LIGHT POWERS THIS LIQUID SEMICONDUCTOR—see p.31

OCTOBER-NOVEMBER 75¢

Science and Electronics

and

Radio-TV EXPERIMENTER

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- AM Stations
- Worldwide SW
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- Sn/Fe Moving-Vane Ammeter
- Perpetual-Motion Freq Standard
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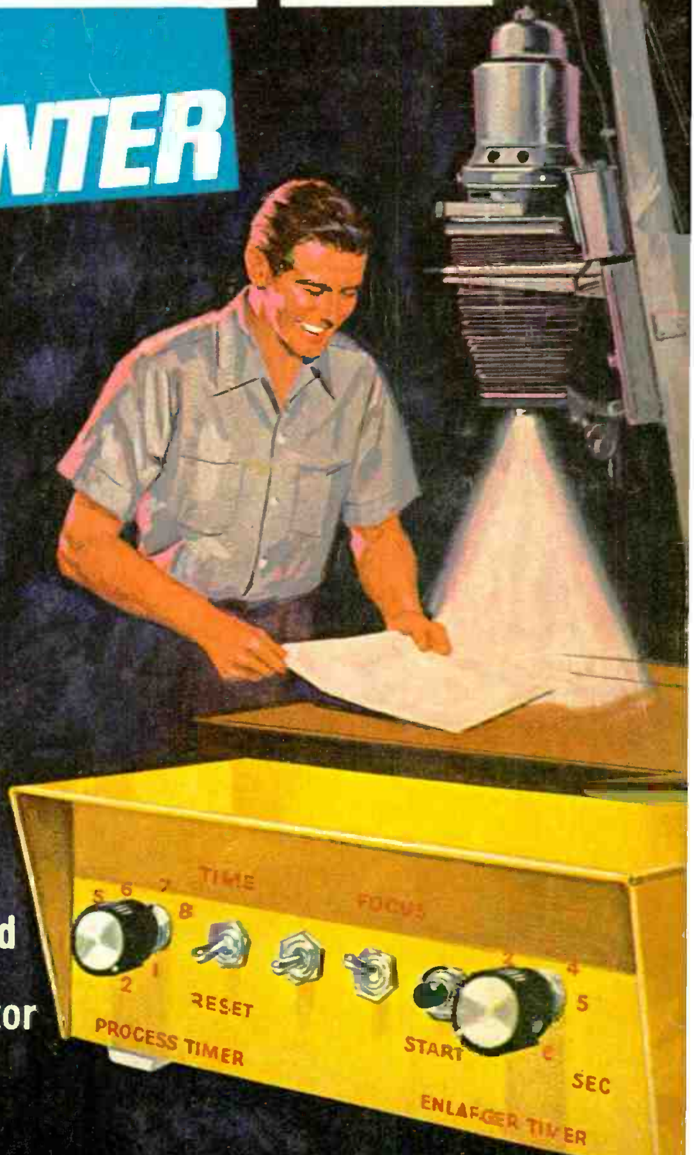

BEGINNING THIS ISSUE

THE SKIES ABOVE US

S/E's roving report on what's what in outer space

Dazzle your friends with lightworks.

Sound n' Color®

The new dimension to music pleasure. EICO All Electronic Solid-State Audio-Color Organs transform sound waves into moving synchronized color images. Connect easily to speaker leads of hi-fi or radio. From $29.95.

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Strobe Lites

High-intensity bursts of white light from Xenon tube flash in cadence with each beat of audio. From $24.95 kit, $39.95 wired.

Build the Stereo Kits praised by experts.

All amplifier power ratings according to IHF standards. Cortina® designed and manufactured in U.S.A. and guaranteed by EICO.

70-Watt AM/FM Stereo Receiver including cabinet. Cortina 3770, $189.95 kit, $279.95 wired.

70-Watt FM Stereo Receiver including cabinet. Cortina 3570, $169.95 kit, $259.95 wired.

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(lo band) $7.95; EC-2800 Aircraft Converter $7.95, EC-2900 Police & Fire Converter (hi band) $7.95. EC-3100 2-Station Intercom (with cases) $10.95, EC-3200 "Do-It-Yourself" PC Etching Kit $4.95; EC-2300 Audio Preamplifier $8.95; EC-2400 Bullhorn $8.95; EC-2500 Fuzzbox $8.95.

EC-1900 TREASURE FINDER $9.95

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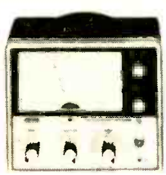
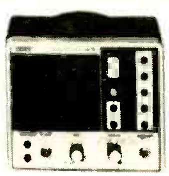
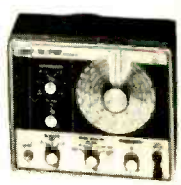
EICO 379 Solid-State Sine/Square Wave Generator $54.95 kit, $74.95 wired



EICO 242 Solid-State Deluxe FET-TVOM $59.95 kit, $79.95 wired.



EICO 150 Solid-State Signal Tracer $49.95 kit, $69.95 wired



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October/November 1969

Science and Electronics

★ Cover Highlights

Cover illustration by Len Goldberg

JUST SAY **WEN**

wen makes soldering simple

Model 199K, 5 pc. kit

130 watt "instant heat" soldering gun for wiring, appliance repair, radio, T.V., etc. Kit includes: solder gun with long nosed tip, 1 tip for cutting plastic and removing putty, 1 flat iron tip for removing dents from wood and heat sealing, 5 ft. solder, attractive heavy gauge metal case.

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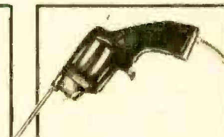

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100 watts in 2½ seconds
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BY ERNEST A. KEHR

● ● The multi-color, 50-lire stamp issued by Italy on Nov. 25, 1968, is simply inscribed, "Centro Telespaziale del Fucino." But the intercontinental communications progress it commemorates is vastly more impressive. It was released to mark the opening of expanded facilities built by the Italian Government to take advantage of satellites for the intercontinental transmission and reception of private messages, radio and TV programs. The design shows the Fucino installations, with one of two Space antennae, each about 30 feet in diameter, in the foreground.

● Once the United States and the Soviet Union rocketed sophisticated hardware into outer Space, and proved satellites could be kept orbiting under meticulous control from ground stations, this new communications technique was adapted to commercial use to serve mankind.

In Washington, the initial efforts were culminated by the organization of INTELSAT, in February of 1965, to harness spacecraft potentials on a private basis. The peculiar ability of sending messages across vast distances not only relieved pressure on overloaded cables beneath the seas; it enabled broadcasters to transmit instantaneous news events in a manner impossible through existing terrestrial equipment.

● ITALCABLE and RAI, Italy's two organizations concerned with private and commercial message transmission, and radio-TV productions respectively, appreciated the potentials of INTELSAT. And almost as soon as its formation was announced, arrangements were made to link themselves into the American satellite program. They created "Telespazio" exclusively for this purpose under the aegis of the Italian Ministry of Posts and Telecommunications.

Italy 1968 Fucino Installation

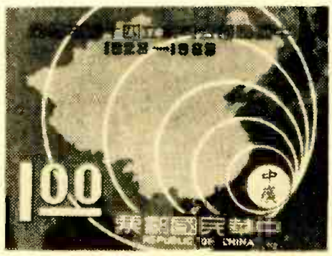
● By June, 1965, Telespazio was ready to make use of the first Early Bird facilities. Equipment which already is outmoded, was installed in a brand new, specifically designed center at Fucino, two miles from Avezzano, in Aquila Province, and once an important source of water in the days of Caesar and Claudius.

● As early as October of that year, Italian TV viewers witnessed the arrival and all-day visit of Pope Paul VI to the UN, in New York via satellite.

● As this communications medium was developed, Telespazio kept pace by acquiring and installing the costly equipment as it came from the manufacturers here. And while the new antennae now are in operation, still more recent equipment already is in the process of being built, including a more sophisticated antenna that is 27.40 meters (90 feet) in diameter.

● ● On Aug. 1, 1928, the Broadcasting Corporation of China was established in Nanking, to provide the populace with early radio news and entertainment programs. To mark the 40th anniversary of that noteworthy event, the Chinese Postal Administration released a pair of special postage stamps produced by the government's engraving plant in Taipeh.

● The $1 value features a map of Asia with concentric circles spreading all over the mainland from Formosa. All during World War II, BCC fostered morale of both the armed forces



China (Taiwan) 1968 Postal 40th Anni.

and the populace; it linked government agents in occupied areas, and conveyed China's voice to allied nations. After it moved to Taiwan in 1949, its facilities are being used to transmit programs to the mainland of China, to keep the Chinese there constantly aware of what is happening on Formosa.

● The $4 shows a small microphone from which an interesting pattern of red circles and

(Continued on page 105)

POSITIVE FEEDBACK

Julian M. Sienkiewicz
EDITOR-IN-CHIEF

Don't look now, but our new name—SCIENCE AND ELECTRONICS—appears on top of our old one . . . and in larger type, too! Yep, we've made the switch. From here on in we can only go to bigger and better coverage of the exciting worlds of science and electronics. However, we can't do the job alone. We need help from you! Look carefully at this issue and let us know what you think of it. Then, in a short letter, let us know exactly what you *like* and what you *dislike*. Tell us, too, what's missing so we can make our coverage more interesting and more complete.

It's as difficult for an editor to judge his magazine as it is for an artist to judge his paintings. (Could this explain why there are many starving artists and editors?) So you see, by writing you can get a better magazine and maybe make the Editor rich simultaneously *(Whee!)*. Please address all your remarks to The Editor, SCIENCE AND ELECTRONICS, 229 Park Avenue So., New New York, N.Y. 10003.

Plot! Programming a computer requires translation of word or picture directions into a numerical language understood by the computer's electronic circuits. Now, a new computer *accessory* simplifies this translation by making many programming tasks as easy as tracing lines on a blueprint or photograph. The *accessory*, a three-axis reversible scaler, was developed by The MicroMetric Corporation, Berkeley, Calif., a member of The Grass Valley Group, Inc. Designed for a wide range of industrial and scientific applications, the new scaler will free programmers, now in short supply, from routine production and laboratory work, allowing them to concentrate on more profitable assignments.

Programming a computer to control a machine tool, for example, can be accomplished merely by tracing a blueprint of the desired part with the plotting cross hairs of a MicroMetric two axis "digitizer," as the combination of the new scaler and its plotting table is called.

(Continued on page 102)

Heathkit® — Your Best Buy In Electronics

NEW Heathkit Solid-State Auto Tune-Up Meter . . . Measures Dwell, RPM And DC Voltage

The new Heathkit ID-29 is most versatile . . . really three automotive test instruments in one . . . and its low price makes it even a better value. Measures Dwell on all 4-cycle 3, 4, 6, or 8 cylinder engines . . . measures RPM in two ranges 0-1500 and 0-4500 . . . measures DC voltage from 0 to 15 volts. And no batteries are needed . . . running engine provides both signal and power. Easy to use . . . on both 6 and 12 volt system without changing leads. It's lightweight, easy to carry . . . comes equipped with black polypropylene case that has a built-in lead storage compartment and is resistant to virtually everything. Fast, simple assembly . . . takes just one evening. The perfect accessory for the handyman who wants to do his own car tune-up, emergency road service personnel, or shop mechanics . . . order your ID-29 now. 4 lbs.

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NEW Heathkit GD-48 Solid-State Metal Locator

A low cost, versatile, professional metal detector at one-third the cost of comparable detectors. Packed with features for long life, rugged reliability, and dozens of uses. Completely portable, battery operated and weighs only 3 lbs. The GD-48 is highly sensitive, probes to 6 feet, and has an adjustable sensitivity control. Its built-in speaker signals presence of metal; front panel meter gives visual indication. Other features include built-in headphone jack, telescoping shaft for height adjustment, smartly styled and smartly designed for easy in-hand use and easy assembly. Whether you're an amateur weekend hobbyist or a professional treasure hunter the GD-48 is for you . . . also a great help to contractors, surveyors, Gas, Electric, Telephone and other public Utility Companies. 4 lbs. GDA-48-1, 9 Volt Battery \$1.30*; GD-396, Headphones, 2000 ohm (Superex) \$3.50*

NEW
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NEW Heathkit Electronic Metronome

The new Heathkit TD-17 is a low cost, precise performing electronic Metronome. . . a handy helper for any music student. Battery operated . . . no springs to wind . . . accurate, steady calibration is always maintained . . . from 40 to 210 beats per minute. Instruction label on bottom gives conversion from time signature and tempo to beats per minute. Stylish fruit wood finished cabinet. Easy solid state circuit board construction . . . assembles and calibrates in only 2-3 hours. The new Heathkit TD-17 Electronic Metronome is so low in cost every music student can afford one . . . order yours now. 1 lb.

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NEW Heathkit GR-88 Solid-State Portable VHF-FM Monitor Receiver

Tunes both narrow and wide band signals between 152-174 MHz . . . for police, fire, most any emergency service. Exceptional sensitivity and selectivity, will outperform other portable receivers. Features smart compact styling . . . with durable brown leatherette case, fixed station capability with accessory AC power supply, variable tuning or single channel crystal control, collapsible whip antenna, adjustable squelch control and easy circuit board construction. The new GR-88 receiver is an added safety precaution every family should have . . . order yours today. 5 lbs.

NEW Heathkit GR-98 Solid-State Portable Aircraft Monitor Receiver

Tunes 108 through 136 MHz for monitoring commercial and private aircraft broadcasts, airport control towers, and many other aircraft related signals. Has all the same exceptional, high performance features as the GR-88 above. The perfect receiver for aviation enthusiast . . . or anyone who wants to hear the whole exciting panorama of America in flight. 5 lbs. GRA-88-1, AC Power Supply \$7.95

NEW
Kit GR-98

NEW
Kit GR-88

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NEW Heathkit GD-28 8-Track Cartridge Tape Player

The new GD-28 is an ideal addition to any home music system. Plays prerecorded tapes through any system with a Tape Recorder, Tuner or Auxiliary input. Just push in the 8-track stereo cartridge . . . it starts and changes tracks automatically . . . even shows which track is playing. Changes tracks instantly with the front panel switch too. Goes together quickly on one circuit board, and the famous Motorola® tape playing mechanism is preassembled & adjusted. Attractive wood-grained polyurethane cabinet included. Order yours now. 10 lbs.

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BOOKMARK
BY BOOKWORM

Here's How! Don't take a back seat to any one when it comes to shortwave and medium-wave DXing. The fifth edition of *How To Listen To The World* is now available and raising eyebrows of shortwave novices and pros alike. One of the main purposes of this book is to enable the listener (and TV viewer) to obtain the greatest benefit from the world of radio through his receiver. Radio world listening nowadays is no longer a purely shortwave matter. Over the last few years, there has been an ever increasing interest in world listening on medium waves. Therefore, such Table of Content titles as "Improving medium-wave reception," "Medium-wave propagation," and "Medium-wave DXing from Australia" offer a guide to the locked-in shortwave DXer who wants to switch to the lower frequencies. *How To Listen To The World* is edited by J. M. Frost and includes articles from qualified authors, radio broadcast organizations and DX-club officials. Get your copy today direct from Gilfer Associates, Inc., Box 239, Park Ridge, N. J. 07656. ■

Soft cover
211 pages
$3.95

Takes Two for Stereo: How does the prospective buyer of hi-fi and stereo equipment spot those features which add up to the best possible equipment in a particular price range and avoid those which are well packaged, but low in quality? And how can the owner of a system improve his rig to gain increased listening pleasure? These are a few of the many questions answered in a practical two-volume paperback set by the noted author Murray P. Rosenthal. The volumes are titled *How To Select and Use Hi-Fi and Stereo Equipment.*

Volume I, which concentrates on the basic hi-fi and stereo equipment, opens with a brief but very thorough discussion of acoustics. Written clearly, concisely, it gives the reader an excellent background, including the often overlooked relationship between enclosure, speaker and listening area. Criteria are given for selecting the various types of speakers. Cutting through the confusing array of enclosure types and sub-types the book tells just how different kinds of enclosures affect sound, and which kinds are particularly effective in given situations. Headphones, preamplifiers, amplifiers, tuners and receivers are then discussed, showing

Volume I
Soft cover
114 pages
$3.25

Volume II
Soft cover
104 pages
$3.25

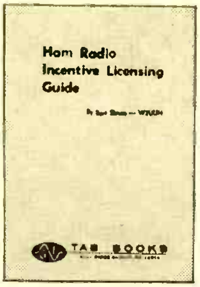
a sampling of control features, connection possibilities, and a comparison of the advantages and disadvantages of tube vs transistorized equipment.

Volume II fully discusses record players and tape recorders, components which may be added to the basic hi-fi or stereo rig at any time. It shows how different kinds of construction in these components can affect performance. Covering phono arms, pick-up types, styli, etc., it gives concrete reasons why certain kinds of equipment should be selected or avoided. A particularly valuable feature of Volume II is a thorough troubleshooting guide. Here are 38 pages of tips on solid-state devices, tools, testing, for those listeners who want to keep their equipment in top working order.

So pick up your copies of *How to Select and Use Hi-Fi and Stereo Equipment* and get with good sound. Available at many electronic parts stores or direct from the publisher, Hayden Book Company, Inc., 116 West 14th Street, New York, N. Y. 10011. ■

Ham Fact Dept. In the United States, anyone can get an amateur license—no prior electronics experience is necessary, and for the Novice Class ticket, age is no barrier. Many youngsters under ten already have theirs, as well as a host of young-at-heart enthusiasts who have begun to climb the ladder toward that General, Advanced, or Extra Class License. To pass the Novice Class exam only a "speaking acquaintance" is required—the basic rules and code. In effect now are new FCC rules intended to encourage present radio amateurs toward achievement of higher class licenses with reserved operating privileges and to stimulate interest among outsiders.

A new book, *Ham Radio Incentive Licensing Guide,* tells how to begin, or to advance, to each succeeding license class, in clear, concise, and easy-to-understand terms. For many, the most formidable obstacle is learning the code. Here the reader will find proven methods of learning and developing proficiency with International Morse Code. An entire Chapter is devoted to each license class, eliminating the necessity of wading through material irrelevant for the reader's immediate goal, and if he is shooting for a higher class ticket, he can simply skip to the appropriate Chapter. The Incentive Licensing Guide, prepared with the aid of the



Soft cover
160 pages
$3.95

FCC, includes actual test material, substantially as it appears on official exam forms, and it covers *every* question which may be encountered in each test, from Novice to Extra Class. Naturally, the text is authorized by a ham, Bert Simon, W2UUN. To get your copy write to the publisher, Tab Books, Blue Ridge Summit, Pa. 17214.

Color Bench Rainbow. Here's a handy benchmate for practicing color TV technicians and B&W experts who want to break into color TV servicing. It's *On the Color TV Service Bench,*

Soft cover
192 pages
$4.95

a brand-new troubleshooting guidebook written by a real pro, Jay F. Shane, an expert who cut his teeth on the first TV circuits 20 years ago. The text describes causes and cures for

(*Continued on page 105*)

Sun of a Gun!

This new movie light unit from Sylvania is named the Sun Gun, is designed for 8 and 16 mm movie cameras, and operates on 9 nickel cadmium energy sources in a separate power pack that weighs only 3 lb. Each energy source has a running time of 10 minutes or approximately two 50-ft. rolls of movie film when batteries are fully charged. The energy power packs can be fully recharged in 60 minutes with a separate recharger. The Sun Gun features a beam selector in the back of the light head so you can regulate the light beam from spot to flood even when shooting. The total light output on the spot position is 15,000 center beam candle power and 7,000 center beam candle power at the flood position. The light source is a 150-watt tungsten-halogen lamp with an average rated life of 30 hours when operated in the Sun Gun system. The total Sun Gun unit will have a price of $119.95, including a custom-made carrying case. For more information write to Sylvania Electric Products Inc., 730 Third Ave., New York, N.Y. 10017.

Sylvania Sun Gun Movie Light Unit

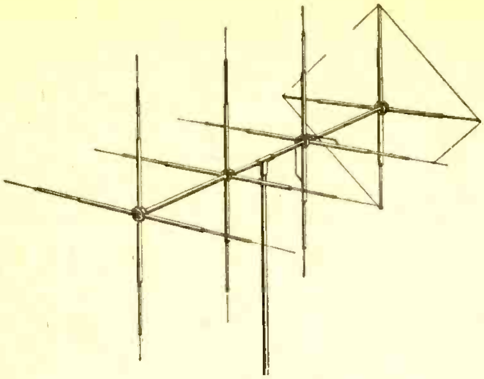
Beep-Beep! Beep-Beep!

Do the kids bug you on road trips? Bell & Howell has devised the Road Runner cassette tape player kit to keep them off your back. Besides the Road Runner cassette, six batteries and earphone, the kit contains two original tapes with stories, travel facts, behavior tips, sing-along songs and games, all set to original music. There's also a travel booklet and a special prerecorded cassette tape bonus offer. The package comes in a sturdy travel carton with handle and sells for $38.88. If you bought the elements separately they would come to $45.00. The Road Runner cassette features touch control for fast forward, play or stop, easy drop-in cassette loading, and a rugged case. You can, of course, use all standard cassette tapes in the Road Runner. At your local dealer or write to Bell & Howell, Video and Audio Products Div., 7235 N. Linder Ave., Skokie, Ill. 60076.

Bell & Howell Road Runner Cassette Kit

CB Base Station Antenna

Avanti has a new CB base station antenna designed along the lines of antennas used to pinpoint signals on "moon bounce." Therefore, they have called it the Moonraker, and it combines ½-wave cross dipole elements with Avanti's PDL design reflector. They include a switch box so you can have either horizontal or vertical operation. Moonraker's shorter boom length (15 ft.) helps keep weight and turning radius to a minimum and lets you use a standard inexpensive TV-type antenna rotor system. Also a plus from the shorter boom length is better signal excitation for greater true gain—14.5 dB. Impedance is 50 ohms,

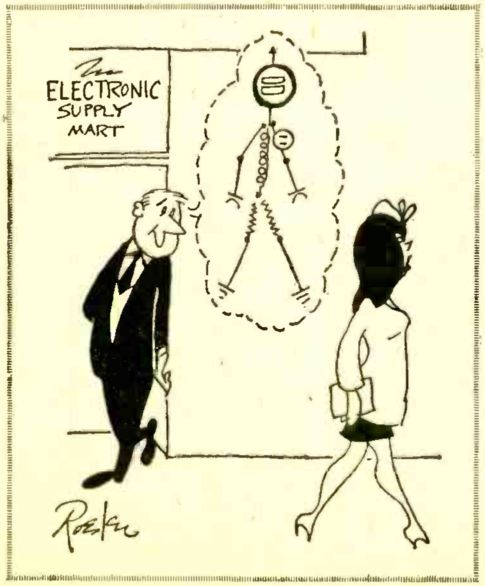


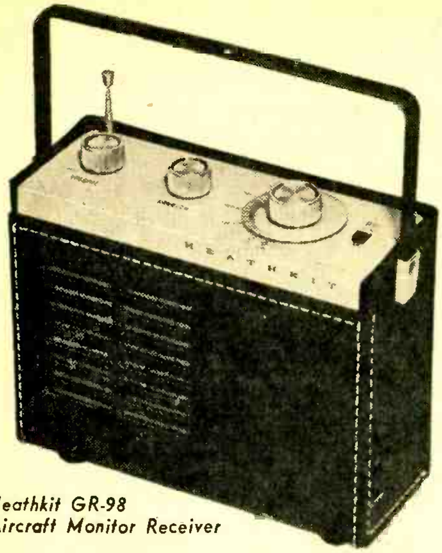
Avanti Moonraker CB Base Station Antenna

power handling 1000 watts. Wind survival is 90 mph, the weight of the Moonraker is 24 lb., and the price is $129.95 with a one-year guarantee. Write to Avanti Research & Development, Inc., 33-35 W. Fullerton Ave., Addison, Ill. 60101.

Skywatch by Ear

Heath Company has a new portable aircraft monitor receiver, the GR-98, which tunes from 108-136 MHz. With it you can hear commercial and private aircraft, airport control towers, air control conversations, and many other aircraft-related signals. There's a six-to-one vernier tuning control, a built-in whip antenna, 40-kHz selectivity and 1.5-μV sensitivity for a 10 dB signal-to-noise ratio. Another feature is adjustable squelch control, and, for those



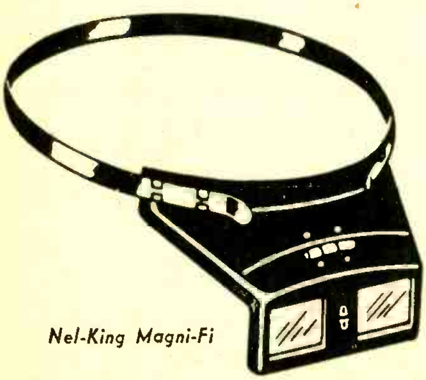


Heathkit GR-98
Aircraft Monitor Receiver

who want to monitor one station almost continuously, the GR-98 has crystal control of one-channel—just plug in the crystal of your choice, tune to the approximate frequency and flip the front panel switch to the *Xtal* position and you're on frequency immediately. GR-98 weighs less than 4 lb. with six C cells installed, and measures 7¼ x 8½ x 3½-in. For fixed station use, the carrying handle converts into a tilt stand and an external antenna jack is provided. The tuner portion is factory assembled and aligned; the rest goes together on a single circuit board. Price: $49.95. For more details write Heath Co., Benton Harbor, Mich. 49022.

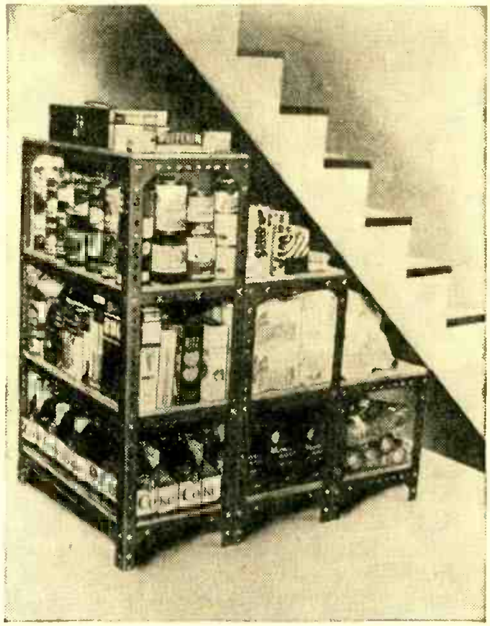
Hobbyists, Stop Squinting!

Having trouble making out details on those printed circuits? The Magni-Fi has a headband that adjusts to any head size and a precision 2½ diopter lens. It not only leaves your hands free to work, but the hinged lens swings up and out of the way when you don't need it. You can wear Magni-Fi without or with glasses. And one of the nicer features of the Magni-Fi is its very low price: $7.95. If desired, a 3-diopter lens is available for $2.98. Magni-Fi is available by mail (35¢ postage) from Nel-King Products, Inc., 811 Wyandotte St., Kansas City, Mo. 64105.


Nel-King Magni-Fi

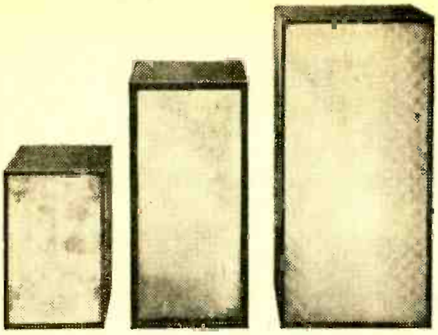
Grownup Erector Set

Dexion Inc.'s slotted steel angle is now available at your local lumber yards, hardware, and department stores. Framework for workbenches, machine stands, shelving, soap box racers, and lots of other items can be assembled just like you did with your Erector set. All you need is a wrench and a hacksaw. Dexion angle is made of cold rolled steel with a baked enamel finish. It's packaged in bundles of 8 five-foot lengths with nuts, bolts and corner braces included. This is called the Dexion 100 kit and its price is $12.65. Write for their Idea Pamphlet, which illustrates 21 do-it-yourself projects—from storage units to pet stands and puppet theatres. For a free copy send to Dexion Inc., 39-27 59th St., Woodside, N.Y. 11377.


Dexion Slotted Steel Angle

New Sound 'N Color Family

A whole new dimension for your music—color! EICO has three new models in their Sound 'N Color line which use special low-voltage, high-intensity lights to achieve their startling effects. The light boxes come in three and four channel models—each channel responding to a different portion of the audio spectrum. Every combination of musical in-



Model 3440 Model 3445 Model 3450

EICO Sound 'N Color Organs

struments produces its own distinct multi-color pattern. Shown are Model 3440, 3-channel, 15 x 10 x 6-in., in kit form $49.95, wired $79.95. Next is Model 3445, 4-channel, 24 x 12 x 10-in., kit $64.95, wired $99.95. The one on the right is the jumbo model, 3450, 4 channels, 30 x 15 x 11-in., kit $79.95, wired $109.95. For more info, write EICO Electronic Instrument Co., Inc., 283 Malta St., Brooklyn, N.Y. 11207.

Clear the Tracks for Stereo!

The new Heathkit GD-28 is a stereo tape player kit designed to play back prerecorded 8-track stereo tape cartridges through any home music system. Unit is completely automatic; the user just plugs in the cartridge of his choice. A metal tape splice switches the play-head from one track to the next automatically, or you can select the track you want by pushing the slide-switch on the front panel. Pilot lamps indicate which track is playing. The tape player mechanism is preassembled and adjusted, and the 6-transistor, 2-diode preamplifier circuit goes together in a trice on one small circuit board.
(Continued on page 106)

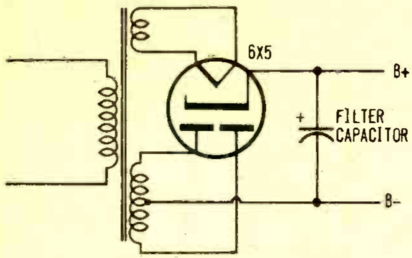
"Sorry, Higgins, you're being replaced but not exactly by a computer."

It's Zapped!

Everytime my amplifier is turned on, the 6X5 rectifier tube burns out. What gives?

—R. L. F., Middletown, N. Y.

Undoubtedly the input filter capacitor (see diagram) is shorted. Replace it with one of the same value in microfarads. The same trouble



occurs in solid-state diode rectifier circuits only there's a very low ohmic resistor between the diode and the filter capacitor that overheats and pops. Replace filter, capacitor, resistor and diode.

Never!!

Can you give me a schematic of a solid-state phono preamplifier?

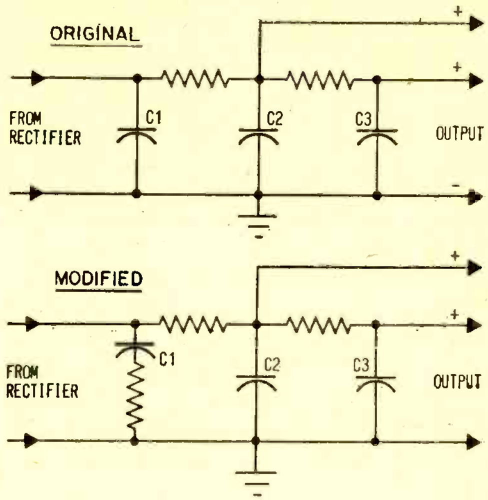
—C. R. B., Amityville, N. Y.

Why? There are several good wired units available on printed circuit boards and modules that are a heck of a lot cheaper than the parts needed to make one. Look through the catalogs of Lafayette Radio, Allied Radio, and Radio Shack for some good buys.

Show Some Resistance

I am having trouble getting the right voltage out of a DC power supply. When I use a capacitor input circuit, the voltage is too high. When I disconnect the input filter capacitor, the voltage is too low. Do I have to add an AC input voltage control?

—A. M., Santa Barbara, Calif.



Try a resistor in series with input capacitor C1. Try various values until the output voltage is correct. The resistor will probably have to be a wire wound type rated at 10 watts or more.

Old Waves

What was the first broadcasting station in the U.S.? Both KDKA in Pittsburgh and WWJ in Detroit claim the title. Also, was it 1920 or 1921?

—D. H., Metairie, La.

The way we heard it, it was KQW in San Jose in 1913. Before that DeForest broadcast live opera in New York. And before that it was just ghosts in the attic.

Point of Information

In reply to *E. E. C., Jr.*, of New Bern, N. C. on where to obtain the light emitting diode for the "Talk on an Infrared Light Beam," they are obtainable from Cleveland Service District, Lamp Division, General Electric Co., 12910 Taft Avenue, Cleveland, Ohio 44108. Request an SSL-4 solid state lamp. The cost is under $10.00. (Our thanks go to G. H. of Dickinson, N. D. for the info.)

DX for UX199

I have an old RCA Radiola 20 which uses type UX199 tubes. Where can I get replacement tubes? Our local stores don't have them.

—L. J. E., Everett, Wash.

Get information on the phone by dialing 206-MA 4-2341 or order direct by mail from Seattle Radio Supply, 2117 Second Avenue, Seattle, Wash. 98121. The Company advertises that they have lots of old tubes (199, 12A, 483, etc.) and sell them at $3.00 each.

Achtung!

I have seen a relatively new Grundig radio in a local drug store. The owner got it out-of-state from a fellow who needed the money. Whom can I contact to obtain Grundig sales information? I am interested in AM and FM stereo plus short wave reception.

—*R. B. V., Montgomery, Ala.*

Write to Grundig Electronic Sales, 355 Lexington Avenue, New York City.

Going Abroad

In recent months I have obtained quite a few 2S transistors. I have found no reference to such types in magazines or books and would like to know if they are interchangeable with (or the same as) 2Ns. If not, please give me some information on them.

—*D. S., Liberty, Mo.*

Get a copy of the Datadex Transistor Reference Book for $3.95 from IRC, Inc., 401 N. Broad St., Philadelphia, Pa. 19108. It lists 2S numbers and their 2N or other equivalents.

Amateur Juvenile

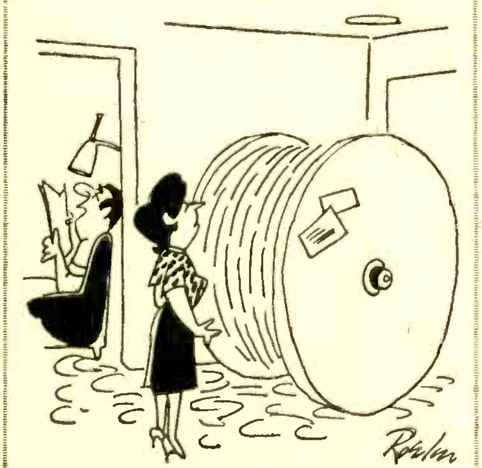
I am not old enough to have a CB license. But I have heard that it does not matter what your age is for ham license. Is this true?

—*D. L. S., Brookfield, Mo.*

Wish I had your problem. Yes, it's true. *If* you can pass the test. Start studying.

Back to School

I know next to nothing about radio or electronics, but would like to learn. I saw an ad in your magazine on kits. Would I be able to gain enough basic knowledge from assembling these



"A cable from Uncle Willie? I didn't know he went abroad!"

kits to go on to more advanced projects, or would I be better off to start out some other way?

—*S. G. K., Wichita, Kansas*

Building kits is a good way to get some practical experience. But, take a home-study course or go to a resident school to learn theory and to get guidance. There's nothing like school for learning.

Museum Piece

I recently acquired an old Burndept SW/BCB receiver and a set of 26 plug-in coils. It will cover 11.8 to 520 meters, but it uses three Burndept Super-Valves in place of tubes. I wonder if you could tell me its age and approximate value. It works and is in fairly good condition.

—*F. W., Kamloops, B.C.*

The Super-Valves are undoubtedly tubes with a glamorous name. Vintage should be around 1929; value about one buck. The Edison Museum in Greenfield Village, Dearborn, Michigan, would probably like to have it.

Way Out

I need some advice about protecting my short-wave antenna from lightning. I have been told to use a lightning arrestor. I have also been told not to use one, because it could very well attract lightning. What should I do?

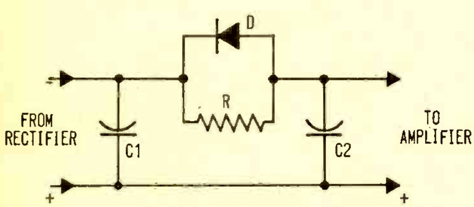
—*C. L., Fredericksburg, Va.*

Use a lightning arrestor. But install it properly, or you'll be exactly where you started, with no protection at all.

Do Hum In

Between musical passages there is an annoying hum in the speaker which is fed by a transistorized amplifier employing a Class B output stage. I don't notice the hum when music is played. How can I stop the hum?

