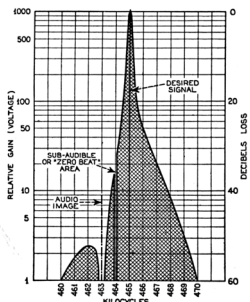


Fig. 5-23 — Graphical representation of single-signal selectivity. The shaded area indicates the overall bandwidth, or region in which response is obtainable.

Figure 1950-3 — The single signal effect, described by Lamb in the previous decade, has been improved by coupling it with the high selectivity of single crystal IF filters.

CHAPTER 5

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CHAPTER 5

An Amateur-Band Eight-Tube Superheterodyne

An advanced type of amateur receiver incorporating one r.f. amplifier stage, variable i.f. selectivity and audio noise limiting is shown in Figs. 5-33, 5-35 and 5-36. As can be seen from the circuit in Fig. 5-34, a 6SG7 pentode is used for the tuned r.f. stage ahead of the 6K8 converter. An antenna compensator, C_4 , controlled from the panel, allows one to trim up the r.f. stage when using different antennas that might modify the tracking. The cathode bias resistor of the r.f. stage is made as low as possible consistent with the tube ratings, to keep the gain and hence the signal-to-noise ratio of the stage high. The oscillator portion of the 6K8 mixer is tuned to the high-frequency side of the signal except on the 28-Mc. band, the usual custom nowadays in communications receivers. The oscillator tuning condenser, C_{12} , is of higher capacity than the r.f. and mixer tuning condensers, in the interest of better oscillator stability.

The i.f. amplifier is tuned to 455 kc., and the first stage is made regenerative by soldering a short length of wire to the plate terminal of the socket and running it near the grid terminal, as indicated by C_{11} in the diagram. Regeneration is controlled by reducing the gain of the tube, and R_{12} , a variable cathode-bias control, serves this function. The second i.f. stage uses a 6K7, selected because high gain is not necessary at this point.

Manual gain-control voltage is applied to the r.f. and second i.f. stages. It is not applied to the mixer because it might pull the oscillator frequency, and it is not tied in with the first i.f. amplifier because it would interlock with the regeneration control used for controlling the selectivity. However, the a.v.c. voltage is applied to the r.f. and both i.f. stages, with the result that the selectivity of the regenerative

stage decreases with loud signals and gives a measure of automatic selectivity control. Using a negative-voltage power supply for the manual gain control is more expensive than the familiar cathode control, but it allows a wide range of control with less dissipation in the components. The a.v.c. is of the delayed type, the a.v.c. diode being biased about 1½ volts by the cathode resistor of the diode-triode detector-audio stage.

The second-detector-and-first-audio is the usual diode-triode combination and uses a 6SQ7. A 1N34 crystal diode is used as a noise limiter, and is left in the circuit all of the time. As is common with this type of circuit, it has little or no effect when the b.f.o. is on, but it is of considerable help to 'phone reception on the bands where automobile ignition is a factor. The constructor can satisfy himself on its operation when first building the receiver and working on it out of the case. By leaving one end of the 1N34 floating and touching it to the proper point in the circuit, a marked drop in ignition noise will be noted. The b.f.o. is loosely-coupled to the detector by soldering one end of an insulated wire to the a.v.c. diode plate and wrapping several turns of the wire around the b.f.o. grid lead. This capacity is designated C_{13} in the diagram. The wire was connected to the a.v.c. diode plate lead only for wiring convenience — the a.v.c. coupling condenser, C_{13} , passing the b.f.o. voltage without introducing appreciable attenuation.

Headphone output is obtained from the plate circuit of the 6SQ7 at J_1 , and loudspeaker output is available from the 6P6 audio-amplifier stage. High-impedance or crystal headphones are recommended for maximum head-phone output.

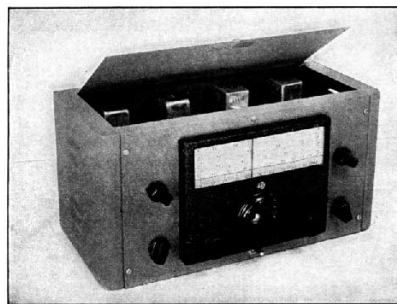


Fig. 5-33 — An amateur-band eight-tube receiver. The knobs on the left control audio volume (upper) and b.f.o. pitch, and the two on the right handle r.f. and i.f. gain (upper) and i.f. regeneration. The knob to the left of the large tuning knob is fastened to the MAN-A.V.C.-B.F.O. switch, and the one on the right is for the antenna trimmer. The toggle switch under the dial throws high negative bias on the r.f. stage during transmission periods.

Figure 1950-4 — This receiver construction project, see schematic in Figure 1950-5, is based on the same architecture as the receiver shown in Figure 1940-3. While an additional RF and IF stage were added, there's not much new here.

abundance of low cost surplus radio equipment that could be put to use with varying levels of effort. In many cases this equipment made the decision to buy new commercial gear, or to build your own difficult. Still, the *Handbook* described receiver construction projects (see Figures 1950-4 and 5) that, while elegant looking, arguably were not very different from those shown in the 1940 edition.

♦ The introduction and increasing

popularity of broadcast television service as the decade drew to a close had a major impact on Amateur Radio, as it would for decades to come. Harmonic and spurious radiation in the VHF range that had been largely unnoticed for years suddenly resulted in non-amateurs becoming very aware of ham radio in a negative way. This gave rise to major changes in transmitter design and construction methods, including shielding, bypassing, filtering and the use of coaxial

cable — available as surplus following the war. This can be seen in Figure 1950-6, a transmitter not very different from those of the previous decade, but with attention paid to shielding and bypassing to “reduce the generation and transmission of harmonics.”

Other developments were shown in the 1950 edition, including an early description of single-sideband suppressed-carrier transmission (see Figure 1950-7). This was to become known as “SSB” in a few years

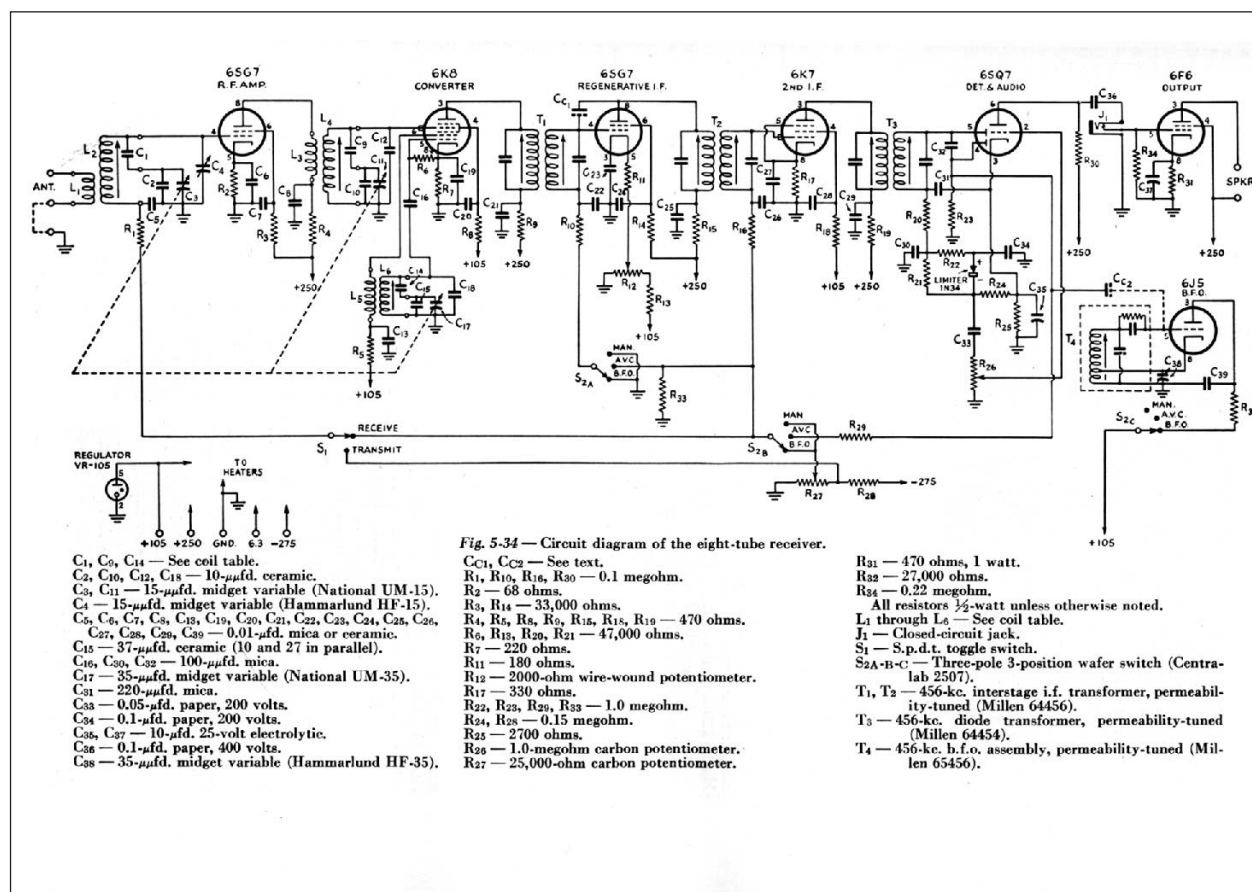


Figure 1950-5 — Schematic diagram of the receiver project shown in Figure 1950-4.

and, while the most popular HF voice mode today, took some years to displace (double-sideband full-carrier) AM from predominance in *Handbook* projects.

The ad section featured the newest of the "postwar" communication equipment. While perhaps shinier and prettier, these radios (see Figures 1950-8 and -9) were not terribly different from those of the previous generation — with the exception of the

introduction of the Collins 75A-1 (see Figure 1950-10) receiver. The 75A-1 featured down conversion to a tunable first IF stage, an architecture that would define the best of the SSB equipment of the upcoming generation. Vibroplex (see Figure 1950-11) continued to offer the same bugs as in previous decades, although the ad has a more modern look. Interestingly, the prices that dipped significantly between 1926 and

1940, returned to around their 1926 levels.

In 1939, the *Handbook* editors had concluded that there was enough material about antennas available that the *Handbook* could not do it justice. Thus a new book, *The ARRL Antenna Book*, was launched. Figure 1950-12 shows the cover of the first edition while Figure 1950-13 shows the cover of subsequent editions which maintained the familiar appearance for decades.

HIGH-FREQUENCY TRANSMITTERS

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A 500-Watt Link-Coupled All-Band Transmitter

In the design of the transmitter shown in Figs. 6-58 through 6-60, an attempt has been made to incorporate means by which harmonic radiation and transmission may be minimized. In addition to the use of thorough shielding and power-line filtering, link coupling is used throughout.

Through the use of plug-in coils, the transmitter may be operated up to 21 Mc. with 1.75-Mc. crystals, and to 28 Mc. with either 3.5- or 7-Mc. crystals. With VFO input, it will go to 7 Mc. with 1.75-Mc. VFO output, to 21 Mc. with 3.5-Mc. VFO output, and to 28 Mc. with 7-Mc. VFO output.

The design of the push-pull triode final amplifier is suitable for any of the usual triodes with plate-cap connection, operating at plate voltages up to 1500 with plate modulation and a plate-voltage/total-plate-current ratio of 5 to 1 or greater.

The transmitter is made up in two sections mounted in a simple shielding enclosure consisting of a wood-strip frame covered with copper screening. The exciter unit is provided with pull handles and is designed to slide out for coil changing. As the unit is returned to the

enclosure, the power-supply connections are automatically made at the rear through a series of plugs which fit into jacks set along the side of a 3 × 4 × 17-inch chassis fastened permanently at the rear. This chassis also encloses and shields the harmonic-filter components for all power-supply leads.

The second section above includes the push-pull final amplifier and an antenna tuner. The top cover is hinged to provide access to the output-stage and antenna tank coils. The meters for the amplifier stage are set in a separate panel between the two main sections.

Circuit Details

Referring first to the circuit diagram of the exciter section shown in Fig. 6-60, either the built-in Pierce crystal oscillator or an external VFO may be used to feed a 6L6 stage which is operated as a doubler, as a tripler, or, when necessary, as a buffer amplifier. This stage feeds a push-push 807 driver stage that may be operated either as a doubler, or as a self-neutralized straight-through amplifier by opening S_2 which controls the heater of one of the 807s. This inactive tube then becomes the

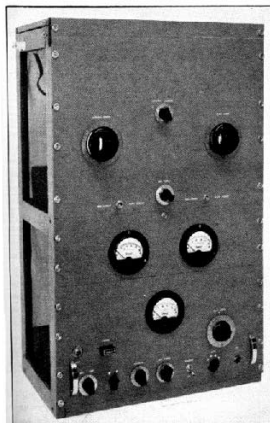


Fig. 6-58 — A complete 500-watt all-band transmitter including antenna tuner. The exciter unit at the bottom slides out for coil changing. The panel screws on this unit are dummies cemented in place. The top of the screened enclosure is hinged to permit changing coils in the final amplifier and antenna tuner.

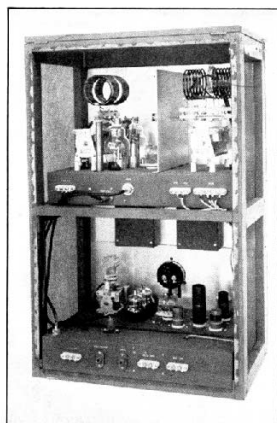


Fig. 6-59 — Rear view of the completed 500-watt all-band transmitter with the back screening panel removed. The rectangular enclosed unit to the rear of the exciter contains the v.h.f. power-line filters. The two matching boxes above enclose the amplifier-stage milliammeters.

Figure 1950-6 — This 1950 edition medium power transmitter construction project includes shielding and filtering to reduce dreaded TVI.

RADIOTELEPHONY

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Single-Sideband Transmission

The most recent development in amateur radiotelephony is the introduction of practical single-sideband suppressed-carrier transmission. This system has tremendous potentialities for increasing the effectiveness of 'phone transmission and for reducing interference. Because only one of the two sidebands normally produced in modulation is transmitted, the channel width is immediately cut in half. However, when only one sideband is transmitted the carrier — which is essential in double-sideband transmission — no longer is necessary; it can be supplied without too much difficulty at the receiver. With the carrier eliminated there is a great saving in power at the transmitter — or, from another viewpoint, a great increase in effective power output. Assuming that the same final-amplifier tube or tubes are used either for normal AM or for single-sideband, carrier suppressed, it can be shown that the use of SSB gives an effective gain of at least 9 db. over AM — equivalent to increasing the transmitter power 8 times. Eliminating the carrier also eliminates the heterodyne interference that wrecks so much communication in congested 'phone bands.

Two basic systems for generating SSB signals are shown in Fig. 9-58. One involves the use of a bandpass filter having sufficient selectivity to pass one sideband and reject the other. Filters having such characteristics can only be constructed for relatively low frequencies, and most filters used by amateurs are designed to work somewhere between 10 and 20 kc. Good sideband filtering can be done at frequencies as high as 100 kc. by using multiple-crystal filters. The low-frequency oscillator output is combined with the audio output of a speech amplifier in a "balanced modulator" — one in which the carrier is "neutralized" out, and only the upper and lower sidebands appear in the output. One of the sidebands is passed by the filter and the other rejected, so that an SSB signal is fed to the mixer. The signal is there mixed with the output of a high-frequency r.f. oscillator to produce the desired output frequency. For additional amplification a linear r.f. amplifier (Class A or Class B) must be used. When the SSB signal is generated at 10 or 20 kc., it is generally first heterodyned to somewhere around 500 kc. and then to the operating frequency. This simplifies the problem of rejecting the "image" frequencies resulting from the heterodyne process.