—*D. E. R., Holywood, Calif.*



You might try adding additional power supply filtering by adding capacitor C2, diode D and resistor R, as shown in the diagram. Capacitor C1 is the existing output filter capacitor. When there is no audio signal going through the amplifier, power supply current is low, the diode does not conduct, and filter section R/C2 reduces power supply ripple. When power supply current rises, the diode conducts, shorting R, and allowing heavy current to flow with a voltage drop of less than a volt across the diode.

Connect a DC voltmeter across D and try various values of R (during no-signal condition) so that the diode will not be forward-biased and therefore conduct. For C2, use a high value electrolytic. If ungrounded output is positive instead of negative, reverse the polarity of the diode and of C2.

Socket to Me

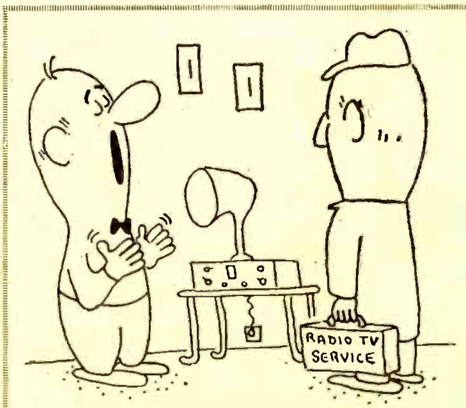
I read somewhere that it is possible to pep up a receiver by replacing the RF amplifier with a tube of higher gain. I decided to do this with my Lafayette HA-63. I replaced the 6BA6 with a 6GM6 (making all socket changes). Now my "S" meter no longer works, there's no increase in sensitivity, but there is some distortion. Can you tell me what I did wrong and possibly how to correct it.

—*P. A. J., Maspeth, N.Y.*

The two tubes have somewhat different characteristics. Make sure you wired socket terminals 2 and 7 together! In general, it's better not to tamper with a receiver. The man who designed it obviously had good reasons for selecting the tubes he did; there is only a small difference in price between these two types. Gain is usually dependent on overall circuit design and the parameters given in tube manuals should not be taken too literally.

Long Story on Long Wire

I am using a Hallicrafters S-120 to listen to the BCB. Sensitivity on the BCB is good with just the ferrite bar antenna. However, being a DX hound, I would like to use a better an-



"I rather fight than switch!"

What good are clean ash trays when you can't get the car the ash trays come in even when you have a reservation and the reservation has been confirmed?

For a long time now, there's been so little difference between car rental companies they argued publicly about who had the cleanest ash trays. Max has changed all that.

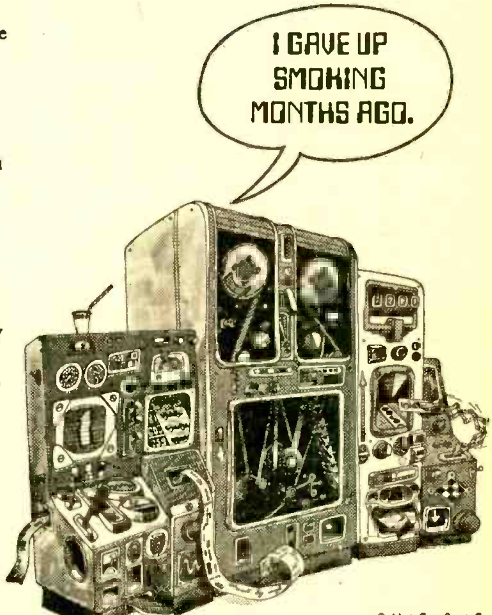
Max is National Car's computer. He knows from minute to minute which of our cars are available.

Wherever you are, anytime of the day or night, you can call National for a reservation toll-free at 800-328-4567. And thanks to Max, we don't have to make any assumptions or blind promises like those New York outfits do.

We just ask Max what's available, Max tells us, and we can guarantee you a car on the spot.

National also features GM cars, gives S&H Green Stamps, and has 1800 locations. Second only to old what's-its-name.

Now *there* are some differences you can sink your credit card into—any recognized credit card.

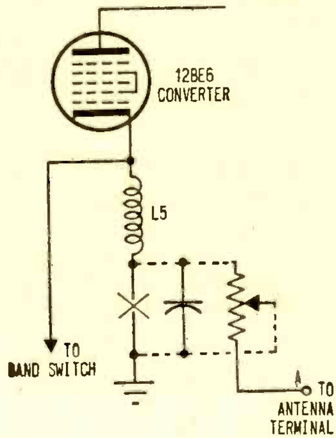


NATIONAL CAR RENTAL

We make the customer No. 1

tenna like the 75-foot long wire in my attic which I use for SW. This is my problem. How do I go about coupling the antenna to the S-120? I've tried connecting it to the antenna terminal on the back, but the results were very poor. The antenna boosted signals, but I got hets, a high-pitched tone, and strong locals all over the band. Also, when I tune in a strong local (on the right frequency) the audio is very distorted. Connecting the antenna to the ferrite bar antenna netted me the same results. How can I couple the antenna to the S-120 so that it works for BCB? Also, how can I eliminate the ferrite bar antenna completely, and just use the antenna?

—*W. W., Chicago, Ill.*



Your receiver's schematic diagram shows that when an external antenna is connected to the antenna terminal the long wire ant signal is fed to a tap on the internal ferrite antenna, which is as it should be. In Chicago, in the proximity of lots of high power radio signals, you can expect the problems you encountered. There's just too much signal being pumped into the receiver input. You could try adding a manual RF gain/level control, as shown in the simplified diagram. Break the circuit at "X" and connect a 5000-ohm pot and an 0.1 μF capacitor as shown by dotted lines.

He Gets the Image

My small, portable eight-transistor radio picks up CW signals on 930 kHz and at about 690 kHz when I'm at Newport Beach. With my communications receiver operating in the 200-400 kHz band, I hear CW signals exactly the same as on the BCB except that they are much stronger. Could you please explain this?

—*L. C. Tucson, Ariz.*

It could be that the signals from the CW station are being heterodyned with a signal from a strong BCB station. For example, if a CW signal on 290 kHz beats with a BCB station on 640 kHz their sum frequency would be 930 kHz. You would hear the CW signal as an *audio* tone since the sum frequency and the carrier of the BCB station on 930 kHz would not be exactly the same. Also, the 290-kHz signal beating with a 980-kHz BCB signal would produce a beat at 690 kHz.

These may no be the actual conditions that existed when you heard the CW signals, but the principles are the same. The CW signals could have come from a beacon, Naval, or commercial shore station, or from a nearby ship.

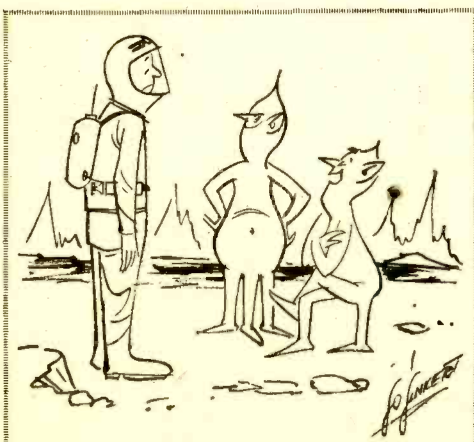
These signals will produce a beat if the first stage of your receiver is non-linear—which would be the case if it has no RF stage ahead of it. If it has one, the RF stage could be overloading or be biased improperly for linear operation.

Cheapy Q Checker

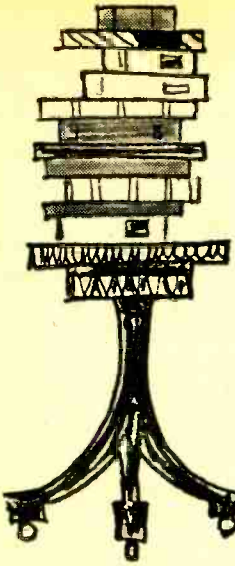
The only test equipment I have is a VOM. How can I test the transistors in my radio with it?

—T. J., Duluth, Minn.

Connect the negative lead of the VOM (set to measure DC volts) to the collector of a pnp transistor and the positive lead to its emitter. If it is an npn transistor, the VOM leads should be just the reverse. Finally, use a clip lead and short the base to the emitter. If the voltage increases, the transistor is active and you're in business. But, let's be honest—you need a transistor tester.



"Actually it's very practical!"



LITERATURE

ELECTRONIC PARTS

★2. Now, get the all-new 512-page, fully illustrated *Lafayette Radio* 1969 catalog. Discover the latest in CB gear, test equipment, ham gear, tools, books, hi-fi components and gifts. Do it now!

★5. *Edmund Scientific's* new catalog contains over 4000 products that embrace many interests and fields. It's a 148-page buyers' guide for Science Fair fans.

★4. *Olson's* catalog is a multi-colored newspaper that's packed with more bargains than a phone book has names. Don't believe us? Get a copy.

★1. *Allied's* catalog is so widely used as a reference book that it's regarded as a standard by people in the electronics industry. Don't *you* have the 1969 *Allied Radio* catalog? The surprising thing is that it's free!

★7. Before you build from scratch, check the *Fair Radio Sales* latest catalog for electronic gear that can be modified to your needs. *Fair* way to save cash.

8. Get it now! *John Meshna, Jr.'s* new 96-page catalog is jam packed with surplus buys—surplus radios, new parts, computer parts, etc.

★140. How cheap is cheap? Well, take a gander at *Cornell Electronics'* latest catalog. It's packed with bargains like 6W4, 12AX7, 5U4, etc., tubes for only 33¢. You've got to see this one to believe it!

★135. Get with ICs! *RCA's* new integrated Circuit Experimenter's Kit KD2112 is the first of its kind and should be a part of your next project. Get all the facts direct from *RCA*. Circle 135.

106. With 70 million TV and 240 million radios somebody somewhere will need a vacuum tube replacement at the rate of one a second! Get *Universal Tube Co.'s* Troubleshooting Chart and facts on their $1.50 flat rate per tube.

10. *Burstein-Applebee* offers a new giant catalog containing 100s of big pages crammed with savings including hundreds of bargains on hi-fi kits, power tools, tubes, and parts.

★11. Now available from *EDI (Electronic Distributors, Inc.)*: a catalog containing hundreds of electronic items. *EDI* will be happy to place you on their mailing list.

★6. Bargains galore, that's what's in store! *Poly-Paks Co.* will send you their latest 8-page flyer chock-full of *Poly-Paks'* new $1.00 electronic and scientific "blis-dor" paks and equipment.

23. No electronics bargain hunter should be caught without the 1969 copy of *Radio Shack's* catalog. Some equipment and kit offers are so low, they look like misprints. Buying is believing.

CB--AMATEUR RADIO SHORTWAVE RADIO

102. No never mind what brand your CB set is. *Sentry* has the crystal you need. Same goes for ham rigs. Seeing is believing, so get *Sentry's* catalog today. Circle 102.

146. It may be the *first—Gilfer's* speciality catalog catering to the SWL. Books, rigs, what-nots—everything you need for your listening post. Go *Gilfer*, circle 146!

100. You can get increased CB range and clarity using the "Cobra-23" transceiver with speech compressor—receiver sensitivity is excellent. Catalog sheet will be mailed by *B&K Division of Dynascan Corporation.*

141. Newly-designed CB antenna catalog by *Antenna Specialists* has been sectionalized to facilitate the picking of an antenna or accessory from a handy index system. Man, *Antenna Specialists* makes the pickin' easy.

130. Bone up on the CB with the latest *Sams* books. Titles range from "ABC's of CB Radio" to "99 Ways to Improve your CB Radio." So Circle 130 and get the facts from *Sams.*

107. Want a deluxe CB base station? Then get the specs on *Tram's* all new Titan II—it's the SSB/AM rig you've been waiting for!

96. Get your copy of *E. F. Johnson's* new booklet, "Can *Johnson* 2-Way Radio Help Me?" Aimed for business use, the booklet is useful to everyone.

129. Boy, oh boy—if you want to read about a flock of CB winners, get your hands on *Lafayette's* new 1969 catalog. *Lafayette* has CB sets for all pocketbooks.

46. Pick up *Hallicrafters'* new four-page illustrated brochure describing Hallicrafters' line of monitor receivers —police, fire, ambulance, emergency, weather, business radio, all yours at the flip of a dial.

116. Pep-up your CB rig's performance with *Turner's* M+2 mobile microphone. Get complete spec sheets and data on other *Turner* mikes.

48. *Hy-Gain's* new CB antenna catalog is packed full of useful information and product data that every CBer should know. Get a copy.

111. Get the scoop on *Versa-Tronics'* Versa-Tenna with instant magnetic mounting. Antenna models available for CBers, hams and mobile units from 27 MHz to 1000 MHz.

45. CBers, Hams, SWLs—get your copy of *World Radio Labs'* 1969 catalog. If you're a wireless nut or experimenter, you'll take to this catalog.

★101. If it's a CB product, chances are *International Crystal* has it listed in their colorful catalog. Whether kit or wired, accessory or test gear, this CB-oriented company can be relied on to fill the bill.

103. *Squires-Sanders* would like you to know about their CB transceivers, the "23'er" and the new "S5S." Also, CB accessories that add versatility to their 5-watters.

TOOLS

★78. *Xcelite's* midget hex socket screwdrivers in *Xcelite's* PS-89 set let you make delicate adjustments easier. "Piggyback" handle adds grip, reach, and power needed for other jobs.

118. Secure coax cables, speaker wires, phone wires, etc., with *Arrow* staple gun tackers. 3 models for wires and cables from 3/16" to 1/2" dia. Get fact-full Arrow literature.

ELECTRONIC PRODUCTS

143. Bring new life to your hobby. Exciting plans for new projects—let Electronics Hobby Shop give you the dope. Circle 143, now.

★44. Kit builder? Like wired products? *EICO's* 1969 catalog takes care of both breeds of buyers. 32 pages full of hi-fi, test, CB, ham, SWL, automotive and hobby kits and products —do you have a copy?

★42. Here's colorful 116 page catalog containing a wide assortment of electronic kits. You'll find something for any interest, any budget. And *Heath Co.* will happily send you a copy.

144. Hear today the organ with the "Sound-of-Tomorrow," the Melo-Sonic by *Whippany Electronics*. It's portable—take it anywhere. Send for pics and descriptive literature.

12. *C. B. Hanson* new Automatic Control records both sides of a telephone call automatically—turns off automatically, too! Get all the details —today!

126. Did you dig *Delta's* new literature package chucked full of pics and

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specs on such goodies as an FET-VOM, SCR ignition system, computerized auto tach, hi-voltage analyzer, etc.? Man, then let *Delta* know you're alive! Circle 126 now!

109. *Seco* offers a line of specialized and standard test equipment that's ideal for the home experimenter and pro. Get specs and prices today.

9. Troubleshooting without test gear? Get with it—let Accurate Instrument clue you in on some great buys. Why do without?

145. *Alco Electronic Products* has 28 circuit ideas using their remote control relay. Get 100-and-one odd jobs done at home without calling an electrician. Get all the facts today!

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★136. You can become an electrical engineer *only* if you take the first step. Circle 136 and *ICS* will send you their free illustrated catalog describing 17 special programs. *ICS* also has practical electrical courses that'll increase your income.

★74. Get two free books—"How to Get a Commercial FCC License" and "How to Succeed in Electronics"—from *Cleveland Institute of Electronics*. Begin your future today!

★3. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools and instructions come with course.

142. *Radio-Television Training of America* prepares you for a career—not a job. 16 big kits help you learn as you build. 120 lessons. Get all the facts today!

114. Prepare for tomorrow by studying at home with *Technical Training International*. Get the facts today on how you can step up in your present job.

137. For success in communications, broadcasting and electronics get your First Class FCC license and *Grantham School of Electronics* will show you how. Interesting booklets are yours for the asking.

HI-FI/AUDIO

104. You can't hear FM stereo unless your FM antenna can pull 'em in. Learn more and discover what's available from *Finco's* 6-pages "Third Dimensional Sound."

119. *Kenwood* puts it right on the line. The all-new *Kenwood* FM-stereo receivers are described in a colorful 16-page booklet complete with easy-to-read-and-compare spec data. Get your copy today!

30. *Shure's* business is hi-fi — cartridges, tone arms, and headphone amps. Make it your business to know *Shure!*

17. Mikes, speakers, amps, receivers—you name it, *Electro-Voice* makes it and makes it good. Get the straight poop from *E-V* today.

99. Get the inside info on why *Koss/Acoustech's* solid-state amplifiers are the rage of the experts. Colorful brochure answers all your questions.

26. The all new, lavishly-illustrated, full-color brochure, "At Home With Stereo" clues you in on *H.H. Scott's* 1969 stereo consoles. Discover how to pick a hi-fi console for your living room.

TAPE RECORDERS AND TAPE

14. You just gotta get *Craig's* new pocket-size, full-color folder illustrating what's new in home tape recorders—reel-to-reel, cartridge and cassette, you name it! It looks like a who's who for the tape industry.

123. Yours for the asking—*Elpa's* new "The Tape Recording Omnibook." 16 jam-packed pages on facts and tips you should know about before you buy a tape recorder.

31. All the facts about *Concord Electronics Corp.* tape recorders are yours for the asking in a free booklet. Portable, battery operated to four-track, fully transistorized stereos cover every recording need.

34. "All the Best from *Sony*" is an 8-page booklet describing *Sony-Superscope* products—tape recorders, microphones, tape and accessories. Get a copy today before you buy!

35. If you are a serious tape audiophile, you will be interested in the all new *Viking/Telex* line of quality tape recorders.

TELEVISION

70. Need a new TV set? Then assemble a *Heath* TV kit. *Heath* has all sizes. B&W and color, portable and fixed. Why not build the next TV you watch?

127. *National Schools* will help you learn all about color TV as you assemble their 25-in. color TV kit. Just one of *National's* many exciting and rewarding courses.

SCIENCE AND ELECTRONICS
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100	101	102	103	104	106	107	109	111	114
116	118	119	123	126	127	129	130	135	136
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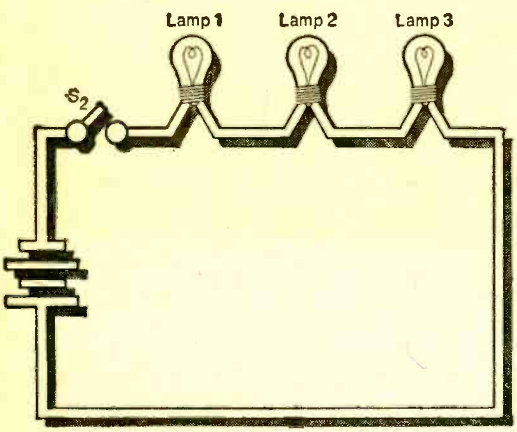

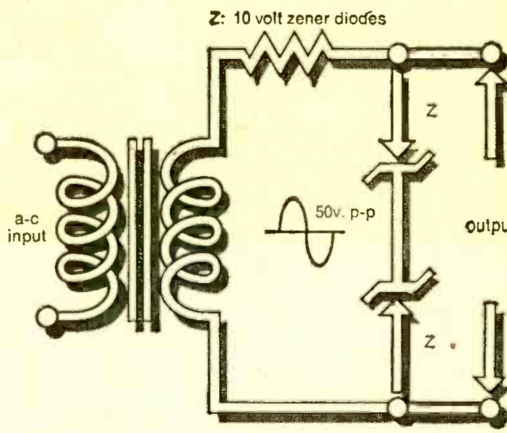

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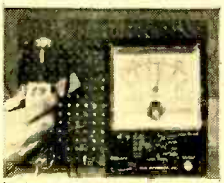

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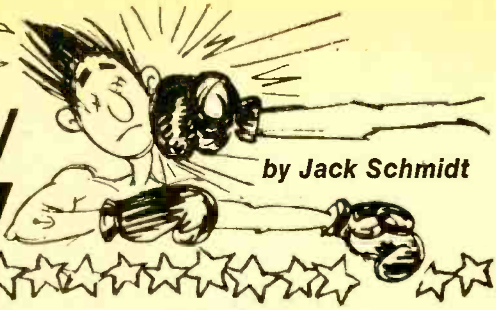
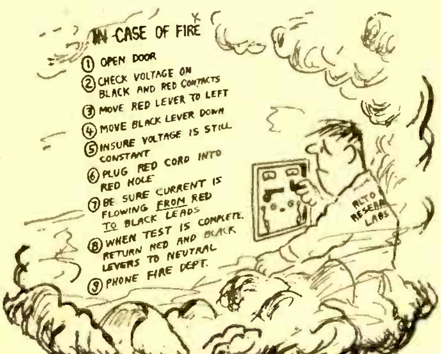
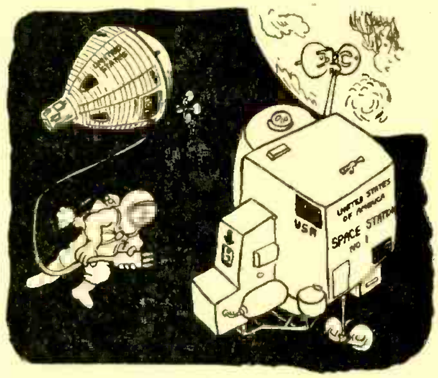
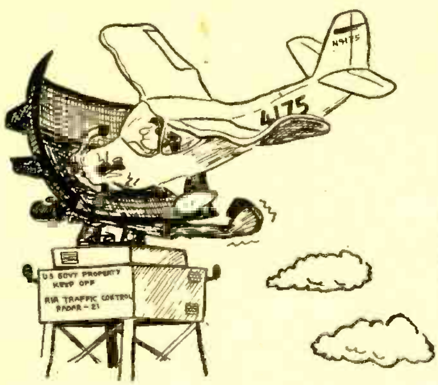


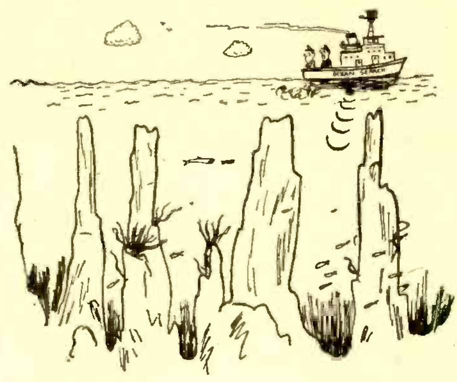
by Jack Schmidt



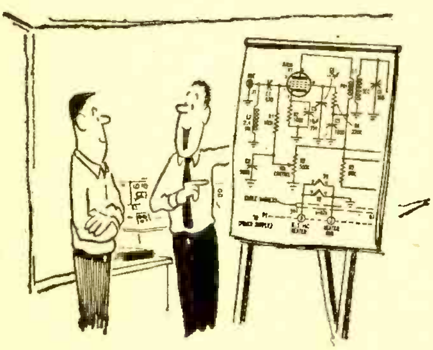




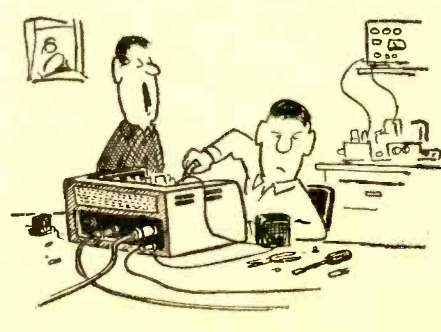
"Roger, 4175, it is confirmed . . .
. . . we have you in radar contact!"



"Our pulsing sonar shows it to be over 80 feet deep along here."



". . . thereby turning off the light when the closet door is closed!"



". . . adjust to 3147.42 kHz, or give the chassis a rap with a hammer!"

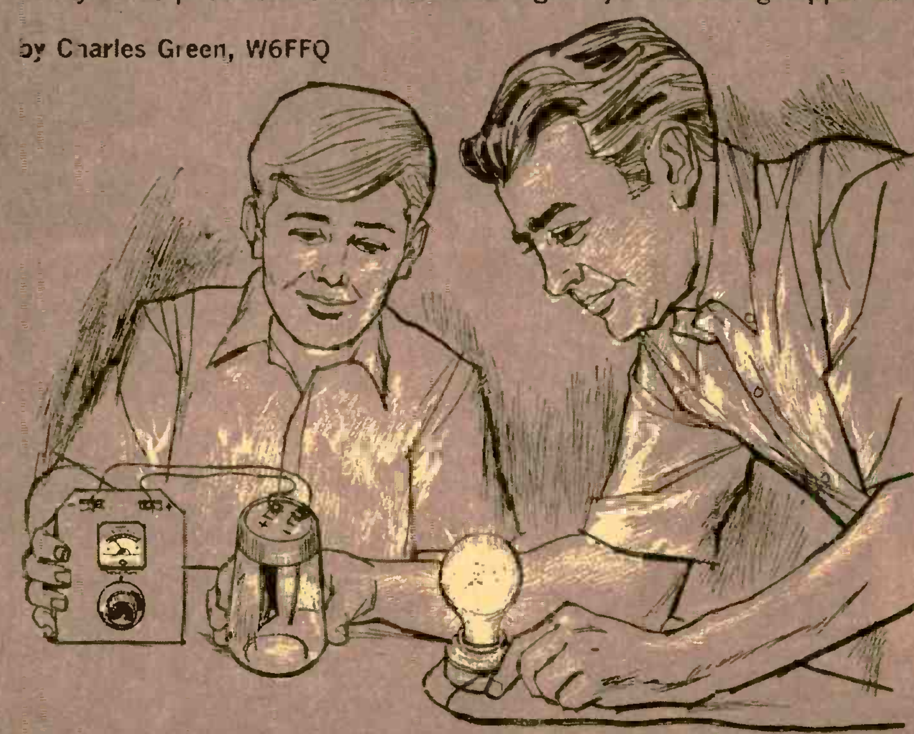
Science and Electronics
OCTOBER-NOVEMBER 1969

LIGHT POWERS THIS LIQUID SEMICONDUCTOR!

Some copper, some lead, some water, a spoonful of chemical, and you've made a PHOTOCELL!

FOR THE PAST few years, solid state electronics have become commonplace. However, back in the Roaring 20s, before the transistor, pioneers in electronics experimented with many unusual devices. One of the most interesting devices of this period was the liquid photocell, an inexpensive, easily made photovoltaic cell housed in a glass jar containing copper and

by Charles Green, W6FFQ



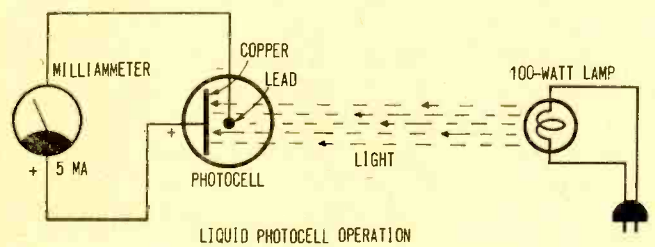
Liquid Semiconductor

lead electrodes and a liquid electrolyte, lead nitrate.

A thin coating of copper oxide on the copper electrode acts as the photosensitive element. You can experiment with the liquid photocell by building this liquid semiconductor described in the article and in the accompanying drawing and photos. Also included are plans for a variable sensitivity meter module that can be used to test DC current output of the liquid photocell.

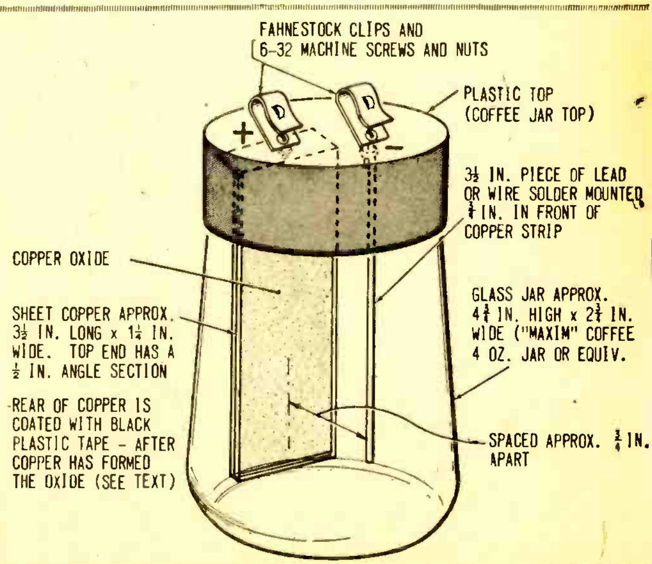
How It Works. When radiant energy, in the form of visible light, strikes a suitably prepared metallic substance, electrons are emitted. In the absence of light, the copper and lead electrodes of this photocell have a small potential difference, as does an electrochemical battery with no load applied. When a load is connected to the electrodes, a small DC current flows from the photocell. The amount of DC current is determined by the internal resistance between the copper and lead electrodes through the electrolyte.

This internal resistance varies with the condition of the copper oxide coating on the copper electrode, which is the photoelectric sensitive surface. When light strikes the copper oxide, electrons are emitted, and the internal resistance of the photocell is changed. This causes a larger DC current to flow out of the photocell into the load. The amount of light controls the DC current output; the more light, the more current output from the photocell.



Liquid photocell produces output of several milliamperes proportional to intensity of light shining on it (the more light, the more current). Cell can be rejuvenated by renewing cuprous oxide on the copper surface.

Construction. You will need sheet copper, a strip of lead or lead solder, and a glass jar approximately 4¾-in. high with a 2¾-in. diameter (we used a "Maxim" instant coffee 4-oz. jar). The size of the jar



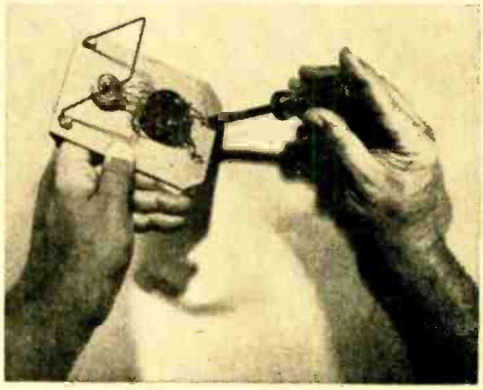
Details of cell's construction appear in drawing (right) and photo (above). We used plastic cap supplied with Maxim coffee jar to insulate electrodes. Be sure to cover rear of copper electrode with plastic tape after oxide forms.

is not critical, but the jar must be made of clear glass and should have a plastic lid, or you will have to make a wooden or plastic lid to fit. The copper sheet may be difficult to obtain. We cut and flattened a length of ½-in. copper tubing for our model.

Begin construction by cutting a 4-in. x 1¼-in. piece of sheet copper. Bend one end to form a right angle ½-in. wide, and drill a hole to clear a 6-32 machine screw in the center, as shown in the drawing. Before the copper strip can be used, a coating of cuprous oxide must be formed on it to serve as the sensitive surface. Hold the sheet by the ½-in. angled section with a large pair of pliers and heat the copper strip evenly in the flame of a gas stove or a torch. Hold the strip well inside the flame, so it does not become covered with soot. Heat the copper until it becomes uniformly dark, then remove the strip from the flame and allow it to cool. Do not let the surface touch anything.

The black surface of the copper strip is cupric oxide. Just below the cupric oxide is a thin layer of cuprous oxide—actually the photosensitive oxide. After the copper strip has cooled, place it in a jar filled with pure household ammonia. Cap the jar and allow the copper strip to soak until most of the black oxide is off. Cuprous oxide has a red color, but because the layer is so thin it may be difficult to see. Also, the ammonia develops a bluish tint from the dissolved copper oxide; therefore, don't wait until all of the black oxide is off, as the inner layer of cuprous oxide may also start to dissolve. Remove the copper from the ammonia and wash it in water to remove the ammonia. (Hold it by the angle.)

While the copper strip is soaking, drill the plastic cap of the jar and mount a length of wire solder (preferably not cored) or a thin strip of pure lead to a Fahnestock clip fastened to the lid as shown in the drawing. Cut the lead electrode to a length of 3½-in. After the copper strip has been washed,



Both meter and shunt potentiometer are mounted on fiberboard panel. Supporting bracket is formed from wire coat hanger.

Completed meter panel rests at convenient angle on supporting bracket. Pair of Fahnestock clips mounted at top serve as terminals.

BILL OF MATERIALS FOR LIQUID SEMICONDUCTOR

J1, J2—Fahnestock clips (Lafayette 32T7601 or equiv.)
R1—1500-ohm potentiometer
1—4 x 5-in. sheet of fiberboard
1—Glass jar (see text)
1—1¼ x 3½-in. sheet of copper (see text)
1—3½-in.-long piece of lead solder or lead strip (see text)
1—0-1 mA milliameter (Lafayette 99T5052 or equiv.) or 0-5 mA milliameter (Lafayette 99T5053 or equiv.)
Misc.—Screws and nuts, black plastic tape, wire coathanger, hookup wire, etc.

Bill of Materials above specifies either 0-1 or 0-5 mA milliammeter, since actual value isn't critical. Idea here is to let you use whatever is most readily available. As explained in text, 100-watt lamp is required to calibrate meter.

Liquid Semiconductor

mount it approximately ¾-in. away from the solder as shown in the drawing. Do not touch the photosensitive surface with your fingers.

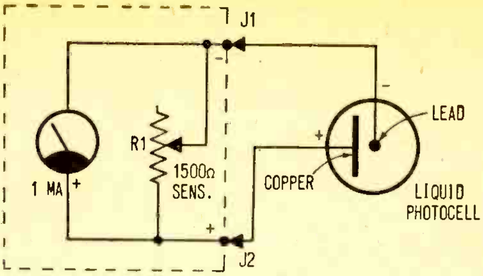
Cover the rear of the copper strip with black plastic tape so that light will strike only the surface facing the lead electrode and the light source.

Fill the jar with water to just below the plastic top, making certain that the water level is below the end of the machine screws holding the electrodes to the jar cover. Dissolve one teaspoon of lead nitrate in the water. Note: all lead compounds are poisonous, therefore thoroughly wash your hands and all items that were in contact with the lead nitrate. Lead nitrate can be obtained from a chemical supply or student science store. After the lead nitrate is dissolved, screw on the plastic cap and electrode assembly. The water should be clear. If, because of chemical treatment of your local water, it does not remain clear after adding the lead nitrate, you may have to use distilled water to mix with the lead nitrate electrolyte.

The Photocell Meter. The liquid photocell has a low impedance output; therefore, it requires a low resistance meter for accurate readings. A 5-mA milliammeter should be used to indicate the change in the DC current output. A VOM with an equivalent 5-mA range usually has a higher internal resistance and will not indicate as well as the individual meter.

Our meter module unit contains a 1-mA meter movement with a variable sensitivity control connected in parallel with the meter (see the drawing). We built our module on a 4 x 5-in. piece of fiberboard. Coathanger wire is bent into a support bracket and is bolted to the bottom of the fiberboard as shown in the photo.

Connect a 5-mA milliammeter or the meter module, to the photocell terminals as shown in the drawing. The copper electrode is connected to the meter plus terminal and the lead one is connected to the meter negative terminal. There may be a high current output from the photocell momentarily. If so, short out the photocell terminals (or turn the meter module sensitivity control to minimum resistance) until this output current drops.



Potentiometer R1 is shunt to adjust range of 0-1 mA meter. It is best viewed as a sensitivity control allowing a wide range of readings.

The photocell has to be aged with the meter connected, until the dark current (DC current output with no light) is from 0.3 to 0.5 mA. This aging may take anywhere from several minutes to an hour, depending upon the quality of the cuprous oxide layer on the copper electrode.

Testing the Photocell. Place a 100-watt lamp near the photocell on the side near the lead electrode. Turn the lamp on and observe that the photocell DC current output increases. Adjust the meter module sensitivity control as necessary for an indication. The amount of current increase will depend on the quality of the cuprous oxide layer formed on the copper electrode. Our unit had a 2 mA increase.

Experiment with various lamps of different wattages, as well as with fluorescent lamps. Also test the photocell in sunlight. Make a chart of the photocell DC output current readings obtained with the lamp at different distances from the cell.

The liquid photocell has a definite life span. As it is used, you will notice that the copper electrode becomes darker and the DC current output from the light source diminishes gradually. This occurs because lead is gradually being deposited on the copper strip through internal electrochemical activity.

When the DC current output becomes too low, remove the copper electrode from the photocell, clean the surface with sandpaper, and then reheat the copper strip to form a new oxide coating, as previously described in the construction of the photocell. Remove the oxide from the copper with ammonia, wash and replace the copper electrode in the photocell. In this way the photocell will have an indefinite life just by renewing the coating on the copper strip. ■

COVER STORY

Now! Control exposure time, development time, any darkroom function with our

UNIVERSAL DARKROOM TIMER

by Ron Michaels

In addition to the purest of chemicals and water, what's the most important factor influencing photographic processes—whether involving films or prints and most decidedly in the case of color? Timing, of course! Accurate, repeatable timing is a must in the darkroom if you want to produce consistently good work.

Our Universal Darkroom Timer provides both accuracy and repeatability over a wide range. This solid-state timer can control exposure time as well as development time at the flick of a switch. In addition to calling

Universal Darkroom Timer

it a *Universal Timer,* we should also refer to it as a *Custom Designed Timer.* Reason is that with the exchange of just a few critical components the timing cycle ranges can be tailored to fit your particular darkroom needs.

For example, we prefer never to expose print paper for more than seven seconds when using the enlarger—that's the maximum exposure time in the process we use. Also, we never keep negatives in their developing solutions for more than seven minutes. Since these two ranges represent the maximum timing cycles we use, we selected the components that produce these ranges for our timer. The Timing Table included with this article gives the proper values of the key components for several other timing ranges.

How It Works. A full-wave silicon controlled rectifier (SCR) switching circuit is the heart of our timer. When the SCR turns

TIMING TABLE

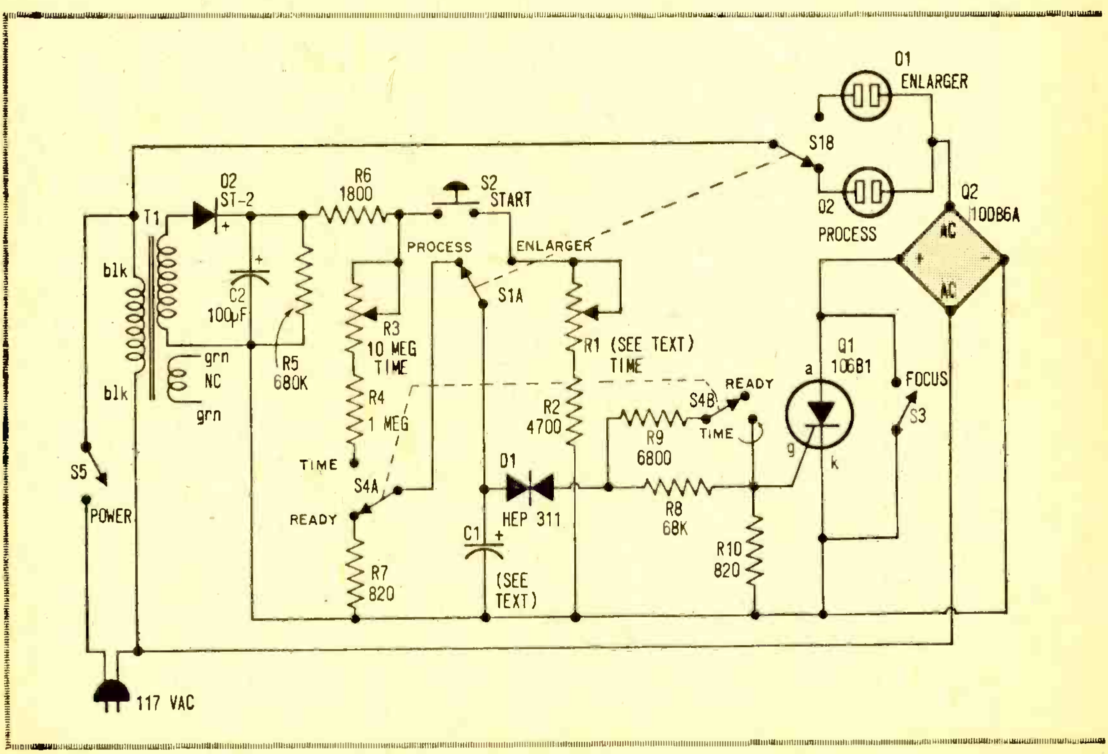
A—For enlarger timing of 0-7 seconds and process timing of 0-7 minutes
R1—50,000-ohm potentiometer
R3—10-megohm potentiometer
C1—200-uF, 350-V electrolytic capacitor

B—For enlarger timing of 0-10 seconds and process timing of 0-10 minutes
R1—50,000-ohm potentiometer
R3—10-megohm potentiometer
C1—300-uF, 350-V electrolytic capacitor

C—For enlarger timing of 0-15 seconds and process timing of 0-15 minutes
R1—100,000-ohm potentiometer
R3—10-megohm potentiometer
C1—400-uF, 350-V electrolytic capacitor

on (allows current flow to pass through), AC current can flow through the bridge rectifier (Q2) and the load, or whatever is plugged into the output sockets. When the SCR is turned *off* the bridge acts like an open switch and no current flows through the load. The balance of the circuit is an unique biasing arrangement that adapts the switching circuit to function as two different timers.

Key point to remember in the following circuit description is that the SCR remains

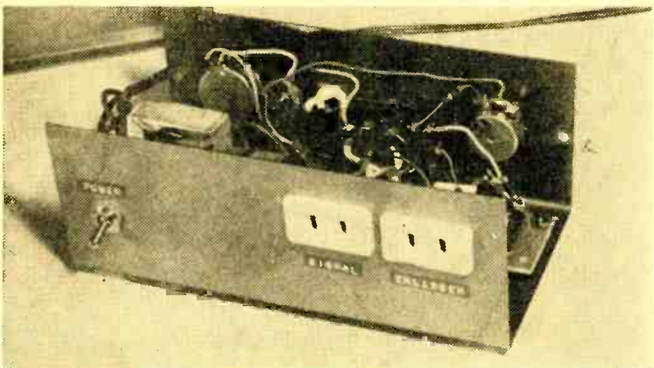


on (and the bridge conducts) whenever a current of more than 200 microamps (1/5 of a milliamp) is fed into the *gate* terminal.

The Enlarger Timer. The desired operation is that the enlarger lamp will turn *on* at the touch of a button, remain *on* for a present time period, then will turn *off* automatically. The desired time period is selected by an adjustable control (R1). When function switch S1 is placed in the ENLARGER position, the timing circuitry for this function is actuated. This is a very straightforward operation.

When pushbutton switch S2 is depressed, timing capacitor C1 is charged to approximately 200 VDC. Instantly this voltage sends a substantial amount of current into the *gate* terminal of the SCR, turning it *on* and thus permitting rectifier bridge current to flow through the load. Switch S1 is a double pole unit; one section is used to select one of the two convenience outlets to be connected to the timer switching circuit. When S1 is placed in the ENLARGER position, outlet "O1", labeled ENLARGER, is connected. This is the outlet the Enlarger's power cord is plugged into.

The SCR remains *on* as long as the gate



Rear view of timer assembly showing locations of two outlets where power cords for audible indicator for both process timer and enlarger are plugged in. Right-hand outlet is connected to short duration timing circuit for enlarging; left-hand outlet is connected to long duration timing circuit for processing. Bell or buzzer is powered through latter outlet.

PARTS LIST FOR UNIVERSAL DARKROOM TIMER

C1—Electrolytic capacitor, 350 volt rating, 200 uF (for 0-7 sec timing) (Cornell Dubilier BR200-350 or equiv.); 300 uF (for 0-10 sec. timing) (Cornell Dubilier BR300-350 or equiv.); 400 uF (for 0-15 sec. timing) (Cornell Dubilier BR400-350 or equiv.)
C2—100 uF, 250 volt electrolytic capacitor (Cornell Dubilier BR100-250 or equiv.)
D1—Silicon, bilateral trigger diode (Motorola HEP 311)
D2—Diac trigger diode (GE ST-2)
O1, O2—Panel mounting AC socket (Allied 47F0830 or equiv.)
Q1—Silicon controlled rectifier (SCR) (GE 106B1)
Q2—Bridge rectifier (International Rectifier 10DB6A)
R1—Potentiometer, 50,000 ohm for 0-7 sec. and 0-10 sec. timing (Allied 46E5314 or equiv.); 100,000 ohm for 0-15 sec. timing (Allied 46E5317 or equiv.)
R2—4700-ohm, ½-watt resistor
R3—10-megohm potentiometer (IRC-CTS D106 with shaft 18 or equiv.)
R4—1-megohm, ½-watt resistor
R5—680,000-ohm, ½-watt resistor
R6—1,800-ohm, ½-watt resistor
R7—820-ohm, ½-watt resistor
R8—68,000-ohm, ½-watt resistor
R9—6,800-ohm, ½-watt resistor
R10—820-ohm, ½-watt resistor
S1, S4—Dpdt toggle switch (Allied 56F3867 or equiv.)
S2—Spst, normally open pushbutton switch (Allied 56F4947 or equiv.)
S3, S5—Spst toggle switch (56F3869 or equiv.)
T1—Power transformer, 117 volt pri.; 125 volt, 0.15 mA sec. and 6.3 volt, 1 amp. sec. (not used) (Allied 54F4163 or equiv.)
1—8 x 5 x 3-in. sloping-front cabinet (Allied 42F8686 or equiv.)
1—Terminal tie strip (Allied 47F2917 or equiv.)
Misc.—Hardware, wire, solder, cement, fiberglass tape, labels, etc.

Schematic detailing Universal Darkroom Timer. Note that text and schematic refer to a position of S4 as "Ready" whereas in the photo this position is marked "Reset." These designations are interchangeable, so mark your timer as you want.

Universal Darkroom Timer

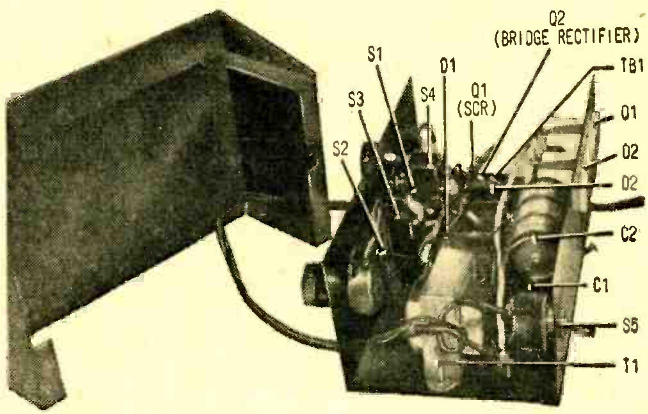
current flow continues. However, the combined current drain of the SCR and the adjustable shunt resistance, consisting of R1 in series with R2, rapidly discharges timing capacitor C1. The exact time of discharge is dependent on the setting of R1. Within a few seconds C1's voltage falls below the breakdown voltage of trigger diode D1 (about 30 V) and the diode blocks any further flow of current into the gate of the SCR.

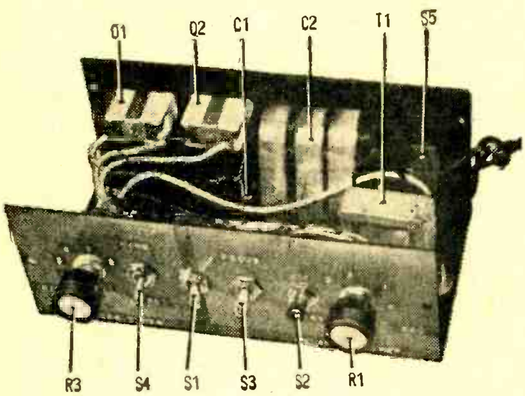
Pushing S2 a second time recharges C1 and recycles the timing circuit. Toggle switch S3 has been added as a bypass switch to enable focusing the enlarger without having to disconnect it from the timer and plug it into wall outlet. When S3 is placed in FOCUS position, the enlarger lamp is turned *on* and remains *on* until S3 is placed in the *off* position, where it must remain whenever using the timer to time an operation.

The Process Timer. For this function the timing cycle is of much longer duration (several minutes), and the timer should sound a signal at the end of the present timing interval. When S1 is placed in the PROCESS position, a biasing circuit is activated that is virtually the opposite of the circuit for the ENLARGER timing just described.

The PROCESS timing operation is controlled by toggle switch S4. With S4 in the READY position, capacitor C1 is kept fully discharged and the SCR is kept turned *off*. Therefore, no current can flow through the load (in this case some type of 117-volt operated signal device—a bell, horn, or buzzer). When S4 is switched to its TIME position, capacitor C1 is connected to the 200-volt DC supply through a high value re-

Timer assembly with cover of cabinet removed to show mounting of components on "U" shaped section of cabinet. This becomes front panel, bottom, and rear panel of timer cabinet assembly. All controls except for power switch S5 are mounted on front panel (power switch was placed on rear panel to simplify wiring). Even if timer should inadvertently be left turned on for long periods of time no harm will result. Nor will your power bill zoom, as timer requires little power.





View shows front panel and interior layout of timer assembly. Notice how C1 and C2 are taped together and cemented in position on rear panel. With exception of variable resistors, all semiconductors and resistors are placed on an insulated tie strip, to which tie strip terminals have been staked. Strip is mounted adjacent to power transformer on bottom of cabinet and raised by spacers to prevent shorting out circuitry.

sistance chain composed of potentiometer R3 in series with R4.

Because of its high capacity, and this resistance chain, C1 charges very slowly, and, after several minutes (the exact time is dependent on the setting of R3), the voltage across capacitor C1 reaches the breakdown voltage of diode D1. Instantly the capacitor begins to discharge through the SCR gate, turning the SCR *on* and allowing current to flow through the load, which in this operation is the signaling device.

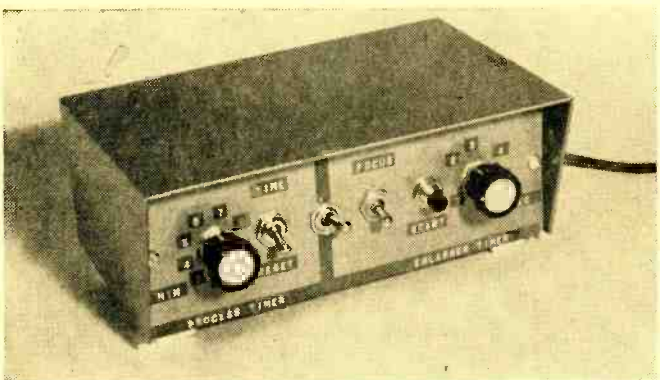
With S1 in the PROCESS position, outlet "O2" is activated through the timer. However, after about 5 seconds, C1's voltage falls below the critical diode breakdown potential, current flow stops, the SCR is turned *off*, and the signaling device stops sounding. The capacitor then again begins building up to the breakdown potential, at which point the signal device would again be activated. However, the person using the timer would normally interrupt the cycle as soon as the signal is first sounded. Used in this manner our circuit behaves in much the same way as an electrical or mechanically driven clock.

Building the Timer. We housed our timer in an aluminum cabinet having a cowl front. Our reason for using this type of cabinet is that the overhang, or cowl avoids accidental operation of the controls in the darkroom. The unit has been well designed and packs a lot of circuitry into a small space. Even so, there is ample room to easily wire the components if you follow our layout as shown in the photos.

All of the resistors, the bridge rectifier, the SCR, and diode D1 are mounted on a phenolic board containing staked terminals, which, in turn, is mounted in the center of the cabinet's base next to the power transformer. All other controls except for power switch S5 are mounted on the front panel. The two convenience outlets and the power switch are mounted on the rear of the cabinet.

The two electrolytic capacitors, C1 and C2, are first taped together with fiberglass binding tape and then cemented to the inside surface of the rear of the cabinet. Before fastening the tie strip to the cabinet base, mount all of the components mentioned above to it.

The timer draws so little current in standby condition that no harm would result from leaving the power *on* when the unit was not being used. Therefore, to facilitate the parts layout and the wiring, the power switch was mounted on the rear panel.



Finished product is very professional looking timing device that is of inestimable value in any darkroom, be it for professional or amateur photographers. It combines facilities to time development of film and/or paper as well as exposure timing for the enlarger. Incorporating silicon controlled rectifier and sophisticated timing approach, unit provides two different timing ranges economically by sharing common components.

Calibrating the Timer. Once the proper timing ranges have been chosen, and the components specified in the Timing Table have been wired in the circuit, calibration points can be marked on the panel adjacent to the knobs for R1 and R3. The exact locations of the marks are determined by checking the timing of *on* status with a stopwatch at each of the timing periods desired to meet your particular darkroom process.

Because many of the components in the circuitry are common to both timing operations there is some interaction between the two adjustable controls. For this reason it is important that S4 be kept in the READY position whenever using the unit as an enlarger timer.

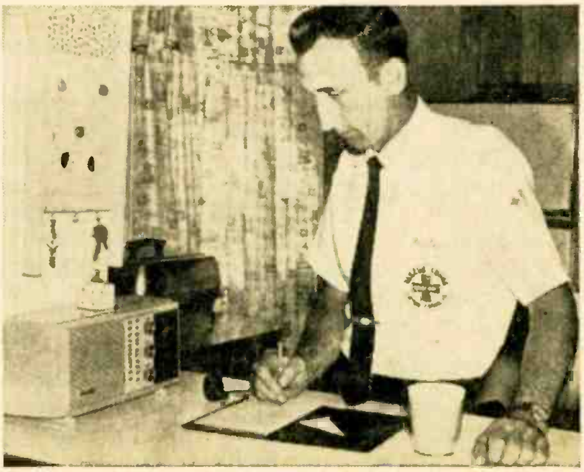
Our Universal Timer has an advantage over commercial units. Should you change your photo processing procedures, which may require a change in timing, this can be easily done by exchanging a few parts. ■

Did you know that...

. . . clouds of nitrogen dioxide were recently studied remotely by a team of Canadian scientists? Working under an HEW contract and using a unique, telescopic, gas-analyzing spectrometer, Toronto's Barringer Research Inc. was able to perform quantitative chemical analyses of polluted air over the Los Angeles basin without making physical contact with the material under study.

. . . new ICs help put market transactions on brokers' desks? Developed by Trans-Lux Corporation, the new Vidi-Quote records current stock-exchange information in binary code, then converts it to alpha-numeric characters which are displayed on a compact TV monitor. Its ICs are by Texas Instruments.

. . . FM radios alert emergency personnel in an unusual use of a CATV system? Cablevision of Virginia, the firm responsible for the community-minded hookup, speeds emergency squad members to disaster scenes by sending distress calls over its CATV system. A Jerrold-operated company, Cablevision devised the hookup to supplement the klaxon atop the courthouse in Clifton Forge, Va. Results are swifter and surer rescues.



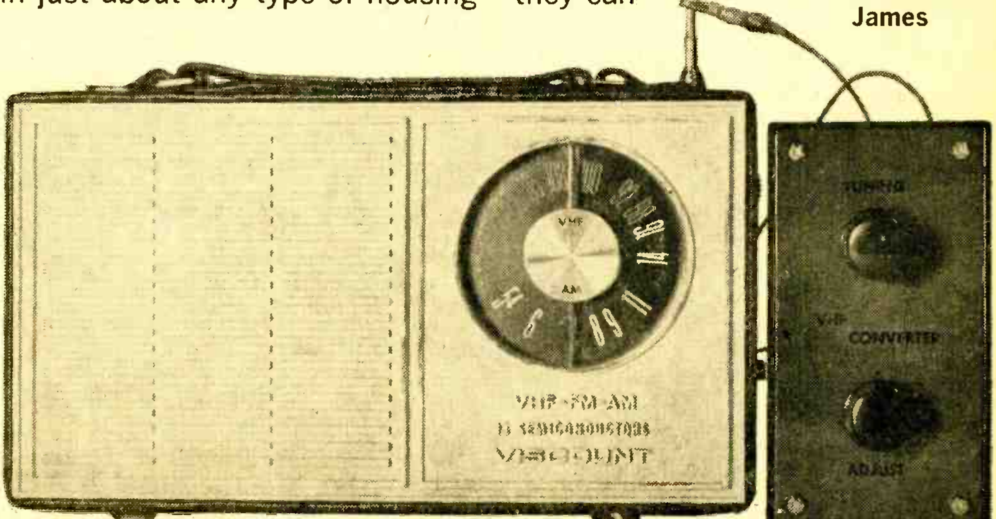
PENNY PINCHER'S POLICE CONVERTOR

New adventures in fuzz snooping for six bucks! !

by
Allen
James

If you don't live so far away from a police or fire transmitter that a strong wind is needed to blow the signal out to you, you can throw together a six-buck vhf converter for listening to these calls in less time than it takes a soldering iron to heat up. By the time the iron is hot you'll have all the parts mounted and ready for final soldering.

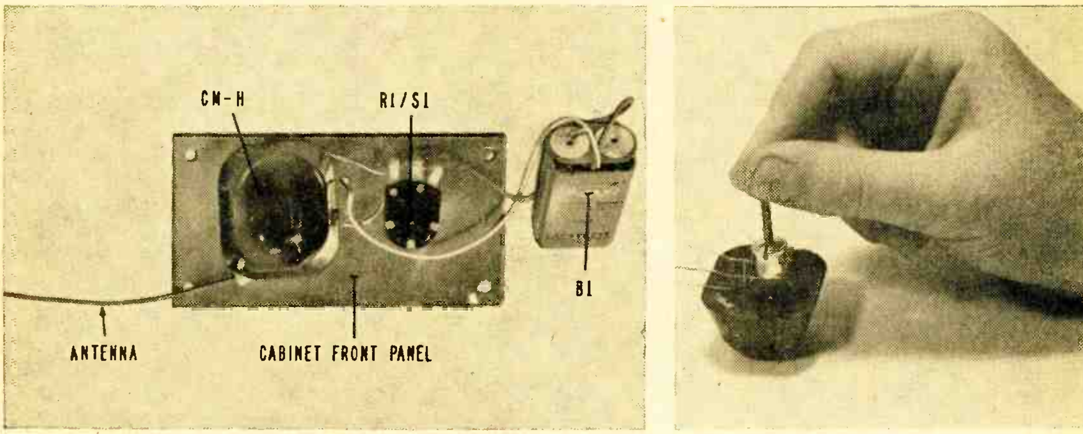
The six-buck converter uses very few parts: a 9-volt battery, a small 5-k pot with a switch and a Cordover CM-H FM Converter Module. The parts can be mounted in just about any type of housing—they can



POLICE CONVERTOR

even be wired together without a housing. If you want to go the deluxe route, you can build the unit in a small utility box for approximately one more dollar, and include a battery connector instead of directly-wired/soldered battery connections.

Works With FM. Unlike the more commonly used converters that are operated in conjunction with an AM radio as the basic module's internal oscillator to 52 MHz, the 52 MHz oscillator signal will beat with the 152 MHz received signal and will produce new signals equal to the sum and difference of the oscillator and received signals. (152 MHz + 52MHz = 204 MHz and, 152 MHz − 52 MHz = 100 MHz). These new signals appear at the module's output along with the original 152 MHz and 52 MHz signals for a total of at least four frequencies: 204 MHz, 152 MHz, 100 MHz and 52 MHz. Since the FM radio is tuned to 100 MHz, only the 100 MHz signal will be received by the FM radio and the audio output of the

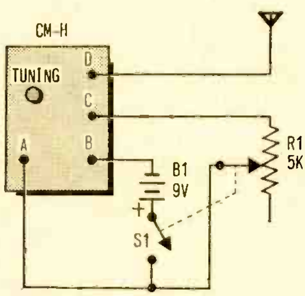


Practically any mounting arrangement will work for Police Converter, but it's best to keep leads from R1 to module as short as possible. Module (at right) is roughly size of ice cube.

receiver, and since vhf police and fire signals are FM, if the CM-H converter module is used with an FM radio you will get better sensitivity.

Even though it's possible to receive FM signals on an AM radio by using slope detection and by tuning the AM set to the sideband of the received signal, since police and fire FM signals are narrow band FM (actually split channel), by the time these signals have passed through the slope detector there would not be much modulation left.

How It Works. The converter module works on the *heterodyne principle*, similar to that used in a standard BC radio. Within the module is an adjustable oscillator whose frequency is approximately 88-108 MHz removed from the frequency of the desired signal. To illustrate, let's assume the desired frequency is 152 MHz, and we want the 152 MHz signal to be received when the FM radio is tuned to 100 MHz. If we adjust the



Schematic of Penny Pincher's Police Converter is simplicity in itself. What unit lacks in sensitivity it makes up in ease of assembly and low cost.

PARTS LIST FOR PENNY PINCHER'S POLICE CONVERTER

- B1—9-V battery (Lafayette 99T6021 or equiv.)
- 1—CM-H Cordover vhf police and fire converter module (Lafayette 19T5528 or equiv.)
- R1—5000-ohm potentiometer with spst switch (S1) (Lafayette 32T7363 or equiv.)
- Misc.—Plastic box (Lafayette 99T8078 or equiv.), hardware, hook-up wire, battery terminal (Lafayette 99T6287), metal strap to hold battery, solder, etc.

radio will be the modulation of the 152 MHz signal.

To provide for reception of various police and fire vhf channels and to ensure that the signal can be heterodyned to a quiet spot of the FM band, the internal oscillator of the module is adjustable over a very wide range, covering reception of the total 150-164 MHz band, which can be positioned on just about any part of the FM band.

Certainly for $6 one doesn't expect to obtain the most sensitive of converters. The unit we assembled was effective up to five miles away from base stations of police and fire transmitters, and reception from mobile units was limited to one or two miles, depending on the terrain.

By feeding output of the converter to an FM radio, the signal is detected by an FM detector and maximum modulation is extracted from the signal. The converter module uses a single 24-in. wire lead both as the receiving antenna and the radio coupling. The lead is clipped or connected to the antenna of the FM radio. The antenna serves both as the antenna for the module and the converter/radio coupling.

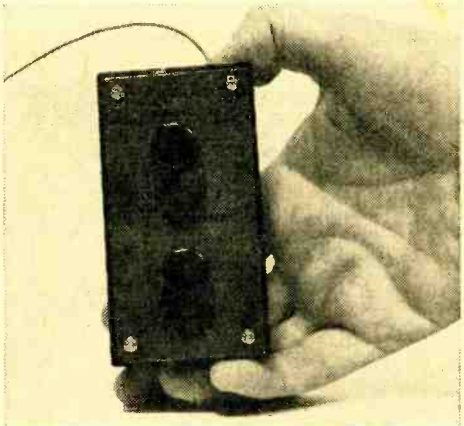
Building the Converter. Our converter is built on the front panel of a 4 x 2⅛ x 1⅝-in. utility case. The converter module is mounted on the front panel by pushing the module's mounting clip through a 27/64-in. or a 13/32-in. hole. Adjustment control R1/S1 should be mounted as close as possible to the module. Connections should be made directly to the module's leads; do not attempt to use terminal strips between the module's connecting leads and the external connections. Make certain all leads are kept away from the metal panel; use sleeving to make certain the splices can't touch the panel.

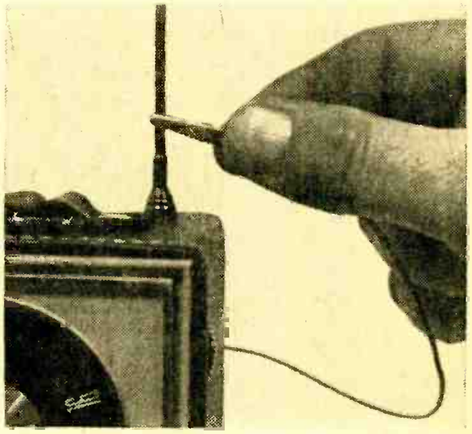
Drill a ⅛-in. hole through the top of the plastic case for the connecting lead from the module to the FM radio (24-in. length of stranded insulated wire). Pass the wire through this hole and then secure the front panel with the screws supplied. Finally, attach a small alligator clip to the radio-connecting wire.

Aligning Converter. Extend the whip antenna of the FM radio and clip the converter wire to any part of the FM antenna. Tune the radio to a dead spot on the band—preferably between 90 and 100 MHz. Turn on the converter by rotating R1's knob, and then very slowly, advance R1 until the background noise heard in the radio reaches a usable volume. If R1 is advanced too far the radio will block up. It will go quiet and you may hear several different FM commercial radio stations as R1 is adjusted. The correct R1 adjustment is maximum noise just before "blocking." As a double check, when R1 is correctly adjusted you will hear clicks as you touch the FM antenna.

If possible, borrow a friend's vhf FM police and fire receiver and tune in the local police or fire frequencies. When you hear a transmission in this receiver, adjust the tuning slug of the converter module until you hear the same station. If you can't borrow a receiver, you'll just have to be patient

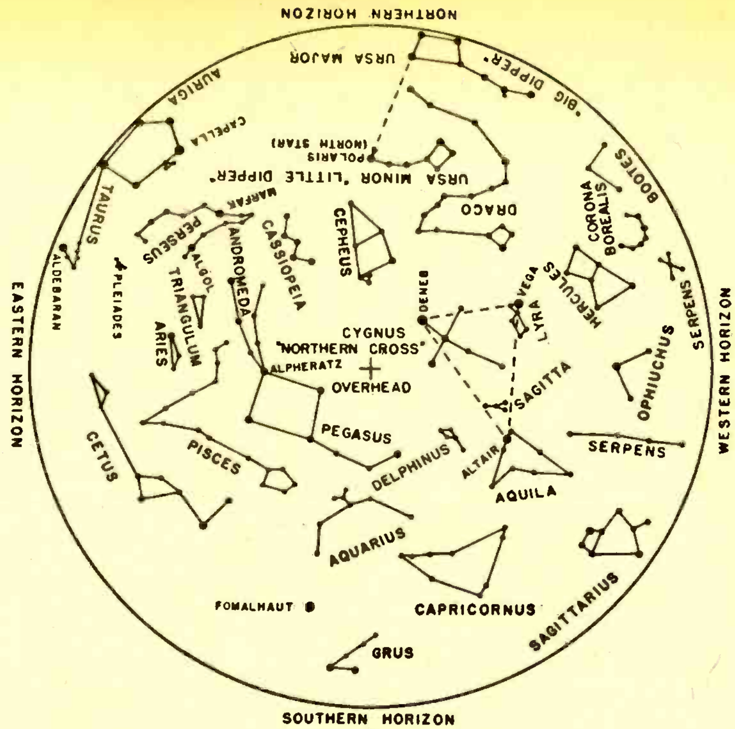
(Continued on page 109)





Completed Converter mounted in plastic box sports symmetrically placed tuning and adjust controls. Converter's antenna lead is ideally clipped to whip antenna on associated FM set.

The Skies Above Us



by Dr. Roy K. Marshall

The Night Sky in October

★★ A pair of 7x50 binoculars or a monocular of that size and power can be very useful in prowling along the Milky Way. (The 7 indicates the magnifying power, in diameters; the 50 tells the diameter of the front lens, in millimeters.) About November 1, the most distant object in the sky that can be seen without optical aid might be picked up with such a glass, as a smudgy, slightly elongated haze, then looked for without the glass, just so you can say that you saw light that is 2,200,000 years old!

The great galaxy in Andromeda stands almost exactly overhead at 10 p.m. on the date suggested above. It consists of about 150 billion stars arranged in a great spiral form that is so distant that light from it arriving here now left there more than two million years ago. And light, remember, travels at a speed of 186,300 miles per second.

Our sun is one of the stars in a similar galaxy, our own, whose flattened spiral shape is responsible for the appearance of the Milky Way.

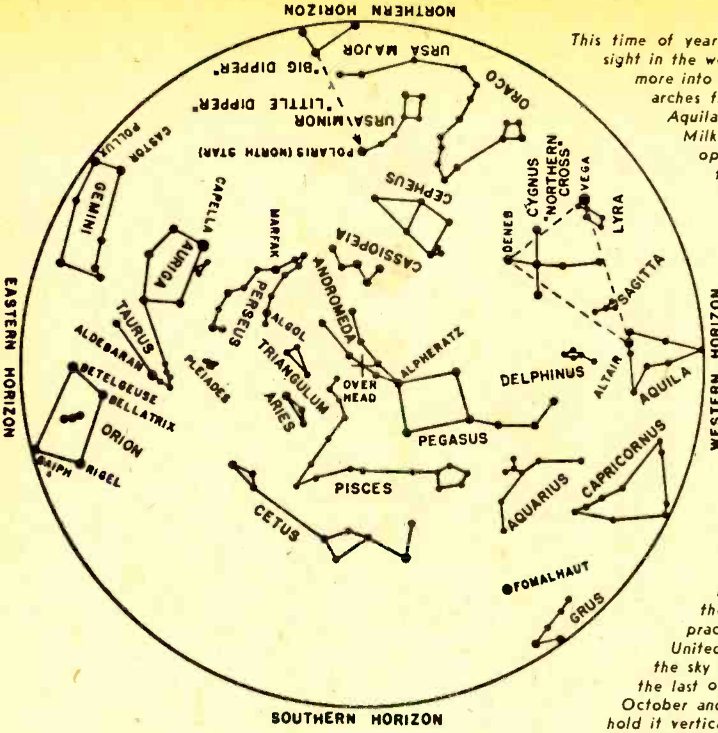
★ The galaxies are interestingly detailed objects as photographed through large telescopes, but disappointing as seen with the eye through the same instruments, because the eye takes only snapshots, while the photograph can be exposed as long as we wish, to build up the strength of the image and reveal the structural details.

Another object that is disappointing visually but shows intricate filamentary structure in photographs has recently come into astronomical news in connection with the strange, periodically pulsing sources of radio signals called "pulsars." The gaseous nebula itself has been known since 1731, when the astronomer [illegible]s ran across it; in a large telescope [illegible] hazy, elongated faint patch of light. It has been called the "Crab Nebula," from a fancied resemblance to that animal.

The gas cloud, first seen by Bevis in 1731, lies in Taurus, in our eastern sky on Nov. 1, closely south of the "A" in Taurus on our map for Nov. 1 at 10 p.m.

★ A close friend of mine among astronomers, Dr. John Charles Duncan, examined many photographs of the Crab Nebula, taken over decades at the Mount Wilson Observatory, and found that before 1926, the Crab Nebula had been expanding at such a rate that, about 900 years earlier, this cloud of gas had been all at one point.

With the cooperation of a scholar in the University of California, he discovered that, in the year 1054, Chinese and Korean as-



This time of year sees the summer stars slipping out of sight in the west and those of the winter coming once more into view in the east. The summer Milky Way arches from the southwest, through Sagittarius, Aquila and Cygnus, then thins into the winter Milky Way and passes into Cepheus, Cassiopeia, Perseus, and finally through Auriga in the northeast. The "summer triangle" of Altair in Aquila, the Eagle, Vega in Lyra, the Lyre, and Deneb in the tail of Cygnus, the Swan, is still displayed in the west, while the Pleiades glitter above ruddy Aldebaran in the east. The golden planet Jupiter which glorifies our sky most of the summer is now lost in the sun's glare, but the other giant of the sun's family, the ringed Saturn, is now closest to us (673,000,000 miles) and is about midway between the two triangles of Cetus and Aries. Red Mars is low in the southwest, in Sagittarius. The almost first quarter moon passes south of Mars on October 17 and again on November 15, while the full moon passes north of Saturn on October 25 and again on November 21. ☆☆☆ The maps show the principal stars and planets which are above the horizon at latitude 34° North at about 9 p.m. standard time at the middle of the month. These maps are practical star location guides anywhere in the United States throughout the month showing the sky at 10 p.m. on the first and at 8 p.m. on the last of the month. To look at the night sky in October and November, select the proper map and hold it vertically. Then turn the map so that the point of the compass toward which you are facing shows at the bottom of the map. ☆☆☆ Our special thanks go to the Griffith Observatory in Los Angeles, California.

The Night Sky in November

tronomers had noted a very bright star in the very spot where the Crab Nebula stands today—a "guest star," which today we call a nova, or new star, which we know today is not really a new star, but one which newly calls our attention to it.

A nova is a star which generates energy so strongly that the overlying layers of the star can't hold it in, so the star literally explodes. For a few days or weeks or even months, the star may be the brightest object in the sky, until it subsides to the obscurity from which it erupted. We have records in both early and later times of many such exploding stars.

What we see when we observe the Crab Nebula in Taurus is the gaseous debris of the colossal explosion when a star literally "blew its top." The gigantic explosion occurred about 3050 years B.C., because modern measures show that the object's distance is 4100 light-years. Now, after a lapse of almost 5000 years, the Crab Nebula may be telling us something of a new state of matter.

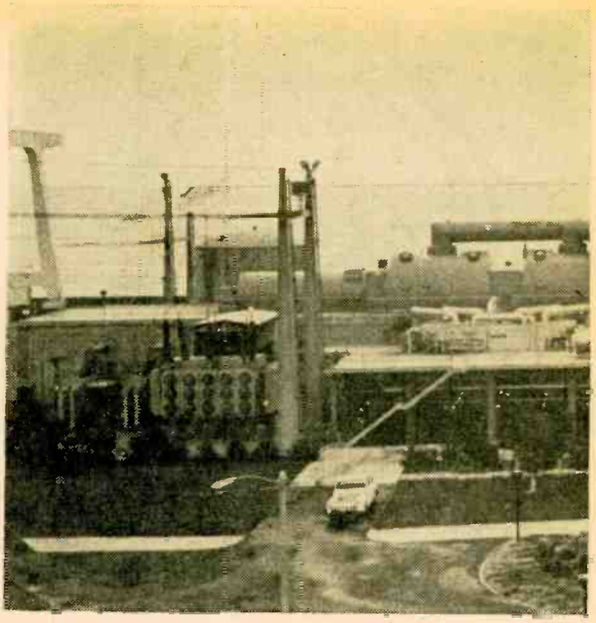
★ The great radio telescopes have been telling us that something in or near the Crab Nebula is sending us radio "beeps" at intervals of one-thirtieth of a second.