The second system is based on the phase relationships between the carrier and sidebands in a modulated signal. As shown in the diagram, the audio signal is split into two components that are identical except for a phase difference of 90 degrees. The output of the r.f. oscillator (which may be at the operating frequency, if desired) is likewise split into two

separate components having a 90-degree phase difference. One r.f. and one audio component are combined in each of two separate balanced modulators. The carrier is suppressed in the modulators, and the relative phases of the sidebands are such that one sideband is balanced out and the other is accentuated in the combined output. If the output from the balanced modulators is high enough, such an SSB exciter can work directly into the antenna, or the power level can be increased in a linear amplifier following the exciter.

Which is the better method of generating an SSB signal, the filter or the phasing method, is a controversial question. Properly adjusted, either system is capable of good results. Arguments in favor of the filter system are that it is

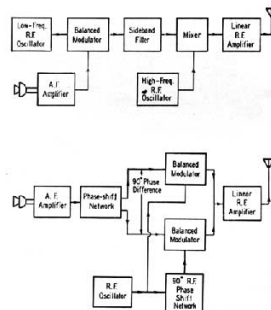


Fig. 9-58 — Two basic systems for generating single-sideband suppressed-carrier signals.

somewhat easier to adjust without an oscilloscope, since it requires only a receiver and a v.t.v.m. for alignment, and it is more likely to remain in adjustment over a long period of time. The chief argument against it, from the amateur viewpoint, is that it requires quite a few stages and at least two frequency conversions after modulation. The phasing system requires fewer stages and can be designed to require no frequency conversions, but its alignment and adjustment are often considered to be a little "trickier" than that of the filter system. This probably stems from lack of familiarity with the system rather than any actual difficulty. In most cases the phasing system will cost less to apply to an existing transmitter.

Figure 1950-7 — Single sideband transmission rated a few pages, but it would be some years before it would become mainstream for amateur use.

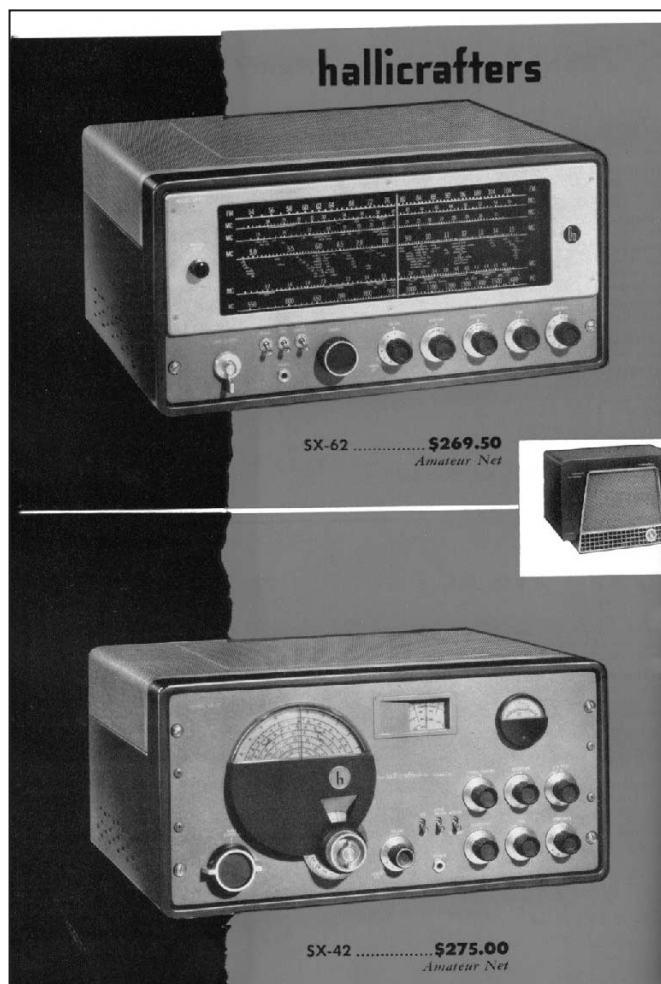


Figure 1950-8 — Hallicrafters receivers in 1950 had a definite postwar look. These receivers covered not only HF, but also VHF through 6 meters and the new FM broadcast band at 3 meters.

**the finest amateur receiver
National has ever built!**

THE NEW DIRECT READING HRO-50

Now, National presents a great new HRO receiver after more than three years of designing, development and testing. Retaining all the world-famous, performance-proved HRO features, this superb receiver — the finest National has ever made — now incorporates no less than 14 advanced-design innovations. Exhaustive comparative tests indicate the new HRO-50, by far the most modern and versatile in its field, will set an entirely new standard of performance for communication receivers.

14 ALL NEW FEATURES

1. Direct frequency reading linear scale with a single range in view at a time.
2. Provisions for using 100/1000 kcs. crystal calibrator unit, switched from panel.
3. Variable front-of-panel antenna trimmer.
4. Built-in power supply with heat resistant barrier.
5. Front-of-panel oscillator compensation control.
6. B.F.O. switch separated from B.F.O. frequency control.
7. Provision for incorporation of NFM adapter inside receiver, switched from front panel.
8. Dimmer control for dial and meter illumination.
9. Miniature tubes in front end and high frequency oscillator.
10. Speaker matching transformer built into receiver with 8 and 500 -ohm output terminals.
11. High frequency and beat frequency oscillator circuits not disabled when receiver in "send" position.
12. High-fidelity push-pull audio amplifier, 8 watts undistorted output.
13. Tip jack for phono input.
14. Accessory socket for Select-a-Ject (see page 4).

TUBE COMPLEMENT:

1st RF, 6BA6; 2nd RF 6BA6; Mixer, 6BE6; HF oscillator 6C4; voltage regulator 0B2; 1st IF, 6K7; 2nd IF, 6K7; Det./AVC, 6H6; B.F. Oscillator, 6J7; Noise Limiter, 6H6; 1st Audio, 6X7; phase inverter/ "S" meter amp. 6SN7; Push-pull audio, 2-6V6; Rectifier, 5V4G; accessory crystal calibrator, 6AQ5; NFM adapter IF amplifier, 6SK7; Ratio detector, 6H6. Frequency ranges: 50 kc-420 kc, 480 kc-35 mc Calls AA, B, C, and D furnished covering standard amateur 160-10 meter bands.

National
INCORPORATED
NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

Figure 1950-9 — National Radio's premier postwar offering was the HRO-50 — an evolution of the prewar HRO that included miniature tubes, an internal power supply, push-pull (hi-fi) audio and a direct reading frequency scale. These were nice features, but it was now a two-person lift!

1950 Parade of Collins Stars



COLLINS 75A-1 AMATEUR RECEIVER

The well known and highly regarded 75A-1 receiver was designed specifically to give the radio amateur the best possible performance in the 80, 40, 20, 15, 11 and 10 meter bands.

Double conversion and crystal filter controls, with a high frequency first i-f and a low frequency second i-f, provide at least 50 db image rejection in all bands. The received bandwidth is variable in 5 steps from 4 kc to 200 cycles at 6 db down from the peak of the resonant frequency. The 6AK5 r-f stage makes possible a threshold sensitivity far better than can be realized in normal installations.

Very high accuracy and stability result from the use of precision quartz crystals in the first conversion circuit, the extreme accuracy and stability

of the v.f.o. in the second conversion circuit, and linearity and absence of backlash in the tuning mechanism. The handlighted slide rule dial indicates frequency in megacycles, while the vernier dial provides a direct reading in kilocycles. Panel controls include tuning, bandswitch, r-f gain, audio gain, c-w pitch, on-off-standby, crystal selectivity, crystal phasing, avc-manual-c-w, and noise limiter switch.

Dimensions: 21½" wide, 12½" high, 13½" deep.

Power source: 115 volts 50/60 cycles a-c.

Shipping weight: 93 pounds including speaker.

Net domestic price, complete with 13 tubes and rectifier, speaker and cabinet assembly, and instruction book (exclusive of state tax but including excise tax).....\$375.00

Coming! Collins KW-1

The New One Kilowatt Transmitter . . . Available Early Summer, 1950

Engineered by Collins expressly for radio amateurs. One kilowatt input, both AM phone and c-w. Designed to avoid TVI. Bandswitching throughout. Usual excellent Collins audio.

Tentative specifications: Exciter, single control

tuning. Dial similar to the new Collins 51J-1 receiver. Output 50 to 75 ohms; single ended pi followed by L section. Tubes: P. A., two type 4-250A; modulator, two type 810.

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Figure 1950-10 — This ad by Collins radio doesn't really highlight the fact that the 75A-1 architecture was radical for its time, and would set the stage for the Collins SSB radios that would appear in the next decade.

THE EASIEST SEMI-AUTOMATIC KEY IN THE WORLD TO OPERATE!

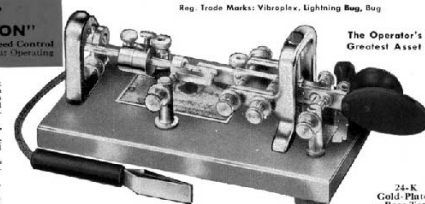
AMAZING NEW VIBROPLEX

Super De Luxe

"PRESENTATION"

The only key with Super-Speed Control Main Spring and Clear-Cover Operating Features

- Touch Control . . . Instant adjustment to perfect touch
- Super-Speed Control Main Spring . . . lets you send slower or faster than has been kept possible
- Joint Movement . . . smoother, easier operation, longer life
- Extra Large Contacts . . . die cast for perfect alignment and clear signals
- Super-Grip Finger and Thumb Pads . . . sensitive aids in the varying operating skill
- Ringer Tip Clear-Cover . . . eliminates key motion
- V-cord controlled 4-position Foot . . . smoother operation and better access on table

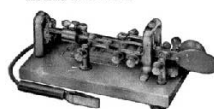


The Operator's Greatest Asset

24-K Gold-Plated Base Top

Illustrated above is the New Vibroplex Model Super Deluxe "PRESENTATION", the smoothest operating key ever built \$27.50

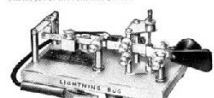
Vibroplex brings to all c.w. keying operations the simplicity and precision which makes high class operating possible. The ability to send perfect signals is further aided by the ease with which these keys can be operated. Perfect balance, simple operation and smooth, positive action encourage users to make the most of their skill. These worthwhile features are important not only to the experienced operator, but to anyone desiring to develop a pleasing sending style.



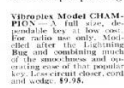
Vibroplex Model ORIGINAL — An exceptionally efficient and popular, economy key, combining all the features for a high class keying performance. Famous the world over for its meriting ease and signal quality. Black crystal base, polished chromium machine parts. \$15.95. Full-size finish — polished chromium base and machine parts, joint movement. \$19.50



Vibroplex Model BLUE RACER — Small in size, BIG in performance. Weight 2 lbs. 8 oz. Patterned after the Original with the same operating ease and signal quality for which that key is internationally famous. Streamlined, compact. Black crystal base, polished chromium machine parts. \$15.95. Full-size finish — polished chromium base and machine parts, joint movement. \$19.50



Vibroplex Model LIGHTNING BUG — A beautifully designed, modernized key, with many advanced features combined in the highest degree of operating skill with less effort, including an improved butyrate lever, adjustable die contact spring and many others. Black crystal base, polished chromium machine parts. \$15.95. Full-size finish — polished chromium base and machine parts, joint movement. \$19.50



Vibroplex Model CHAMPION — A full size, dependable key at low cost. For radio use only. Modified after the Lightning Bug and combining much of the smoothness and accuracy of that popular key. Low current shock cord and socket. \$9.98.



Vibroplex CARRYING CASE — Finished in black, semi-simulated black material. Polished chrome corners. Heavy leather handle. Inside a carrying case. Fits in box. Keys, key like new. Lock and key. \$5.95.

All Vibroplex keys are available for left hand operation, \$1.00 more. Choose from the world's finest semi-automatic keys. If your dealer cannot supply you ORDER DIRECT.

FREE descriptive literature

To get the genuine Vibroplex key, look for the "BUG" trade mark stamped on nameplate.



THE VIBROPLEX CO., INC., 533 Broadway, NEW YORK 3, N. Y.

W. W. Albright, President

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Figure 1950-11 — Vibroplex continued to advertise its popular "Bugs." This ad has a more modern layout than earlier ones, and the prices are back to 1926 levels.

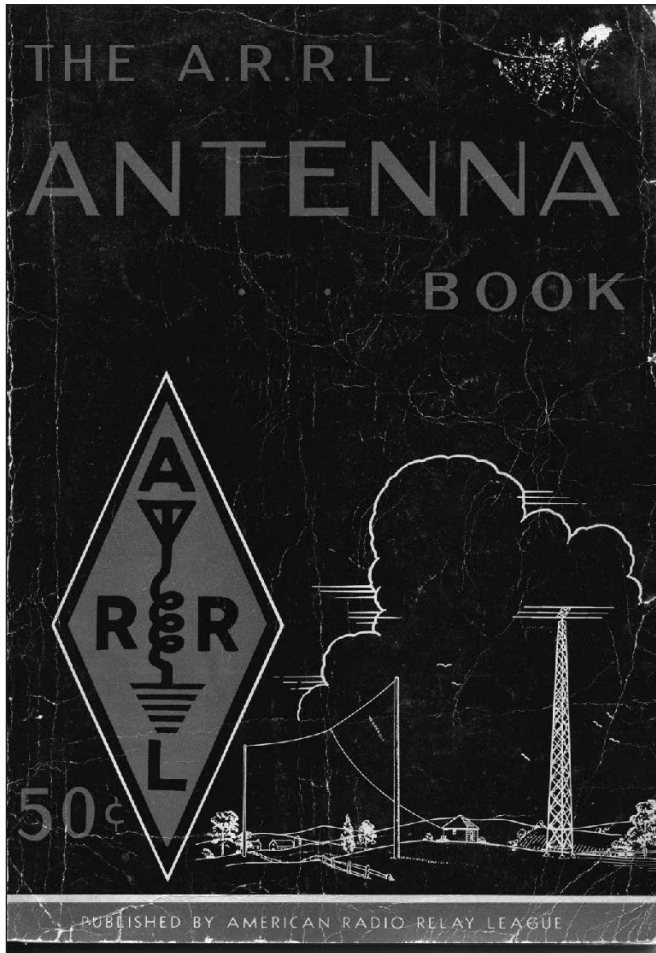


Figure 1950-12 — In 1939, the *Handbook* editors concluded that there was enough material about antennas available that a new reference text was needed, creating the *ARRL Antenna Book*.