(Continued on page 110)

Our new columnist Dr. Roy K. Marshall

You wouldn't think the man looking so directly at you has spent most of his life gazing at stars . . . but that's his story. From a doctorate in astrophysics at the University of Michigan through stints at various planetariums (planetaria?), Dr. Roy K. Marshall has perhaps not as many qualifications as there are stars, but enough. Dr. Marshall has been associated with the Adler Planetarium, Chicago; the Yerkes Observatory, University of Chicago; the Harvard Observatory; the Fels Planetarium, Philadelphia; Morehead Planetarium, Chapel Hill, N.C.; Odessa College Planetarium, Odessa, Texas and is currently Director of the Gibbes Planetarium, Columbia Museum of Science, Columbia, S.C. Dr. Marshall is the author of "The Nature of Things," "Sun, Moon and Planets," "Star Maps for Beginners" and "Sundials." A man for all media, Roy Marshall has been education director for the Philadelphia Inquirer radio and TV stations, science editor of the Philadelphia Evening Bulletin, columnist for SKY AND TELESCOPE magazine, and now astronomy columnist for SCIENCE AND ELECTRONICS. He is the recipient of an honorary degree from the Philadelphia College of Pharmacy and Science "for propagating the knowledge of science via writings, lecturing, planetarium work, radio and television." Let him welcome you aboard on a fascinating trip to the heavens! ■

by James Robert Squires

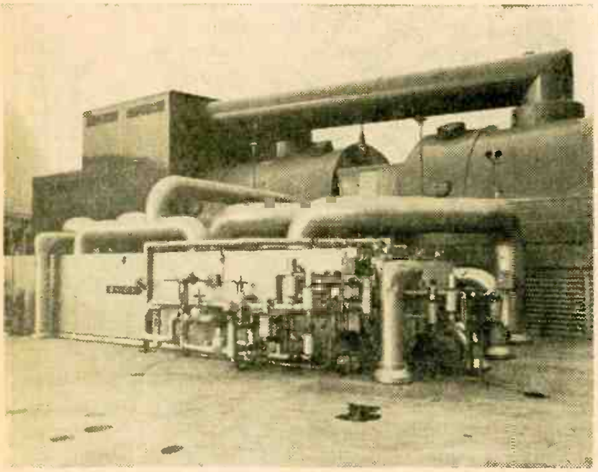


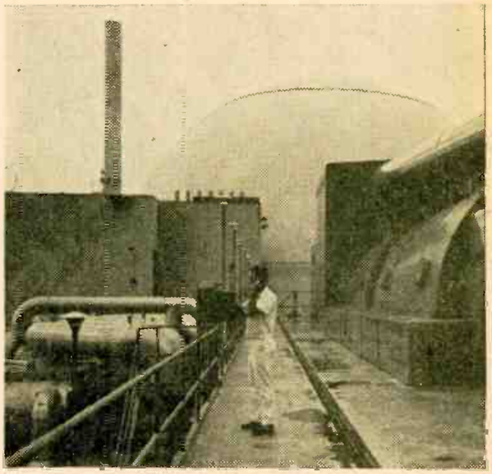
One of San Onofre's five watch engineers, Pat Riley is empowered with making go/no-go decisions in event of trouble. His job: to make sure that everything remains AOK.

SAN ONOFRE'S

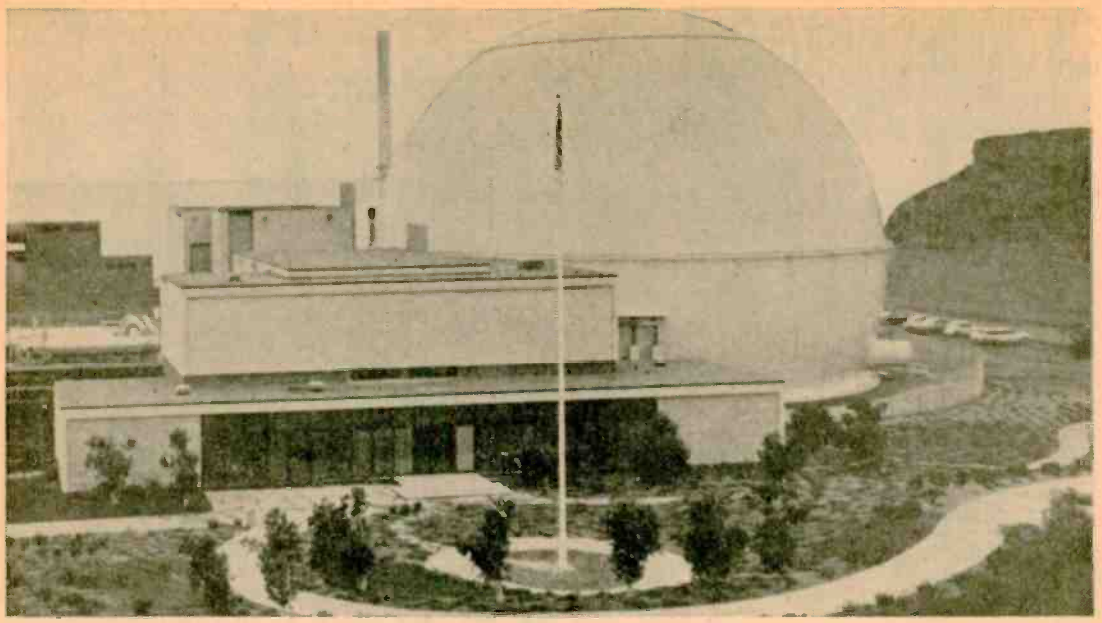
☐ Set beside the Pacific Ocean in a man-made cavity 90 ft. below the cliffs, the San Onofre nuclear-powered generating station is located roughly 60 miles south of Los Angeles. In operation since January of last year, the station is capable of generating 450 megawatts of electrical power, 80% of which is used by the Southern California Edison Company and 20% by the San Diego Gas and Electric Company, co-owners of the project.

The generating station, which is of the





Twin flash evaporators (left), powered by steam from secondary system, convert sea water into distilled water at rate of 120 gallons per minute. Water is stored in huge tanks for later use; any excess is pumped to reservoir high on cliffs for supplying domestic water needs.

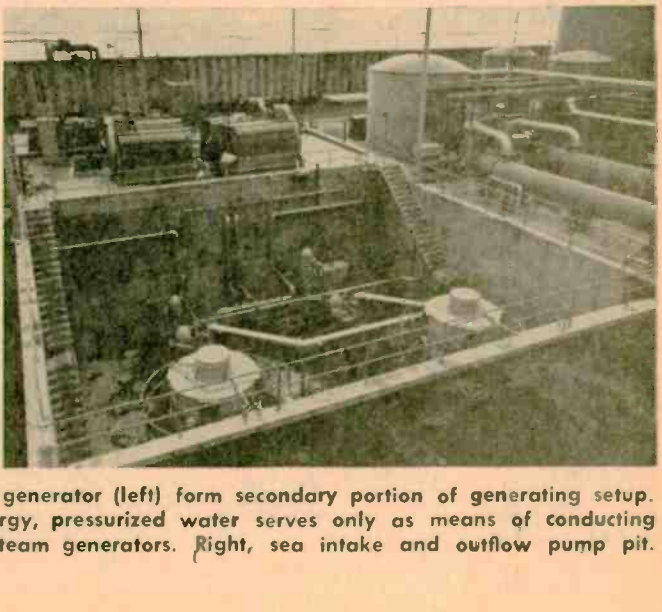


FABULOUS 450

Overall view of San Onofre. Large sphere at right houses nuclear reactor and its associated steam generators; sphere is vented to relieve pressure in event of mishap.

pressurized water type similar to that used by nuclear submarines and surface vessels typified by the aircraft carrier *Enterprise*, has its nuclear reactor located at the bottom of the big sphere (see our photos).

To understand how the station works, remember that whenever the pressure on a quantity of water is raised above 14.7 pounds per square inch (psi), the water will no longer boil at 212 F. Because of the 2000 psi pressure within the reactor's primary system, water doesn't even boil at the

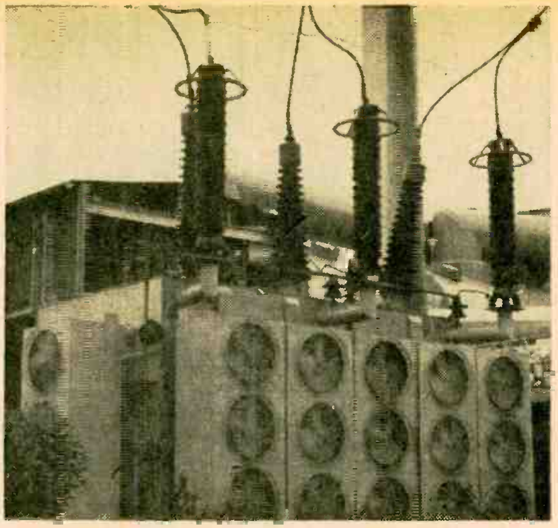


Steam generators and turbine generator (left) form secondary portion of generating setup. Though heated by nuclear energy, pressurized water serves only as means of conducting energy between reactor and steam generators. Right, sea intake and outflow pump pit.

SAN ONOFRE'S FABULOUS 450

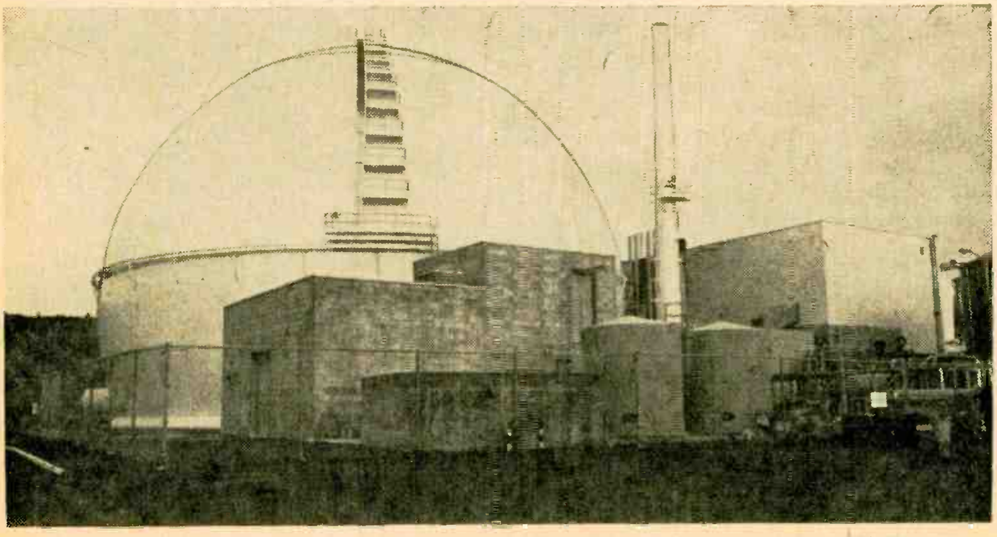
system operating temperature of 575 F —hence the term, pressurized water reactor.

In operation, distilled water in the primary system circulates around the nuclear reactor and in doing so absorbs tremendous energies in the form of heat. This pressurized water is then forced to one of three steam generators located with the reactor inside the sphere. Steam produced by these generators is used to drive the plant's turbine-generator, thus producing electrical energy in the same manner as conventional, fossil-fueled stations. ■

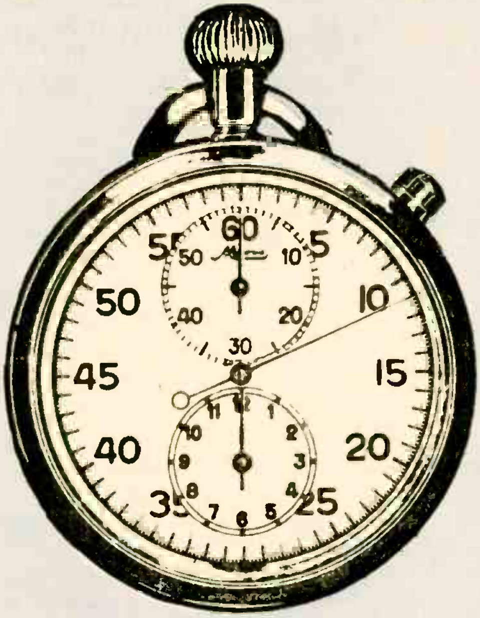


Above, output transformer at San Onofre; below, master control room. Indicator panels continuously flash status of instruments and equipment to engineer in charge; levers control position of rods in core.

Structure immediately in front of sphere is waste collection building. Here, radioactive substances which cannot be otherwise disposed of are baled and pressed into cement containers.



by Don Jensen



Their Time Is Your Time

A multi-million-dollar effort by many nations of the world converts your shortwave receiver into an electronic Timex!

☐ Regularly as clockwork, the shortwave time stations split the hours into tiny fragments with their incessant electronic pulses. No music, no personalities, no entertainment, not even a newscast to break the monotony. Their programming is a bomb—a *time* bomb!

On the whole, their ticks, tones, and tech data are of interest mostly to scientific sorts who rely on their specialized services. Still, these "clock radios" offer some interesting DX to shortwave listeners.

Mention standard time stations, and most SWLs figure you're talking about the 46-year-old WWV, the National Bureau of Standards' operation at Ft. Collins, Colorado. For, truth to tell, WWV has been ticking away since 1923 (originally from Greenbelt, Maryland) on 2.5, 5, 10, 15, 20, and 25 MHz. And the more hip also know its Hawaiian counterpart, WWVH, at Puunene on Maui Island, which joined in on 5, 10, and 15 MHz in 1948. Still others are familiar with Canada's CHU, widely heard on 3.330, 7.335, and 14.670 MHz.

(turn page)

Their Time Is Your Time

But there are scores of other shortwave time stations operating around the globe. They are run by astronomical observatories, private and government labs, and military commands.

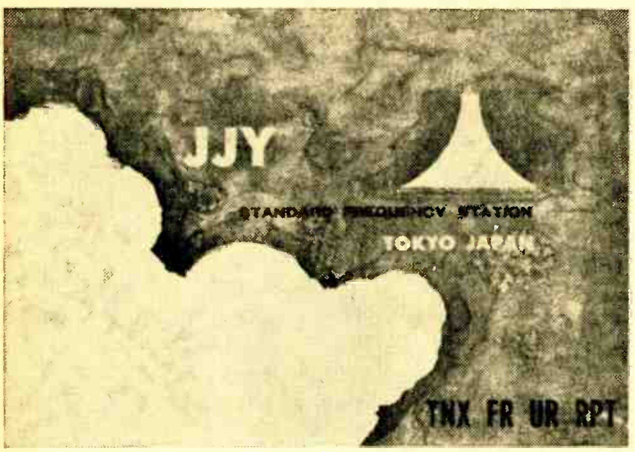
Little-Known DX. There are several reasons why many SWLs don't realize the DX potential of these services. Some share the standard frequencies with WWV and WWVH, which usually dominate the channels. Others have mini-skeds, transmitting just a few minutes each week. Then, too, some use off-beat wavelengths, which makes them tough to tune unless you know when and where to listen.

But when conditions are right, the foreign time-tickers can be logged during the WWV/WWVH silent periods—quarter to and quarter past the hour, respectively—or during brief pauses in their voice announcements. Sometimes, unexpectedly, alien ticking can be heard right through the U.S. time stations.

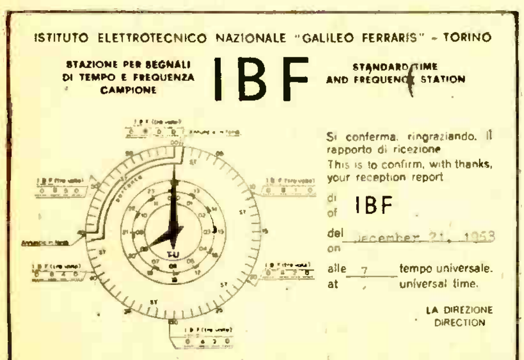
Some identify only in International Morse Code, causing problems for SWLs who can't read CW. Way to get around this is to tape the signals, then play them back at half-speed to decipher the individual di-dah combinations.

Three On Five. For openers, stake out 5 MHz during the early evening hours, when WWV will no doubt be pounding in. However, during the voice announcement just before each quarter hour, you may hear a CW signal in the background, tapping out the call ZUO three times. This station, one of the most frequently heard overseas standard time services, belongs to South Africa's Republic Observatory in Johannesburg. Its transmitter at Olifantsfontein sometimes puts in a surprisingly good signal for just 4 kW.

A few hours later, between 0645 and 0700 GMT, the same 5-MHz frequency has been offering the electronic time signals of IBF, the Instituto Elettrotecnico Nazionale station at Turin, Italy. At times it manages



Putting together a QSL collection can be interesting when cards are grouped by topics—stamp collectors do this. A topical collection of time stations on six continents and Oceania set up in a nice display. For once it will be possible to show your friends the interesting world of shortwave listening. The chart at the top of the facing page tells you what will be needed in effort to get a complete set. Some of the nicer QSLs are shown on these pages — JJY-Japan, IBF-Italy, CHU-Canada, VNG-Australia. Get yours today!



STANDARD TIME STATIONS AROUND THE WORLD

Country	Station	Address	Frequency (MHz)	When to Tune (GMT)
ARGENTINA	LOL	Observatorio Naval, Buenos Aires, Avenida Costanera Sur 2099	5.000	0000-0100
AUSTRALIA	VNG	Australian Post Office, Postmaster General's Dept., 57 Bourke St., Melbourne 3000	7.515	1200-1300
BRAZIL	PPE	Observatorio Nacional, Rua Gen. Bruce 586, Rio de Janeiro, GB ZC-08	8.721	0025-0030
CANAL ZONE	NBA	U.S. Naval Observatory, Balboa	5.870	0155-0200
CEYLON	4PB	Colombo Radio, Colombo	8.742	1325-1330
CHILE	CCV	Instituto Hidrografico, Casilla 324, Valparaiso	8.205	0055-0100
CHINA	XSG	Zikawei Observatory, Shanghai	8.333	0855-0905
CZECHOSLOVAKIA	OMA	Standard Frequency Station, Budecska 6, Praha 2, Vinohrady	3.170	Evenings
ENGLAND	MSF	National Physical Lab, Teddington, Middlesex	5.000	Evenings
GERMANY, EAST	DIZ	German Geodetic Institute, DDR15, Potsdam	4.525	Evenings
GUAM	NPN	U.S. Naval Observatory	5.448.5	1155-1200
ITALY	IBF	Instituto Elettrotecnico Nazionale, Corso Massimo d'Azeglio 42, Torino	5.000	0645-0700
JAPAN	JJY	Radio Research Laboratories, Koganei, Tokyo	15.000	2200-2300
PERU	OBC	Comunicaciones Navales Radio, Callao	12.307	0055-0100
SOUTH AFRICA	ZUO	Republic Observatory, Johannesburg	5.000	0200-0400

to bull its way through the WWV transmissions, identifying both by CW and voice—in Italian, naturally.

Also noted on 5 MHz from time to time is LOL, the Argentine Naval Observatory station at Buenos Aires. It's identified by its thrice-repeated Morse call letters. Unfortunately, while the station's staff claims it wants reception reports, DXers complain that QSLs are few and far between.

Most of the stations, though, are good verifiers. One of the best—with a sharp QSL to boot—is Japan's JJY. Recently, this service of Radio Research Laboratories in Tokyo has been heard through WWV on 15 MHz during our late afternoons.

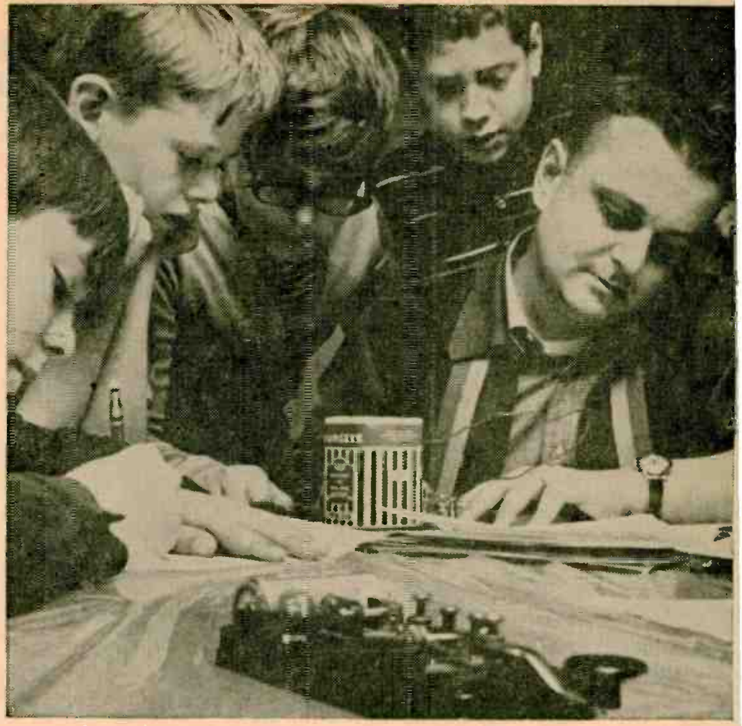
Off-Beat Frequencies. If you don't want to fight the QRM on the standard frequencies, switch to the time stations that use the far-out frequencies. For example, there's the German Geodetic Institute's DIZ in the East Berlin suburb of Potsdam. (Its 5-kW transmitter, on 4.525 MHz, is actually located in nearby Nauen.) No identifications here, but on this frequency it is unmistakable, particularly during the later afternoon and around midnight in the U.S.

Halfway around the world is VNG, the time station of the Australian post office in Melbourne. It identifies by voice—and in English, happily enough—on the hour only.

(Continued on page 109)


THE ONLY
COLOR TV
TOTALLY
ENGINEERED
FOR TRAINING
NEW

Code practice occupies sizable portion of Saturday morning sessions. Informal gatherings normally begin with Joe tapping telegrapher's key while boys jot down letters they hear. To earn FCC Novice license, boys must pass test showing they can send and receive code at 5 wpm.



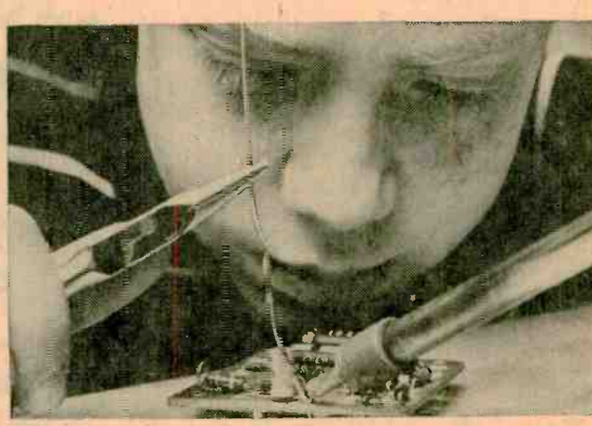
Saturday Morning

Keen ears pick out coded letters as slow but steady di-dahs issue from oscillator. Once code has been memorized, boys begin pounding out their own messages (photos at right).

☐ This is the world of diodes . . . transistors . . . toroids. It's a maze of tiny electronic components . . . of wire and perf boards . . . of telegraphers' keys . . . 9-volt batteries and soldering guns.

This is Joseph R. Wasserman's 90-minute Saturday morning world spent with a dozen or more (depending on the vagaries of weather, homework, and colds) wide-eyed

Concentration is a must when it comes to absorbing cold facts. Boy at left is poring over ARRL's License Manual which lists 50 sample questions and answers would-be Novice may face during his exam.



Ham-in

and quick-to-learn kids from suburban Philadelphia. It's a 90-minute world that has a way of stopping the clock, for those 90 minutes more often than not somehow stretch into two or more hours.

Joe is a school psychologist (Monday to Friday) with the Upper Darby School System (adjacent in Delaware County, Pa.) and a ham radio buff of long standing. And

Soldering is yet another skill successfully acquired by members of Joe's Saturday Morning Ham-in. Friendly word from Joe encourages do-it-yourselfer to develop sure, light touch.

Saturday Morning Ham-in

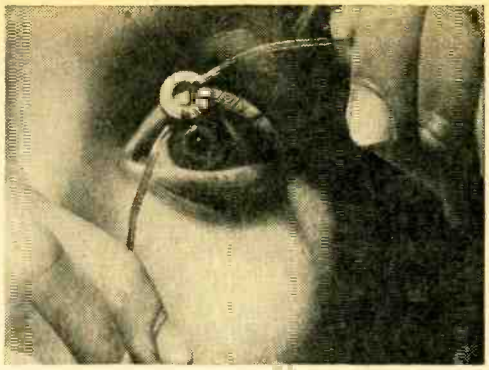
he has some provocative theories about education as well as a mutual love for his hobby and "his boys."

"These kids," he says, "are 10, 11, and 12. Just look at what they can learn about electronics, about circuitry and radio theory once a week in this room. I believe we can teach children more detailed, more difficult, and certainly more useful material of all kinds at earlier ages."

The LaMott Community Center in Cheltenham Township, Montgomery County, Pa., began sponsoring Joe's class last fall. The youngsters learn the International Morse Code, prepare to take the Federal Communications Commission's Novice License test, and are building their own transistorized receivers.

Just to keep spirits high and to show his Saturday morning Marconis what they may strive to achieve, Joe brings his own transmitter and receiver. The boys have listened in while ham operators around the world have carried on contacts across the poles and over the seas.

The talk from Texas, California, Alaska, the U.S.S.R., England, even Nairobi is frequently technical. But Joe's boys understand. Not all, to be sure. But more and more each week. —*Joe Gronk*



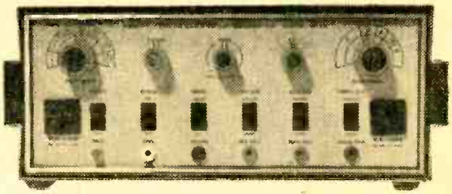
Two toroids are required for receivers boys are building, and they wind them themselves. Below, boy samples signals from Joe's rig.

Thrilled with romance of communicating with earth's four corners, boys cluster around Joe's transmitter and receiver. Often, they too manage to take part in exciting world of DX action.

Science and Electronics LAB CHECK

HEATHKIT MODEL IG-28

All-IC Color Bar and Dot Generator



☐ Just as with one of the airlines' claims, there's a "something extra" with the Heathkit Color Bar and Dot Generator. In this instance that something is extra features hung on a standard color generator. What they do is make it a lot easier to align a TV for darn good color quality; you might say they're akin to the fine tuning adjustments common to lab-grade service equipment.

The IG-28 is all solid-state, using the latest in computer type design to obtain the necessary waveforms. Thing is, the step counters and adjustable dividers generally associated with color generators normally require at least an oscilloscope for proper generator alignment. With the IG-28, however, integrated circuit flip-flops and gates mean that you build it and it works.

Except for the non-critical circuits, such as the RF oscillators and modulator, the IG-28 is all-IC, with printed circuits for everything except the front-panel controls. Since the ICs are essentially direct coupled through the printed foils, should any problems arise you simply plug in a new IC (all ICs use sockets).

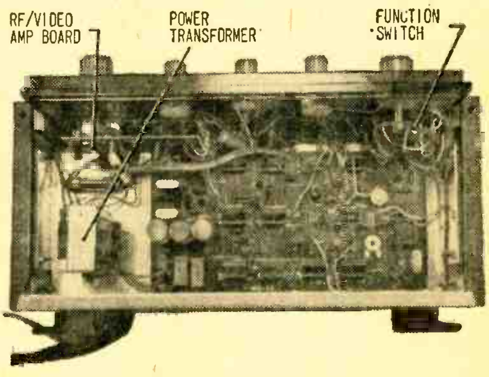
Even the RF oscillator is made trouble-free through use of a printed "tank coil." Rather than rely on the usual type of wire coil, which can be damaged, the IG-28's oscillator coil is part of the printed foil on the RF printed circuit board. And though it appears to be a "wavy foil," it's actually a coil.

Features, Features. The IG-28 provides the usual color generator patterns: dots, cross hatch, horizontal lines, vertical lines, and color bar. What's more, it also provides for purity adjustment, a "plaid" gray scale, and a 3x3 divide for the vertical and horizontal lines.

In addition to the tunable RF output covering channels 2 through 6 (with an associated level control), there is a video signal output with level control, a 4.5-MHz sound carrier output, a sync take-off on the front panel, and the usual "gun killer" switches. Since some of these features are totally new to some of you we'll take time out to explain.

If you look at a color bar pattern on a black-and-white TV, or a color receiver with the color turned *off*, the color bars appear as shades of gray. Now picture many of these shades of gray running both vertically and horizontally so they form a "plaid" pattern of gray scale covering the entire CRT.

When a color set is properly adjusted (using the test procedure given in the Heath manual), the color gun levels are such that no color tinting occurs on the "plaid" pattern. In short, it makes it easy to adjust the TV so black and white reproduces as black



Large printed-circuit board in IG-28 contains all electronics except RF oscillator and video output amplifier. All pulse circuits are IC self-locking flip-flops or gates, and all ICs plug into sockets for quick and easy servicing.

LAB CHECK

and white—not B & W with a smidgen of color.

A 3x3 divider does what it says—it divides the number of vertical and horizontal lines by three, so that only three H and V lines (rather than 8 to 10) appear on the CRT. The intersection of the two center lines represents "dead center" on the CRT, and the reduced number of lines is often much easier to use for centering linearity, and dynamic convergence adjustments.

Attached gun killer cables have insulation-piercing alligator clips that stab through insulation, making contact but not injuring wires to CRT color grids.

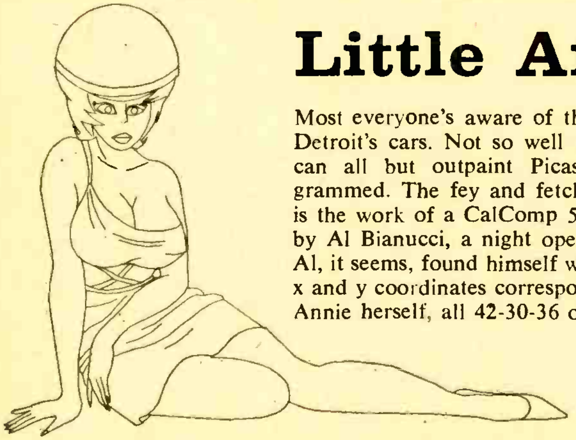
A 4.5-MHz sound carrier is also just what it says—a sound carrier for adjustment of sound traps. It also aids in correct frequency adjustment of the color bar generator. The sound carrier beats with the color carrier in the TV set to produce a herringbone pattern in the color bars. When the receiver is properly tuned to the generator, or vice versa, the herringbone pattern disappears, indicating correct tuning. If the pattern does not disappear it means the receiver's sound carrier trap must be adjusted. (All you do is adjust the trap until the pattern disappears.)

Assembling The Kit. In addition to the panel controls, for which a wiring harness is supplied, the IG-28 kit has two PC boards: a large one for the color generator and a small board for the RF oscillator and video output amplifier. Much of the assembly involves nothing more than plugging in the correct component and soldering.

If you're careful and make no mistakes in selecting the components, the IG-28 will work right off the bat, giving you horizontal lines and an RF output. Then, using the supplied alignment tool, you adjust the RF oscillator trimmer capacitor so the IG-28's tuning corresponds to the channel selected on the TV. Two quick adjustments bring in the vertical lines, and the IG-28 is ready for use.

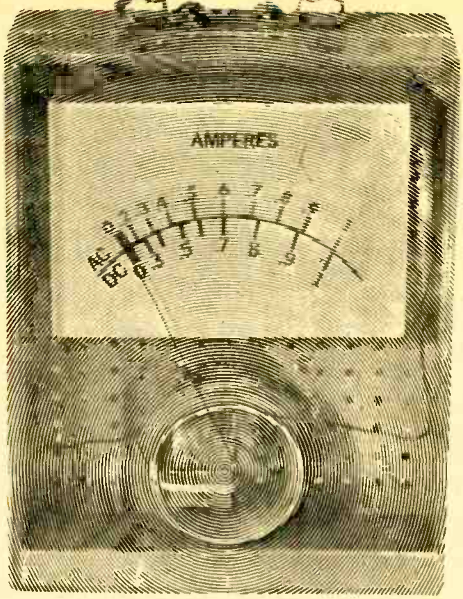
A notable feature of the IG-28, by the way, is the assembly/instruction manual, with perhaps the best written, illustrated, and thorough color adjustment procedure we have seen to date.

The Heathkit IG-28 Color Bar and Dot Generator is priced at $79.95; a wired version is available for $114.95. For additional information write to the Heath Co., Dept. 19, Benton Harbor, Mich. 49022. ■



Little Annie Fanny

Most everyone's aware of the role computers play in the design of Detroit's cars. Not so well known is the fact that some computers can all but outpaint Picasso—if, that is, they're properly programmed. The fey and fetching Little Annie Fanny you see at left is the work of a CalComp 563 plotter, programmed in this instance by Al Bianucci, a night operator at Chicago's H. W. Lockner, Inc. Al, it seems, found himself with next to nothing to do, so he digitized x and y coordinates corresponding to Annie's fanny et al. Result was Annie herself, all 42-30-36 of her. ■



Sn/Fe MOVING VANE AMMETER

Easy to build—works on AC and DC

by Charles Green, W6FFQ

When the first electric indicator was made by Hans Öersted in 1819 out of a magnetic compass and some wire, he could not have imagined that millions of meters that are its direct descendants would be in use wherever a low-cost rugged indicator is required. For example: as an ammeter in an automobile.

The iron vane electrical meter (ammeter or voltmeter as it's called today) is made in two general types: the polarized vane type—a magnet or an iron vane moving in a magnetic field, or, the repulsion vane type—two iron vanes repelling each other in an induced magnetic field created by the current flow being measured.

Our project uses the repulsion vane principle in an easy-to-build iron vane ammeter. This project will provide the reader the opportunity to combine education with the fun of building. This simple ammeter indicates from 0 to 1 ampere, AC or DC. A solenoid, two sections of a tin can, and a rubber band (in lieu of the conventional metal pivot and spiral spring) are the essential meter components housed in a plastic "P" box. Included in this article are experiments to help you better understand the repulsion vane action of this type of meter.

Vane Repulsion Experiments. Fig. 1 shows the components used in one experiment that can be performed to show how iron vanes move by magnetic repulsion. In our experimental hookup shown in the photo, the coil is made by random winding 200 turns of #22 enameled magnet wire on a 1¼-in. diameter cardboard coil form, about 1-in. long. This cardboard form can be made by cementing cardboard wound around a bottle having 1¼-in. diameter. Use plastic tape to hold the wire in place and leave 10-in. leads coming out of the coil. Remove about 1 in. of the enamel from the end of each lead.

Next, cut up a clean tin can to make two 1½ x ½-in. pieces. These will become the iron vanes in this experiment. Make sure the tin can is made from sheet iron and not from aluminum. Bend each iron piece about ½-in. from one end into a right angle.

MOVING VANE AMMETER

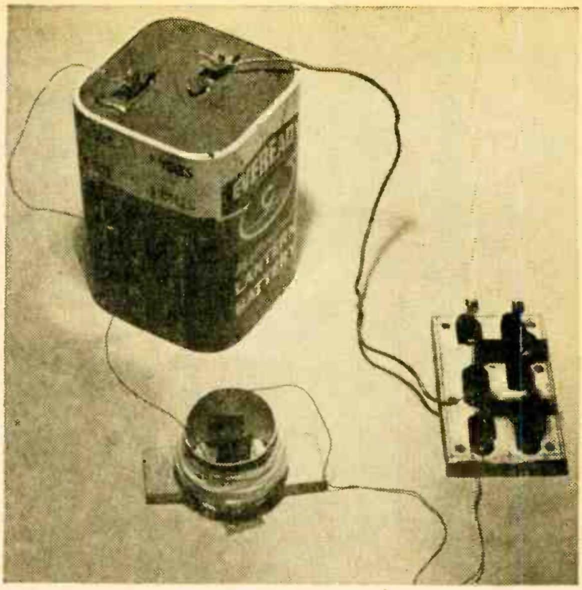


Fig. 1. Vane repulsion experiments demonstrate basic operation of moving-vane ammeter. Circuit works with 6-V battery or filament transformer.

Then make two 1 x 1 x ¼-in. wood blocks, and place them under the coil form about ¾ in. apart, as shown in the photo. Place the two sheet iron vanes inside the center of the coil, with the longer ends upright, and about ⅛-in. apart. Make sure they do not touch the wood blocks. The small ½-in. bends should be in the clear space between the blocks.

Connect the coil leads to a knife switch, and a 6-volt battery. Polarity isn't important, as the coil will work with the battery connected either way. See Fig. 2.

Close the switch and note that the two iron vanes repel each other. This is because the magnetic field of the coil magnetizes each iron vane with the same magnetic polarity; both north ends of the vanes are adjacent to one another, as well as both south ends. This is the reason why they repel one another. Fig. 3 explains this action.

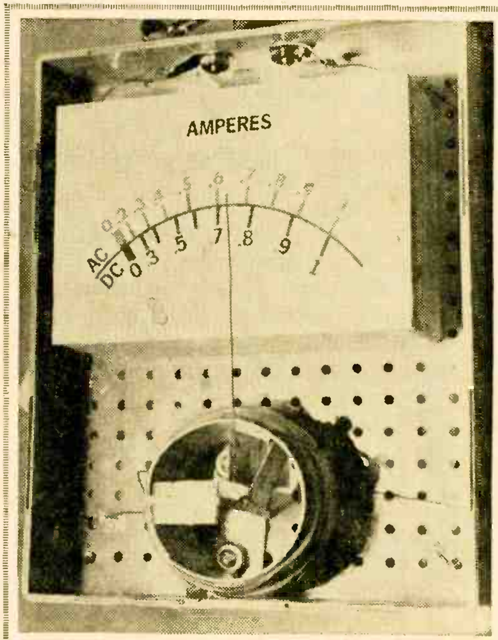
Repeat the experiment, but hold one of the vanes with a wood pencil (or other nonmagnetic item) so that it does not move. Observe that the free vane is still repelled by the fixed vane. It is this action, with one fixed, and one moving vane, that is used in iron vane meters.

Disconnect the battery, and replace it with a 6.3-V transformer (as in Fig. 2). Repeat the previous experiments with the transformer replacing the battery in the circuit, and observe that the iron vane is repelled in the same manner with AC as it is with DC. Even though the AC changes its direction of flow, the magnetic fields still magnetize the iron vanes in a similar manner.

Building the Meter. The iron vane ammeter is built into a 4⅝ x 3⅝ x 1½-in. plastic box supplied with a clear plastic lid. Use the same coil wound for the vane experiments for this meter unit (see the ammeter assembly drawing).

Start construction by making the vane bracket out of 0.05-in. or heavier sheet aluminum. Make the iron vanes from tin can sheet metal as indicated in Fig. 4. Use a rubber band that fits snugly over the bracket as shown, but not too tightly. It should be able to be twisted and then spring back easily. Mount the moving vane on the rubber band about ½-in. down from the top of the bracket, by bending a ⅛-in. lap of the bracket end around the rubber band.

Mount the bracket and the fixed vane in the bottom of the plastic box as shown in Fig. 5. Before tightening the mounting



Basic structure of moving-vane ammeter is shown in photo above and in detail drawing at right. Text describes how unit is calibrated for both AC and DC readings.

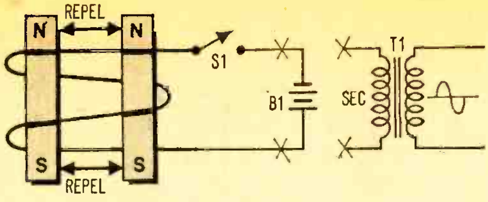


Fig. 2. Because of nature of hookup, iron vanes will always repel one another regardless of battery polarity. If desired, 6.3-V filament transformer (T1) can replace B1.

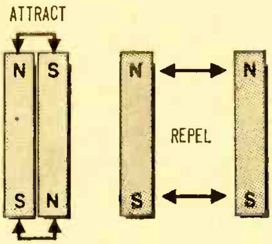


Fig. 3. Vanes can attract one another only when polarities differ. Here, polarities are always same, so vanes repel.

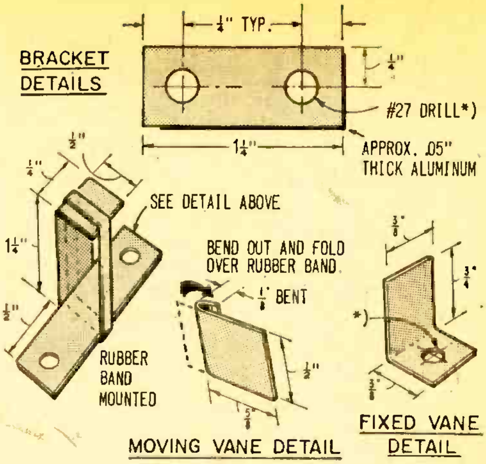
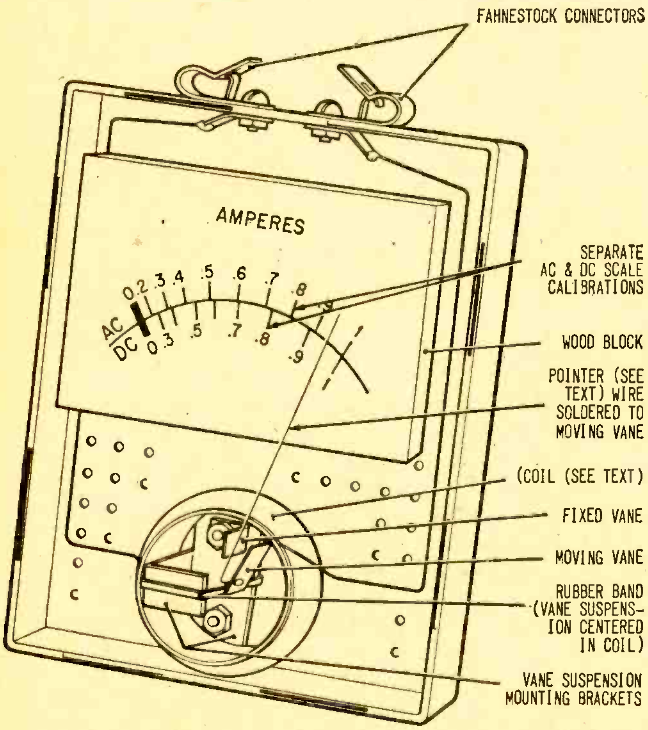


Fig. 4. Details of bracket, moving vane, and fixed vane. Bracket is made of 0.05-in. aluminum strip, vanes from tin can.

screws, shift the rubber band so that the top of the moving vane is even with the top of the fixed vane. Make sure that the rubber band is in the center of the bracket. Notch out the bottom of the left side of the coil form so that it will fit over the bracket base, and cement the coil form to the bottom of the box. Position it as shown in the drawing of Fig. 5.

Install Fahnestock clips on the plastic box as shown and connect them to the coil leads. Dress the coil leads to the sides of the box and hold the leads in place with a drop of cement. *(Continued overleaf)*



PARTS LIST FOR SN/FE MOVING VANE AMMETER

3—6-V batteries
1—Cardboard tube, 1 ¼-in. diam., 1-in. long (or cardboard sheet to make tube—see text)
¼ lb.—#22 enameled copper wire
2—Fahnestock clips
1—"P" plastic box, 4 ⅝ x 3 ⅝ x 1 ½-in. with clear plastic lid (Radio Shack 270-105 or equiv.)
1—Heavy rubber band for vane suspension (see text)
R1—200-ohm wirewound potentiometer (Mallory MR-200F with MR-1250 shaft, or equiv.)
T1—Filament transformer, 6.3-V, 1-A
1—3 x 2 x 1-in. wood block
Misc.—Tin can (iron only—see text), 0.05-in. or heavier aluminum strip, DC ammeter (0-1A), AC ammeter (0-1A), rubber feet, hardware, solder, etc.

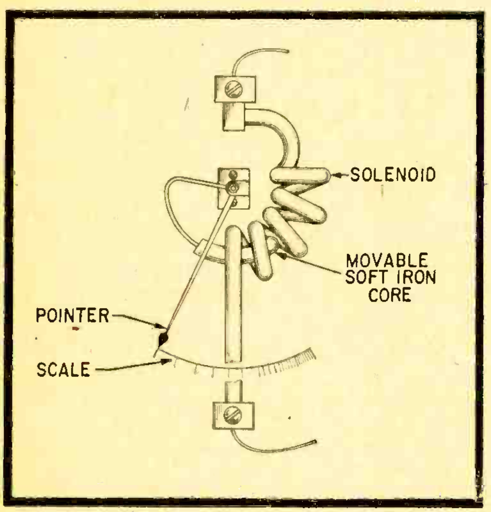
MOVING VANE AMMETER

Cement the scale, drawn on a sheet of paper, to a block of wood, 3 x 2 x 1-in. The wood block is bolted to the box bottom with two sheet metal or wood screws, positioned as shown in the drawing. Screw small rubber feet on each corner of the box.

Make a pointer for the meter from a straightened length of #22 enameled magnet wire, and solder one end to the moving vane as shown in the photo and drawing. Do not use too much heat as heat can damage the rubber band. Bend the wire to make a pointer for the meter scale and cut off the excess wire. The pointer is about 2¾-in. long. Place a small drop of cement inside the coil form to act as a vane stop and prevent the pointer from hitting the side of the box cover. Make sure that the pointer and vane swings freely and returns to a zero point.

Calibrating the Meter. You will need both a DC and an AC meter having 1-ampere ranges; a 200-ohm, wire-wound rheostat; and AC and DC power sources. Three 6-V batteries will serve as the DC source and a 6.3-V, 1-ampere filament transformer will do for the AC source.

Before calibrating, draw an arc on the meter scale and establish a zero point. The meter will have separate AC and DC calibrations as shown in the photo and drawing. If necessary, reposition the meter pointer by bending the top of the bracket.



Commercial moving-vane ammeters of yester-year were much like water meters. Note that device was accurate only if vertical.

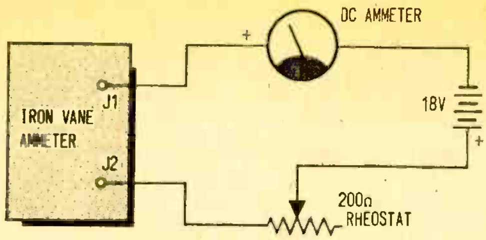


Fig. 6. Hookup for calibrating moving-vane ammeter for DC. See text for details.

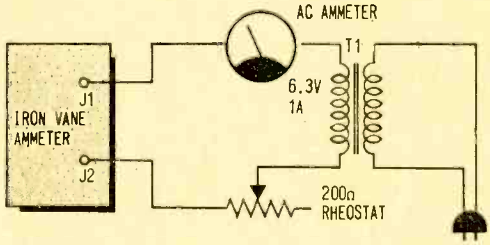


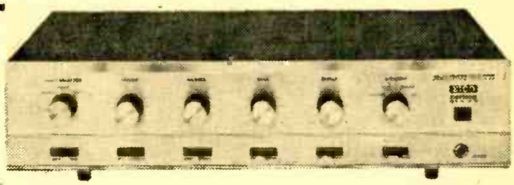
Fig. 7. Filament transformer and AC ammeter are required for easy AC calibration.

Adjust the rheostat to maximum resistance and connect it in series with the calibrated DC ammeter, 18-volt battery and the iron vane meter as shown in the circuit of Fig. 6. Adjust the rheostat and calibrate the iron vane meter according to the DC ammeter readings. Note that the iron vane meter will not respond near the zero position. Calibration of our unit was started at the 0.3 ampere position and was marked at every 0.1 ampere position to 1 ampere. Now connect the AC ammeter and filament transformer as shown in the circuit of Fig. 7 for the AC calibration. Be sure to set the rheostat to maximum resistance before beginning calibration. We started calibration of our unit at the 0.2 ampere point and continued as in the DC calibration. We used rub-on lettering to make the scale for the best appearance.

Operation. The use of a rubber band instead of the more conventional metal pivot and spiral spring makes for easier construction. But temperature changes and sagging and aging rubber may cause the meter indications to vary. The meter will still work as a good indicator for approximate current readings.

Try using the ammeter to check the current of household light bulbs. The ammeter, together with the vane repulsion experiments, will also make a good science fair project. ■

EICO CORTINA
Model 3150
Integrated Stereo Amplifier



☐ When the original EICO *Cortina* amplifier was introduced a year or so ago, just about nothing else was available that delivered comparable performance at such a low price, But the original *Cortina* unfortunately lacked the punch needed to drive low-efficiency speakers to high volume levels. Now, a new, high-power *Cortina*, Model 3150, overcomes that limitation with 150 watts (IHF) of stereo power output—a lot more than needed by any speaker system. (For those who don't need the extra power the original 70-watt *Cortina* is still available.)

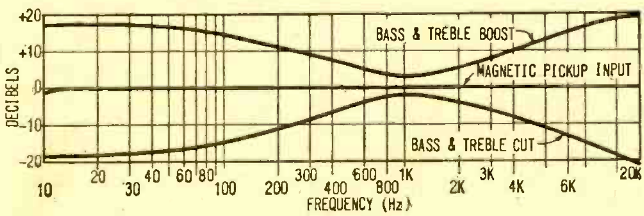
In addition to packing more punch, the 3150 *Cortina* also utilizes the latest in high-power solid-state technology for rock-bottom distortion. The new *Cortina* offers four inputs: a selector switch handles magnetic phono, tuner, and auxiliary; a tape-monitor switch provides the tape-recorder input. Outputs include main speaker, remote speaker, headphones, and tape recorder.

Other Controls. Volume and tone controls are ganged, which means that what you do to one channel you automatically do to the other. A balance control is provided for equalizing the stereo volume; a speaker selector selects either headphones, main speakers, remote speakers, or all speakers.

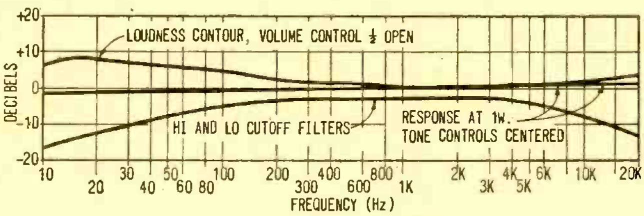
Panel switches provide for loudness contour, mono/stereo, lo-cut, hi-cut, and power; the rear apron contains both switched and non-switched AC outlets.

Though the circuitry is fairly conventional, the mono/stereo switch is somewhat unusual. Reason is that the mono connection is made by parallel-connecting the signal inputs together, rather than the preamplifier outputs. This method avoids the

The 3150's frequency response and the effect of its controls



RIAA equalization on 3150 was ruler flat from 20 to 20,000 Hz. Bass and treble controls had fulcrum around 1-kHz point, with maximum boost and cut of some 20 dB.

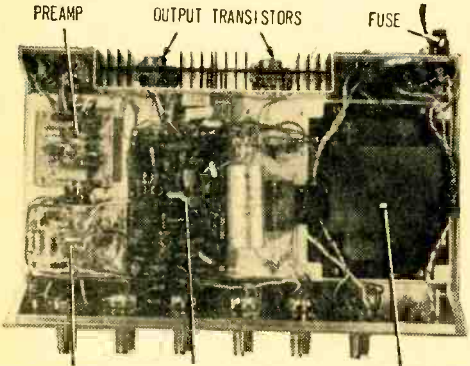


Response at 1-watt output with tone controls centered was also pretty much ruler flat. High filter was effective, though low filter proved somewhat broad.

crossloading of the amplifiers which often results in increased distortion. (We could not determine any deleterious effects, including increased noise level, caused by the EICO-type connection.)

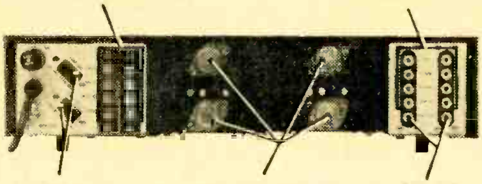
The 3150, available wired ($225.00) or kit ($149.95), complete with wood finish cabinet, uses modular construction; each individual section—preamp, driver, etc.—is on a separate printed-circuit board, and each channel has its own boards. There appear to be no assembly problems other than the usual tedium of plugging many components into matching holes.

Performance. Typical of the most modern solid-state designs, the EICO *Cortina*



Each side of chassis contains printed circuit modules for single amplifier channel (this is upper side of completed amplifier). Topside also contains power-supply filter, shown to left of husky power transformer. Even chassis is assembled in modular form: front (with controls), back, and amplifier base.

amplifier is absolutely ruler flat from 20 Hz to 20 kHz at normal listening levels of 1 watt, and almost ruler flat at the rated power output of 40 rms watts (sine-waveform) per channel into an 8-ohm load. As with most solid-state amplifiers, power output varies somewhat with load impedance. For the *Cortina,* the rated power output per channel is 50 watts into 4 ohms and 25 watts into 16 ohms. (Under no circumstances should the total per channel speaker load be less than 4 ohms. Reason is that the 3150, like most solid-state amplifiers, will attempt to deliver a tremendous amount of power into anything even remotely resembling a short circuit. And, unfortunately, any load offering an impedance of less than 4 ohms is going to look too much like a short circuit for comfort.)



Output transistors are recessed in heat sinks, which are themselves recessed to provide flat, non-protruding rear apron. Both main and remote speaker terminals (at left) have their own common (ground) connections.

Distortion is about as low as can be measured with standard lab-grade instruments. Total harmonic distortion (THD) at the threshold of clipping was 0.1% at 20 Hz, 0.08% at 1 kHz, and 0.18% at 20 kHz.

As shown in our curves, tone-control range is very wide, with almost 20 dB cut and boost at the extreme ends of the listening spectrum. The loudness switch adds about 7 dB boost at 20 Hz.

Our curves also show high-frequency cut to be good: only 3 dB down at 7 kHz. The low-frequency cut, however, is a little more broad than usual. This means that a listener would likely notice a slight loss of bass when the lo-cut is used to reduce turntable rumble (though we can't see why anyone would connect anything other than a quality turntable to this amplifier).

The magnetic input equalization is absolutely ruler flat, with a sensitivity of 0.0015 V (rms) for rated power output. Hum and noise measured better than 80 dB down, which is absolutely dead quiet at any volume-control setting.

How It Sounds. The EICO 3150 is easily identified as having "transistor sound." Its output is exceptionally clean and transparent, noticeably so at the higher frequencies where the amplifier can deliver some 5% more than the rated power before clipping. In fact, it is quite something to listen to a soprano's high C at full power output; few other amplifiers can handle it as well as the 3150.

For additional information on the 3150 *Cortina,* write EICO, Dept. T, 283 Malta St., Brooklyn, N.Y. 11207. ■

97-cent Hard-Rock Fuzz Box

Add "Fuzz" to your guitar amp for mere pennies

by Herb Friedman, W2ZLF/KBI9457

For just 97¢ you can modify the amplifier of your practice, or budget, guitar by adding the hottest sound going with the hard-rock combos—*fuzz.* For those too square to know what fuzz is, we'll explain.

Fuzz is distortion, out-and-out distortion of the original guitar sound. Unlike random distortion, most fuzz effects are accomplished by squaring the waveform of the guitar pickup, thereby obtaining a husky sound quality akin to that of a saxophone.

Most new guitar amplifiers have the fuzz built in, the technical terms for fuzz being harmonic modifier, overtone, or something

Hard-Rock Fuzz Box

similar. Whatever it's called, it's still fuzz. If the amplifier doesn't have built-in fuzz, the fuzz sound can be added through the use of a fuzz box—an adapter connected between the guitar pickup and amplifier input. Though fuzz boxes provide the conveniences of adjustable fuzz quality and a foot switch, the price range of $12 to $40 often puts it well outside the budget, particularly for units considered practice or budget units that originally cost less than the commercial fuzz box. Well, for you budget-minded people, we offer the *97¢ Fuzz Box*, actually a fuzzing circuit that is built directly into the amplifier (see Fig. 1).

What Is Fuzz. As shown in the schematic, the fuzz circuit is nothing more than a diode clipper (D1 and D2), a switch to turn it *on* and *off* (S1), and a depth control (R1) that sets the degree of fuzz effect. The *on-off* switch can be combined with the control, and if you use the recommended source for parts the whole bit will cost 97¢. If you want to build a super-deluxe version having a separate *on-off* switch it may run about $2. When a separate switch is used the setting of the depth control is not affected as the fuzz is switched in and out.

How It Works. Diodes D1 and D2 are the silicon type, requiring approximately 0.5 to 0.7 volt before they conduct. The fuzz circuit is connected into the amplifier at a

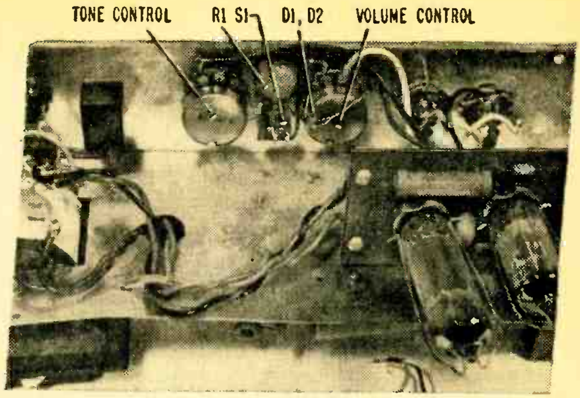
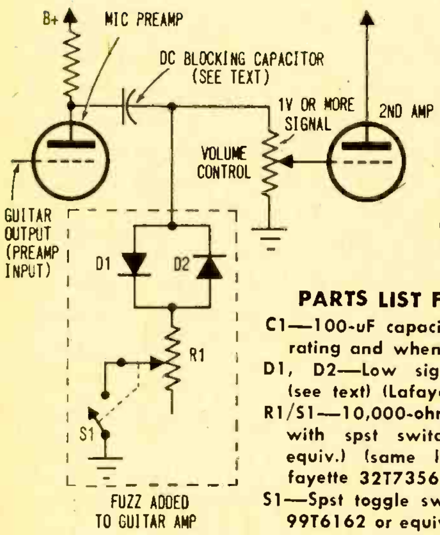


Fig. 1. Parts for fuzz circuit mounted on amplifier panel surrounding existing controls.

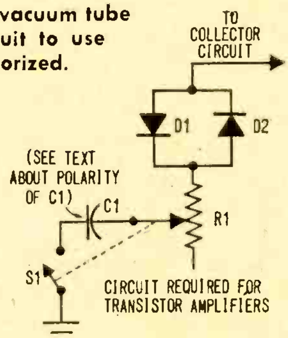
point, usually across the volume control, where the guitar signal is approximately 1 to 3 volts. Therefore, the diodes will clip that part of the signal waveform that exceeds 0.5 to 0.7 volt. R1 increases the conduction voltage, allowing the user to set the clipping level anywhere from just peaks of the waveform (slight fuzz) to the husky sound obtained when the diodes are returned directly to ground. The photographs clearly indicate the effect of the fuzz circuit. Fig. 2 shows a sine-waveform simulating the guitar sound with *no* fuzz—S1 open. Fig. 3 is the fuzz circuit *cut-in*, with R1 at almost full resistance (note that the waveform is just slightly distorted). Fig. 4 shows the high degree of distortion obtained when R1 is set to zero resistance—*full* fuzz.

The scope pictures have been adjusted to be almost equal in size for clarity of illustration. Actually, as you would expect, the fuzz circuit causes a loss in sound level of up to 6 dB, depending on the degree of fuzz. This is generally no problem since most guitar amplifiers have much more than 6 dB reserve gain.

When fuzz is added to transistor ampli-



Left, fuzz circuit added to vacuum tube amplifier. Right, fuzz circuit to use if your amplifier is transistorized.



PARTS LIST FOR 97¢ FUZZ BOX

C1—100-uF capacitor (see text about voltage rating and when required)
D1, D2—Low signal voltage silicon diode (see text) (Lafayette 19T6001 or equiv.)
R1/S1—10,000-ohm miniature potentiometer with spst switch (Lafayette 32T7364 or equiv.) (same less switch—see text—Lafayette 32T7356 or equiv.)
S1—Spst toggle switch (Lafayette 34T3301 or 99T6162 or equiv.—see text)

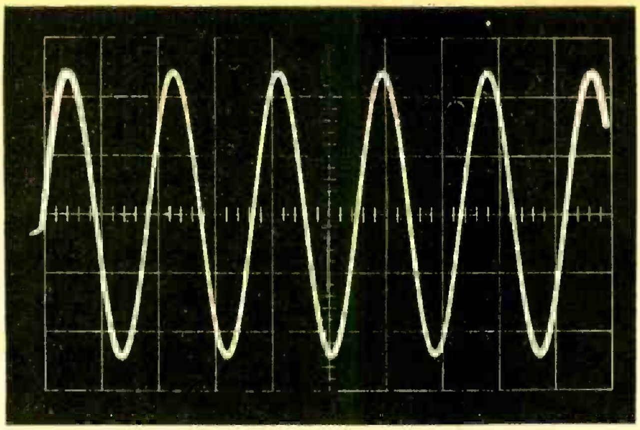


Fig. 2. Undistorted sine wave output of guitar amplifier simulating guitar sound with no fuzz added.

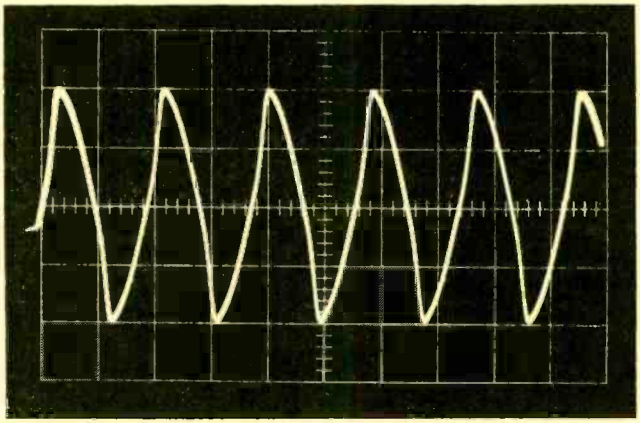


Fig. 3. Output of guitar amplifier with fuzz in, R1 at nearly full resistance. Note waveform slightly distorted.

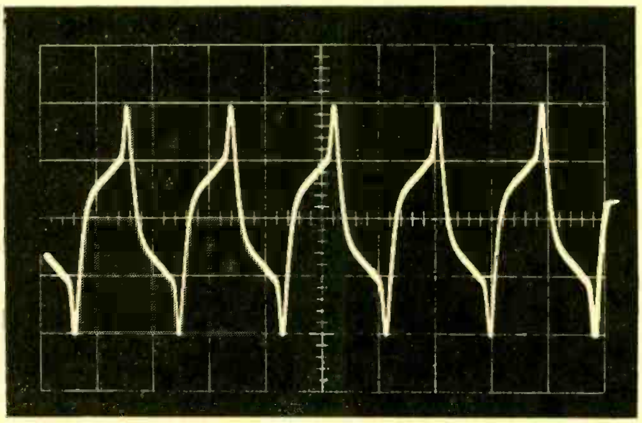


Fig. 4. Output of guitar amplifier with maximum fuzz, R1 set to 0 resistance. Note high degree of distortion.

fiers the circuit must be modified slightly by inserting a 100-uF capacitor (C1) in series with the arm of R1, as shown in the schematic. Voltage rating of C1 should be equal, at least, to the voltage to which D1 and D2 connect. Polarity connections of C1 are determined by the amplifier circuit voltage at D1-D2 (usually + for npn and − for pnp transistors). When the voltage is positive, C1's positive lead is connected to the arm of R1, or, if the voltage is negative, C1's negative lead is connected to it.

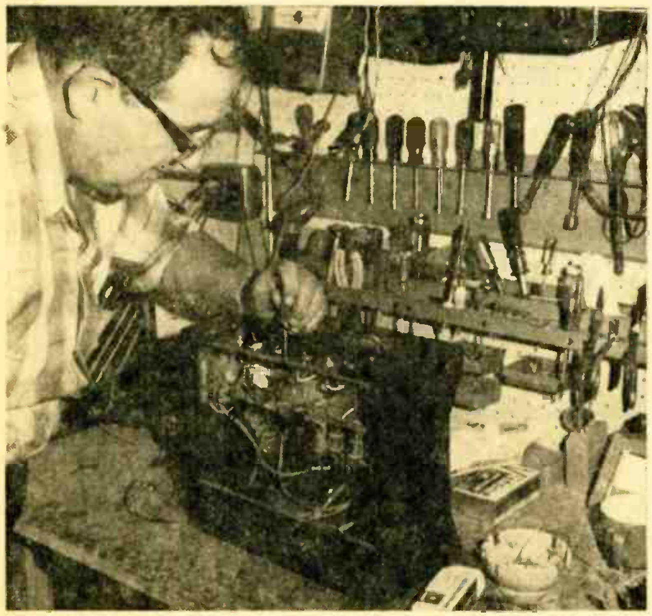
Where to Connect. The fuzz circuit must be connected into the amplifier at some point where the signal level exceeds 1 V. This is normally after the microphone preamplifier, across the volume control. (If tone controls are also connected across the volume control they are ignored.) If the volume control is in the circuit before the microphone preamplifier rather than after it (which would not be normal), or if it follows a second amplifier stage, connect the fuzz after the first amplifier, following the plate DC blocking capacitor. Do not connect the fuzz to the wiper arm of the volume control as this will disable the volume control, causing the volume control to affect only the degree of fuzz. Similarly, don't try to get more fuzz by connecting to the grid of the output tube as this will sharply reduce the overall amplifier gain, and the volume control again will affect only the degree of fuzz. The best location for the fuzz circuit is at the point where the signal voltage just exceeds 1 V, usually after the microphone preamplifier.

In transistor amplifiers you

Hard-Rock Fuzz Box

will most likely find the 1-V signal level point is the collector of the second transistor. Connect the transistor-version fuzz (with C1) to the collector of this transistor.

Placing the Parts. Try to keep the fuzz circuit away from power leads because it is a relatively low level circuit, and is prone to hum pickup. It is better to locate it as close as possible to the volume control or associated circuit. A typical installation is shown in the photographs. A miniature potentiometer (R1) is used to squeeze in between existing components.



Using a center punch to mark panel before drilling prevents possibility of bit slipping and inadvertently scratching panel.

First step is to drill the holes in the panel. To avoid shaking the amplifier to pieces with an electric drill, leave the amplifier mounted in its case for support and center punch the panel (so the drill doesn't walk into other components). Then drill the mounting hole(s), preferably with a slow speed drill. The slower the speed the lower the vibration.

Whether you use a separate *on-off* switch, or one mounted on the back of R1, try to connect the ground end to the low level amplifier ground. There usually is a ground wire connecting the ground lug of the volume control to the input jack ground. If the volume control is grounded to the chassis through its mounting bushing (no ground bus wire), connect the fuzz ground from S1 to the volume control ground *at the volume control*—do not ground the fuzz just any old place on the chassis. Nine times out of ten it doesn't matter where the fuzz is grounded, but yours might be the tenth case.

Using the Fuzz. When S1 is open (fuzz *off*) the amplifier will function normally. With S1 closed (fuzz *on*) the fuzz effect can be varied from full *on* to fuzz *off*, as determined by R1's setting; full resistance is little or no fuzz, while zero resistance is maximum fuzz. Do not expect the rough, harsh fuzz associated with add-on fuzz boxes. The 97¢ Fuzz simply cannot generate that much distortion. You'll get a definite husky sound, quite different from the normal guitar sound, but not quite the rough effect of an add-on commercial unit.

Since the fuzz sound is really harmonics created by distorting the original waveform, the amplifier must be capable of passing the harmonic frequencies, for if the harmonics are reduced, or filtered out completely, the final sound won't be much different from the normal guitar sound. Therefore, when using the fuzz make certain the amplifier's tone control—which is usually of the highcut type—is wide open to pass all of the high frequencies. After a little practice, of course, you can use the tone control to get subtle shading of fuzz tone quality.

About the Parts. D1 and D2 are the cheapest small-signal silicon type: usually sold in packages of 10 for about 90 cents. R1 is a "dime size" transistor potentiometer of 10,000 ohms, available with a switch (Lafayette 32T2405, 79¢) or without a switch (Lafayette 32T7356, 59¢). If you use a separate *on-off* switch for S1 you can buy a standard size toggle type (Lafayette 34T3301, about 50¢) or a subminiature type (Lafayette 99T6162, price around $1.50) if space is at a premium. ■

Science and Electronics LAB CHECK

UNIVOX Super-Fuzz Guitar Fuzzbox

☐ Imagine, if you can, a guitar sound so *with it*, so *now*, so *far out*, that it can't be put on a record! That's just what you get with a Univox *Super-Fuzz*—the ultimate in a guitar fuzzbox.

Unlike conventional fuzzboxes, the Univox *Super-Fuzz* neither distorts the waveform by clipping signal peaks, nor generates a slight kickback oscillation that causes a peak burst of distortion. Instead, this unusual unit generates almost completely new sound waveforms which are triggered by the basic guitar waveforms. And the sound no longer resembles that of a guitar. Rather, it can simulate many new ethereal instruments depending on the setting of the Univox's controls.

V For Vibrato. For example, with a guitar, *vibrato*—a rapid variation in pitch—can only be obtained by changing the tension on the guitar strings; this is normally accomplished by physical movement of a guitar's vibrato arm which is mechanically connected to the guitar strings. The closest you can get electronically is *wah-wah*, a simple system whereby a foot control causes an oscillator to trigger *on* guitar waveforms in a manner that simulates a frequency shift.

On the other hand, the Univox can be set to automatically trigger a slight frequency shift at the beginning of each note that creates a continuous "blue note" sound. End result sounds as though the vibrato handle had actually been moved at the beginning of each note!

And that's only one effect. The Univox can generate everything from standard fuzz effect to impulse waveforms that can be handled by only the finest of amplifier equipment—waveforms so steep they couldn't be traced by a phono stylus even if they could be cut on disc.

Picture Gallery. Some typical effects that can be obtained are shown in our waveform photographs. These were made using a sine-waveform test signal. Since guitar sounds aren't necessarily sine-waveform, the actual effects obtained surpass those shown in our photos.

Fig. 1 is our 600-Hz reference, a pure sine-waveform. In Fig. 2, the Univox No. 1 fuzz has been slightly opened, distorting the basic waveform as in a typical fuzzbox and also adding some second harmonic (note 6

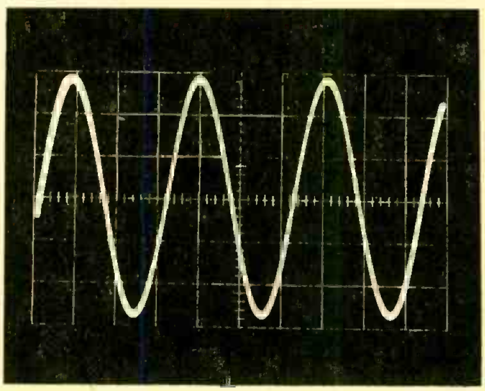


Fig. 1. Pure, 600-Hz sine-waveform.

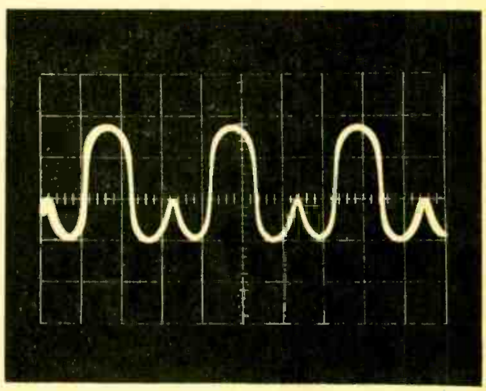


Fig. 2. With No. 1 fuzz slightly open.

cycles rather than 3). Increasing the No. 1 fuzz effect gives distorted second harmonic as shown in Fig. 3; and even more No. 1 fuzz gives a severely distorted second harmonic, producing a high order harmonic fuzz tone (Fig. 4). These are all the effects which give the so-called saxophone guitar sounds.

Fig. 5 is a slight amount of No. 2 fuzz, which virtually destroys the guitar's normal sound and makes it multiple harmonics and some basic original frequency. Fig. 6 shows even more No. 2 fuzz with multiple harmonics, distorted basic tone, and impulses at slightly lower than the second harmonic frequency. The sound here is unbelievably weird. And it is at the point where the impulses are generated that the slide tone effect is obtained as the impulse starts at a slightly lower frequency and slides up about ¼ to ½ tone.

Fig. 7 is maximum No. 2 fuzz Note that the waveform is not blurred because of poor scope sync. Rather, the sound is harmonics, added to harmonics, creating more harmonics, on top of the distorted basic frequency, with impulses added. It's an unbelievable effect somewhere west of Pepperland!

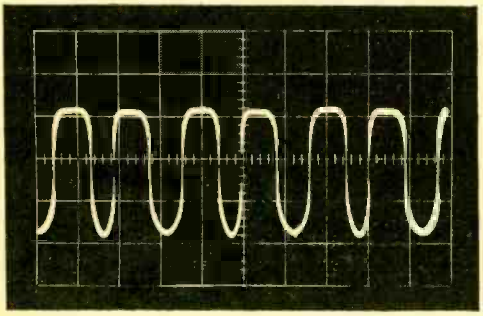


Fig. 3. With No. 1 fuzz more open.