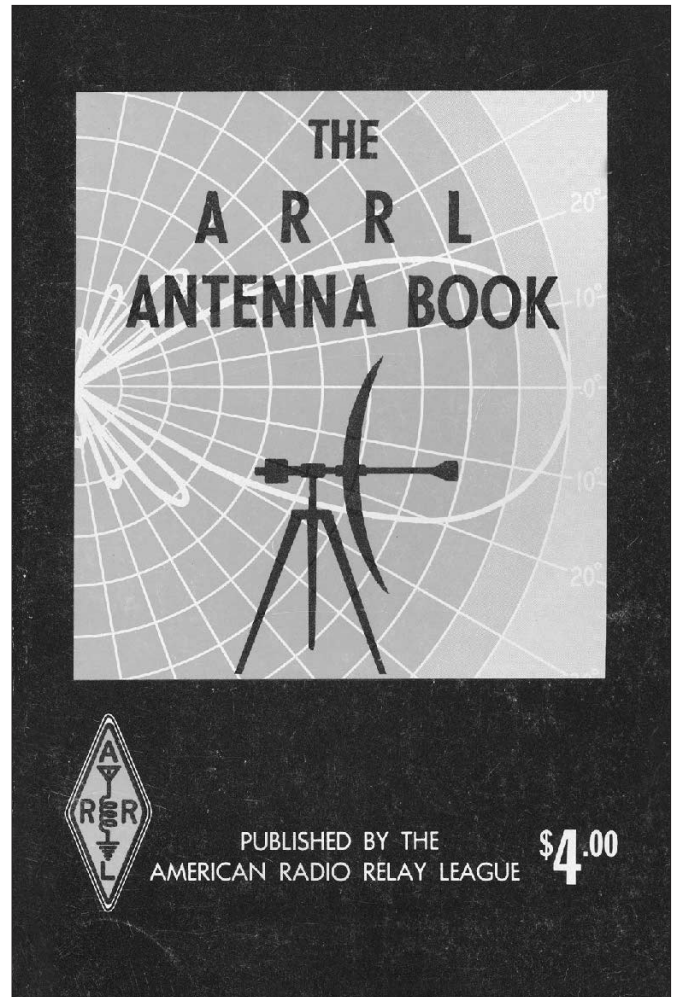


Figure 1950-13 — By 1949, the amount of material in the *Antenna Book* had increased substantially and the cover assumed the familiar look that subsequent editions maintained for decades.

A Decade of Advancement and Change — The 1960 Edition

The advancements in technology and engineering that were starting to emerge in the 1950s were solidified in the period building toward 1960, although not evident in the cover plate (see Figure 1960-1). While complete solid state equipment is some years away, transistor circuitry was showing up in projects where it was readily applied (see Figure 1960-2). In this figure,

the mostly vacuum tube receiver includes a two transistor 100 kHz calibrator. Also note the two crystal IF band-pass filter. This arrangement was chosen with an ear toward SSB reception, in preference to the sharper single crystal filters of earlier year designs.

Figures 1960-3 and -4 illustrate a *Handbook* transmitter project that, while superficially similar to earlier CW transmitter

projects, is of a significantly different design. In place of the plug-in link-coupled transmitter coils of earlier generations, this transmitter uses a pi-network output circuit that allows band-switching with a single switch section on the output circuit. It is now possible to have a tightly RF-sealed transmitter that provides instant bandswitching across the HF

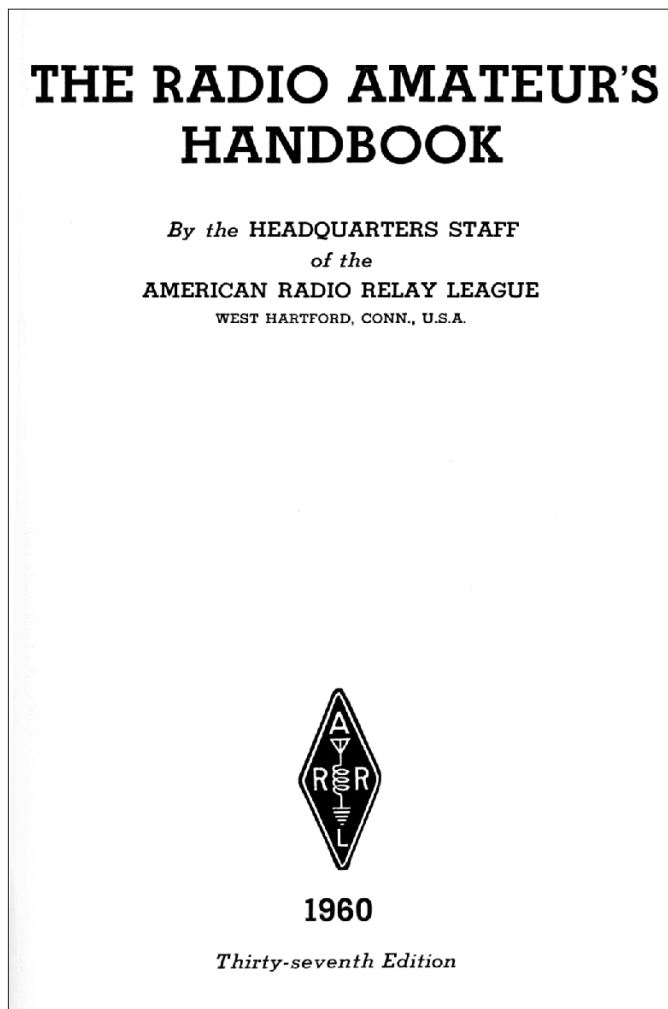
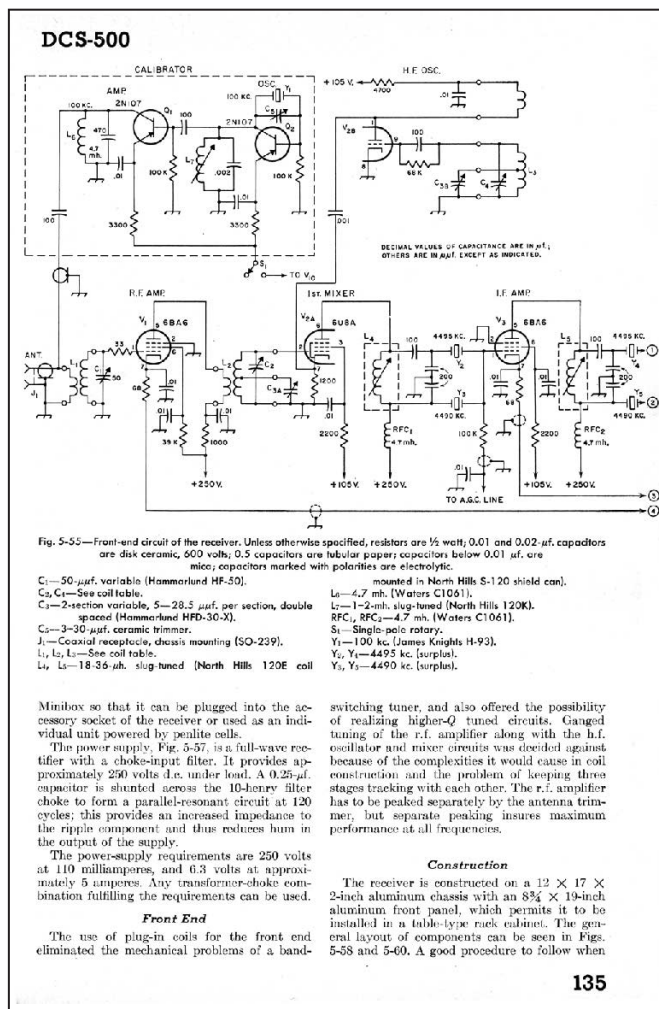


Figure 1960-1 — The cover plate of the 1960 *Handbook* offers no clues to the changes over the past decade.



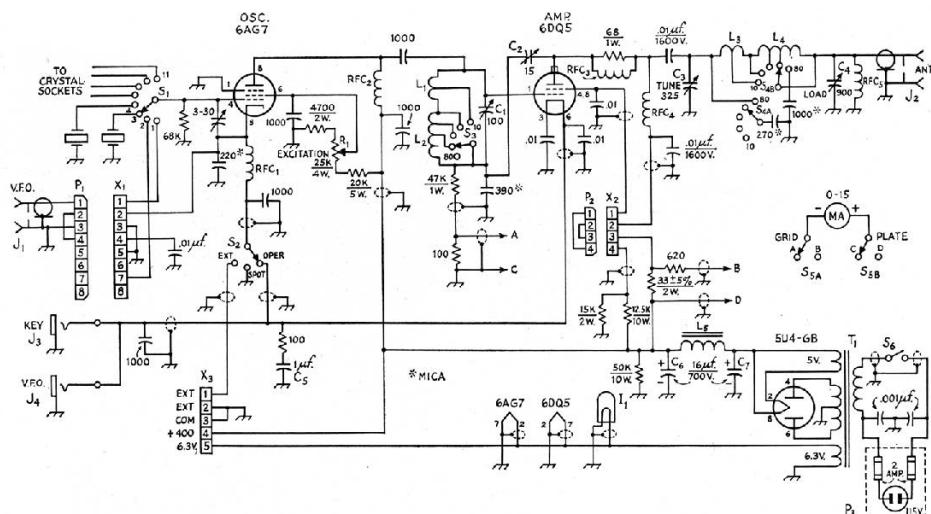


Fig. 6-44—Circuit diagram of the 75-watt 6DQ5 transmitter. Unless specified otherwise, capacitance is in μf , resistance is in ohms, resistors are $\frac{1}{2}$ watt.
 C_1 —100- μf . midget variable (Hammarlund HF-100).
 C_2 —15- μf . midget variable, .025 inch spacing (Johnson 15J12).
 C_3 —325- μf . variable (Hammarlund MC-325-M).
 C_4 —Dual 450- μf . broadcast replacement variable, two sections connected in parallel.
 C_5 —1- μf . 400-volt tubular.
 C_6, C_7 —16- μf . 700-volt electrolytic (Aerovox PRS).
 I_1 —6-volt pilot lamp.
 J_1 —Phono jack.
 J_2 —Coaxial connector, chassis mounting, type SO-239.
 J_3, J_4 —Open-circuit phone jack.
 L_1 —7½ t. No. 18, ½ inch diam., 8 t.p.i., tapped 5½

turns from grid end (B&W 3006).
 L_2 —38 t. No. 32, 1 inch diam., 32 t.p.i., tapped 23 and 31 turns up (B&W 3016).
 L_3 —5 turns No. 14, 1-inch diam., 4 t.p.i., self-supporting, tapped 3½ turns from plate end.
 L_4 —15 turns No. 14, 1¼ inch diam., 4 t.p.i., tapped 6¼ and 10¼ from output end (B&W 3021).
 L_5 —10-henry 200-ma. filter choke (Triad C-16A).
 P_1 —Octal plug (Amphenol 86-PM8).
 P_2 —4-pin plug (Amphenol 86-PM4).
 P_3 —Fused line plug.
 R_1 —25,000-ohm 4-watt potentiometer (Mullory M25MPK).
 RFC_1, RFC_2 —750- μh . 100-ma. r.f. choke (National R-33).
 RFC_3 —3 turns No. 14 around 68-ohm 1-watt composition resistor.

RFC_4 —1-mh. r.f. choke, 500 ma. (Johnson 102-752).
 RFC_5 —2.5-mh. r.f. choke (National R-100S).
 S_1 —1-pole 11-position rotary ceramic switch (Centralab Y section on P-121 index assembly).
 S_2 —Single-pole 11-position (3 used) non-shorting rotary switch (Centralab PA-1001).
 S_3 —Single-pole 12-position (5 used) rotary ceramic switch (Centralab PA-1 on PA-301 index assembly).
 S_4 —2-pole 5-position rotary ceramic switch (Centralab 2505).
 S_5 —S.p.s.t. toggle.
 T_1 —800 v.c.t. 200-ma. power transformer (Triad R-21A).
 X_1 —Octal tube socket.
 X_2 —4-pin tube socket.
 X_3 —5-pin tube socket.

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Figure 1960-3 — Schematic of a 1960 *Handbook* transmitter project that features a pi-network output circuit that allows band-switching and helps with harmonic reduction.

spectrum. The pi-network has other advantages — it is naturally low pass in response and it is unbalanced, and so it was a perfect fit to coax-fed antenna systems. Both features tended to reduce harmonic radiation and TVI.

The advertising section illustrated the diversity of technology available during the period. Collins Radio was at the head of the pack with its compact 100 W PEP HF SSB transceiver that could be used in a mobile setup, as shown in Figure 1960-5. This transceiver made use of the architectural design of the 75A-1 receiver

shown in Figure 1950-10.

Other equipment manufacturers offered a mix of technologies. The Heath Company (see Figure 1960-6) offered AM transmitters, such as their TX-1 Apache with an optional phasing type SSB exciter. Their companion multimode receiver, the RX-1 would be announced soon. E. F. Johnson offered a wide range of high quality AM and CW transmitters (see Figure 1960-7), including an SSB adapter similar to the one provided by Heath. Hallicrafters offered a modern heterodyning transmitter, the

HT-32, along with an SSB oriented receiver, the SX-101, and high power linear amplifier as shown in Figure 1960-8.

National Radio was still offering a full line of receivers, including a further update to the venerable HRO. Added to the line was an amateur band only receiver, the NC-300, a direct competitor to the Hallicrafters SX-101. A careful look at the Vibroplex ad (see Figure 1960-10) will reveal an entirely new product — the Vibrokeyer, “paddles” for an electronic keyer — a competitor to their mechanical bug.

6—HIGH-FREQUENCY TRANSMITTERS

A 75-Watt 6DQ5 Transmitter

The transmitter shown in Fig. 6-43 is designed to satisfy the requirements of either a Novice or General class licensee. As described here it is capable of running the full 75 watts limit in the 80-, 40- and 15-meter Novice bands, with band-switching, crystal switching and other operating features. The General license holder can use the transmitter in any band 80 through 10 meters, and he can add v.f.o. control or amplitude modulation at any time without modifying the 6DQ5 transmitter. Crystal switching is a convenience for rapidly shifting frequency within a band to dodge QRM, and a error position on the operate switch permits identifying one's frequency relative to others in a band. An accessory socket, X_3 , furnishes a convenient point for borrowing power for a v.f.o. or for controlling the oscillator by an external switch.

Referring to Fig. 6-44, the circuit diagram of the transmitter, the crystal selector switch, S_1 , is used to choose the desired crystal. For crystal-controlled operation crystals would be plugged in pins 1 and 3 and 5 and 7 of socket X_1 . Similar sockets (not shown in the diagram) are used to hold the other crystals. When v.f.o. operation is desired, the v.f.o. output is connected to J_1 , the plug P_1 is inserted in socket X_1 , and the former 6AG7 crystal oscillator stage becomes an amplifier or multiplier stage when switch S_1 is turned to position 1.

Since the output of the 6AG7 stage will vary considerably with the bands in use, an excitation control, R_1 , is included to allow for proper adjustment of the drive to the 6DQ5 amplifier. The 6DQ5, a highly sensitive tube, is neutralized to avoid oscillation; the small variable capacitor C_2 and the 390- $\mu\mu\text{f}$. men capacitor form the neutralizing circuit. Screen or screen and plate modulation power can be introduced at socket X_2 ; for radiotelegraph operation these connections are

completed by P_2 . Grid or plate current of the 6DQ5 can be read by proper positioning of S_2 ; the 0-15 milliammeter reads 0-15 ma. in the grid-current position and 0-300 ma. in the plate-current position.

The transmitter is keyed at J_2 and a key-click filter (100-ohm resistor and C_3) is included to give substantially click-free keying. The v.f.o. jack, J_3 , allows a v.f.o. to be keyed along with the transmitter for full break-in operation.

Construction

A $10 \times 17 \times 3$ -inch aluminum chassis is used as the base of the transmitter, with a standard 8 $\frac{3}{4}$ -inch aluminum relay rack panel held in place by the bushings of the pilot light, excitation control and other components common to the chassis and panel. The panel was cut down to 17 inches in length so that the unit would take a minimum of room on the operating table. A good idea of the relative location of the parts can be obtained from the photographs. The support for the r.f. portion housing is made by fastening strips of 1-inch aluminum angle stock (Reynolds aluminum, available in many hardware stores) to the panel and to a sheet of aluminum $9\frac{1}{2}$ inches long that is held to the rear chassis apron by screws and the key jack, J_2 . A piece of aluminum angle must also be cut to mount on the chassis and hold the cane-metal (Reynolds aluminum) housing. Fig. 6-45 shows the three clearance holes for the screws that hold this latter angle to the chassis after the cane metal is in place. Build the cane-metal housing as though the hinges weren't there and the box has to hold water; this will minimize electrical leakage and the chances for TVI. To insure good electrical contact between panel and angle stock, remove the paint where necessary by heavy applications of varnish remover, with the rest of the panel

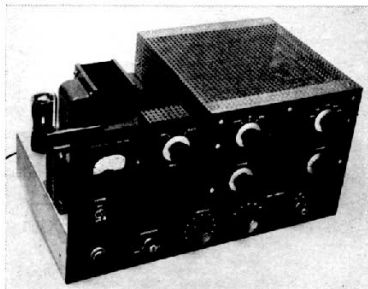


Fig. 6-43 — This 75-watt crystal-controlled transmitter has provision for the addition of v.f.o. control. A 6AG7 oscillator drives a 6DQ5 amplifier on 80 through 15 meters.

As a precaution against electrical shock, the meter switch, to the immediate right of the meter, is protected by a cane-metal housing. The switch to the right of the meter switch handles the spot-operate function, and the switch at the far top right is the plate-circuit band switch.

Along the bottom, from left to right: pilot light, excitation control, crystal switch, grid circuit band switch, and grid circuit tuning.

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Figure 1960-4 — Front panel view of the 1960 *Handbook* transmitter project shown in Figure 1960-3. This tight design is fully enclosed and features front panel bandswitching.

Collins mobile transceiver KWM-2

Another Collins creative design — the advanced amateur's 80-10 meter transceiver — system engineered for mobile and home operation.

Superior single sideband performance in a variety of installations is assured by the Collins KWM-2 Mobile Transceiver. Engineered for the amateur who desires an 80 through 10 meter mobile transceiver, the KWM-2 design incorporates time-proven and advanced communication concepts.

The Mobile Transceiver provides outstanding frequency stability on fourteen 200 kc bands from 3.4 mc to 30.0 mc. With 175 watts PEP input on SSB, or 160 watts on CW, the KWM-2 provides ample power for dependable amateur communication. Filter type SSB generation, Collins permeability-tuned variable oscillator, crystal-controlled HF double conversion oscillator, VOX and anti-trip circuits, and exclusive ALC and RF inverse feedback are among the features of the KWM-2. The Collins Mechanical

Filter, RF amplifier, all tuned circuits, and several tubes perform the dual role of transmitting and receiving. CW break-in and monitoring sidetone circuits are built-in, and all four plugs in the mobile mount connect the KWM-2 automatically. A connector on the rear provides for antenna selection or loading coil selection for mobile operation.

The Collins KWM-2 Mobile Transceiver weighs 18 lbs., 3 oz. and measures 7 $\frac{3}{4}$ " H (including legs), 14 $\frac{1}{4}$ " W, and 13 $\frac{1}{4}$ " D. Mounts, accessories, and power supplies are available for 12 v dc, and 115 v ac operation.

See the KWM-2 now on display at your Collins Distributor. Ask for the colorful KWM-2 brochure with complete specifications.



Figure 1960-5 — This Collins Radio ad featuring their KWM-2 SSB transceiver was at the leading edge of Amateur Radio technology. The architecture closely followed that of the 75A-1 receiver shown in Figure 1950-10.



COMPANION UNITS



HEATHKIT TX-1 \$234⁹⁵

"APACHE" HAM TRANSMITTER KIT

The many features and modern styling of the "Apache" will provide you with just about everything you could ask for in transmitting facilities. Emphasizing high quality the "Apache" operates with a 150 watt phone input and 180 watt CW input. In addition to CW and phone operation, built-in switch selected circuitry provides for single-sideband transmission using the SB-10 External adapter. The newly designed, compact and stable VFO provides low drift frequency control necessary for SSB transmission. A slide rule type illuminated rotating VFO dial with full gear drive vernier tuning provides ample bandspread and precise frequency settings. The bandswitch allows quick selection of the amateur bands on 80, 40, 20, 15 and 10 meters. This unit also has adjustable low-level speech clipping and a low distortion modulator stage employing two of the new 6CA7/EL34 tubes in push-pull class AB operation. Time sequence keying is provided for "chirpless" break-in CW operation. The final amplifier is completely shielded for TVI protection and neutralized for greater stability. A cooling fan is also provided. The formed one-piece cabinet with convenient access hatch provides accessibility to tubes and crystal sockets. Die-cast aluminum knobs and control panel escutcheons add to the attractive styling of the transmitter. Pi network output coupling matches antenna impedances between 50 and 72 ohms. A "spotting" push button enables the operator to "zero beat" an incoming frequency without putting the transmitter on the air. Equip your ham shack now for top transmitting enjoyment with this outstanding unit. Shpg. Wt. 110 lbs. Shipped motor freight unless otherwise specified.

HEATHKIT SB-10 SINGLE SIDEBAND ADAPTER KIT

\$89⁹⁵



Designed as a compatible plug-in adapter unit for the TX-1 "Apache" transmitter, this unit lets you operate on SSB at a minimum of cost, yet does not affect the normal AM and CW functions of the transmitter. By making a few simple circuit modifications, the DX-100 and DX-100-B transmitters can be used, utilizing all existing RF circuitry. Extremely easy to operate and tune, the adapter employs the phasing method for generating a single-sideband signal, thus allowing operation entirely on fundamental frequency. The critical audio phase shift network is supplied completely preassembled and wired in a sealed plug-in unit. Produces either a USB, LSB or DSB signal, with or without carrier insertion. Covers 80, 40, 20, 15 and 10 meter bands. An easy-to-read panel meter indicates power output to aid in tuning. A built-in electronic voice control with anti-skip circuit is also provided. 10 watts PEP output. Unwanted sideband suppression is in excess of 30 db and carrier suppression is in excess of 40 db. An EL84/6BQ5 tube is used for linear RF output. Shpg. Wt. 12 lbs.

MODIFICATION KIT. Modifies DX-100 and DX-100-B for use with the SB-10 Adapter. Model MK-1. Shpg. Wt. 1 lb. \$8.95.



HEATHKIT AR-3 \$29⁹⁵

(less cabinet)

ALL-BAND RECEIVER KIT

A fine receiver for the beginning ham or short wave listener, designed for high circuit efficiency and easy construction. Covers 550 kc to 30 mc in four bands clearly marked on a slide-rule dial. Transformer operated power supply. Features include: bandswitch, bandspread tuning, phone-ready-CW switch, phone jack, antenna trimmer, noise eliminator, RF gain control and AF control. Shpg. Wt. 12 lbs. CABINET: Opt. extra. No. 91-15A. Shpg. Wt. 5 lbs. \$4.95.



HEATHKIT QF-1 \$9⁹⁵

"Q" MULTIPLIER KIT

Useful on crowded phone and CW bands, this kit adds selectivity and signal rejection to your receiver. Use it with any AM receiver having an IF frequency between 450 and 460 kc that is not AC-DC type. Provides an effective "Q" of approximately 4,000 for extremely sharp "peak" or "null". The QF-1 is powered from the receiver with which it is used. Shpg. Wt. 3 lbs.

30

Figure 1960-6 — The Heath Company offered AM transmitters, such as their TX-1 Apache with an optional phasing type SSB exciter.

Your best buy!

Johnson Amateur Equipment

... For Full Communication POWER!



VIKING "ADVENTURER" 50 WATT TRANSMITTER—Used to earn first Novice (Worked All Continents) Self-contained, effectively TVI suppressed, instant banding 80, 40, 20, 15, and 10 meters. Operates by crystal or external VFO. In-line power receptacle located on the rear apron provides full 450 VDC at 150 ma with VAC at 2 amp. output of supply to power auxiliary equipment such as a VFO, monitor, or modulator for phone operation. This receptacle also permits using the output of the supply to power other equipment when the transmitter is not operating. Pi-network output handles virtually any antenna without separate antenna. Break-in keying is clean and crisp. Designed for easy assembly. With tubes, less crystal and key. Dimensions: 10 9/16" x 8 5/8" x 7 3/4". Shipping Weight: 19 lbs. Cat. No. 240-181-1...Kit.....Amateur Net \$34

SPEECH AMPLIFIER SCREEN MODULATOR—Designed to provide phone speech for the "Adventurer". High gain—use with either crystal or dynamic microphone. Installation—only minor wiring changes necessary in "Adventurer". With tubes. Cat. No. 250-40...Kit.....Amateur Net \$12

VIKING "NAVIGATOR" TRANSMITTER EXCITER—This compact, flexible CW transmitter has enough RF power to excite most high powered final amplifiers on CW with 40 watts—bandswitching 160 through 10 meters. Highly stable, built-in VFO is temperature compensated and voltage regulated—may also be operated crystal control. Sequence keying—effectively TVI suppressed. Pi-network antenna load matching 50 to 600 ohms. With tubes, less crystals and key. Dimensions: 13 1/4" x 9 1/4" x 1 1/2". Shipping Weight: 27 lbs. Cat. No. 240-126-1...Kit.....Amateur Net \$19

Cat. No. 240-126-2...Wired and tested.....Amateur Net \$19

VIKING "CHALLENGER" TRANSMITTER—Ideal for fixed station, emergency use, or field day use, the "Challenger" is a full size transmitter with three RF stages—designed for fast, easy tuning, excellent stability and plenty of reserve drive. 70 watts phone 80 through 6 meters, 120 watts CW input 80 through 10 meters...85 watts CW on 6 meters. A single 6BQ6A buffer drives two husky 6BQ6A bridge rectifier tetrodes in the final amplifier. Hi "Q" wide range pi-network output—effectively suppressed and filtered. For crystal or external VFO control. Excellent keying on VFO tubes and built-in power supply. Cat. No. 240-182-1...Kit.....Amateur Net \$19

Cat. No. 240-182-2...Wired and tested.....Amateur Net \$19

VIKING "RANGER" TRANSMITTER—This outstanding amateur transmitter will serve as an RF and audio exciter for high power equipment. As an exciter, it will drive the popular kilowatt level tubes. No internal changes necessary to switch from transmitter to exciter operation. Self-contained, 75 watts CW or 65 watts phone...instant bandswitching 160, 80, 40, 20, 15, and 10 meters. Extremely stable, VFO or crystal control—effectively TVI suppressed—high gain audio—linear seq (break-in) keying—adjustable wave shaping. Pi-network antenna load matching 50 to 500 ohms. Easily assembled—with tubes, less crystals, key and microphone. 15 9/16" x 14". Shipping Weight: 54 lbs. Cat. No. 240-161-1...Kit.....Amateur Net \$32

Cat. No. 240-161-2...Wired and tested.....Amateur Net \$32

VIKING "VALIANT" TRANSMITTER—Designed for outstanding flexibility and performance, 275 watts input on CW and SSB (P.E.P. with auxiliary SSB exciter), 200 AW. Instant bandswitching 160 through 10 meters—operates by built-in VFO or crystal control. Pi-network tank circuit will match antenna loads from 50 to 600 ohms—tank coil is silver-plated. Other features: TVI suppressed—linear sequence keying—high gain push-to-talk audio system—low level audio clipping—built-in pass audio filter—self-contained power supplies. With tubes, less crystals, key, and microphone. Dimensions: 21" x 11 1/2" x 16 1/4". Shipping Weight: 83 lbs. Cat. No. 240-104-1...Kit.....Amateur Net \$34

Cat. No. 240-104-2...Wired and tested.....Amateur Net \$34

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Figure 1960-7 — E. F. Johnson offered a wide range of high quality AM and CW transmitters, including an SSB adapter similar to the one provided by Heath.

Big signal



HT-33A
Linear Amplifier

SX-101A Receiver



Heavyweight champion in stability, performance

SX101A is setting new standards for dependability and ruggedness throughout the amateur world. It's all amateur provides complete coverage, and every technical feature desired for years to come.

FREQUENCY COVERAGE: Band 1—30.5-34.5 Mc. Band 2—3.48-4.02 Mc. Band 3—6.99-7.31 Mc. Band 4—13.8-14.415 Mc. Band 5—20.99-21.52 Mc. Band 6—26.9-29.8 Mc. Band 7—10 Mc. WWV.

FEATURES: Complete coverage of ham bands plus a 2 and 6 meter coverage band—80, 40, 20, 15, 10 meters. Large slide rule dial. Band-in-use scales individually illuminated. Illuminated



HT-32A
Transmitter

The new ideas in communications are born at...

Figure 1960-8 — Hallicrafters offered a modern heterodyning transmitter, the HT-32, along with an SSB oriented receiver, the SX-101, and the HT-33 high power linear amplifier.

Send for this FREE National Catalog for up-to-date information on America's finest receivers!

Gives Complete Specifications, Full List of Accessories, Latest Prices on these Famous NATIONAL RECEIVERS.




 <p>HRO-60 Features widest frequency coverage of any receiver available, 50 kc to 54 mc... the world's most famous receiver.</p>	 <p>NC-400 National's newest general coverage receiver. Covers 540 kc to 31 mc in 7 bands. 18 tubes (including rectifier) AM-CW-SSB. May be used in fixed channel or diversity operation.</p>
 <p>NC-303 National's newest "ham band only" receiver. 10 separate dial scales cover 160 to 1 1/2 meters. Dual conversion. New 5-position "IF SHIFT" provides optimum selectivity for a CW-PHONE-PHONE NET-VHF Selectable SSB.</p>	 <p>NC-109 One of America's lowest priced SSB receivers! Covers 540 kc to 40 mc. National's exclusive "MICROTONE" filter provides 5 degrees of sharp selectivity for all modes of operation. VOICE-CW-SSB.</p>
 <p>NC-188 Low-priced general coverage receiver. Covers 540 kc to 40 mc, and is directly calibrated for the 4 general coverage ranges and five bandspread ranges for 80-10 meter amateur bands.</p>	 <p>NC-66 AC/DC-Battery Portable. Covers 150 kc to 23 mc in 5 bands. Exclusive RDF-66 Direction Finder Accessory provides accurate navigation for small boats.</p>
 <p>NC-60 <i>Special "A"</i> ... First all-new, low-priced shortwave/standard broadcast receiver in over 10 years! Covers 540 kc to 31 mc in 4 bands. 110 volt AC/DC. Built-in speaker.</p>	<p>NATIONAL RECEIVERS AND ACCESSORIES ARE SOLD ONLY BY FRANCHISED DISTRIBUTORS. MOST OF THESE DISTRIBUTORS OFFER TRADE-IN ALLOWANCES AND LIBERAL BUDGET TERMS.</p> <p>National RADIO CO., INC. MELROSE 76, MASS. A wholly owned subsidiary of National Co., Inc. Export: AD ALPHEA, INC. 85 Broad St., New York, N.Y., U.S.A. In Canada: CANADIAN MARCONI CO., 830 Bayview Ave., Toronto, Ont. Specifications subject to change without notice.</p>

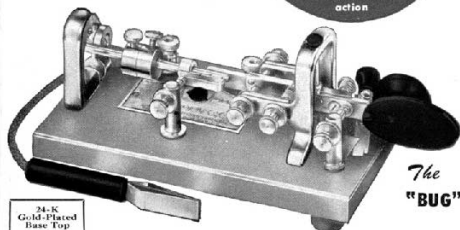
Figure 1960-9 — National Radio still offered the latest of the HRO series, the HRO-60 featuring double conversion, but they also would supply an amateur band only receiver designed for SSB. The new NC-300 was similar to the SX-101 from Hallicrafters.