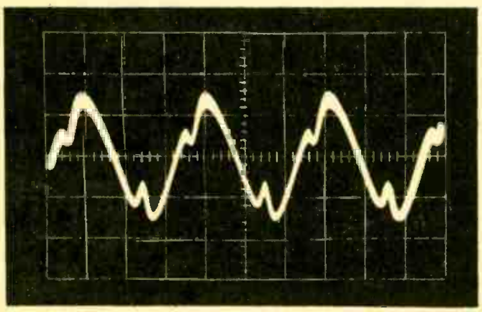


Fig. 4. With No. 1 fuzz fully open.

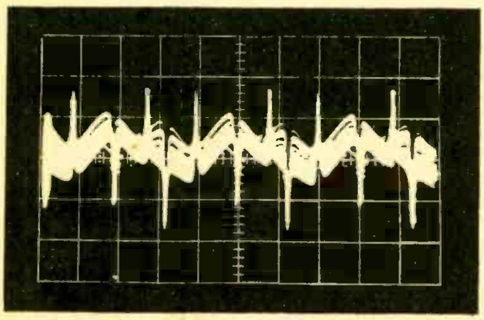


Fig. 5. With No. 2 fuzz slightly open.

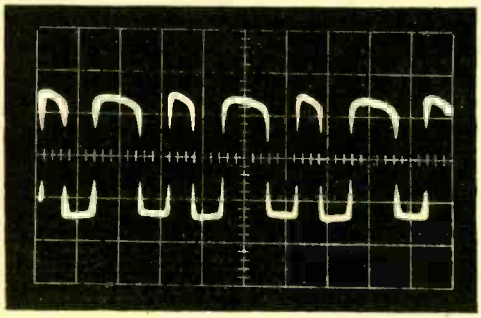


Fig. 6. With No. 2 fuzz more open.

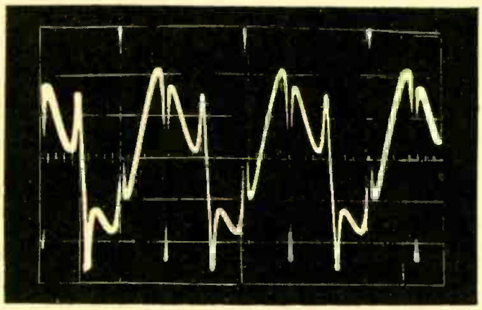


Fig. 7. With No. 2 fuzz fully open.

As shown, the Univox *Super-Fuzz* gets its myriad effects from only two of three controls, for one is a BALANCE control and contributes nothing to the effects.

The FOOTSWITCH on the top cuts the superfuzz in and out. The BALANCE control sets the superfuzz level so that the amplifier's output sound level is the same with or without fuzz. The EXPANDER control carries the power switch and provides the desired fuzz depth; the more it is advanced the greater the degree of fuzz effect.

(Continued on page 107)

Facts and photos courtesy Communications News

TALLEST TOWER

Tallest self-supporting antenna tower in the U.S. was recently erected by the Monroe County Electric Co-op just north of Waterloo, Illinois.

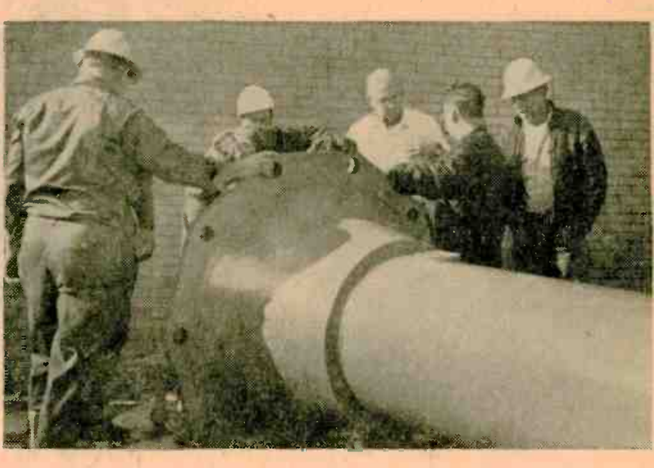
Interestingly enough, the Union Metal Manufacturing Company in Canton, Ohio has fabricated a series of monotube self-supporting antenna poles from 25 feet through 200 feet since 1941. But the 225-ft antenna pole in our photos is the first to be manufactured in this series and the first one erected in the U.S.

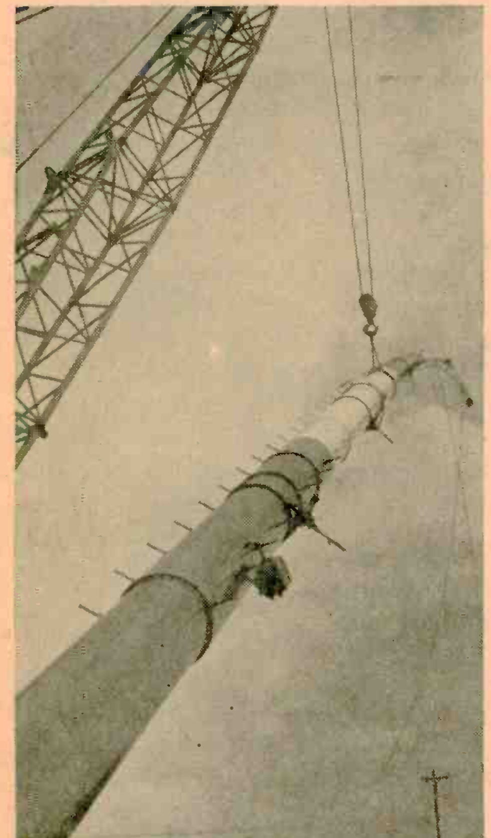
L.V. Hard, manager of the Cooperative, said this pole was ordered to complete his excellent communications hookup. His system consists of a Motorola base station and six Motorola mobile units, broadcasting on 158.78 MHz and covering three counties with a range of 35 miles.

Prior to its erection, the antenna

TALLEST TOWER

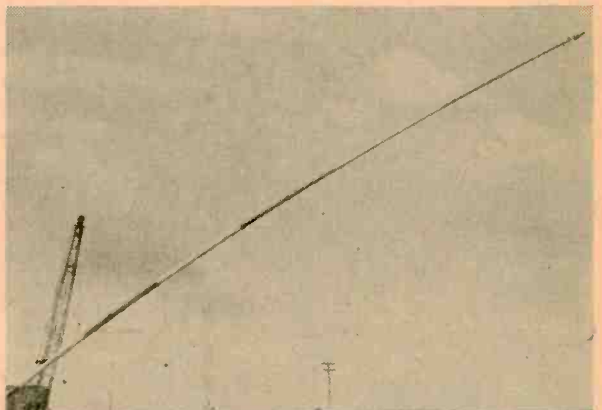
Below, left, ten 80-in. anchor rods made up pole's anchorage. Below, right, Alois Luhr (no hat) checks pole's 16-ft-deep foundation.





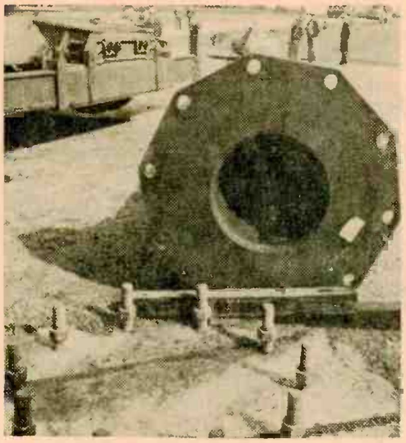
pole was assembled and painted, and the aircraft warning lights installed and wired. The three lower sections had the wire rope slings in place with the come-a-longs (coffin hoists) in tension. Before raising the pole into position, a tag line was fastened at the top of the pole and another one about halfway down. Taking care to protect the aircraft warning light at the top of the pole, workers fastened the wire sling at the balance point of the pole.

Not entirely self-supporting, the antenna pole is comprised of 13 tapered tubular sections telescoped together to a total length of 225 ft. The butt tubular section is 24-in.



Breathtaking part of 20-minute erection time came as 225-ft pole was progressively raised higher and higher toward true vertical. As safety precaution, steel cable was placed around pole near base and held taut by winch truck. Erection crew found plenty of opportunity to put their two-way radios to good use during course of actually raising 26,850-lb. tower.

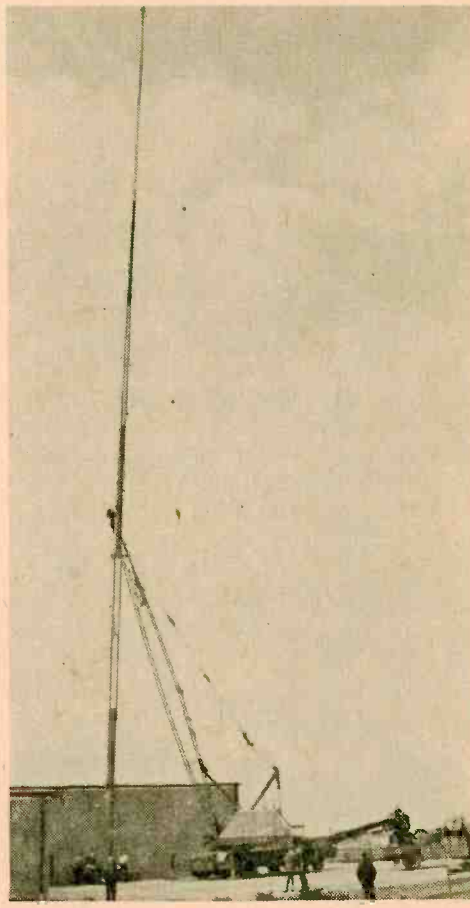
Wire rope slings with come-alongs and heavy copper wire around joints were in place at start. At first lift, entire antenna pole was carefully checked. Crew of Monroe Coop took special care to guard aircraft warning beacon at top of pole.



in diameter, while the very top is a mere 3.8-in. in diameter.

L. E. Dechant of Dechant Electric Service in Belleville, Ill., supervised installation of the coaxial cable and antenna at the top of the pole. Equipped with Motorola two-way radios to talk to the ground, one of Dechant's men and a member of the Cooperative's crew climbed the pole to attach the antenna and coaxial cable. Addition of the antenna gave the pole/antenna combo an overall height of 247 ft.

The Motorola base station was moved from its former location in Waterloo and on the air by 4:30 p.m. of the same day. ■



Coop engineer Wiley Jones (sweater) checks pole position over anchor bolts before pole is lowered into final position. Once pole had been seated on anchor bolts, workmen then adjusted first leveling nuts, then anchor nuts to ensure that entire 247-ft-high structure was both adequately secure and accurately locked in true 90-degree-from-horizontal position.

HAM TRAFFIC DE W7DQS

by MARSHALL LINCOLN

Watch Not, Have Not

☐ SWLing generally is thought of as being completely separate from ham radio. Separate it is, though there's a form of this activity that has become very important to hams. The SWLs in question are hams who're active in a specialized form of SWLing. They perform a vital service for all of us.

Though these SWLs scan the ham bands, they're mainly interested in finding non-hams! They're not looking for bootleggers in the usual sense—but they are looking for radio stations which don't belong on our frequencies.

These SWL-hams are officially known as members of the Intruder Watch. This is a ham activity which is little known, but vitally important to all of us. It was organized about five years ago by the ARRL to provide a systematic, effective way of spotting commercial stations which operate illegally on ham frequencies. It also provides a means to get these intruders moved with FCC help.

The Intruder Watch corps has grown to include several dozen dedicated hams who spend a few hours each week tuning across the ham bands searching for signals, mostly from foreign broadcast stations, that have moved in and set up shop. Once these are located, their frequencies must be determined and the stations identified. Then a written report is made to ARRL headquarters.

These reports from Intruder Watchers all over the country are dovetailed together and forwarded regularly to the FCC. Then, either the FCC or the State Department makes official contact with the offending stations or with their government authorities. From this procedure, which is unavoidably slow and cumbersome at times, has come considerable relief from foreign broadcasters who have created undue interference on the ham bands.

Among the hams who help guard our precious frequencies against commercial stations moving in are two Intruder Watch listeners, Dr. William W. McGrannahan, KØORB, Kansas City, Mo. (right) and Elmer P. Fruhardt, Jr. W9GFF (left), Chicago, Ill. They are among the dozens of hams over the country who regularly submit reports of commercial stations they've heard interfering with legal ham operations. It is through this group's actions that it is possible for our government to take action that will stop this infringement on overcrowded ham frequencies.

It's important that such complaints be processed against these intruders. If their intrusion on ham frequencies goes unchallenged, these broadcasters can claim in the future that no one objected to their use of ham frequencies and that they therefore should be allowed to continue to use them legally!

This can happen because of a loophole in the international ham regulations: some frequencies are reserved world-wide for ham use, but other portions of our bands are *shared* with various commercial users in other parts of the world. If there is no official complaint that these commercial stations interfered with legal ham operations, then the commercial boys can legally continue to use ham frequencies. That would be a sneaky way to steal some of our frequencies!

Bandits In Our Brotherhood. The FCC has confirmed its agreement in principle with the concern expressed in this column some time ago regarding the guttersnipe behavior of a growing number of ham radio operators.

In a recent report of its own activities, the FCC had this to say: "The past year has shown a significant trend toward increased on-the-air feuding and use of questionable language in a radio service which historically has prided itself on cooperative self-regulation. Limited manpower has prevented attention to any but the most flagrant cases. Approximately 2800 violation and advisory notices were issued to licensees during the year."

If some of us tend to shrug this off, it should be emphasized this is a pretty serious condemnation of the behavior of some of our brother operators. Never before has the FCC had to make such a criticism of the Amateur Radio Service.

Generally, it has been complimentary about our actions and our service. But now, the federal rule makers are beginning to frown at what some of those in our midst are beginning to do to the once-proud world of amateur radio.

Anyone who has done much listening in recent years can only marvel that the FCC hasn't complained about this before. But now the handwriting is on the wall. The "criminal element" in our midst—the fellows who carry on with dirty language and roughhouse manners—consists of more than just a few scattered cases. Fact is, they've become numerous enough to deserve official condemnation by the government agency that writes the rules we're supposed to live by.

Formerly hams were noted for doing a good job of policing their own bands. As a result, FCC enforcement could be at a minimum and still our bands could be pretty clean in terms of individual behavior. But now sterner measures may become necessary unless hams can clean their own house. There's no room in our wonderful hobby for those who have no respect for one another or for decent public conduct.

Remember, even in the privacy of your home, you're on public display every time you key up the transmitter and talk into the mike. Anyone can be listening just as if you were down at the courthouse square on a soap box.

To protect our hobby and our future op-
(Continued on page 108)

By ARTHUR S. COOKFAIR

FAMOUS PATENTS

No. 763,772

THE FOUR-CIRCUIT TUNING PATENT

In the year 1901, accepted scientific theory said that wireless communication must be limited to about 165 miles. When Guglielmo Marconi announced his plan to transmit signals across the Atlantic, the greatest scientific minds in the world said *it couldn't be done!*

But the 26-year-old engineer went ahead and invented a better "wireless" system and, on Dec. 13, 1901, used it in the first transatlantic transmission. He had done the thing that *couldn't be done.*

The irony of it is that *40 years later* the Supreme Court of the United States found his claim to that accomplishment invalid.

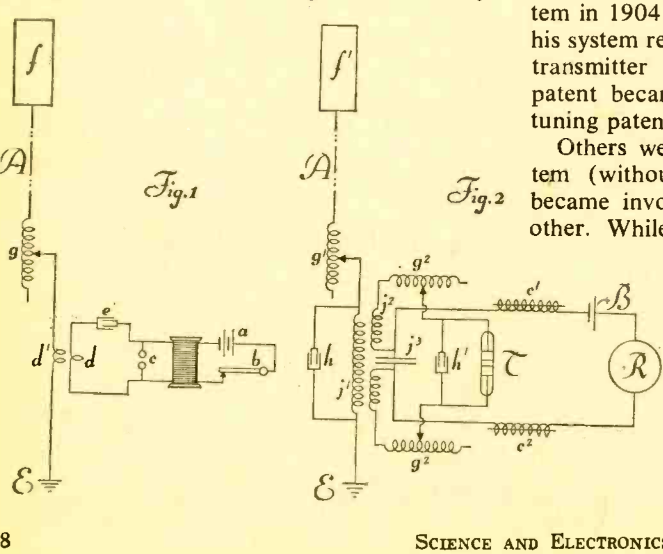
The pessimistic predictions of the turn-of-the-century scientists were based on the *line-of-sight theory*. According to that theory, radio waves, which travel in a straight line, would *not* follow the curve of the earth, but would go off into space. Despite the gloomy forecasts of failure, Marconi succeeded in sending radio waves across the Atlantic Ocean. Explanations were quick to follow. The following year Sir Oliver Heaviside and Arthur Kennelly showed that radio waves are bounced back to earth by an ionized layer in the stratosphere (the "Heaviside-Kennelly layer").

Marconi's achievement was acclaimed by the scientific world. But it's one thing to convince a group of scientists and quite another to convince a group of lawyers and judges. In the legal world, the young Italian's troubles were just beginning.

Marconi patented his improved radio system in 1904 (Patent No. 763,772.) Because his system required two tuning circuits in the transmitter and two in the receiver, the patent became known as the "four-circuit tuning patent."

Others were quick to use Marconi's system (without permission) and the patent became involved in one law suit after another. While the rest of the world acknowledged the inventor's accomplishment, lawyers and judges continued to argue about it.

(Continued on page 109)

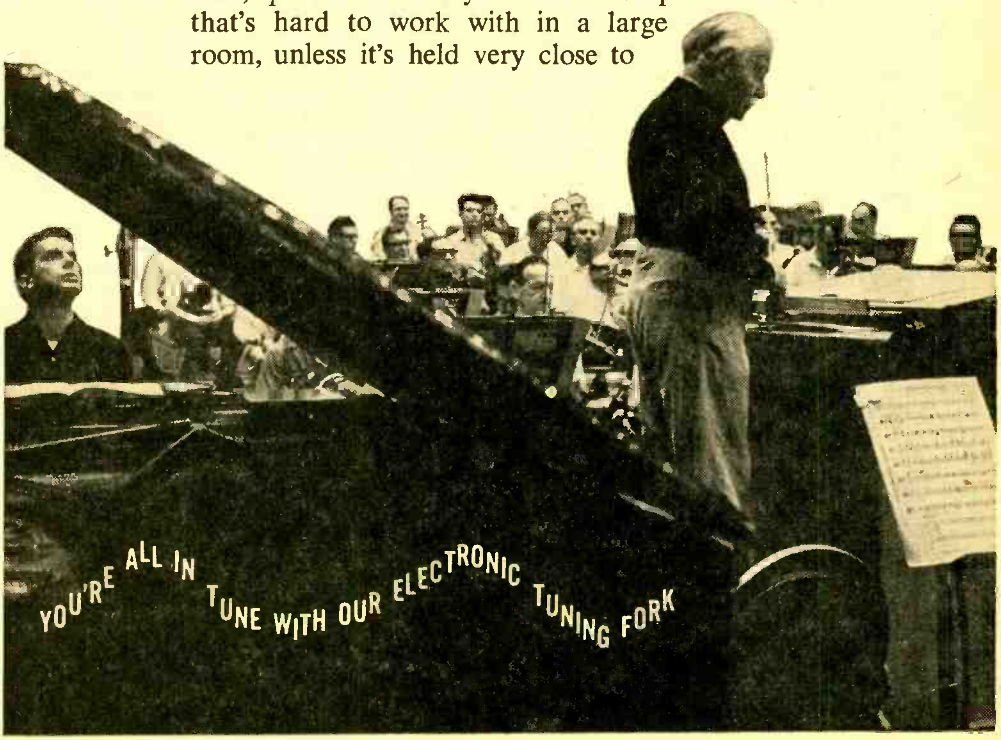


Marconi's four-circuit tuning patent filed on June 28, 1904 illustrated circuits for both his transmitter (Fig. 1) and his long-wave receiver (Fig. 2).

PERPETUAL MOTION FREQ STANDARD

by Ron Michaels

Bach or Rock . . . no matter what kind of music you make, you'll make it better if the instrument you play is in tune. Obviously, if this statement is true for one instrument—and who will dispute it—it's unquestionably true for an instrumental group. Trouble is, tuning up an assembly of different instruments can be a problem: none of the standard assortment of tuning aids (pitch pipes, whistles, etc.) is really very accurate. On the other hand, the tuning fork, a universal standard for musical tone, produces a very low-level output that's hard to work with in a large room, unless it's held very close to

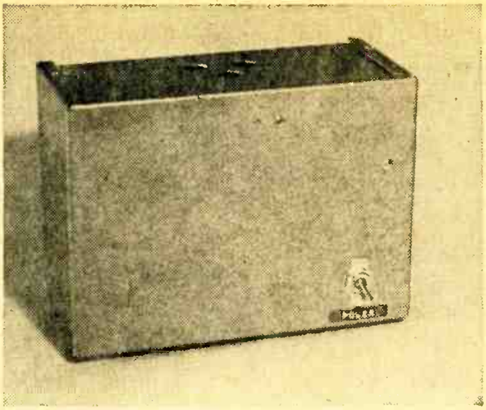


FREQ STANDARD

your ear. For this reason the fork must be passed from player to player—a time-consuming job.

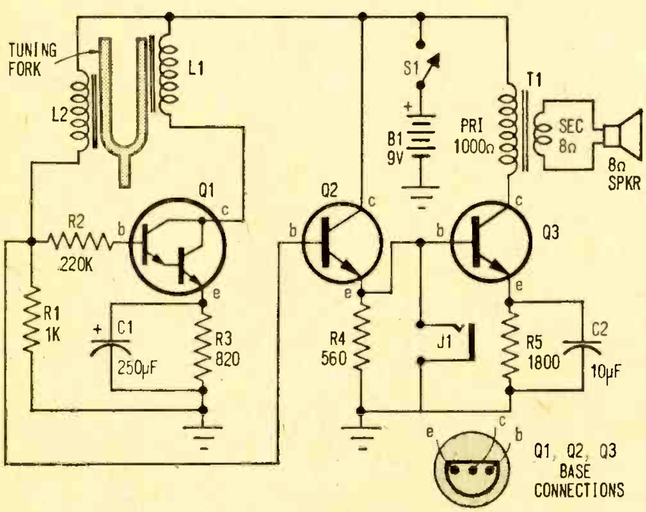
Our amplified electronic tuning fork oscillator will lick this problem. The heart of this unit is a conventional tuning fork, that produces a pure sine wave output that is absolutely accurate. Its electronic circuitry is arranged so that the tone output is continuous and at sufficient volume from the built-in loudspeaker for most group applications. It's not necessary to repeat striking it during tune-up-time.

How It Works. Q1, a Darlington amplifier, is connected as an oscillator that, suspiciously, looks like any conventional feedback oscillator configuration. And so it is—with one major difference: the collector and base inductors (coils L1 and L2) are coupled together via the tuning fork. In essence, this circuit can be compared to a dog chasing its own tail.



Completed perpetual motion Freq Standard. That's on/off switch S1 at lower right, only control to be found anywhere on unit.

The tuning fork vibrations induce a sinusoidal current flow in coil L2, connected to the base of Q1, which is amplified by the transistor and fed through collector coil L1. This produces a magnetic field around L1 that is sinusoidal, forcing the tuning fork to vibrate. Because the fork vibrates at this



Schematic reveals Freq Standard's simple but highly accurate circuit. Mechanical tuning fork controls Q1's frequency of oscillation; audio tone appearing at Q1's base is then amplified and fed to either J1 (for further amplification) or direct to Freq Standard's speaker.

PARTS LIST FOR PERPETUAL MOTION FREQ STANDARD

- B1—9-V battery (Eveready 266 or equiv.)
- C1—250-uF, 12-V electrolytic capacitor
- C2—10-uF, 12-V electrolytic capacitor
- J1—Open-circuit phone jack
- L1, L2—See text
- Q1—2N5306 Darlington Amplifier (GE)
- Q2, Q3—2N5172 transistor (GE)
- R1—1000-ohm, ½-watt resistor
- R2—220,000-ohm, ½-watt resistor
- R3—820-ohm, ½-watt resistor
- R4—560-ohm, ½-watt resistor
- R5—1800-ohm, ½-watt resistor
- S1—Spst toggle switch
- T1—Output transformer: 1000-ohm pri.; 8-ohm sec. (Lafayette 33T8550 or equiv.)
- 1—Tuning fork (see text)
- 1—2½-in., 8-ohm speaker (Lafayette 99T6038 or equiv.)
- Misc.—Aluminum minibox, ¼-round wood molding, epoxy cement, battery strap, tie strip (4 lug), perfboard and push-in terminals, wire, solder, hardware, etc.

fundamental resonant frequency, the output frequency is stable and accurate.

What starts the fork vibrating in the first place? Random electrical noise. The minute you turn *on* the power switch, Q1 amplifies this noise which, in turn, starts the fork vibrating. In a few seconds (typically 5 to 10) the fork stabilizes at its resonant frequency.

Transistors Q2 and Q3 form a straightforward audio amplifier circuit that drives the built-in speaker. The signal to be amplified is taken from the base of Q1, its input, rather than its output, because the sine wave is purer at this point. The trip through the Darlington amplifier tends to distort the waveform.

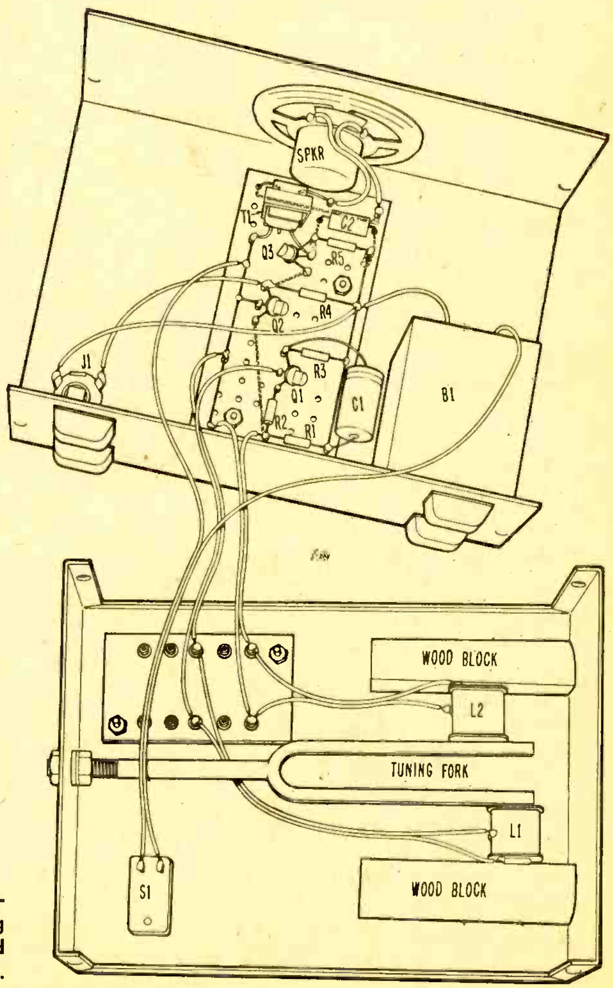
If you desire greater output volume, the oscillator output can be fed from J1 to any external audio amplifier.

Building It. You must use a steel tuning fork, so be sure that the one you buy is not aluminum. A magnet tells all. Your local music supply shop will have (or will be able to order) steel forks in a wide range of fundamental frequencies. The fork we use vibrates at 440 Hz (standard *A*). However, you do not have to stick with a 440-Hz fork as any other frequency will work in the device.

Thread the end of the fork's stem with a steel threading die. The fork will, in all prohability, have a stem diameter of ¼-in., so that a ¼-20 NC die is perfect. This threading enables mounting the fork securely with ¼-20 nuts to the aluminum minibox that serves as the chassis/cabinet (as shown in photo). A secure mount is necessary for proper operation since the fork must be firmly held in place between the two coils.

From Phones To Oscillator. L1 and L2 are coils obtained from a Trim 2000-ohm impedance headphone. Each coil has an impedance of 1000 ohms—the two coils are wired in series in the headphone case to total the 2000 ohms of the unit. To remove the coils, first unscrew the hard rubber cap and lift off the thin metal diaphragm (it is held in place by magnetic attraction). Remove the two bolts that hold the horseshoe magnet to the coil assemblies (each coil assembly consists of a coil of wire mounted on a right angled pole piece to facilitate its mounting to the magnet). Carefully cut the very thin copper wires that join the coils together and also the wires from each coil to its respective output terminal of the headphone.

Firmly fasten coils L1 and L2, each to a separate wooden block, made from ¼-round wood molding approximately 2-in. long, by means of a wood screw through the hole in their pole piece/mounting support



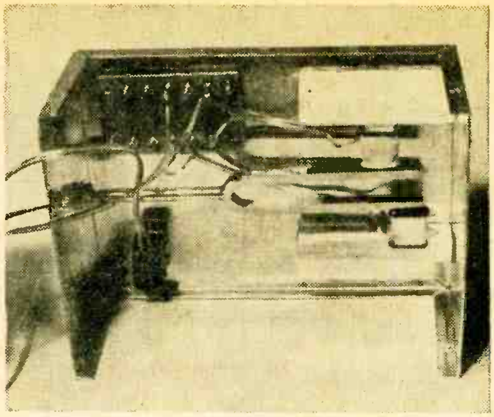
Freq Standard's mechanical construction is simplified by placing tuning fork in bottom of minibox, perfboard and most related components in top.

FREQ STANDARD

into the wood block. Using epoxy cement, cement the wooden blocks to the base of the minibox, as shown in the photograph. The blocks should be positioned so that the space between a tuning fork tine and the pole piece of a coil is 1/16-in. L2 should be mounted so that it is placed about a coil's length further down the length of its respective tine than coil L1 is down its tine (see photo). This positioning will improve signal linearity.

Carefully solder flexible, insulated wire extensions to the fine wires of each coil, of sufficient length to dress them away from the fork and long enough to reach a tie strip. The wire from the coils is very fine and enameled. Be careful in removing the enamel when preparing the fine wire for soldering to the extension leads. Make sure all the enamel has been removed and the copper is bright and clean. Handle the fine wires with the care you would give a delicate piece of china; they are fragile, and can be easily broken at the coil bobbin.

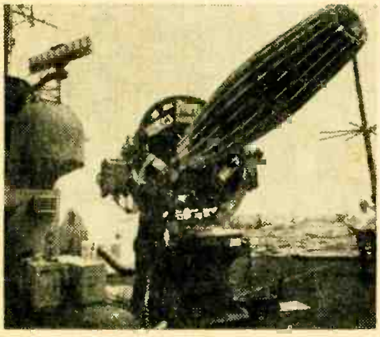
The balance of the components are mounted and wired on a piece of perfboard, using push-in terminals as soldering points.

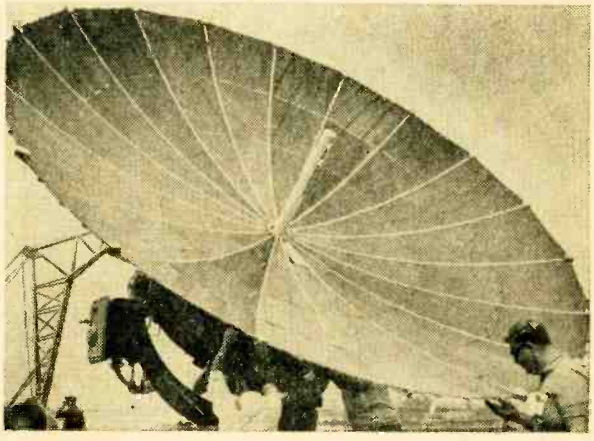


View of bottom portion of Freq Standard, showing tuning fork, coils L1 and L2, and wooden blocks which hold them. See text for recommendations re placement of coils.

Since AC hum pickup (from adjacent power lines) is a potential problem, keep all interconnecting leads as short as possible. Another reason to keep them short is to ensure that they will not droop onto the tuning fork when the minibox is closed. This will affect the fork's output. Note: The phasing of the two coils is important. If you get no tone from the unit after checking out your wiring job, reverse the connections to either one of the coils, but not both. ■

TV's long, long way to Tipperary





It's a long, long way from the Apollo 11's Pacific splashdown point to Tipperary, but Tipperary TV viewers enjoyed live coverage nevertheless. Reason was an unusual furled parabolic reflector antenna which Western Union International used to beam the event to a Comstat communications satellite and thence to TV stations in some 49 countries around the world. The 15-ft antenna was mounted on gyro-stabilized platform on deck of U.S.S. Hornet and maintained unerring aim on satellite regardless of motion of ship.

WHITE'S
RADIO LOG

An up-to-date Directory of North American AM, FM, and TV Stations, including special sections on World-Wide Shortwave Stations and Emergency Stations for Selected Areas

WHITE'S RADIO LOG CONTENTS FOR 1969*

* If you save six consecutive issues of Radio-TV Experimenter and Science and Electronics, you will have a complete White's Radio Log. If you have missed an issue, you may be able to get a copy by writing directly to the publisher stating which issue you wish and enclosing $1.00 for each issue.