Never tires the arm . . . never upsets the nerves
SENDING MADE EASIER FOR EVERYBODY

World's No. 1 Key

VIBROPLEX

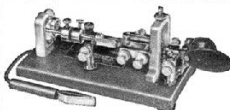
Semi-automatic
action



24-K
Gold-Plated
Base Top

Vibroplex Super Deluxe

Fast operation and easy action make this newest Vibroplex a popular choice among the elite. Equipped with the world's easiest sending features. In addition to all former Vibroplex features, it has a super deluxe speed control mounting base, the greatest speed range and allows sending without extra weight. Precision machined, trouble-proof and adjustable to any desired speed. A beautiful key, built to give a lifetime of sending enjoyment. Everybody wants one. With circuit closer, Deluxe only \$29.95.*



Vibroplex Original

Here's a key you can buy with confidence. In daily use for over 40 years has pleased thousands with its ease of operation, strong, clean signal and all-around sending efficiency. "Sure easy on the arm." Trouble-proof, adjustable to any speed. Many of these keys still in service after 40 years' use. After circuit closer. Standard \$19.95; Deluxe \$23.95.*

Vibroplex Blue Racer

Small, compact, rugged built extra sturdy like the Original, but only half the size. 2 lbs. 8 oz. Occupies small space. Precision machined, adjustable to any desired speed. Has the same features as the Original and very popular with thousands of users for a fine sending performance with the least labor. With circuit closer. Standard, \$19.95; Deluxe, \$23.95.*

Vibroplex Carrying Case

Black simulated moosehide. Cloth lined. Reinforced corners. Plastic leather handle. Keeps key free of dirt, dust and moisture, and insures safekeeping when not in use. With lock and key, \$6.75.

Avoid imitations!
The "BUG" Trade Mark
Identifies the
Genuine Vibroplex.
Accept no substitute

The
"BUG"

Its semi-automatic action actually performs the work for you.

Vibroplex is a positive key. Suits any hand or style of sending. Its easy, natural response helps develop speed fast.

You take it easy, while Vibroplex performs the arduous work for you. Send the way you like best, sending your signals are clear and easy to read.

It's the signal that counts. Vibroplex signals are uniformly good at whatever speed it is being operated.

Vibroplex never tires the arm, never stresses the nerves, is one of the old keys often does.

Precision machined, rugged, Vibroplex stands rough usage. Trouble-proof and adjustable to any desired speed. Dependable as the day is long.

Vibroplex then is the perfect key for you. Try it and see for yourself. At Dealers or direct.

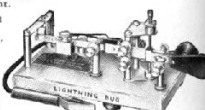
Standard Models have Gray base, chrome top parts. Deluxe Models have Polished Chromium base and top parts, red trim and jewel mounting.

All Vibroplex models available for left hand operation.

All Vibroplex keys equipped with 2/16" contacts.

Vibroplex Lightning Bug

Beautifully styled, precision machined, rugged with an improved frame, a flat pendulum bar with slotted weights that don't work loose, a designed damper frame prevents damage to key an instantly adjustable die contact spring that may be moved without disturbing the speed weight. A great buy at this low low price. With circuit closer. Standard, \$18.95; Deluxe, \$22.95.*



"VIBRO-KEYER"

The Vibro-Keyer supplies the answer to the demand for Vibroplex keys for the construction of electronic transmitting units. Its beautiful large, colored base is 3 1/2" by 1 1/2", and weighs 2 1/2 pounds. It uses the Deluxe Vibroplex contacts, main frame and super finished parts. Colorful red finger and thumb pieces. Has the same smooth and easy operating Vibroplex frame, fully adjustable to your own taste. Priced at \$15.95.

* Cord and wedge, \$1.75 additional

NEW SPECIAL ENLARGED Edition of PHILLIPS CODE, \$2.75 Postpaid

Also includes:
Radio & Cable Signals
International Morse
American Morse
Russian, Greek, Arabic
Turkish and Japanese
Morse Codes
World Time Chart

United States Time Chart
Commercial "Z" Code
Aeronautical "Q" Code
Miscellaneous Abbreviations
List of International
cable and radio telegraph
signals

Get your copy today!



You must be tired of the old-fashioned key and their annoyances; or maybe you're long to old and not getting as good a key. Then why not hitch up to a new Vibroplex and enjoy your operating as never before. Choose yours from those illustrated here. You can be sure it's a Vibroplex.

Prices subject to change without notice



THE VIBROPLEX CO., Inc., 833 Broadway, New York 3, N. Y.

W. W. ALBRIGHT, President

IF YOU SEND YOU SHOULD USE THE VIBROPLEX

Use Vibroplex for the easier sending of your life

90

Figure 1960-10 — The Vibroplex ad featured a new product — the Vibrokeyer, designed to be used with the newly popular electronic keys.

The Decade of Solid State and the SSB Transceiver — The 1970 Edition

Between the 1960 and 1970 Handbooks (see Figure 1970-1), two major game changers went from being interesting technology to becoming mainstream Amateur Radio. The first was the acceptance of solid state devices as appropriate for most sections of radio equipment — although RF power stages would remain largely in the

domain of vacuum tubes for some time. This trend can be seen in a solid state receiver project (see Figure 1970-2) and a hybrid (solid state except for the transmit driver and power amplifier stages) SSB transmitter (see Figure 1970-3). There were still tube projects galore, since many amateurs felt most comfortable with the earlier

technology. The beginner transmitter shown in Figure 1970-4 could have appeared in much earlier editions.

The second advance was the emergence of single sideband telephony, and especially SSB transceivers, as the primary HF voice mode and equipment configuration. While SSB was introduced in a general way in past

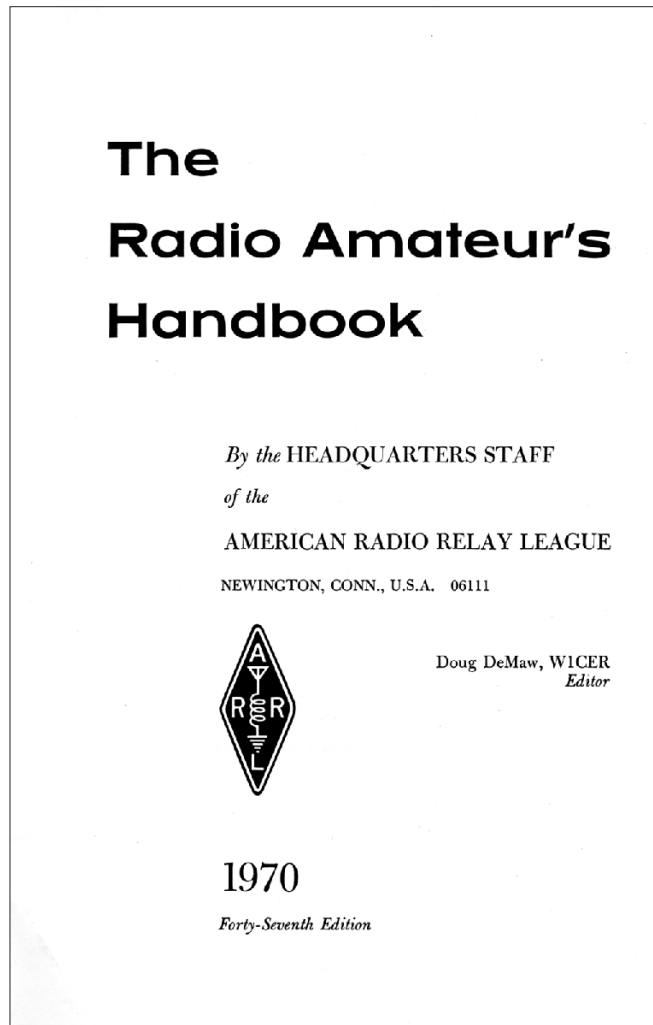


Figure 1970-1 — The front matter on the 1970 *Handbook* had a more modern look than in the past.

decades, it was the emergence of the one box transceiver as shown previously in Figure 1960-5, that made the big difference. During this decade, the benefits of a transceiver, not only for SSB, but for CW as well, became apparent. Companies such as Collins Radio (see Figure 1970-5), the Heath Company (see Figure 1970-6), R.L.

Drake (see Figure 1970-7) and others provided their versions of both transceivers and separate transmitters and receivers that could be locked together as if they were transceivers.

Not everything changed. The Vibroplex ad (Figure 1970-8) maintained its

consistency over yet another decade. In recognition of the amount of operating, in contrast to technical information available, or needed by operators, *The Radio Amateur's Operating Manual* (see Figure 1970-9) was introduced in 1966 as something of a spinoff from the *Handbook*.

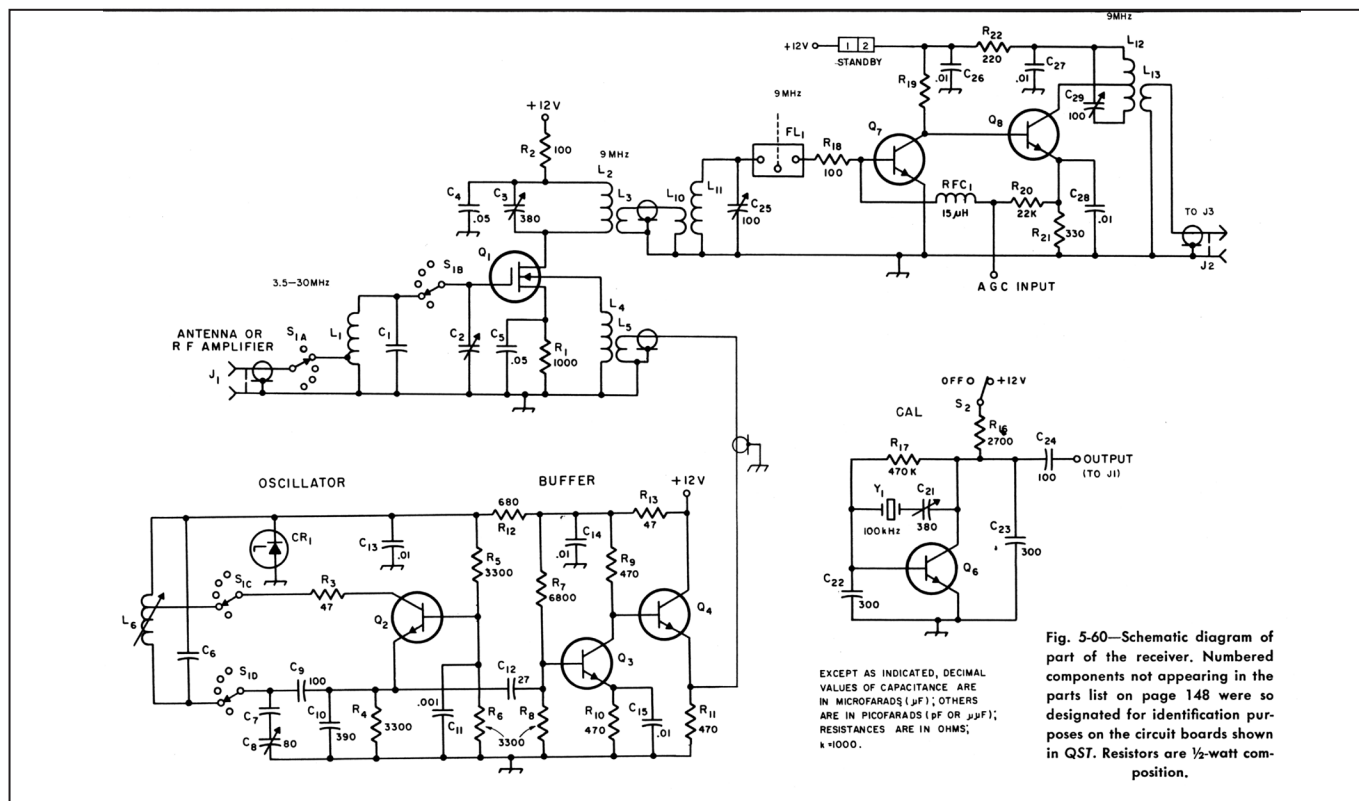


Figure 1970-2 — This 1970 *Handbook* receiver project is entirely solid state.

A 175-WATT MECHANICAL-FILTER EXCITER

This 3.5 to 4.0-MHz. s.s.b./c.w. transmitter can be used by itself, or it can be used to drive any of the amplifiers described in Chapter 6. It will drive most commercially-built amplifiers also. The power output from this unit, while maintaining an acceptable IMD level (intermodulation distortion) is 100 watts, p.e.p.

Block diagrams have been added to each schematic illustration to help the reader understand how the circuit operates. The power supply, "A 650-Volt General-Purpose Supply," is shown in Chapter 12. Information on building the modular solid-state v.f.o. is given in Chapter 5 ("A General-Purpose V.F.O."). This transmitter was designed to be used with these two units.

This exciter has effective a.l.c., which helps to maintain a high average talk-power level. Grid-block keying is used for c.w. The keying is shaped to provide a clean, clickless note. If low-power a.m. operation is desired, carrier can be inserted for this purpose. The power input to the p.a. must be limited to approximately 25 watts if this is done, and the output signal will be single-sideband a.m.

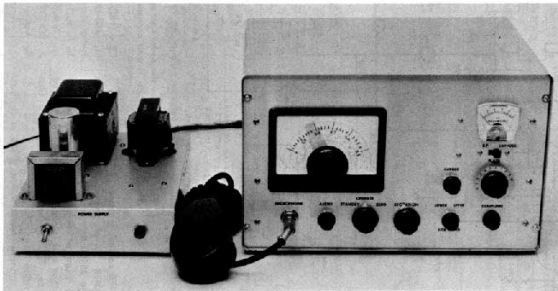
Circuit Information

In the circuit of Fig. 9-31, output from a hi-impedance microphone is amplified by V_1 and fed to a twin-triode balanced-modulator, V_2 . The 455-kHz. carrier is generated by V_{3A} and routed to V_2 . The double-sideband suppressed-carrier a.m. signal from V_2 is next passed through FL_1 where it becomes a s.s.b.

suppressed-carrier signal; the sideband (upper or lower) depends upon the crystal selected at V_{3A} . Output from FL_1 is amplified by V_4 , whose actual gain at a given instant is dependent upon the level of the minus-polarity a.l.c. voltage supplied to its grid; the lower the a.l.c. voltage, the higher will be the gain of V_4 . V_{3B} is used as a cathode-follower to supply carrier (455 kHz.) to V_5 for tuneup, c.w., or a.m. operation, thus bypassing the mechanical filter and balanced-modulator with some of the signal. The carrier-insertion level is controlled by R_8 . S_2 , a part of R_8 , opens that branch of the circuit during s.s.b. operation to minimize carrier leak-through from V_{3B} to V_5 .

A transistorized v.f.o. is used to beat a 3045-kHz. signal against the 455-kHz. s.s.b. signal at V_5 . The sum frequency from the mixer provides the desired 3.5 to 4.0-MHz. transmitter output frequency. Output from the v.f.o. is filtered by L_4 , L_5 , and their related network capacitors. The filtering keeps spurious output from the v.f.o. from reaching the balanced mixer and generating unwanted frequencies. A vacuum-tube buffer stage, V_6 , is used between the v.f.o. and V_7 to reduce "pulling" and to transform the v.f.o.'s low output impedance to a higher impedance for feeding the grid of the balanced mixer. L_6 is broadbanded (no parallel capacitor) to assure fairly constant mixer injection across the entire tuning range of the v.f.o.

The mixer tuned circuit, L_7 - C_{2A} , is connected to the grid of the driver stage, V_8 . The plate cir-



The exciter is housed in a home-made cabinet. Several commercial cabinets are available to the builder, many of which are similar in size and style to this one. An LMB type W-21 would be a good choice, and could be ventilated. Black decals are used for identifying the controls on the satin-finish aluminum panel. The panel was soaked in a lye bath to get the dull finish, then sprayed with clear lacquer.

Figure 1970-3 — The 1970 *Handbook* featured this compact 75 meter, 175 W SSB exciter/transmitter. This was a "hybrid" design, similar to some commercial equipment of the day — transistors were used in low level stages, while tubes remained in the transmitter power driver and output sections.

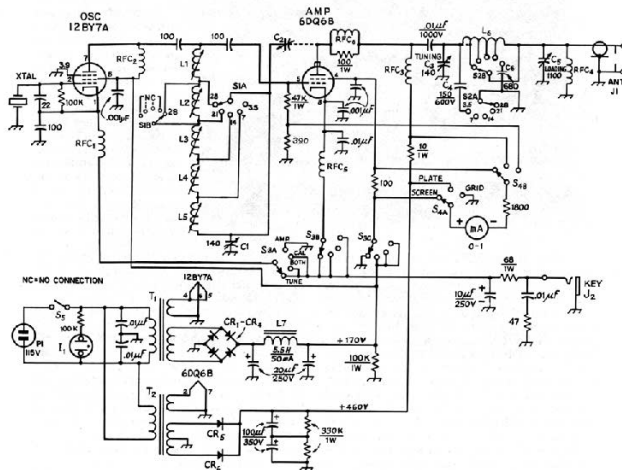


Fig. 4-42—Circuit diagram of the five-band 50 watter. Unless indicated otherwise, capacitances are in pf. and resistances are in ohms, 1/2-watt. Capacitors marked with polarity are electrolytic; capacitors with decimal value of pf. are disc ceramic.

- C₁—140-pf. variable (Hammarlund APC-140).
- C₂—One-inch wide aluminum strips. See Fig. 6-43.
- C₃—140-pf. variable (Hammarlund MFA-140-A).
- C₄—150-pf. zero-temp.-coefficient (Centralab type TCZ).
- C₅—1100-pf. variable, 3-section, 365 pf. per section, stator sections connected in parallel, trimmers removed (Allied Radio 43A3522).
- C₆—680 pf., 500 volts, dipped mica.
- CR₁, CR₂—400 p.i.v. 750 ma. silicon diode.
- CR₃, CR₄—1000 p.i.v. 400-ma. silicon diode (1N3563).
- I₁—Neon indicator (Droke R-117-603).
- J₁—Coaxial receptacle SO-239.
- J₂—Open-circuit phone jack.
- L₁—68-1.25 μh. adjustable (Miller 21A104RB1).
- L₂—68-1.25 μh. adjustable (Miller 21A104RB1).
- L₃—1.35-2.75 μh. adjustable (Miller 21A226RB1).
- L₄—9.4-15.0 μh. adjustable (Miller 21A155RB1).
- L₅—27.5-58 μh. adjustable (Miller 21A475RB1).
- L₆—31½ turns No. 16, 8 t.p.i., 1½ inch diameter (B&W 3018) topped from C₅ end; 2%, 6%, 10%, 22% turns.
- L₇—5.5-henry 50-ma. choke (Allied Radio 54A2135).
- M₁—0.1 milliammeter (Lafayette 99G5040).
- P₁—Fused plug, 1½-amp. fuses.
- RFC₁, RFC₂—1-mh. 125-ma. r.f. choke (Miller 4662).
- RFC₃—7 turns No. 18 space-wound on 100-ohm 1-watt composition resistor.
- S₁—2-pole 6-position (5 used) rotary switch (Mallory 32261).
- S₂—2-pole 4-position (4 used) rotary switch (Centralab PA-2003).
- S₃—3-pole 4-position rotary switch (Mallory 3234J).
- S₄—2-pole 6-position (1, 3, 5, used) rotary switch (Mallory 32261).
- S₅—S.p.a.t. toggle.
- T₁—125-volt 50-ma., 6.3-volt 2-amp. transformer (Knight 54A1411).
- T₂—700 v.c.t. 90-ma., 6.3-volt 3.5-amp. transformer (Knight 54A1429).

Figure 1970-4 — Not all projects were modernized — this beginner transmitter looks a lot like Novice transmitters from previous decades.

32S-3 Transmitter



The 32S-3 operates in SSB or CW modes with 175 watts PEP input from 3.4 to 5.0 MHz and from 6.5 to 30.0 MHz. Supplied crystals cover the 80-, 40-, 20-, and 15-meter bands, and 200 kHz of the 10-meter amateur band, with provision for two more crystals. Features include mechanical filter sideband generation, permeability-tuned VFO and crystal-controlled HF oscillator.

30S-1 Linear Amplifier



Collins linear amplifiers can be driven by the KWM-1, KWM-2, 32S-3 or equivalent. The 30S-1 is a completely self-contained, single tube, grounded grid linear amplifier providing full legal power input for SSB, CW or RTTY. It may be used on any frequency between 3.4 and 30.0 MHz. A special comparator tuning circuit allows tune-up at low power. Select linear amplifier or exciter output by front panel push-button. Antenna relay included.

75S-3B, -3C Receivers



The finest amateur receivers available for SSB, CW or RTTY. The 75S-3B provides SSB, CW and AM reception from 3.4 to 5.0 MHz and from 6.5 to 30.0 MHz. Crystals furnished with the 75S-3B cover the 80-, 40-, 20-, and 15-meter bands and 200 kHz of the 10-meter band. The 75S-3C has provisions for 14 additional switch-selected crystals. Both units have crystal-controlled first oscillator, permeability-tuned VFO, and 2.1 kHz mechanical filter. Simple patch-cord connections permit operation with the 32S-3 as a transceiver.

30L-1 Linear Amplifier



A compact linear amplifier for table-top or console operation, the 30L-1 provides 1 kw PEP input on SSB and 1 kw average on CW. It has a self-contained power supply, RF inverse feedback, and automatic load control. The 30L-1 features instant warm-up and self-contained antenna relay.

KWM-2, -2A Transceivers



The KWM-2 and -2A SSB transceivers give unmatched flexibility for fixed-station or mobile operation. They cover the same bands as the S-Line with 175 watts PEP input SSB or 160 watts CW. Both have provision for two extra crystals, and 14 more can be added to the KWM-2A. Both have filter-type SSB generation, permeability-tuned oscillator, crystal controlled HF double conversion oscillator, VOX and anti-trip circuits, automatic load control and RF inverse feedback. Either unit will drive the 30S-1 or 30L-1 linear amplifiers. Optional matched accessories are available for mobile conversion.

312B-4 Speaker Console




The 312B-4 is a unitized control for the S-Line or KWM-2. It houses a speaker, RF directional wattmeter, and switches for station control functions.




Collins Radio Company • Cedar Rapids, Iowa

Figure 1970-5 — Collins Radio's 1970 ad features a full complement of gear built in the image of its successful KWM-2 showcased in Figure 1960-5.




The World's Largest


THE FAMOUS HEATH DELUXE SB-SERIES




SB-101 80 Through 10 Meter SSB Transceiver... 180 watts PEP SSB, 170 watts CW. Front panel control for SSB or CW selectivity. Provisions for external LMO. Features USB/LSB & CW, PTT & VOX. Fixed or mobile optional power supplies. Unmatched engineering & design.
Kit SB-101, 23 lbs..... \$370.00*




SB-110A 6-Meter SSB Transceiver... puts the famous Heath SB-Series on "6"! 180 watts PEP input SSB... 150 watts CW—with single-knob linear tuning, 1 kHz dial calibration, and the ultimate in stability.
Kit SB-110A, 23 lbs..... \$299.00*




SB-301 Amateur Band Receiver... SSB, AM, CW, and RTTY reception on 80 through 10 meters—15 MHz WWV reception. Tunes 6 & 2 meters with SBA-300-3 and SBA-300-4 plug-in converters.
Kit SB-301, 25 lbs. (less speaker)..... \$270.00*




SB-401 Amateur Band SSB Transmitter... 180 watts PEP SSB, 170 watts CW on 80 through 10 meters. Operates "Transceive" with SB-301—requires SBA-401-1 crystal pack for independent operation.
Kit SB-401, 36 lbs..... \$295.00*
SBA-401-1 crystal pack, 1 lb..... \$29.95*




SB-200 KW SSB Linear Amplifier... 1200 watts PEP input SSB, 1000 watts CW on 80 through 10 meters. Built-in antenna relay, SWR meter, and power supply. Can be driven by most popular SSB transmitters (100 watts nominal output).
Kit SB-200, 41 lbs..... \$220.00*



SB-610 Signal Monitor Scope... operates with transmitters on 160 through 5 meters at power levels from 15 watts through 1 kw. Shows transmitted envelope. Operates with receiver if it's up to 6 MHz, showing received signal waveforms. Spots over modulation, etc.
Kit SB-610, 14 lbs..... \$79.95*



SB-220 2-kW PEP Linear Amplifier for a really big signal on 80-10. Uses a pair of rugged, dependable Eimac 3-600Z's. Double shielded for T13 protection. Continuous monitor of P_{p} plus switch-selected monitor of Rel Pow, Ep & Ig. The world's best value in a 2-kW Linear Amplifier.
Kit SB-220, 55 lbs..... \$349.95*



SB-500 2-Meter Transverter puts your SB-101, SB-301/401 combo, SB-110A or HW-100 on "2".... full CW & SSB transceive. Inexpensive 6145's in the final deliver a solid 50 watts output.
Kit SB-500, 19 lbs..... \$179.95*

2

Figure 1970-6 — The Heath Company took hold of the Collins idea and offered kits to build similar looking compact SSB gear.

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DRAKE *Equipment for RADIO AMATEURS*

DRAKE FINEST 4 LINE

R-4B Receiver

- Permeability-tuned VFO reads to 1 MHz • Crystals cover all of 80, 40, 20, 15 mtrs. and part of 10 • Ten 500 kHz accessory ranges (1.5-30 MHz) • Four bandwidths • Passband tuning • Noise Blanker on CW-SSB-AM, Notch Filter, Xcal Cal

T-4XB Transmitter

Frequency coverage and VFO reads to 1 MHz • USB/LSB • Semi Break-In CW • Controlled Carrier AM • VOX or PTT • Adjustable Pk-act • Xmit AGC, no flat topping • 200 watts • 8 pole SB Filters

Transceive with R-4B or T-4XB VFO or use separately.

DRAKE SIDEBAND TRANSCEIVERS

TR-4 & TR-6

BOTH have Linear VFO, 1 MHz acc., 300W PEP-SSB, Semi Break-In CW with Sidebands, VOX or PTT, Adjustable Pk-act, Plate and AGC Meters. TR-4 covers 10-80 meters; USB/LSB, CW, AM. TR-6 tunes 6M plus MARS with 9 state (2 turn), USB-CW-AM.

RV-4 & RV-6

RECEIVERS: Sensitivity for 10 dB S/N: TR-4 5 µV, TR-6 1 µV (FT front end). Selectivity: Both 2.1 kHz @ 6 dB, TR-4 3.5 kHz @ 60 dB. BOTH have diode & prod detectors, 5 meter. Permit rxvg, xmts or xva on separate freq in same range as transceiver.

L-4B Linear Amplifier

- 2000W PEP-SSB, 1000W AM, CW, RTTY • Class B Grid • Broad Band Tuned Input • RF Neg Feedback • Kind AGC • Directional Wattmeter • Taut band Meters • Plate Current Meter reads FCC reg • Quiet hi-volume blower.

Incl. sep. 500-wt. Power Supply

TRANSCEIVER ACCESSORIES

MMK-3 Mobile Mounting Kit
Pencor Supplies: AC-4, DC-4, CC-24
MS-4 Matching Speaker
PT-1 Fixed Freq. Adapter
MC-4 Mobile Spkr Wattmeter
34-4B Noise Blanker Kit for TR-4

HAMS SAY... "Best Receiver buy since the 2-B"

2-C Receiver

- Xtal control 1st converter • 500 kHz Ranges: 80, 40, 20, 15, 10 meters • Accessory ranges: 3-30 MHz • SSB-AM-CW • Accessories: Spkr, Q Muff, Calib, Noise Blanker, Xtals.

CW Transmitter 2-NT

- 100 (or 75) watts • Break-in CW with 2-C • 80, 40, 20, 15 10 metre xtal controlled • Ant. Relay • Sidebands • LP Filter • Per. Sup. Incl.

DRAKE 2 and 6 Meter CONVERTERS

For Receivers

PEI, Lo Noise, Uniform Gain, Low Spurious Response meters—SC-8
2 meters—SC-5
Power Supply CPS-1
VHF Xcal Cal Sec-1
Comble — CC-1

Transmitting Converters

TC-2 • Entire 2-meter band • 180 watt input
TC-6 • All of 6-meter band • 300 watt input
BOTH: • Xmit AGC—no flat top • Antenna Relay • Need no separate pwr supply with Drake units.

DRAKE TVI FILTERS

TV-300-HP High Pass Filter
TV-1000-LP Low Pass Filter
TV-100-LP Low Pass Filter
TV-50-LP Cutoff Band
TV-300-FMS 1-M Band Stop
TV-300-FMI FM Tunable
LN-4 Power Line Filter

T-4B Transmitter

Like T-4XB except use with R-4B in Xcv mode or from 10 accessory crystals • Built-in speaker for R-4B
TR-4B Communications Station • Consists of R-4B and T-4B in same cabinet • Less power supply and crystals

... to your distributor or write:

Dept. HB0 - R. L. DRAKE COMPANY - 540 Richard St., Miamisburg, Ohio 45342

VIBROPLEX

THE PIONEER AND ALWAYS THE LEADER
WORLD'S NO. 1 KEY SEMI-AUTOMATIC



"PRESENTATION"

24-K Gold-Plated Base Top

ALL LABOR TAKEN OUT OF SENDING

Never tires the arm Never upsets the Nerves

SEND BETTER — Vibroplex makes uniformly good signals at any speed. They are sharp and easy to read. You will like them.