WHITE'S

RADIO LOG

U. S. AM Stations by Call Letters

Call	Location	kHz
KAAA	Kingman, Ariz.	1230
KAAY	Little Rock, Ark.	1090
KABC	Los Angeles, Calif.	790
KABH	Midland, Tex.	1510
KABI	Abilene, Kans.	1560
KABL	Oakland, Calif.	960
KABQ	Albuquerque, N.M.	1350
KABR	Aberdeen, S.Dak.	1420
KACE	Riverside, Calif.	1570
KACI	The Dalles, Oreg.	1300
KACL	Santa Barbara, Cal.	1290
KACT	Andrews, Tex.	1360
KACY	Port Hueneme, Calif.	1520
KADA	Ada, Okla.	1230
KADL	Pine Bluff, Ark.	1270
KADO	Marshall, Tex.	1410
KAFE	Sante Fe, N.M.	810
KAFF	Flagstaff, Ariz.	930
KAFY	Bakersfield, Calif.	550
KAGE	Winona, Minn.	1380
KAGH	Crossett, Ark.	800
KAGI	Grants Pass, Oreg.	930
KAGO	Klamath Falls, Oreg.	1150
KAGT	Anacortes, Wash.	1340
KAHI	Auburn, Calif.	950
KAHU	Waipahu, Hawaii	940
KAIM	Honolulu, Hawaii	870
KAIN	Nampa, Ida.	1340
KAIR	Tucson, Ariz.	1490
KAJO	Grants Pass, Oreg.	1270
KAKC	Tulsa, Okla.	970
KAKE	Wichita, Kan.	1240
KALB	Alexandria, La.	580
KALE	Richland, Wash.	960
KALF	Mesa, Ariz.	1510
KALG	Alamogordo, N.Mex.	1230
KALI	San Gabriel, Cal.	1430
KALL	Salt Lake City, Utah	910
KALM	Thayer, Mo.	1290
KALN	Iola, Kan.	1370
KALO	Little Rock, Ark.	1250
KALT	Atlanta, Tex.	900
KALV	Alva, Okla.	1430
KAMD	Camden, Ark.	910
KAMI	Cozad, Neb.	1580
KAML	Kenedy-Karnes City, Tex.	990
KAMO	Rogers, Ark.	1390
KAMP	El Centro, Calif.	1430
KANA	Anaconda, Mont.	580
KAND	Corsicana, Tex.	1340
KANE	New Iberia, La.	1240
KANI	Wharton, Tex.	1500
KANN	Ogden, Utah	1090
KANO	Anoka, Minn.	1470
KANS	Larned, Kan.	1510
KAOH	Duluth, Minn.	1390
KAOK	Lake Charles, La.	1400
KAOL	Carrollton, Mo.	1430
KAOR	Oroville, Calif.	1340
KAPA	Raymond, Wash.	1340
KAPB	Marksville, La.	1370
KAPE	San Antonio, Tex.	1480
KAPI	Pueblo, Colo.	690
KAPR	Douglas, Ariz.	930
KAPS	Mt. Vernon, Wash.	1470
KAPT	Salem, Ore.	1220
KAPY	Port Angeles, Wash.	1290
KARE	Atchison, Kan.	1470
KARI	Blaine, Wash.	550
KARK	Little Rock, Ark.	920
KARM	Fresno, Calif.	1430
KARR	Great Falls, Mont.	1400
KARS	Belen, N.M.	860
KART	Jerome, Idaho	1400
KARV	Russellville, Ark.	1490
KARY	Prosser, Wash.	1310
KASA	Phoenix, Ariz.	1540
KASH	Eugene, Ore.	1590
KASI	Ames, Iowa	1430
KASL	Newcastle, Wyo.	1240
KASM	Albany, Minn.	1150
KASO	Minden, La.	1240
KAST	Astoria, Ore.	1370
KASY	Auburn, Wash.	1220
KATA	Arcata, Calif.	1340
KATE	Albert Lea, Minn.	1450
KATI	Casper, Wyo.	1400
KATL	Miles City, Mont.	1340
KATN	Boise, Ida.	950
KATO	Safford, Ariz.	1230
KATQ	Texarkana, Tex.	940
KATR	Eugene, Ore.	1320
KATY	San Luis Obispo, Cal.	1340
KATZ	St. Louis, Mo.	1600
KAUS	Austin, Minn.	1480
KAVA	Burney, Cal.	1450
KAVE	Carlsbad, N.Mex.	1240
KAVI	Rocky Ford, Colo.	1320
KAVL	Lancaster, Calif.	610

Call	Location	kHz
KAVR	Apple Valley, Calif.	960
KAWA	Waco-Marlin, Tex.	1010
KAWL	York, Neb.	1370
KAWT	Douglas, Ariz.	1450
KAWW	Heber Springs, Ark.	1370
KAYC	Beaumont, Tex.	1450
KAYE	Puyallup, Wash.	1450
KAYG	Lakewood, Wash.	1480
KAYL	Storm Lake, Iowa	990
KAYO	Seattle, Wash.	1150
KAYS	Hays, Kans.	1400
KAYT	Rupert, Idaho	970
KAZA	Gilroy, Cal.	1290
KBAB	Indianola, Iowa	1490
KBAD	Carlsbad, N.M.	740
KBAL	San Saba, Tex.	1410
KBAM	Longview, Wash.	1270
KBAN	Bowie, Tex.	1410
KBAR	Burley, Idaho	1230
KBAT	San Antonio, Tex.	680
KBBA	Benton, Ark.	690
KBBB	Borger, Tex.	1600
KBBC	Centerville, Utah	1600
KBBO	Yakima, Wash.	1390
KBBQ	Burbank, Cal.	1500
KBBR	North Bend, Oreg.	1340
KBBS	Buffalo, Wyo.	1450
KBCH	Oceanlake, Oreg.	1380
KBCL	Shreveport, La.	1220
KBEA	Mission, Kans.	1480
KBEC	Waxahachie, Tex.	1390
KBEE	Modesto, Calif.	970
KBEK	Elk City, Okla.	1240
KBEL	Idabel, Okla.	1240
KBEN	Carrizo Sprgs., Tex.	1450
KBER	San Antonio, Tex.	1150
KBEW	Blue Earth, Minn.	1560
KBFS	Belle Fourche, S.Dak.	1450
KBFW	Bellingham, Wash.	930
KBGH	Memphis, Tex.	1130
KBGN	Caldwell, Idaho	910
KBGO	Waco, Tex.	1580
KBHB	Sturgis, S. D.	810
KBHC	Nashville, Ark.	1260
KBHM	Branson, Mo.	1220
KBHS	Hot Springs, Ark.	590
KBIB	Monette, Ark.	1560
KBIF	Fresno, Calif.	900
KBIG	Avalon, Cal.	740
KBIL	Liberty, Mo.	1140
KBIM	Roswell, N.Mex.	910
KBIS	Bakersfield, Calif.	970
KBIX	Muskogee, Okla.	1490
KBJM	Lemmon, S.D.	1400
KBJS	Sallisaw, Okla.	1510
KBIZ	Ottuwa, Iowa	1240
KBJT	Fordyce, Ark.	1570
KBKR	Baker, Oreg.	1490
KBKW	Aberdeen, Wash.	1450
KBLC	Lakeport, Cal.	1270
KBLE	Seattle, Wash.	1050
KBLF	Red Bluff, Calif.	1490
KBLI	Blackfoot, Idaho	690
KBLL	Helena, Mont.	1240
KBLR	Bolivar, Mo.	1130
KBLT	Big Lake, Tex.	1290
KBLU	Yuma, Ariz.	1320
KBLW	Logan, Utah	1390
KBLY	Gold Beach, Oreg.	1220
KBMI	Henderson, Nev.	1400
KBMN	Bozeman, Mont.	1230
KBMO	Benson, Minn.	1290
KBMR	Bismarck, N. D.	1350
KBMW	Wahpeton, N.D.-Breckenridge, Minn.	1450
KBMY	Billings, Mont.	1240
KBND	Bend, Oreg.	1110
KBOA	Kennett, Mo.	830
KBOE	Oskaloosa, Iowa	740
KBOI	Boise, Ida.	670
KBOK	Malvern, Ark.	1310
KBOL	Boulder, Colo.	1490
KBOM	Bismark-Mandan, N.Dak.	1270
KBON	Omaha, Nebr.	1490
KBOP	Pleasanton, Tex.	1380
KBOR	Brownsville, Tex.	1600
KBOW	Butte, Mont.	550
KBOX	Dallas, Tex.	1480
KBOY	Medford, Oreg.	730
KBPS	Portland, Oreg.	1450
KBRB	Ainsworth, Neb.	1400
KBRC	Mt. Vernon, Wash.	1430
KBRF	Fergus Falls, Minn.	1250
KBRI	Brinkley, Ark.	1570
KBRK	Brookings, S.Dak.	1430
KBRL	McCook, Nebr.	1300
KBRN	Brighton, Colo.	800
KBRO	Bremerton, Wash.	1490
KBRR	Leadville, Colo.	1230
KBRS	Springdale, Ark.	1340
KBRV	Soda Springs, Ida.	790
KBRX	O'Neill, Nebr.	1350
KBRZ	Freeport, Texas	1460
KBSF	Springhill, La.	1460
KBSN	Crane, Tex.	970
KBST	Big Spring, Tex.	1490
KBTA	Batesville, Ark.	1340

Call	Location	kHz
KBTC	Houston, Mo.	1250
KBTM	Jonesboro, Ark.	1230
KBTN	Neosho, Mo.	1420
KBTO	El Dorado, Kans.	1360
KBTR	Denver, Colo.	710
KBUB	Sparks, Nev.	1270
KBUC	San Antonio, Tex.	1310
KBUD	Athens, Tex.	1410
KBUH	Brigham City, Utah	800
KBUN	Bemidji, Minn.	1450
KBUR	Burlington, Iowa	1490
KBUS	Mexia, Tex.	1590
KBUY	Ft. Worth, Tex.	1540
KBUZ	Mesa, Ariz.	1310
KBVM	Lancaster, Calif.	1380
KBWD	Brownwood, Tex.	1380
KBXM	Kennett, Mo.	1540
KBYE	Okla. City, Okla.	890
KBYG	Big Spring, Tex.	1400
KBYP	Shamrock, Tex.	1580
KBYR	Anchorage, Alaska	1270
KBZB	Odessa, Tex.	920
KBZY	Salem, Oreg.	1490
KBZZ	LaJunta, Colo.	1400
KCAB	Dardanelle, Ark.	980
KCAC	Phoenix, Ariz.	1010
KCAD	Abilene, Tex.	1560
KCAL	Redlands, Calif.	1410
KCAM	Glennallen, Alaska	790
KCAN	Canyon, Tex.	1550
KCAP	Helena, Mont.	1340
KCAR	Clarksville, Tex.	1350
KCAS	Slaton, Tex.	1050
KCAT	Pine Bluff, Ark.	1530
KCAW	Port Arthur, Tex.	1510
KCBC	Des Moines, Iowa	1390
KCBD	Lubbock, Tex.	1590
KCBN	Reno, Nev.	1230
KCBQ	San Diego, Calif.	1170
KCBS	San Fran., Calif.	740
KCCB	Corning, Ark.	1260
KCCC	Carlsbad, N.M.	930
KCCL	Paris, Ark.	1460
KCCN	Honolulu, Hawaii	1420
KCCD	Lawton, Okla.	1050
KCCR	Pierre, S. D.	1240
KCCT	Corpus Christi, Tex.	1150
KCCV	Independence, Mo.	1510
KCEE	Tucson, Ariz.	790
KCEY	Tunlock, Calif.	1390
KCFA	Spokane, Wash.	1330
KCFH	Cuero, Tex.	1600
KCFI	Cedar Falls, Iowa	1250
KCGO	Cheyenne, Wyo.	1590
KCHA	Charles City, Iowa	1580
KCHE	Cherokee, Iowa	1440
KCHI	Chillicothe, Mo.	1010
KCHJ	Delano, Calif.	1010
KCHR	Charleston, Mo.	1350
KCHS	Truth or Consequences, New Mexico	1400
KCHV	Coachella, Calif.	970
KCID	Caldwell, Idaho	1490
KCII	Washington, Iowa	1380
KCIJ	Shreveport, La.	980
KCIM	Carroll, Iowa	1380
KCIN	Victorville, Calif.	1590
KCJB	Minot, N.Dak.	910
KCKC	San Bernardino, Cal.	1350
KCKN	Kansas City, Kans.	1340
KCKW	Jena, La.	1480
KCKY	Coolidge, Ariz.	1150
KCLA	Pine Bluff, Ark.	1400
KCLE	Cleburne, Tex.	1120
KCLM	Redding, Cal.	1330
KCLN	Clinton, Iowa	1390
KCLO	Leavenworth, Kans.	1410
KCLR	Ralls, Tex.	1530
KCLS	Flagstaff, Ariz.	600
KCLU	Rolla, Mo.	1590
KCLV	Clovis, N.Mex.	1240
KCLW	Hamilton, Tex.	900
KCLX	Colfax, Wash.	1450
KCMC	Texarkana, Tex.	1230
KCMJ	Palm Sprgs., Calif.	1010
KCMO	Kansas City, Mo.	810
KCMS	Manitou Sprgs., Colo.	1490
KCNI	Broken Bow, Nebr.	1280
KCNO	Alturas, Calif.	570
KCNW	Tulsa, Okla.	1300
KPNW	Eugene, Ore.	1120
KCNY	San Marcos, Tex.	1470
KCOB	Newton, Iowa	1280
KCOG	Centerville, Iowa	1400
KCOH	Houston, Tex.	1430
KCOK	Tulare, Calif.	1270
KCOL	Ft. Collins, Colo.	1410
KCOM	Comanche, Tex.	1550
KCON	Conway, Ark.	1230
KCOR	San Antonio, Tex.	1350
KCOW	Alliance, Nebr.	1400
KCOY	Santa Maria, Cal.	1440
KCPX	Salt Lake City, Utah	1320
KCRA	Sacramento, Calif.	1320
KCRB	Chanute, Kans.	1460
KCRC	Enid, Okla.	1390
KCRG	Cedar Rapids, Iowa	1600

Call	Location	kHz
KCRL	Reno, Nev.	780
KCRM	Crane, Tex.	1380
KCRS	Midland, Tex.	550
KCRT	Trinidad, Colo.	1240
KCRV	Caruthersville, Mo.	1370
KCSJ	Pueblo, Colo.	590
KCSR	Chadron, Nebr.	610
KCTA	Corpus Christi, Tex.	1030
KCTI	Gonzales, Tex.	1450
KCTO	Columbia, La.	1540
KCTY	Salinas, Calif.	980
KCTX	Childress, Tex.	1510
KCUB	Tucson, Ariz.	1290
KCUE	Red Wing, Minn.	1250
KCUZ	Clifton, Ariz.	1490
KCVL	Colville, Wash.	1270
KCVR	Lodi, Calif.	1570
KCYL	Lampasas, Tex.	1450
KCYN	Williams, Ariz.	1240
KDAC	Ft. Bragg, Calif.	1230
KDAK	Carrington, N.D.	1600
KDAL	Duluth, Minn.	610
KDAV	Lubbock, Tex.	580
KDAY	Santa Monica, Calif.	1580
KDB	Santa Barbara, Calif.	1490
KDBM	Dillon, Mont.	800
KDBS	Alexandria, La.	1410
KDCE	Espanola, N.M.	970
KDOA	Dumas, Ark.	1560
KDDD	Dumas, Tex.	800
KDEC	Decorah, Iowa	1240
KDEF	Albuquerque, N.Mex.	1150
KDEN	Denver, Colo.	1340
KDEO	El Cajon, Calif.	910
KDES	Palm Sprgs., Calif.	920
KDET	Center, Tex.	930
KDEW	DeWitt, Ark.	1470
KDEX	Dexter, Mo.	1590
KDFL	Sumner, Wash.	1560
KDFN	Doniphan, Mo.	1500
KDGO	Durango, Colo.	1240
KDHI	Twenty-nine Palms, California	1250
KDHL	Faribault, Minn.	920
KDHN	Dimmitt, Tex.	1470
KDIA	Oakland, Calif.	1310
KDIO	Ortonville, Minn.	1350
KDIX	Dickinson, N.Dak.	1230
KDJI	Holbrook, Ariz.	1270
KDJW	Amarillo, Tex.	1010
KDKA	Pittsburgh, Pa.	1020
KDKD	Clinton, Mo.	1280
KDKO	Littleton, Colo.	1510
KDLA	DeRidder, La.	1010
KDLK	Del Rio, Tex.	1230
KDLM	Detroit Lakes, Minn.	1340
KDLR	Devils Lake, N.Dak.	1240
KDLS	Perry, Iowa	1310
KDMA	Montevideo, Minn.	1450
KDMO	Carthage, Mo.	1490
KDMS	El Dorado, Ark.	1290
KDNC	Spokane, Wash.	1440
KDNT	Denton, Tex.	1440
KDOK	Tyler, Tex.	1490
KDOL	Mojave, Calif.	1340
KDOM	Windom, Minn.	1580
KDON	Salinas, Calif.	1460
KDOT	Scottsdale, Ariz.	1440
KDOV	Medford, Oreg.	1300
KDOX	Marshall, Tex.	1410
KDQN	DeQueen, Ark.	1390
KDRG	Deer Lodge, Mont.	1400
KDRO	Sedalia, Mo.	1490
KDRS	Paragould, Ark.	1490
KDRY	Alamo Hts., Tex.	1110
KDSJ	Deadwood, S.Dak.	980
KDSN	Denison, Ia.	1530
KDSX	Denison-Sherman, Tex.	950
KDTA	Delta, Colo.	1400
KDTH	Dubuque, Iowa	1370
KDUZ	Hutchinson, Minn.	1260
KDWA	Hastings, Minn.	1460
KDWB	St. Paul, Minn.	630
KDWT	Stamford, Tex.	1400
KDXE	No. Little Rock, Ark.	1380
KDXI	Mansfield, La.	1360
KDXU	St. George, Utah	1430
KDYL	Tooele, Utah	990
KDZA	Pueblo, Colo.	1230
KEAN	Brownwood, Tex.	1240
KEAP	Fresno, Calif.	980
KEBE	Jacksonville, Tex.	1400
KECH	Ketchikan, Alaska	620
KEDA	San Antonio, Tex.	1540
KEDD	Dodge City, Kans.	1550
KEDO	Longview, Wash.	1400
KEED	Eugene, Ore.	1450
KEEE	Nacogdoches, Tex.	1230
KEEL	Shreveport, La.	710
KEEN	San Jose, Calif.	1370
KEEP	Twin Falls, Idaho	1450
KEES	Gladewater, Tex.	1430
KEGG	Daingerfield, Tex.	1560
KEHG	Fosston, Minn.	1480
KELA	Centralia-Chokalis, Wash.	1470

Call	Location	kHz
KELD	El Dorado, Ark.	1400
KELI	Tulsa, Okla.	1430
KELK	Elko, Nev.	1240
KELO	Sioux Falls, S.Dak.	1320
KELP	El Paso, Tex.	920
KELR	El Reno, Okla.	1460
KELY	Ely, Nev.	1230
KENA	Mena, Ark.	1450
KENE	Toppenish, Wash.	1490
KENI	Anchorage, Alaska	550
KENM	Portales, N.Mex.	1450
KENN	Farmington, N.M.	1390
KENO	Las Vegas, Nev.	1460
KENR	Houston, Tex.	1070
KENT	Prescott, Ariz.	1340
KEOR	Atoka, Okla.	1110
KEOS	Flagstaff, Ariz.	690
KEPR	Kennevick-Richland-Pasco, Wash.	610
KEPS	Eagle Pass, Tex.	1270
KERB	Kermit, Tex.	600
KERC	Eastland, Tex.	1590
KERG	Eugene, Oreg.	1280
KERN	Bakersfield, Calif.	1410
KERV	Kerrville, Tex.	1230
KESM	Eldorado Springs, Mo.	1580
KEST	Boise, Idaho	790
KETX	Livingston, Tex.	1440
KEUN	Eunice, La.	1490
KEVA	Evanston, Wyo.	1240
KEVL	White Castle, La.	1590
KEVT	Tucson, Ariz.	690
KEWE	Ft. Collins, Colo.	600
KEWI	Topeka, Kans.	1440
KEWQ	Paradise, Cal.	930
KEX	Portland, Oreg.	1190
KEXO	Grand Junc., Colo.	1230
KEXS	Excelsior Springs, Mo.	1090
KEYD	Oakes, N.Dak.	1220
KEYE	Perryton, Tex.	1400
KEYJ	Jamestown, N.Dak.	1400
KEYL	Long Prairie, Minn.	1400
KEYN	Wichita, Kan.	900
KEYR	Terrytown, Nebr.	690
KEYS	Corpus Christi, Tex.	1440
KEYY	Provo, Utah	1450
KEYZ	Williston, N.Dak.	1360
KEZU	Rapid City, S.Dak.	920
KEZY	Anaheim, Calif.	1190
KFAB	Omaha, Nebr.	1110
KFAC	Los Angeles, Calif.	1330
KFAH	Lakewood Center, Wash.	1480
KFAL	Fulton, Mo.	900
KFAM	St. Cloud, Minn.	1450
KFAR	Fairbanks, Alaska	660
KFAX	San Francisco, Calif.	1100
KFAY	Fayetteville, Ark.	1250
KFBC	Cheyenne, Wyo.	1240
KFBD	Waynesville, Mo.	1270
KFBK	Sacramento, Calif.	1530
KFBR	Nogales, Ariz.	1340
KFCB	Redfield, S. Dak.	1380
KFDF	Van Buren, Ark.	1580
KFDI	Wichita, Kansas	1070
KFDR	Grand Coulee, Wash.	1360
KFEL	Pueblo, Colo.	970
KFEQ	St. Joseph, Mo.	680
KFFA	Helena, Ark.	1360
KFGO	Fargo, N.D.	790
KFGQ	Boone, Iowa	1260
KFH	Wichita, Kans.	1330
KFI	Los Angeles, Calif.	640
KFIL	Preston, Minn.	1060
KFIR	Sweet Home, Ore.	1370
KFIV	Modesto, Calif.	1360
KFIZ	Fond du Lac, Wis.	1450
KFJB	Marshalltown, Iowa	1230
KFJM	Grand Forks, N.Dak	1370
KFJZ	Ft. Worth, Tex.	1270
KFKA	Greeley, Colo.	1310
KFKF	Bellevue, Wash.	1540
KFKU	Lawrence, Kans.	1250
KFLA	Scott City, Kans.	1310
KFLD	Floydada, Tex.	900
KFLI	Mountain Home, Ida.	1240
KFLJ	Walsenburg, Colo.	1380
KFLN	Baker, Mont.	960
KFLW	Klamath Falls, Oreg.	1450
KFLY	Corvallis, Oreg.	1240
KFMB	San Diego, Cal.	760
KFMI	Tulsa, Okla.	1050
KFML	Denver, Colo.	1390
KFMO	Flat River, Mo.	1240
KFNV	Ferriday, La.	1600
KFNW	Fargo, N.Dak.	900
KFOR	Lincoln, Nebr.	1240
KFOX	Long Beach, Calif.	1280
KFPW	Ft. Smith, Ark.	1230
KFQD	Anchorage, Alaska	750
KFRA	Franklin, La.	1390
KFRB	Fairbanks, Alaska	900
KFRC	San Francisco, Calif.	610
KFRD	Rosenberg-Richmond, Tex.	980
KFRE	Fresno, Calif.	940
KFRM	Salina, Kan.	550
KFRO	Longview, Tex.	1370
KFRU	Columbia, Mo.	1400
KFSA	Ft. Smith, Ark.	950
KFSB	Joplin, Mo.	1310
KFSC	Denver, Colo.	1220
KFST	Ft. Stockton, Tex.	860
KFTM	Ft. Morgan, Colo.	1400
KFTW	Frederickstown, Mo.	1450
KFUN	Las Vegas, N.Mex.	1230
KFUO	Clayton, Mo.	850
KFVS	Cape Girardeau, Mo.	960
KFWB	Los Angeles, Calif.	980
KFXD	Nampa, Idaho	580
KFXM	San Bernardino, Calif.	590
KFYN	Bonham, Tex.	1420
KFYO	Lubbock, Tex.	790
KFYR	Bismarck, N.Dak.	550
KGA	Spokane, Wash.	1510
KGAF	Gainesville, Tex.	1580
KGAK	Gallup, N.Mex.	1330
KGAL	Lebanon, Oreg.	920
KGAR	Vancouver, Wash.	1550
KGAS	Carthage, Tex.	1590
KGAY	Salem, Oreg.	1430
KGB	San Diego, Calif.	1360
KGBC	Galveston, Tex.	1540
KGBS	Los Angeles, Calif.	1020
KGBT	Harlingen, Tex.	1530
KGBX	Springfield, Mo.	1260
KGCA	Rugby, N.D.	1450
KGCL	East Prairie, Mo.	1080
KGCX	Sidney, Mont.	1480
KGDN	Edmonds, Wash.	630
KGEE	Bakersfield, Calif.	1230
KGEK	Sterling, Colo.	1230
KGEM	Boise, Idaho	1140
KGEN	Tulare, Calif.	1370
KGER	Long Beach, Calif.	1390
KGEZ	Kalispell, Mont.	600
KGFF	Shawnee, Okla.	1450
KGFJ	Los Angeles, Calif.	1230
KGFL	Roswell, N.M.	1430
KGFW	Kearney, Nebr.	1340
KGFX	Pierre, S.D.	1060
KGGF	Coffeyville, Kans.	690
KGGM	Albuquerque, N.Mex.	610
KGHL	Billings, Mont.	790
KGHM	Brookfield, Mo.	1470
KGHO	Hoquiam, Wash.	1560
KGHS	International Falls, Minn.	1230
KGIL	San Fernando, Calif.	1260
KGIW	Alamosa, Colo.	1450
KGKL	San Angelo, Tex.	960
KGKO	Benton, Ark.	850
KGLA	Gretna, La.	1540
KGLC	Miami, Okla.	910
KGLE	Glendive, Mont.	590
KGLM	Avalon, Calif.	740
KGLN	Glenwood Sprgs., Colo.	980
KGLO	Mason City, Iowa	1300
KGLU	Safford, Ariz.	1480
KGMB	Honolulu, Hawaii	590
KGMC	Englewood, Colo.	1150
KGMI	Bellingham, Wash.	790
KGMO	Cape Girardeau, Mo.	1220
KGMR	Jacksonville, Ark.	1500
KGMS	Sacramento, Calif.	1380
KGMT	Fairbury, Nebr.	1310
KGMY	Missoula, Mont.	1450
KGNB	New Braunfels, Tex.	1420
KGNC	Amarillo, Tex.	710
KGNO	Dodge City, Kans.	1370
KGNS	Laredo, Tex.	1300
KGNU	Santa Clara, Cal.	1430
KGO	San Francisco, Calif.	810
KGOL	Palm Desert, Cal.	1270
KGOS	Torrington, Wyo.	1490
KGPC	Grafton, N.Dak.	1340
KGRB	West Loma, Cal.	900
KGRI	Henderson, Tex.	1000
KGRL	Bend, Oreg.	940
KGRN	Grinnell, Iowa	1410
KGRO	Pampa, Tex.	1230
KGRS	Pasco, Wash.	1340
KGRT	Las Cruces, N.Mex.	570
KGST	Fresno, Calif.	1600
KGTN	Georgetown, Tex.	1530
KGU	Honolulu, Hawaii	760
KGUC	Gunnison, Colo.	1490
KGUD	Santa Barbara, Calif.	990
KGUL	Port Lavaca, Tex.	1560
KGVL	Greenville, Tex.	1400
KGVO	Missoula, Mont.	1290
KGVW	Belgrade, Mont.	630
KGW	Portland, Oreg.	620
KGWA	Enid, Okla.	960
KGY	Olympia, Wash.	1240
KGYN	Guymon, Okla.	1210
KHAC	Window Rock, Ariz.	1300
KHAD	DeSoto, Mo.	1190
KHAI	Honolulu, Hawaii	1090
KHAK	Cedar Rapids, Iowa	1360
KHAL	Homer, La.	1320
KHAP	Aztec, N.M.	1340
KHAR	Anchorage, Alaska	590
KHAS	Hastings, Nebr.	1230
KHAT	Phoenix, Ariz.	1480
KHBM	Monticello, Ark.	1430
KHBR	Hillsboro, Tex.	1560
KHDN	Hardin, Mont.	1230
KHEM	Big Springs, Tex.	1270
KHEN	Henryetta, Okla.	1590
KHEP	Phoenix, Ariz.	1280
KHEY	El Paso, Tex.	690
KHFH	Sierra Vista, Ariz.	1420
KHFI	Austin, Tex.	970
KHHH	Pampa, Tex.	1230
KHIL	Willcox, Ariz.	1250
KHIT	Walla Walla, Wash.	1320
KHJ	Los Angeles, Calif.	930
KHLO	Hilo, Hawaii	850
KHMO	Hannibal, Mo.	1070
KHOB	Hobbs, N.Mex.	1390
KHOG	Fayetteville, Ark.	1440
KHOS	Tucson, Ariz.	940
KHOT	Madera, Calif.	1250
KHOW	Denver, Colo.	630
KHOZ	Harrison, Ark.	900
KHQ	Spokane, Wash.	590
KHRB	Lockhart, Tex.	1060
KHRT	Minot, N. D.	1320
KHSJ	Hemet, Calif.	1320
KHSL	Chico, Calif.	1290
KHUB	Fremont, Nebr.	1340
KHUZ	Borger, Tex.	1490
KHVH	Honolulu, Hawaii	1040
KHYT	Tucson, Ariz.	1330
KIBE	Palo Alto, Calif.	1220
KIBH	Seward, Alaska	950
KIBL	Beeville, Tex.	1490
KIBS	Bishop, Calif.	1230
KICA	Clovis, N.M.	980
KICD	Spencer, Iowa	1240
KICK	Springfield, Mo.	1340
KICO	Calexico, Calif.	1490
KICS	Hastings, Neb.	1550
KICX	McCook, Neb.	1360
KICY	Nome, Alaska	850
KID	Idaho Falls, Idaho	590
KIDD	Monterey, Calif.	630
KIDO	Boise, Idaho	630
KIEV	Glendale, Calif.	870
KIFG	Iowa Falls, Ia.	1510
KIFN	Phoenix, Ariz.	860
KIFW	Sitka, Alaska	1230
KIGO	St. Anthony, Ida.	1400
KIHN	Hugo, Okla.	1340
KIHR	Hood River, Oreg.	1340
KIJV	Huron, S.Dak.	1340
KIKI	Honolulu, Hawaii	830
KIKK	Pasadena, Tex.	650
KIKO	Miami, Ariz.	1340
KIKS	Sulphur, La.	1310
KIKX	Tucson, Ariz.	580
KIKZ	Seminole, Tex.	1250
KILE	Galveston, Tex.	1400
KILO	Grand Forks, S.Dak.	1440
KILR	Estherville, Ia.	1070
KILT	Houston, Tex.	610
KIMA	Yakima, Wash.	1460
KIMB	Kimball, Nebr.	1260
KIML	Gillette, Wyo.	1270
KIMM	Rapid City, S.D.	1150
KIMN	Denver, Colo.	950
KIMP	Mt. Pleasant, Tex.	960
KIND	Independence, Kans.	1010
KINE	Kingsville, Tex.	1330
KING	Seattle, Wash.	1090
KINN	Alamagordo, N. M.	1270
KINO	Winslow, Ariz.	1230
KINS	Eureka, Calif	980
KINT	El Paso, Tex.	1590
KINY	Juneau, Alaska	800
KIOA	Des Moines, Iowa	940
KIOT	Barstow, Calif.	1310
KIOX	Bay City, Tex.	1270
KIQS	Willows, Calif.	1560
KIRL	St. Charles, Mo.	1460
KIRO	Seattle, Wash.	710
KIRT	Mission, Tex.	1580
KIRV	Fresno, Cal.	1510
KIRX	Kirksville, Mo.	1450
KISD	Sioux Falls, S.Dak.	1230
KISN	Vancouver, Wash.	910
KIST	Santa Barbara, Calif.	1340
KIT	Yakima, Wash.	1280
KITE	San Antonio, Tex.	930
KITI	Chahalis-Centralia, Wash.	1420
KITN	Olympia, Wash.	920
KIUL	Garden City, Kans.	1240
KIUN	Pecos, Tex.	1400
KIUP	Durango, Colo.	930
KIVY	Crockett, Tex.	1290
KIWA	Sheldon, Iowa	1550
KIXF	Fortuna, Cal.	1090
KIXI	Seattle, Wash.	910
KIXL	Dallas, Tex.	1040
KIXX	Provo, Utah	1400
KIXZ	Amarillo, Tex.	940
KIZZ	El Paso, Tex.	1150
KJAM	Madison, S.Dak.	1390
KJAN	Atlantic, Iowa	1220
KJAX	Santa Rosa, Calif.	1150
KJAY	Sacramento, Calif.	1430
KJBC	Midland, Tex.	1150
KJCF	Festus, Mo.	1400
KJCK	Junction City, Kans.	1420
KJDY	John Day, Ore.	1400
KJEF	Jennings, La.	1290
KJEM	Oklahoma City, Okla.	800
KJET	Beaumont, Tex.	1380
KJFJ	Webster City, Iowa	1570
KJIM	Ft. Worth, Tex.	870
KJIN	Houma, La.	1490
KJLT	North Platte, Nebr.	970
KJNO	Juneau, Alaska	630
KJNP	North Pole, Alaska	1170
KJOE	Shreveport, La.	1480
KJOY	Stockton, Calif.	1280
KJPW	Waynesville, Mo.	1390
KJR	Seattle, Wash.	950
KJRB	Spokane, Wash.	790
KJRG	Newton, Kans.	950
KJSK	Columbus, Nebr.	900
KJST	Joshua Tree, Cal.	1420
KJWE	Burien, Wash.	800
KJWH	Camden, Ark.	1450
KKAL	Denver City, Tex.	1580
KKAM	Pueblo, Colo.	1350
KKAN	Phillipsburg, Kans.	1490
KKAR	Pomona, Calif.	1220
KKAS	Silsbee, Tex.	1300
KKAT	Roswell, N.M.	1430
KKDA	Grand Prairie, Tex.	730
KKEP	Estes Park, Colo.	1470
KKEY	Portland, Ore.	1150
KKGF	Great Falls, Mont.	1310
KKHI	San Francisco, Calif.	1550
KKIN	Aitkin, Minn.	930
KKIS	Pittsburg, Calif.	990
KKIT	Taos, N.Mex.	1340
KKJO	St. Joseph, Mo.	1550
KKOK	Lompoc, Calif.	1410
KKUA	Honolulu, Hawaii	690
KKUB	Brownfield, Tex.	1300
KLAC	Los Angeles, Calif.	570
KLAD	Klamath Falls, Oreg.	960
KLAK	Lakewood, Colo.	1600
KLAM	Cordova, Alaska	1450
KLAN	Lemoore, Calif.	1320
KLAV	Las Vegas, Nev.	1230
KLBK	Lubbock, Tex.	1340
KLBM	La Grande, Oreg.	1450
KLBS	Los Banos, Calif.	1330
KLCB	Libby, Mont.	1230
KLCN	Blytheville, Ark.	910
KLCO	Poteau, Okla.	1280
KLEA	Lovington, N.Mex.	630
KLEB	Golden Meadow, La.	1600
KLEE	Ottumwa, Iowa	1480
KLEI	Kailua, Hawaii	1130
KLEM	LeMars, Iowa	1410
KLEN	Killeen, Tex.	1050
KLEO	Wichita, Kans.	1480
KLER	Orofino, Idaho	950
KLEX	Lexington, Mo.	1570
KLEY	Wellington, Kan.	1130
KLFB	Lubbock, Tex.	1420
KLFD	Litchfield, Minn.	1410
KLGA	Algona, Iowa	1600
KLGR	Redwood Falls, Minn.	1490
KLIB	Liberal, Kans.	1470
KLIC	Monroe, La.	1230
KLID	Poplar Bluff, Mo.	1340
KLIF	Dallas, Tex.	1190
KLIK	Jefferson City, Mo.	950
KLIN	Lincoln, Nebr.	1400

Are your home-town AM stations listed correctly in *White's Radio Log?* If you believe there is a correction called for in *White's* listings, please check first with your local station. For each callsign obtain the correct city location, frequency, and power. (Remember, even though your local paper may list a station as a "home-town" station, it may be officially licensed by the FCC for operation in the next city.) Get all the facts on a piece of paper (be very brief), include your name and address, and mail to *White's Radio Log*, RADIO-TV EXPERIMENTER, 229 Park Avenue South, New York, N. Y. 10003. Your help in contributing to the accuracy and completeness of *White's Radio Log* will be sincerely appreciated. See page 96. —*Editor*

WHITE'S RADIO LOG

Call	Location	kHz
KLIP	Fowler, Calif.	1220
KLIQ	Portland, Oreg.	1290
KLIR	Denver, Colo.	990
KLIV	San Jose, Cal.	1590
KLIX	Twin Falls, Idaho	1310
KLIZ	Brainerd, Minn.	1380
KLKC	Parsons, Kans.	1540
KLLA	Leesville, La.	1570
KLLL	Lubbock, Tex.	1460
KLME	Laramie, Wyo.	1490
KLMO	Longmont, Colo.	1060
KLMR	Lamar, Colo.	920
KLMS	Lincoln, Nebr.	1480
KLMX	Clayton, N.Mex.	1450
KLO	Ogden, Utah	1430
KLOA	Ridgecrest, Calif	1240
KLOC	Ceres, Calif.	920
KLOE	Goodland, Kans.	730
KLOG	Kelso, Wash.	1490
KLOH	Pipestone, Minn.	1050
KLOK	San Jose, Calif.	1170
KLOL	Lincoln, Neb.	1530
KLOM	Lompoc, Calif.	1330
KLOO	Corvallis, Ore.	1340
KLOU	Lake Charles, La.	1580
KLOW	Loveland, Colo.	1570
KLPL	Lake Providence, La.	1050
KLPM	Minot, N.Dak.	1390
KLPR	Okla. City, Okla.	1140
KLPW	Union, Mo.	1220
KLRA	Little Rock, Ark.	1010
KLRS	Mountain Grove, Mo.	1360
KLSI	Salina, Kan.	910
KLTF	Little Falls, Minn.	960
KLTI	Macon, Mo.	1560
KLTR	Blackwell, Okla.	1580
KLTZ	Glasgow, Mont.	1240
KLUB	Salt Lake City, Utah	570
KLUC	Las Vegas, Nev.	1140
KLUE	Longview, Tex.	1280
KLUV	Haynesville, La.	1580
KLVI	Beaumont, Tex.	560
KLVL	Pasadena, Tex.	1480
KLVT	Levelland, Tex.	1230
KLWN	Lawrence, Kans.	1320
KLWT	Lebanon, Mo.	1230
KLWW	Cedar Rapids, Iowa	1450
KLYD	Bakersfield, Calif.	1350
KLYQ	Hamilton, Mont.	980
KLYR	Clarksville, Ark.	1360
KLZ	Denver, Colo.	560
KMA	Shenandoah, Iowa	960
KMAC	San Antonio, Tex.	630
KMAD	Madill, Okla.	1550
KMAK	Fresno, Calif.	1340
KMAM	Butler, Mo.	1530
KMAN	Manhattan, Kans.	1350
KMAQ	Maquoketa, Iowa	1320
KMAR	Winnsboro, La.	1570
KMAS	Shelton, Wash.	1280
KMAV	Mayville, N.D.	1520
KMBL	Junction, Tex.	1450
KMBY	Monterey, Calif.	1240
KMBZ	Kansas City, Mo.	980
KMCD	Fairfield, Iowa	1570
KMCL	McCall, Ida.	1240
KMCM	McMinnville, Oreg.	1260
KMCO	Conroe, Tex.	900
KMCW	Augusta, Ark.	1190
KMDO	Ft. Scott, Kans.	1600
KMED	Medford, Oreg.	1440
KMEL	Wenatchee, Wash.	1340
KMEN	San Bernardino, Cal.	1290
KMEO	Phoenix, Ariz.	740
KMER	Kemmerer, Wyo.	950
KMFB	Mendocino, Cal.	1300
KMHL	Marshall, Minn.	1400
KMHT	Marshall, Tex.	1450
KMIL	Cameron, Tex.	1330
KMIN	Grants, N.M.	980
KMIS	Portageville, Mo.	1050
KMJ	Fresno, Calif.	580
KMLB	Monroe, La.	1440
KMLO	Vista, Cal.	1000
KMMJ	Grand Island, Nebr.	750
KMMO	Marshall, Mo.	1300
KMNS	Sioux City, Iowa	620
KMO	Tacoma, Wash.	1360
KMON	Great Falls, Mont.	560
KMOR	Murray, Utah	1230
KMOX	St. Louis, Mo.	1120
KMPC	Los Angeles, Calif.	710
KMPG	Hollister, Cal.	1540
KMPL	Sikeston, Mo.	1520
KMRC	Morgan City, La.	1430
KMRE	Anderson, Cal.	1580
KMRS	Morris, Minn.	1230
KMUL	Muleshoe, Tex.	1380
KMUS	Muskogee, Okla.	1380
KMVI	Wailuku, Hawaii	550