SEND EASIER — Vibroplex is a perfectly balanced key. You are relieved of all nervous and muscular tension.

New Super DeLuxe VIBROPLEX Presentation

The Super DeLuxe model's SLOW MOVEMENT completely revolutionizes sending. Makes it easy for every operator. It has SUPER-SPEED CONTROL mechanism, you go from slowest to highest speed without changing weights. Vibroplex has TOUCH CONTROL, adjustable to your individual touch. Vibroplex has FIRM STANCE, a very important item. The rubber feet are so placed the key stays in position. RICHLY DESIGNED — 24K gold-plated base top, polished chromium machine parts, red trim and jeweled movement. DeLuxe, only \$43.95.



Vibroplex Original

Acclaimed by thousands of the world's finest operators for ease of operation, clean signals and all around sending excellence. Precision machined, trouble-proof and efficient. A strong favorite of the elite. Standard, with circuit closer, grey base and chrome top parts. \$27.50. DeLuxe, with polished chromium base and top parts, red trim and jewel movement. \$32.95.



"VIBRO-KEYER"

Supplies the answer to many years of requests for Vibroplex parts for a keying mechanism to 35 wpm with ELECTRONIC TRANSMITTING UNITS. 4 1/2" and weighing 2 1/2 pounds. Red finger and thumb pieces, same large "w" contacts on main frame and trunnion lever as used in Vibroplex. A real beauty, adjustable to suit your speed requirements. Standard model, priced at \$20.95. DeLuxe model, with Chrome Plated Base, priced at only \$27.50.

*Cord and wedge, \$2.75 additional.



Vibroplex Lightning Bug

Improved design with slotted weights that can't walk loose. A trigger-damper frame that protects key against damage. Instantly adjustable dot contact spring may be removed without disturbing speed weights. Precision machining, trouble proof and adjustable to any speed. Standard, with circuit closer, grey base and chrome top parts, priced at \$24.95. DeLuxe model priced at \$32.95.



Vibroplex Carrying Case

Keeps key like new. Black simulated morocco. Flexible leather handle. Protects key against dust, dirt and moisture, and insures safe-keeping when not in use. With lock and key, \$8.00.

Every Vibroplex key has 3/16 contacts and is available for left-hand operation, \$2.50 extra.

Avoid Imitation! The "BUD" Trade Mark. Credit the genuine Vibroplex. Ask for satisfaction.

Prices subject to change without notice

THE VIBROPLEX CO., Inc., 833 Broadway, New York 3, N. Y.

IF YOU SEND YOU SHOULD USE THE VIBROPLEX
Buy Vibroplex for the easiest sending of your life

Figure 1970-7 — The R. L. Drake Company, a relative newcomer to the scene, offered a line of similar and highly regarded transceivers and separate units.

Figure 1970-8 — Vibroplex continued to produce their fine line of semi-automatic keys and paddles.

The ARRL Radio Amateur's Handbook — From Its Beginning 33

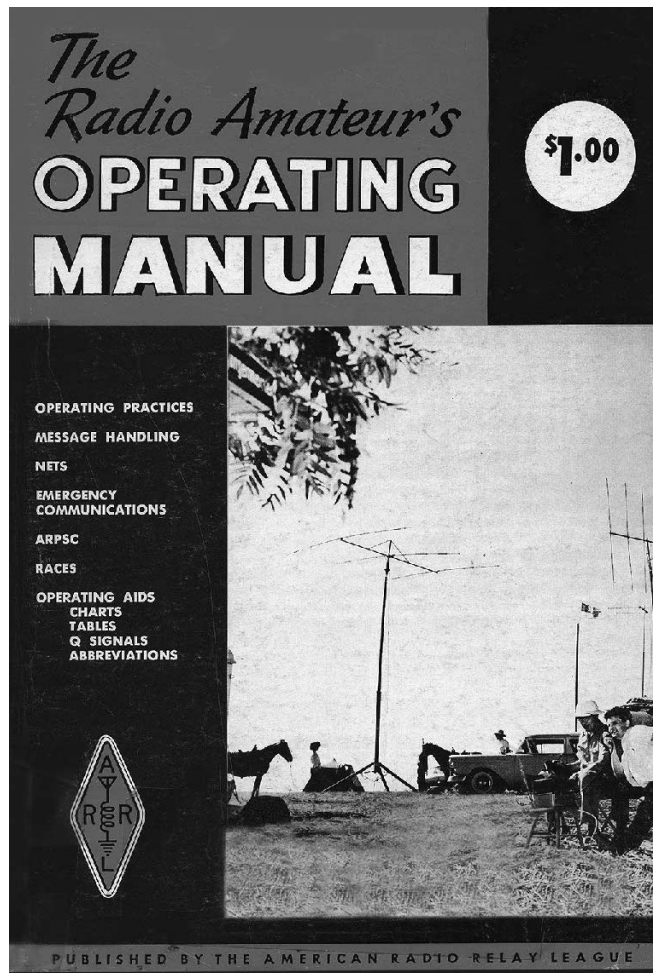


Figure 1970-9 — *The Radio Amateur's Operating Manual* was introduced in 1966.

FM Becomes the Mode on VHF — The 1980 Edition

The decade leading toward the 1980 *Handbook* saw a structural change — there was no longer an advertising section at the rear! Readers would need to look through the pages of *QST* to keep up with the advance of “Bug” technology from Vibroplex. The cover page (see Figure 1980-1) continued with an updated look.

During the decade between the 1970 and 1980 *Handbooks*, there were continued advancements in the application of solid state to mainstream projects as shown in a high

performance miniature solid state receiver (see Figures 1980-2 and -3) and an all solid state transmitter (see Figure 1980-4). While low power transmitters were headed toward solid state, a lack of available devices for typical HF power levels (100 W and higher) would keep vacuum tubes in the picture for a while longer.

One big change in the decade was the emergence of FM as the mode of choice for local voice communications. The genesis of this resulted from a change in bandwidth

requirements for commercial and government public service VHF users that resulted in a large amount of surplus equipment becoming available. By the 1970s, this equipment had been supplemented by equipment designed especially for amateurs, generally providing more channel choices than in the modified commercial gear. This was all accompanied by a new “FM and Repeaters” section in the *Handbooks* of the period.

The Radio Amateur's Handbook

By the HEADQUARTERS STAFF
of the
AMERICAN RADIO RELAY LEAGUE
Newington, CT, USA 06111

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1980
Fifty-Seventh Edition

Figure 1980-1 — The front matter in the 1980 *Handbook* had a more modern look than in the past.

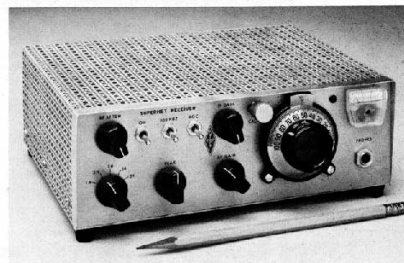


Fig. 58 — Photograph of the miniature 50-watt superheterodyne receiver. This layout arrangement was developed by WA0UZO of Circuit Board Specialists.

part of the tuned circuit at 500 and is a center-tapped broadband transformer.

Mixer and Amplifier

Two 40673 or 3N211 MOSFETs are used as a singly balanced active mixer (Q1 and Q2). Local-oscillator injection is applied to the paralleled gates no. 2 of Q1 and Q2. Output from the mixer is by means of T1, a broadband trifilar-wound pot-core transformer. A 10kΩ resistor is bridged across the mixer drains to limit the signal swing — an aid to mixer IMD. FL2 filters the LO voltage to keep harmonic energy to the mixer at a low level. The 68-pF capacitor between FL2 and the mixer gates can be changed in value to obtain the 3-volt pk-pk LO voltage which is specified.

An MPF102 or 2N4416 JFET is used as a post-mixer amplifier (Q3). The drain load resistor is chosen to match the filter impedance. A 2-kΩ value is specified for use with the Collins F455FD-64 filter at FL1. If a different filter is used, such as anis type, the drain load resistor may have to be changed to match the impedance of the filter. Also, the end resonating capacitors at FL1 may need to be a different value (see manufacturer's data sheets).

I-F Amplifier

A two-stage CA3028A i-f amplifier is used following the i-f filter, FL1. Series regulation is applied to the operating voltage of this circuit in order to provide 9.1 volts. Automated gain control is developed by the age strip and supplied to pin 4 of the CA3028A through Q7. Maximum gain occurs when the age voltage is

+9. Minimum gain is at the +2-volt age level.

Product Detector and Audio Channel

A singly balanced product detector is fed from the low-Z secondary winding of T4. BFO injection is supplied by Q5, which is shown with a 454.3-kHz crystal for use with the Collins CW filter specified for FL1. If a Collins sis i-f filter is used at FL1, the BFO crystal will have to be of a frequency that falls 20 dB down on the filter curve, upper or lower sideband. The manufacturer specifies which frequencies are correct for the filter being used. For upper and lower sideband operation it will be necessary to use two BFO crystals. Thus, a selector switch will be needed between the gate of Q5 and the two crystals.

RC filtering is used at the output of the product detector to keep the BFO and i-f leakage from reaching the audio preamplifier, Q4. Any JFET will suffice at Q4, such as a 2N4416.

Q17 functions as an audio muting switch during transmit. It is actuated via J2 by grounding the Q17 base line through an external set of relay contacts or bipolar-transistor de switch.

U4 amplifies the audio to speaker level. LC filtering is used at the output of U4 to suppress unwanted hf oscillations which could interfere with overall receiver performance (spurious responses). The MC1306P IC is designed for low-voltage operation. Therefore, the 3-terminal regulator, U5, has been included in the circuit.

AGC System

Audio-derived age is used in this

receiver. Output is sampled from the product detector, then amplified by means of U3. D3 and D4 rectify the amplified audio and drive a cascaded de amplifier consisting of Q6 and Q7. The age time constant is set by a 1-μF capacitor in parallel with a 1MΩ resistor. The time constant can be varied to suit the operator by changing the value of the charging capacitor in that network. Values of less than 1 μF will shorten the discharge time and vice versa. D5 serves as a gating diode to prevent loss of the age drive voltage through the i-f gain control, R3.

The age strip drives the S meter, M1, through Q7. Age voltage for U1 and U2 is obtained at the emitter of Q7. R2 should be set so that maximum receiver input signal provides +9 volts at pin 4 or U1 and U2.

Local Oscillator

Q13 operates as a highly stable series-tuned Colpitts oscillator. Polystyrene fixed-value capacitors are used to ensure stability and offer drift compensation which corrects for the positive drift of the core material in L12. Silver-nickel capacitors can be substituted with a possible degradation in long-term stability. C2 is the main-tuning capacitor. C4 is optional. If it is used it should be parallel-mounted to permit dial calibration from band to band. This will be necessary because the converter crystals may not be precisely on the specified frequencies.

Q14 serves as a source-follower/buffer stage. The signal level is built up by means of Q15, a Class A broadband amplifier. Sufficient LO output is available at 500 to swing the no. 2 gates of the balanced mixer to 3 volts pk-pk. The added power developed by Q15 is necessary to provide the required injection voltage across the 50-Ω load presented by harmonic filter FL2. A 40673 can be used in place of the 3N211 specified at Q15. Similarly, a 2N4416 will be satisfactory at Q14.

Front-End Converters

The same circuit-board pattern is used for the 40, 20 and 15 meter converters. In order to obtain a 200-kHz bandwidth on 80 meters, FL3 is used. Also, no rf amplifier stage is necessary on 80 meters. Therefore, the pc-board pattern is different from that for the other hf bands.

The converters of Fig. 60 are designed for a broadband i-f output of 1.8 to 2.0 MHz. They are selected for the desired operating band by means of S1. When this switch is placed in the 160-meter position the converters are bypassed to permit routing the antenna directly to the mixer of the main frame for reception on 160 meters.

Q8 performs as a low-gain, common-gate rf amplifier. The source-tuned circuit is peaked for the center of the band segment of interest. It is broad enough in response to require no additional tuning.

Receiving Systems B-36

Figure 1980-2 — This 1980 *Handbook* miniature receiver project is entirely solid state, but also incorporates features designed to limit IMD and improve dynamic range — issues with some early solid state receivers.

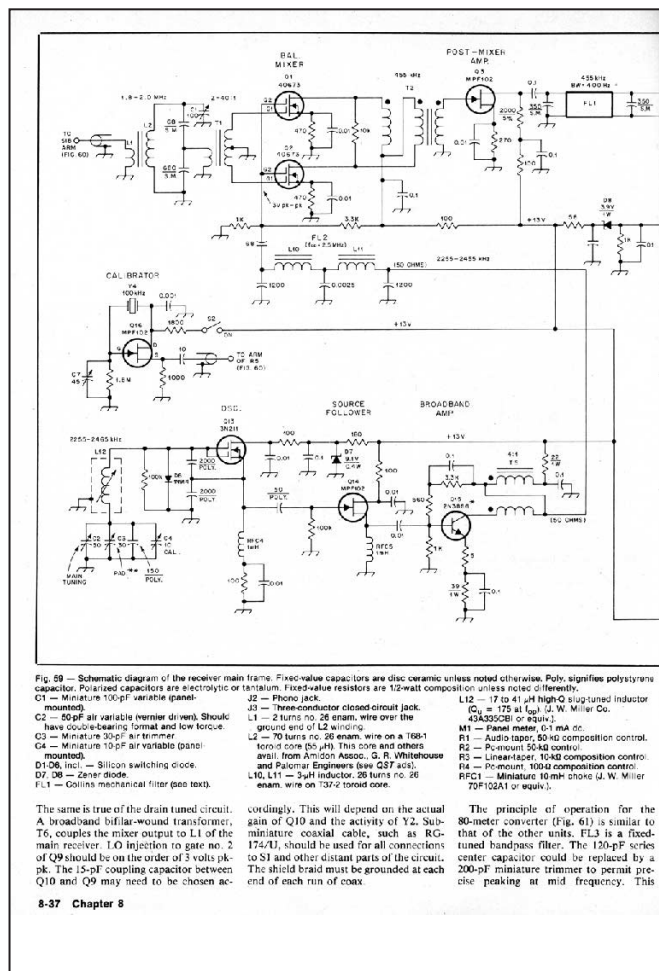
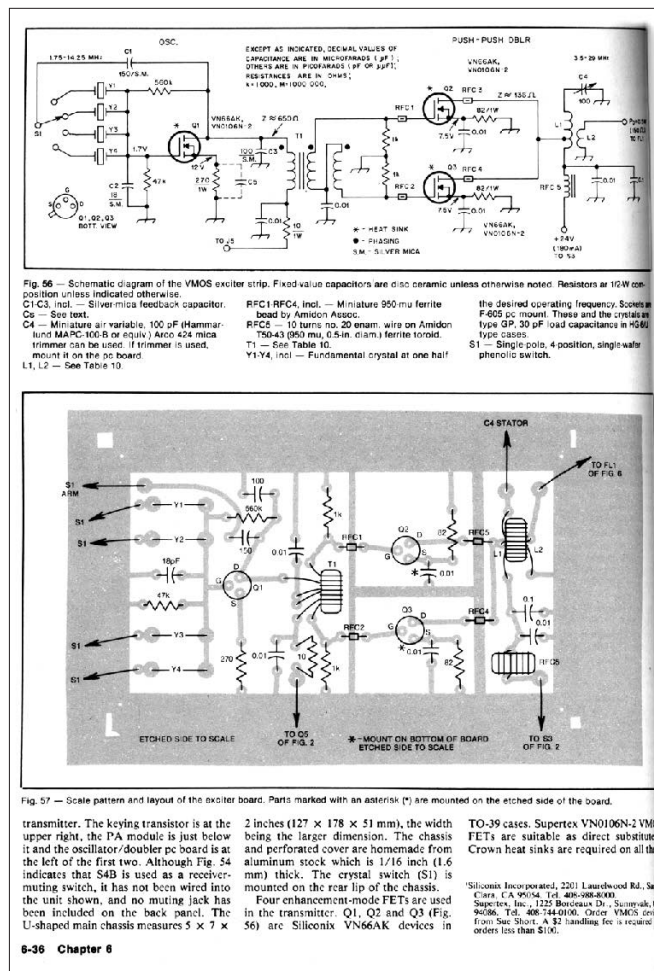


Figure 1980-3 — The schematic of part of the receiver of Figure 1980-2 shows the modern mixer and IF post mixer amplifier.



We Embrace Computers and Space Communications — The 1990 Edition

During the 1980s, the *Handbook* quietly assumed a subtly different name. Instead of the longstanding title *The Radio Amateur's Handbook*, it was now *The ARRL Handbook for the Radio Amateur*. It also increased dramatically in page count and number of chapters and took on a different

cover appearance, as shown in Figures 1990-1 and 1990-2.

The 1980s saw the beginning of the popularity of personal computers throughout the developed world. Amateur Radio was quick to embrace the new technology — first in off-line applications such as log

keeping and contest scoring — then in radio system control and finally in signal processing in various forms.

Projects now added large numbers of integrated circuits to the mix, as well as digital logic and their families of integrated circuits.

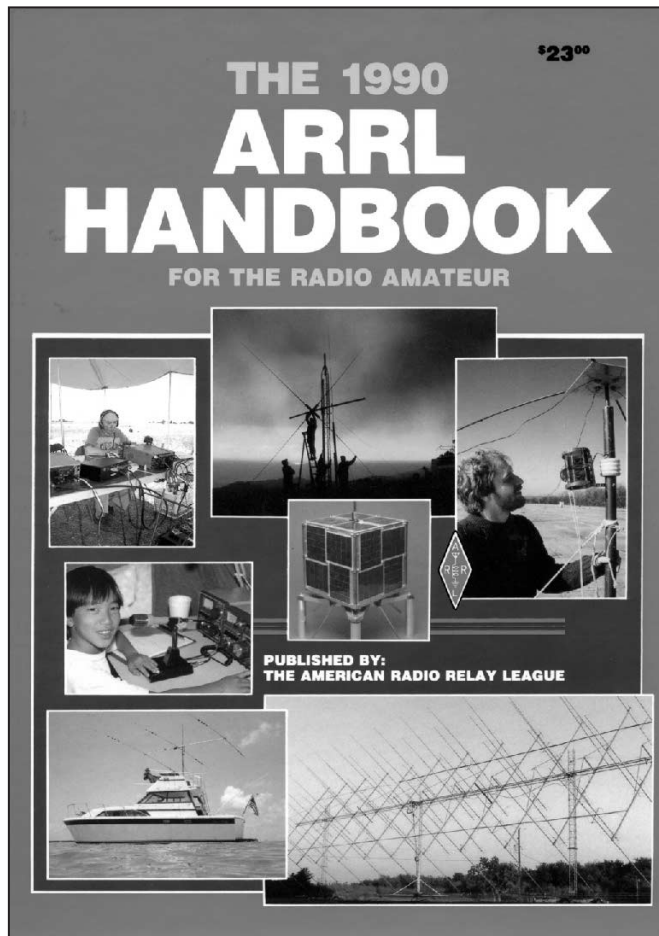


Figure 1990-1 — The cover of the 1990 *Handbook* has a completely different look than in the past. In addition, during the past decade, the size changed to approximately 8½ x 11 and the title has been slightly revised.

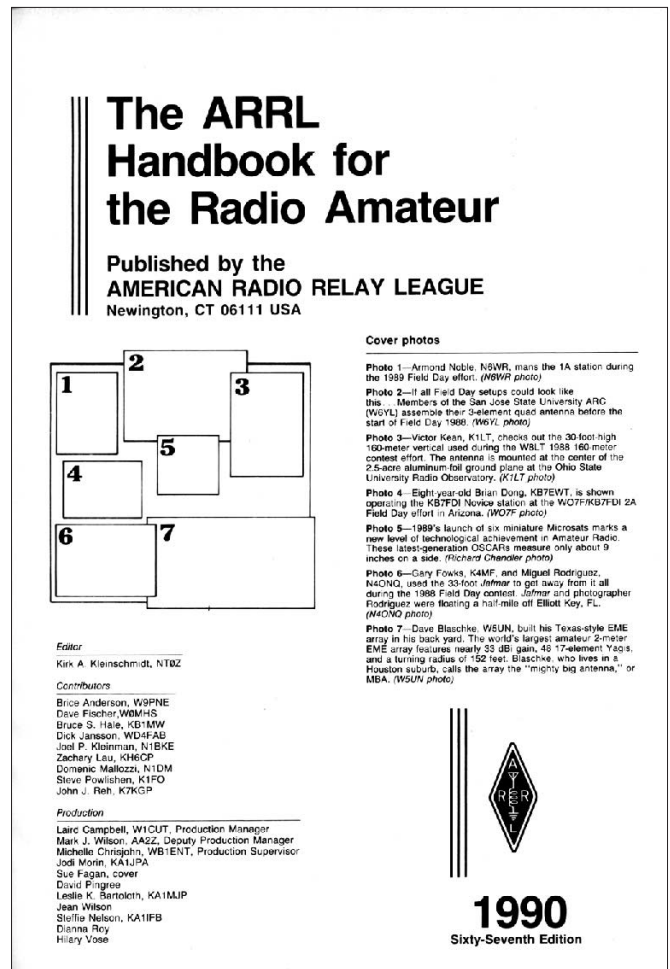


Figure 1990-2 — The 1990 cover has so much going on that it takes a navigation screen inside to keep track of it all.

The End of a Century — The 2000 Edition

During the 1990s, the *Handbook* continued the successful cover appearance, as shown in Figures 2000-1 and 2000-2.

The 1990s saw the expansion of the applications of integrated circuits. PC boards

were being designed and produced using computer software and Amateur Radio was quick to embrace and integrate the technology of the ubiquitous Internet. The *Handbook* was becoming as much a

reference book for electronic and radio engineering theory, as well as a source for projects, usually with much more design information than in previous generations.

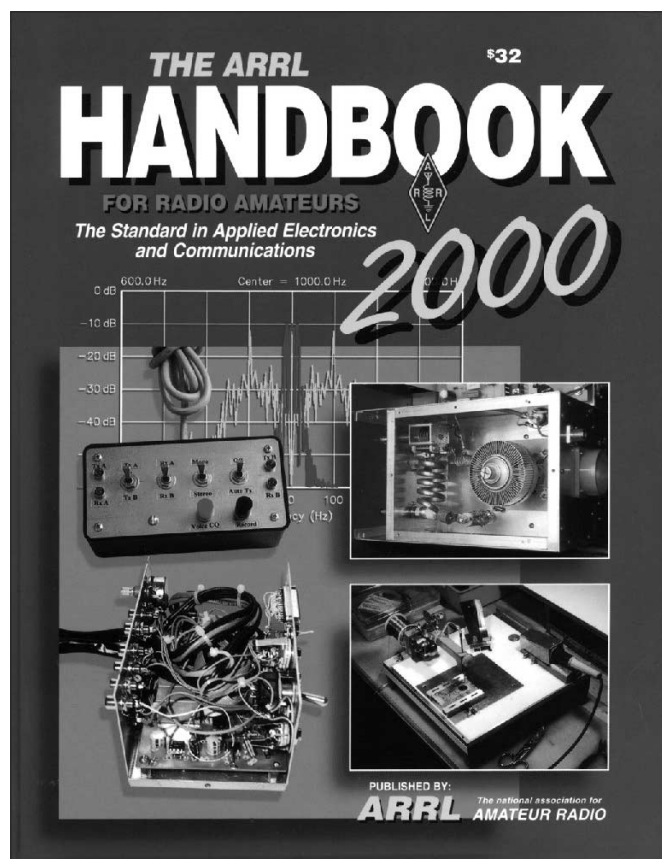


Figure 2000-1 — The cover of the 2000 *Handbook* builds on the look over the past decade.

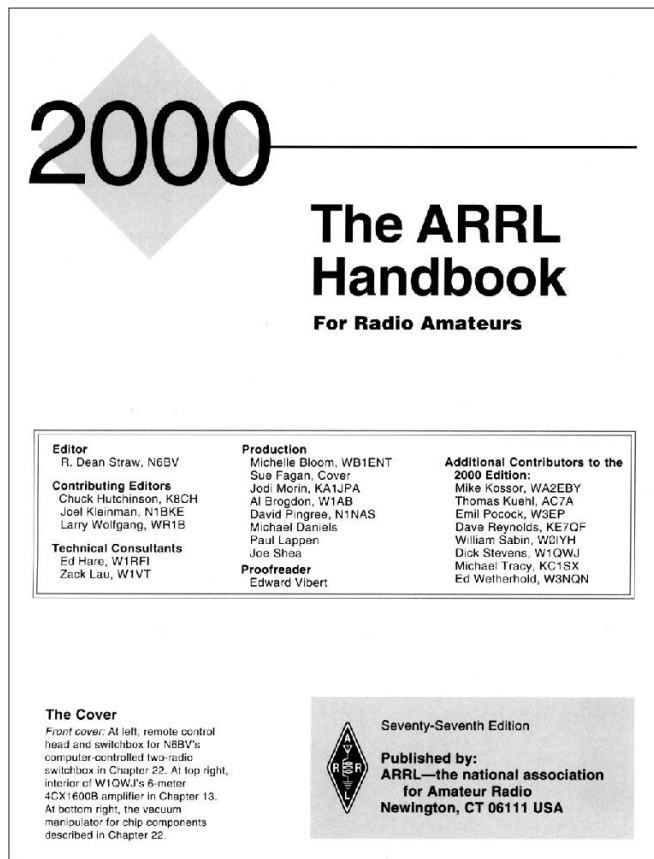


Figure 2000-2 — The 2000 cover can be described in a short paragraph — perhaps an improvement over 1990.

The Beginning of the Current Century — The 2010 Edition

During the 2000s, the *Handbook* continued the successful cover appearance, as shown in Figures 2010-1 and 2010-2. Note the subtle shift to a new name, now it is *The ARRL Handbook for Radio Communications*. This is perhaps in recognition of the fact we've known for a long time — the *Handbook* is not just for hams. Visit the office of a radio or telecommunications engineer and it's an even bet that a

copy of the *Handbook* will be found on a bookshelf there. This is as true today as it was when I started my career as a radar engineer in 1969!

The 1990s saw the expansion of the applications of integrated circuits. PC boards were being designed and produced using computer software and Amateur Radio was quick to embrace and integrate the technology of the ubiquitous Internet.

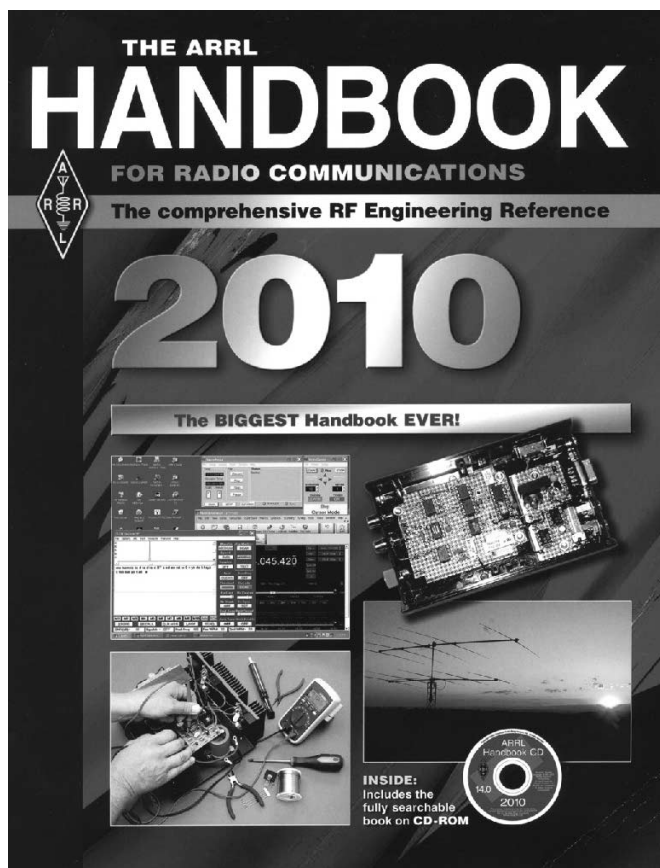


Figure 2010-1 — The cover of the 2010 *Handbook* builds on the look over the past decade. Note the change to a more general title — the *Handbook* isn't just for hams anymore — of course it never was.

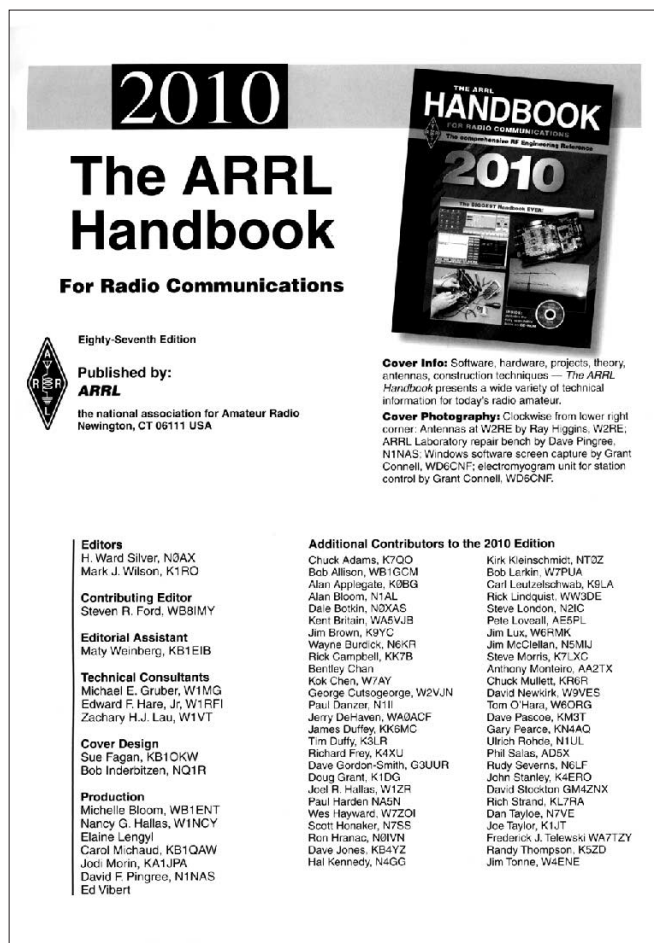


Figure 2010-2 — Look at the list of contributors to the 2010 edition — quite a difference from the single name on the inside of the 1926 edition! This major new edition featured lot of material by a lot of contributors — W1ZR is even on the list!