Call	Location	kHz
KMYC	Marysville, Calif.	1410
KMYO	Little Rock, Ark.	1050
KNAB	Burlington, Colo.	1140
KNAF	Fredericksburg, Tex.	910
KNAK	Salt Lake City, Utah	1280
KNAL	Victoria, Tex.	1410
KNBA	Vallejo, Calif.	1190
KNBI	Norton, Kan.	1530
KNBR	San Francisco, Cal.	680
KNBY	Newport, Ark.	1280
KNCB	Vivian, La.	1600
KNCK	Concordia, Kans.	1390
KNCY	Nebraska City, Nebr.	1600
KNDC	Hettinger, N.Dak.	1490
KNDI	Honolulu, Hawaii	1270
KNDK	Langdon, N. D.	1080
KNDY	Marysville, Kans.	1570
KNEA	Jonesboro, Ark.	970
KNEB	Scottsbluff, Nebr.	960
KNED	McAlester, Okla.	1150
KNEI	Waukon, Ia.	1140
KNEL	Brady, Tex.	1490
KNEM	Nevada, Mo.	1240
KNET	Palestine, Tex.	1450
KNEW	Oakland, Cal.	910
KNEX	McPherson, Kans.	1540
KNEZ	Lompoc, Calif.	960
KNFT	Bayard, N.M.	950
KNGS	Hanford, Calif.	620
KNIA	Knoxville, Iowa	1320
KNIC	Winfield, Kan.	1550
KNIM	Maryville, Mo.	1580
KNIN	Wichita Falls, Tex.	990
KNIR	New Iberia, La.	1360
KNIT	Abilene, Tex.	1280
KNLV	Ord, Neb.	1060
KNND	Cottage Grove, Oreg.	1400
KNNN	Friona, Tex.	1070
KNOC	Natchitoches, La.	1450
KNOE	Monroe, La.	540
KNOK	Ft. Worth, Tex.	970
KNOP	N. Platte, Nebr.	1410
KNOR	Norman, Okla.	1400
KNOT	Prescott, Ariz.	1450
KNOW	Austin, Tex.	1490
KNOX	Grand Forks, N.Dak.	1310
KNPT	Newport, Ore.	1310
KNUI	Makawao, Hawaii	1310
KNUJ	New Ulm, Minn.	860
KNUZ	Houston, Tex.	1230
KNWC	Sioux Falls, S.D.	1270
KNWS	Waterloo, Iowa	1090
KNX	Los Angeles, Calif.	1070
KOA	Denver, Colo.	850
KOAC	Corvallis, Oreg.	550
KOAD	Lemoore, Calif.	1240
KOAG	Arroyo Grande, Cal.	1280
KOAK	Red Oak, Ia.	1080
KOAL	Price, Utah	1230
KOAM	Pittsburg, Kans.	860
KOB	Albuquerque, N.Mex.	770
KOBE	Las Cruces, N.Mex.	1450
KOBH	Hot Springs, S.Dak.	580
KOBY	Reno, Nev.	1550
KOCA	Kilgore, Tex.	1240
KOCY	Oklahoma City, Okla.	1340
KODA	Houston, Tex.	1010
KODE	Joplin, Mo.	1230
KODI	Cody, Wyo.	1400
KODL	The Dalles, Oreg.	1440
KODY	North Platte, Nebr.	1240
KOEL	Oelwein, Iowa	950
KOFE	St. Maries, Idaho	1480
KOFI	Kalispell, Mont.	1180
KOFO	Ottawa, Kans.	1220
KOFY	San Mateo, Calif.	1050
KOGA	Ogallala, Nebr.	930
KOGO	San Diego, Calif.	600
KOGT	Orange, Tex.	1600
KOH	Reno, Nev.	630
KOHI	St. Helens, Ore.	1600
KOHO	Honolulu, Hawaii	1170
KOHU	Hermiston, Oreg.	1570
KOIL	Omaha, Nebr.	1290
KOIN	Portland, Oreg.	970
KOJM	Havre, Mont.	610
KOKA	Shreveport, La.	1550
KOKE	Austin, Tex.	1370
KOKL	Okmulgee, Okla.	1240
KOKO	Warrensburg, Mo.	1450
KOKX	Keokuk, Iowa	1310
KOKY	Little Rock, Ark.	1440
KOL	Seattle, Wash.	1300
KOLD	Tucson, Ariz.	1450
KOLE	Port Arthur, Tex.	1340
KOLI	Coalinga, Cal.	1050
KOLJ	Quanah, Tex.	1150
KOLM	Rochester, Minn.	1520
KOLO	Reno, Nev.	920
KOLS	Pryor, Okla.	1570
KOLT	Scottsbluff, Nebr.	1320
KOLY	Mobridge, S.Dak.	1300
KOMA	Okla. City, Okla.	1520
KOMO	Seattle, Wash.	1000
KOMW	Omak, Wash.	680
KOMY	Watsonville, Calif.	1340
KONE	Reno, Nev.	1450
KONG	Visalia, Calif.	1400
KONI	Spanish Fork, Utah	1480
KONO	San Antonio, Tex.	860
KONP	Port Angeles, Wash.	1450
KOOD	Lakewood Center, Wash.	1480

Call	Location	kHz
KOOK	Billings, Mont.	970
KOOL	Phoenix, Ariz.	960
KOOO	Omaha, Nebr.	1420
KOOS	Coos Bay, Oreg.	1230
KOPR	Butte, Mont.	550
KOPY	Alice, Tex.	1070
KOQT	Bellingham, Wash.	1550
KORA	Bryan, Tex.	1240
KORC	Mineral Wells, Tex.	1140
KORD	Pasco, Wash.	910
KORE	Springfield-Eugene, Ore.	1050
KORK	Las Vegas, Nev.	920
KORL	Honolulu, Hawaii	650
KORN	Mitchell, S.Dak.	1490
KORT	Grangeville, Idaho	1230
KOSE	Osceola, Ark.	860
KOSG	Panshuska, Okla.	1500
KOSI	Aurora, Colo.	1430
KOSY	Texarkana, Ark.	790
KOTA	Rapid City, S.Dak.	1380
KOTN	Pine Bluff, Ark.	1490
KOTS	Deming, N.M.	1230
KOUR	Independence, Iowa	1220
KOVC	Valley City, N.Dak.	1490
KOVE	Lander, Wyo.	1330
KOVO	Provo, Utah	960
KOWB	Laramie, Wyo.	1290
KOWL	South Lake Tahoe, Cal.	1490
KOWN	Escondido, Calif.	1450
KOXR	Oxnard, Calif.	910
KOY	Phoenix, Ariz.	550
KOYL	Odessa, Tex.	1310
KOYN	Billings, Mont.	910
KOZA	Odessa, Tex.	1230
KOZE	Lewiston, Idaho	1300
KOZI	Chelan, Wash.	1220
KOZN	Omaha, Neb.	660
KOZY	Grand Rapids, Minn.	1490
KPAC	Port Arthur, Tex.	1250
KPAL	Palm Springs, Calif.	1450
KPAM	Portland, Oreg.	1410
KPAN	Hereford, Tex.	860
KPAR	Albuquerque, N.M.	1190
KPAS	Banning, Calif.	1490
KPAT	Berkeley, Calif.	1400
KPAY	Chico, Calif.	1060
KPBA	Pine Bluff, Ark.	1590
KPBC	Port Sulphur, La.	1510
KPCA	Marked Tree, Ark.	1580
KPCO	Quincy, Cal.	1370
KPCR	Bowling Green, Mo.	1530
KPDN	Pampa, Tex.	1340
KPDQ	Portland, Oreg.	800
KPEG	Spokane, Wash.	1380
KPEL	Lafayette, La.	1420
KPEP	San Angelo, Tex.	1420
KPET	Lamesa, Tex.	690
KPGE	Page, Ariz.	1340
KPHO	Phoenix, Ariz.	910
KPIK	Colorado Sprgs., Colo.	1580
KPIN	Casa Grande, Ariz.	1260
KPLC	Lake Charles, La.	1470
KPLT	Paris, Tex.	1490
KPLY	Crescent City, Calif.	1240
KPMC	Bakersfield, Calif.	1560
KPNG	Port Neches, Tex.	1150
KPNW	Eugene, Ore.	1120
KPOC	Pocahontas, Ark.	1420
KPOD	Crescent City, Calif.	1310
KPOF	Denver, Colo.	910
KPOI	Honolulu, Hawaii	1380
KPOJ	Portland, Oreg.	1330
KPOL	Los Angeles, Calif.	1540
KPOP	Roseville, Cal.	1110
KPOR	Quincy, Wash.	1370
KPOS	Post, Tex.	1370
KPOW	Powell, Wyo.	1260
KPPC	Pasadena, Calif.	1240
KPQ	Wenatchee, Wash.	560
KPRB	Redmond, Oreg.	1240
KPRC	Houston, Tex.	950
KPRE	Paris, Tex.	1250
KPRK	Livingston, Mont.	1340
KPRL	Paso Robles, Calif.	1230
KPRM	Park Rapids, Minn.	1240
KPRO	Riverside, Calif.	1440
KPRS	Kansas City, Mo.	1590
KPSO	Falfurrias, Tex.	1260
KPST	Preston, Idaho	1340
KPTN	Central Point, Ore.	1400
KPUA	Hilo, Hawaii	970
KPUB,	Pueblo, Colo.	1480
KPUG	Bellingham, Wash.	1170
KPUL	Pullman, Wash.	1150
KPUR	Amarillo, Tex.	1440
KPWB	Piedmont, Mo.	1140
KPXE	Liberty, Tex.	1050
KQAQ	Austin, Minn.	970
KQEN	Roseburg, Ore.	1240
KQEO	Albuquerque, N.Mex.	920
KQIK	Lakeview, Oreg.	1230
KQIL	Grand Junction, Col.	1340
KQIQ	Santa Paula, Cal.	1400
KQMS	Redding, Calif.	1400
KQOT	Yakima, Wash.	930
KQRS	Golden Valley, Minn.	1440
KQV	Pittsburgh, Pa.	1410
KQWB	Fargo, N. D.	1550
KQXI	Arvada, Colo.	1550
KQYX	Joplin, Mo.	1560

Call	Location	kHz
KRAD	E. Grand Forks, Minn.	1590
KRAE	Cheyenne, Wyo.	1480
KRAF	Reedsport, Ore.	1470
KRAI	Craig, Colo.	550
KRAK	Sacramento, Cal.	1140
KRAL	Rawlins, Wyo.	1240
KRAM	Las Vegas, Nev.	920
KRAN	Morton, Tex.	1280
KRAY	Amarillo, Tex.	1360
KRBA	Lufkin, Tex.	1340
KRBC	Abilene, Tex.	1470
KRBI	St. Peter, Minn.	1310
KRBN	Red Lodge, Mont.	1450
KRCB	Council Bluffs, Ia.	1560
KRCK	Ridgecrest, Calif.	1360
KRCO	Prineville, Oreg.	690
KRDD	Roswell, N. M.	1320
KRDG	Redding, Calif.	1230
KRDO	Colo. Springs, Colo.	1240
KRDR	Gresham, Ore.	1230
KRDS	Tolleson, Ariz.	1190
KRDU	Dinuba, Calif.	1240
KRED	Eureka, Cal.	1480
KREH	Oakdale, La.	900
KREI	Farmington, Mo.	800
KREK	Sapulpa, Okla.	1550
KREL	Corona, Cal.	1370
KREM	Spokane, Wash.	970
KREN	Renton, Wash.	1420
KREO	Indio, Calif.	1400
KREW	Sunnyside, Wash.	1230
KREX	Grand Junction, Colo.	1100
KRFO	Owatonna, Minn.	1390
KRFS	Superior, Nebr.	1600
KRGI	Grand Island, Neb.	1430
KRGO	Salt Lake City, Utah	1550
KRGV	Weslaco, Tex.	1290
KRHD	Duncan, Okla.	1350
KRIB	Mason City, Iowa	1490
KRIG	Odessa, Tex.	1410
KRIH	Rayville, La.	990
KRIO	McAllen, Tex.	910
KRIZ	Phoenix, Ariz.	1230
KRKC	King City, Calif.	1490
KRKD	Los Angeles, Calif.	1150
KRKO	Everett, Wash.	1380
KRKT	Albany, Ore.	990
KRLA	Pasadena, Calif.	1110
KRLC	Lewiston, Ida. Clarkston, Wash.	1350
KRLD	Dallas, Tex.	1080
KRLN	Canon City, Colo.	1400
KRLW	Walnut Ridge, Ark.	1320
KRMD	Shreveport, La.	1340
KRME	Hondo, Tex.	1460
KRMG	Tulsa, Okla.	740
KRML	Carmel, Calif.	1410
KRMO	Monett, Mo.	990
KRMS	Osage Beach, Mo.	1150
KRNO	San Bernardino, Calif.	1240
KRNR	Roseburg, Oreg.	1490
KRNS	Burns, Oreg.	1230
KRNT	Des Moines, Iowa	1350
KRNY	Kearney, Nebr.	1460
KROB	Robstown, Tex.	1510
KROC	Rochester, Minn.	1340
KROD	El Paso, Tex.	600
KROE	Sheridan, Wyo.	930
KROF	Abbeville, La.	960
KROP	Brawley, Calif.	1300
KROS	Clinton, Iowa	1340
KROW	Dallas, Ore.	1460
KROX	Crookston, Minn.	1260
KROY	Sacramento, Calif.	1240
KRPL	Moscow, Idaho	1400
KRRR	Ruidoso, N.Mex.	1340
KRRV	Sherman, Tex.	910
KRSA	Alisal, Calif.	1570
KRSC	Othello, Wash.	1400
KRSD	Rapid City, S.Dak.	1340
KRSI	St. Louis Park, Minn.	950
KRSL	Russell, Kans.	990
KRSN	Los Alamos, N.Mex.	1490
KRSP	Salt Lake City, Utah	1060
KRSY	Roswell, N.Mex.	1230
KRTN	Raton, N.Mex.	1490
KRTR	Thermopolis, Wyo.	1490
KRUN	Ballinger, Tex.	1400
KRUS	Ruston, La.	1490
KRUX	Glendale, Ariz.	1360
KRVC	Ashland, Oreg.	1350
KRVN	Lexington, Neb.	880
KRWB	Roseau, Minn.	1410
KRWL	Carson City, Nev.	1300
KRXK	Rexburg, Idaho	1230
KRYS	Corpus Christi, Tex.	1360
KRYT	Colo. Springs, Colo.	1530
KRZE	Farmington, N.M.	1280
KRZY	Albuquerque, N.M.	1450
KSAC	Manhattan, Kans.	580
KSAL	Salina, Kans.	1150
KSAM	Huntsville, Tex.	1490
KSAY	San Francisco, Calif.	1010
KSCB	Liberal, Kans.	600
KSCJ	Sioux City, Iowa	1360
KSCO	Santa Cruz, Calif.	1080
KSD	St. Louis, Mo.	550
KSDN	Aberdeen, S.Dak.	930
KSDO	San Diego, Calif.	1130
KSDR	Waterton, S.Dak.	1480
KSEE	Santa Maria, Calif.	1480
KSEI	Pocatello, Idaho	930

Call	Location	kHz
KSEK	Pittsburg, Kans.	1340
KSEL	Lubbock, Tex.	950
KSEM	Moses Lake, Wash.	1470
KSEN	Shelby, Mont.	1150
KSEO	Durant, Okla.	750
KSET	El Paso, Tex.	1340
KSEW	Sitka, Alaska	1400
KSEY	Seymour, Tex.	1230
KSFA	Nacogdoches, Tex.	860
KSFE	Needles, Calif.	1340
KSFO	San Francisco, Calif.	560
KSGM	Ste. Genevieve, Mo.	1340
KSGT	Jackson, Wyo.	1340
KSHA	Medford, Ore.	860
KSIB	Creston, Iowa	1520
KSID	Sidney, Nebr.	1340
KSIG	Crowley, La.	1450
KSIL	Silver City, N.Mex.	1340
KSIM	Sikeston, Mo.	1400
KSIS	Sedalia, Mo.	1050
KSIW	Woodward, Okla.	1450
KSIX	Corpus Christi, Tex.	1230
KSJB	Jamestown, N.Dak.	600
KSKI	Sun Valley, Idaho	1340
KSKY	Dallas, Tex.	660
KSL	Salt Lake City, Utah	1160
KSLM	Salem, Oreg.	1390
KSLO	Opelousas, La.	1230
KSLV	Monte Vista, Colo.	1240
KSLY	San Luis Obispo, Cal.	1400
KSMA	Santa Maria, Calif.	1240
KSMK	Kennewick, Wash.	1340
KSMM	Shakopee, Minn.	1530
KSMN	Mason City, Iowa	1010
KSMO	Salem, Mo.	1340
KSND	Seattle, Wash.	1590
KSNN	Pocatello, Ida.	1290
KSNO	Aspen, Colo.	1260
KSNY	Snyder, Tex.	1450
KSO	Des Moines, Iowa	1460
KSOA	Ava, Mo.	1430
KSOK	Arkansas City, Kans.	1280
KSOL	San Francisco, Cal.	1450
KSOM	Ontario, Cal.	1510
KSON	San Diego, Calif.	1240
KSOO	Sioux Falls, S.Dak.	1140
KSOP	Salt Lake City, Utah	1370
KSOX	Raymondville, Tex.	1240
KSPI	Stillwater, Okla.	780
KSPL	Diboll, Tex.	1260
KSPO	Spokane, Wash.	1230
KSPR	Springdale, Ark.	1590
KSPT	Sandpoint, Idaho	1400
KSRA	Salmon, Idaho	960
KSRC	Socorro, N.Mex.	1290
KSRM	Soldatna, Alaska	920
KSRO	Santa Rosa, Calif.	1350
KSRV	Ontario, Oreg.	1380
KSSS	Colorado Springs, Colo.	740
KSST	Sulphur Springs, Tex.	1230
KSTA	Coleman, Tex.	1000
KSTB	Breckenridge, Tex.	1430
KSTL	St. Louis, Mo.	690
KSTN	Stockton, Calif.	1420
KSTP	St. Paul, Minn.	1500
KSTR	Grand Junction, Colo.	620
KSTT	Davenport, Iowa	1170
KSTV	Stephenville, Tex.	1510
KSUB	Cedar City, Utah	590
KSUD	W. Memphis, Ark.	730
KSUE	Susanville, Calif.	1240
KSUM	Fairmont, Minn.	1370
KSUN	Bisbee, Ariz.	1230
KSVC	Richfield, Utah	980
KSVN	Ogden, Utah	730
KSVP	Artesia, N.Mex.	990
KSWA	Graham, Tex.	1330
KSWB	Seaside, Ore.	930
KSWM	Aurora, Mo.	940
KSWO	Lawton, Okla.	1380
KSWS	Roswell, N. M.	1020
KSWW	Wickenburg, Ariz.	1250
KSXX	Salt Lake City, Utah	630
KSYC	Yreka, Calif.	1490
KSYL	Alexandria, La.	970
KSYX	Santa Rosa, N.Mex.	1420
KTAC	Tacoma, Wash.	850
KTAE	Taylor, Tex.	1260
KTAR	Phoenix, Ariz.	620
KTAT	Frederick, Okla.	1570
KTBB	Tyler, Tex.	600
KTBC	Austin, Tex.	590
KTCB	Malden, Mo.	1470
KTCH	Wayne, Neb.	1590
KTCR	Minneapolis, Minn.	690
KTCS	Fort Smith, Ark.	1410
KTDL	Farmersville, La.	1470
KTDO	Toledo, Oreg.	1230
KTEE	Idaho Falls, Idaho	1260
KTEL	Walla Walla, Wash.	1490
KTEM	Temple, Tex.	1400
KTEO	San Angelo, Tex.	1340
KTER	Terrell, Tex.	1570
KTFI	Twin Falls, Idaho	1270
KTFS	Texarkana, Tex.	1400
KTGO	Tioga, N. D.	1090
KTGR	Columbia, Mo.	1580
KTHE	Thermopolis, Wyo.	1240
KTHO	South Lake Tahoe, Cal.	590
KTHS	Berryville, Ark.	1480
KTHT	Houston, Tex.	790
KTIB	Thibodaux, La.	630
KTIL	Tillamook, Oreg.	1590
KTIM	San Rafael, Calif.	1510
KTIP	Porterville, Calif.	1450
KTIS	Minneapolis, Minn.	900
KTIX	Pendleton, Ore.	1240
KTKN	Ketchikan, Alaska	930
KTKR	Taft, Calif.	1310
KTKT	Tucson, Ariz.	990
KTLD	Tullulah, La.	1360
KTLN	Denver, Colo.	1280
KTLO	Mountain Home, Ark.	1240
KTLQ	Tahlequah, Okla.	1350
KTLU	Rusk, Tex.	1580
KTLW	Texas City, Tex.	920
KTMC	McAlester, Okla.	1400
KTMF	New Prague, Minn.	1350
KTMN	Trumann, Ark.	1530
KTMS	Santa Barbara, Calif.	1250
KTNC	Falls City, Nebr.	1230
KTNM	Tucumcari, N.Mex.	1400
KTNT	Tacoma, Wash.	1400
KTOB	Petaluma, Cal.	1490
KTOC	Jonesboro, La.	920
KTOD	Sinton, Tex.	1590
KTOE	Mankato, Minn.	1420
KTOH	Lihue, Hawaii	1350
KTOK	Oklahoma City, Okla.	1000
KTOM	Salinas, Cal.	1380
KTON	Belton, Tex.	940
KTOO	Henderson, Nev.	1280
KTOP	Topeka, Kans.	1490
KTOT	Big Bear Lake, Cal.	1050
KTOW	Sand Spring, Okla.	1340
KTPA	Prescott, Ark.	1370
KTRB	Modesto, Calif.	860
KTRC	Santa Fe, N.Mex.	1400
KTRE	Lufkin, Tex.	1420
KTRF	Thief River Falls, Minn.	1230
KTRG	Honolulu, Hawaii	990
KTRH	Houston, Tex.	740
KTRI	Sioux City, Iowa	1470
KTRM	Beaumont, Tex.	990
KTRN	Wichita Falls, Tex.	1290
KTRT	Truckee, Cal.	1400
KTRY	Bastrop, La.	730
KTSA	San Antonio, Tex.	550
KTSL	Burnett, Tex.	1340
KTSM	El Paso, Tex.	1380
KTTN	Trenton, Mo.	1600
KTTR	Rolla, Mo.	1490
KTTS	Springfield, Mo.	1400
KTTT	Columbus, Nebr.	1510
KTUC	Tucson, Ariz.	1400
KTUE	Tulia, Tex.	1260
KTUF	Tempe, Ariz.	1580
KTUI	Sullivan, Mo.	1560
KTW	Seattle, Wash.	1250
KTWO	Casper, Wyo.	1030
KTXJ	Jasper, Tex.	1350
KTXO	Sherman, Tex.	1500
KTYM	Inglewood, Calif.	1460
KTYN	Minot, N.D.	1430
KUAD	Windsor, Colo.	1170
KUAI	Eleele, Kauai, Hawaii	720
KUAM	Agana, Guam	610
KUAT	Tucson, Ariz.	1550
KUBA	Yuba City, Calif.	1600
KUBC	Montrose, Colo.	580
KUDE	Oceanside, Calif.	1320
KUDI	Great Falls, Mont.	1450
KUDL	Fairway, Kan.	1380
KUDU	Ventura, Calif.	1590
KUDY	Spokane, Wash.	1280
KUEN	Wenatchee, Wash.	900
KUGN	Eugene, Oreg.	590
KUIK	Hillsboro, Oreg.	1360
KUJ	Walla Walla, Wash.	1420
KUKA	San Antonio, Tex.	1250
KUKI	Ukiah, Calif.	1400
KUKU	Willow Springs, Mo.	1330
KULA	Honolulu, Hawaii	690
KULE	Ephrata, Wash.	730
KULP	El Campo, Tex.	1390
KULY	Ulysses, Kan.	1420
KUMA	Pendleton, Oreg.	1290
KUMU	Honolulu, Hawaii	1500
KUNO	Corpus Christi, Tex.	1400
KUOA	Siloam Springs, Ark.	1290
KUOM	Minneapolis, Minn.	770
KUPD	Tempe, Ariz.	1060
KUPI	Idaho Falls, Idaho	980
KUPK	Garden City, Kan.	1050
KURA	Moab, Utah	1450
KURB	Mountlake Terrace, Wash.	1510
KURL	Billings, Mont.	730
KURV	Edinburg, Tex.	710
KURY	Brookings, Oreg.	910
KUSD	Vermillion, S.Dak.	690
KUSH	Cushing, Okla.	1600
KUSN	St. Joseph, Mo.	1270
KUTA	Blanding, Utah	790
KUTI	Yakima, Wash.	980
KUTY	Palmdale, Calif.	1470
KUVR	Holdredge, Nebr.	1380
KUXL	Golden Valley, Minn.	1570
KUZN	W. Monroe, La.	1310
KUZZ	Bakersfield, Calif.	800
KVAC	Forks, Wash.	1490
KVAL	Sauk Rapids, Minn.	800
KVAN	Vancouver, Wash.	1480
KVAS	Astoria, Ore.	1230
KVBR	Brainerd, Minn.	1340
KVCK	Wolf Point, Nebr.	1450
KVCL	Winnfield, La.	1270
KVCV	Redding, Calif.	600
KVDB	Sioux City, Iowa	1090
KVEC	San Luis Obispo, Calif.	920
KVEE	Conway, Ark.	1330
KVEG	Las Vegas, Nev.	970
KVEL	Vernal, Utah	920
KVEN	Ventura, Calif.	1450
KVET	Austin, Tex.	1300
KVFC	Cortez, Colo.	740
KVFD	Ft. Dodge, Iowa	1400
KVGB	Great Bend, Kans.	1590
KVI	Seattle, Wash.	570
KVIC	Victoria, Tex.	1340
KVIL	Highland Park, Tex.	1150
KVIN	Vinita, Okla.	1470
KVIO	Cottonwood, Ariz.	1600
KVIP	Redding, Calif.	540
KVKM	Monahans, Tex.	1330
KVLB	Cleveland, Tex.	1410
KVLF	Alpine, Tex.	1240
KVLG	LaGrange, Tex.	1570
KVLH	Pauls Valley, Okla.	1470
KVLL	Woodville, Tex.	1220
KVLV	Fallon, Nev.	980
KVMA	Magnolia, Ark	630
KVMC	Colorado City, Tex.	1320
KVML	Sonora, Calif.	1450
KVNC	Winslow, Ariz.	1010
KVNI	Coeur d'Alene, Idaho	1240
KVNU	Logan, Utah	610
KVOB	Bastrop, La.	1340
KVOC	Casper, Wyo.	1230
KVOD	Albuquerque, N. Mex.	730
KVOE	Emporia, Kans.	1400
KVOG	Ogden, Utah	1490
KVOL	Lafayette, La.	1330
KVOM	Morrilton, Ark.	800
KVON	Napa, Calif.	1440
KVOO	Tulsa, Okla.	1170
KVOP	Plainview, Tex.	1400
KVOR	Colo. Springs, Colo.	1300
KVOU	Uvalde, Tex.	1400
KVOW	Riverton, Wyo.	1450
KVOX	Moorhead, Minn.	1280
KVOY	Yuma, Ariz.	1400
KVOZ	Laredo, Tex.	1490
KVPI	Ville Platte, La.	1050
KVRA	Vermillion, S. D.	1570
KVRC	Arkadelphia, Ark.	1240
KVRD	Cottonwood, Ariz.	1240
KVRE	Santa Rosa, Calif.	1460
KVRH	Salida, Colo.	1340
KVRS	Rock Springs, Wyo.	1360
KVSA	McGehee, Ark.	1220
KVSF	Santa Fe, N.Mex.	1260
KVSH	Valentine, Nebr.	940
KVSI	Montpelier, Ida.	1450
KVSL	Show Low, Ariz.	1450
KVSO	Ardmore, Okla.	1240
KVWC	Vernon, Tex.	1490
KVWG	Pearsall, Tex.	1280
KVWM	Show Low, Ariz.	970
KVWO	Cheyenne, Wyo.	1370
KVYL	Holdenville, Okla.	1370
KWAC	Bakersfield, Calif.	1490
KWAD	Wadena, Minn.	920
KWAK	Stuttgart, Ark.	1240
KWAL	Wallace, Idaho	620
KWAM	Memphis, Tenn.	990
KWAT	Watertown, S.Dak.	950
KWBA	Baytown, Tex.	1360
KWBB	Wichita, Kans.	1410
KWBC	Navasota, Tex.	1550
KWBE	Beatrice, Nebr.	1450
KWBG	Boone, Iowa	1590
KWBW	Hutchinson, Kans.	1450
KWCB	Searcy, Ark.	1300
KWCL	Oak Grove, La.	1280
KWCO	Chickasha, Okla.	1560
KWDR	Del Rio, Tex.	810
KWEB	Rochester, Minn.	1270
KWED	Seguin, Tex.	1580
KWEI	Weiser, Idaho	1260
KWEL	Midland, Tex.	1440
KWEW	Hobbs, N.Mex.	1480
KWFA	Merkle, Tex.	1500
KWFR	San Angelo, Tex.	1260
KWFT	Wichita Falls, Tex.	620
KWG	Stockton, Calif.	1230
KWHI	Brenham, Tex.	1280
KWHK	Hutchinson, Kans.	1260
KWHN	Fort Smith, Ark.	1320
KWHO	Salt Lake City, Utah	860
KWHW	Altus, Okla.	1450
KWIK	Pocatello, Idaho	1240
KWIL	Albany, Oreg.	790
KWIN	Ashland, Oreg.	580
KWIP	Merced, Calif.	1580
KWIQ	Moses Lake, Wash.	1260
KWIV	Douglas, Wyo.	1050
KWIX	Moberly, Mo.	1230
KWIZ	Santa Ana, Calif.	1480
KWJJ	Portland, Oreg.	1080
KWK	St. Louis, Mo.	1380
KWKC	Abilene, Tex.	1340
KWKH	Shreveport, La.	1130
KWKW	Pasadena, Calif.	1300
KWKY	Des Moines, Iowa	1150
KWLA	Many, La.	1530
KWLC	Decorah, Iowa	1240
KWLG	Wagoner, Okla.	1530
KWLM	Willmar, Minn.	1340
KWMC	Del Rio, Tex.	1490
KWMT	Ft. Dodge, Iowa	540
KWNA	Winnemucca, Nev.	1400
KWNO	Winona, Minn.	1230
KWNS	Pratt, Kans.	1290
KWNT	Davenport, Iowa	1580
KWOA	Worthington, Minn.	730
KWOC	Poplar Bluff, Mo.	930
KWOE	Clinton, Okla.	1320
KWON	Bartlesville, Okla.	1400
KWOR	Worland, Wyo.	1340
KWOS	Jefferson City, Mo.	1240
KWOW	Pomona, Calif.	1600
KWPC	Muscatine, Iowa	860
KWPM	West Plains, Mo.	1450
KWPR	Claremore, Okla.	1270
KWRC	Woodburn, Ore.	940
KWRD	Henderson, Tex.	1470
KWRE	Warrenton, Mo.	730
KWRF	Warren, Ark.	860
KWRG	New Roods, La.	1500
KWRO	Coquille, Oreg.	630
KWRT	Boonville, Mo.	1370
KWRW	Guthrie, Okla.	1490
KWSD	Mt. Shasta, Calif.	620
KWSH	Wewoka-Seminole, Oklahoma	1260
KWSO	Wasco, Calif.	1050
KWSR	Rifle, Colo.	810
KWSU	Pullman, Wash.	1250
KWTC	Barstow, Calif.	1230
KWTO	Springfield, Mo.	560
KWTX	Waco, Tex.	1230
KWUN	Concord, Cal.	1480
KWVR	Enterprise, Oreg.	1340
KWVY	Waverly, Iowa	1470
KWWL	Waterloo, Iowa	1330
KWXY	Cathedral City, Cal.	1340
KWYK	Farmington, N.Mex.	960
KWYN	Wynne, Ark.	1400
KWYO	Sheridan, Wyo.	1410
KWYR	Winner, S.Dak.	1260
KWYS	W. Yellowstone, Mont.	920
KWYZ	Everett, Wash.	1230
KXA	Seattle, Wash.	770
KXAR	Hope, Ark.	1490
KXEL	Waterloo, Iowa	1540
KXEN	Festus-St. Louis, Mo.	1010
KXEO	Mexico, Mo.	1340
KXEW	Tucson, Ariz.	1600
KXEX	Fresno, Calif.	1550
KXGI	Ft. Madison, Iowa	1360
KXGN	Glendive, Mont.	1400
KXIC	Iowa City, Iowa	800
KXIT	Dalhart, Tex.	1410
KXIV	Phoenix, Ariz.	1400
KXJK	Forrest City, Ark.	950
KXKW	Lafayette, La.	1520
KXL	Portland, Oreg.	750
KXLE	Ellensburg, Wash.	1240
KXLF	Butte, Mont.	1370
KXLJ	Helena, Mont.	1240
KXLO	Lewiston, Mont.	1230
KXLR	Little Rock, Ark.	1150
KXLW	Clayton, Mo.	1320
KXLY	Spokane, Wash.	920
KXO	El Centro, Calif.	1230
KXOA	Sacramento, Calif.	1470
KXOK	St. Louis, Mo.	630
KXOL	Ft. Worth, Tex.	1360
KXOW	Hot Springs, Ark.	1420
KXOX	Sweetwater, Tex.	1240
KXRA	Alexandria, Minn.	1490
KXRB	Sioux Falls, S.D.	1000
KXRO	Aberdeen, Wash.	1320
KXRX	San Jose, Calif.	1500
KXTO	Sherman, Tex.	1500
KXXL	Bozeman, Mont.	1450
KXXX	Colby, Kans.	790
KXYZ	Houston, Tex.	1320
KYA	San Francisco, Calif.	1260
KYAC	Kirkland, Wash.	1460
KYAK	Anchorage, Alaska	630
KYAL	McKinney, Tex.	1600
KYCA	Prescott, Ariz.	1490
KYCN	Wheatland, Wyo.	1340
KYES	Roseburg, Oreg.	950
KTET	Payette, Idaho	1450
KYJC	Medford, Oreg.	1230
KYLT	Missoula, Mont.	1340
KYME	Boise, Idaho	740
KYMN	Northfield, Minn	1080
KYND	Burlington, Ia.	1150
KYNG	Coos Bay, Oreg.	1420
KYNO	Fresno, Calif.	1300
KYNT	Yankton, S.Dak.	1450
KYOK	Houston, Tex.	1590
KYOR	Blythe, Calif.	1450
KYOS	Merced, Calif.	1480
KYOU	Greeley, Colo.	1450
KYRO	Potosi, Mo.	1280
KYSM	Mankato, Minn.	1230
KYSN	Colorado Sprgs., Colo.	1460
KYSS	Missoula, Mont.	930
KYUM	Yuma, Ariz.	560
KYVA	Gallup, N.Mex.	1230
KYW	Philadelphia, Pa.	1060
KYXI	Oregon City, Ore.	1520
KZAK	Tyler, Tex.	1330
KZEE	Weatherford, Tex.	1220
KZEL	Eugene, Ore.	1540

WHITE'S RADIO LOG

Call	Location	kHz
KZEY	Tyler, Tex.	690
KZIA	Albuquerque, N.M.	1580
KZIN	Yuba City, Cal.	1450
KZIP	Amarillo, Tex.	1310
KZNG	Hot Springs, Ark.	1340
KZOE	Princeton, Ill.	1490
KZOL	Farwell, Tex.	1570
KZON	Santa Maria, Cal.	1600
KZOO	Honolulu, Hawaii	1210
KZOT	Marianna, Ark.	1460
KZOW	Globe, Ariz.	1240
KZRK	Ozark, Ark.	1540
KZUN	Opportunity, Wash.	630
KZYX	Weatherford, Okla.	1590
KZYM	Cape Girardeau, Mo.	1220
KZZN	Littlefield, Tex.	1490
VOUS	Argentia, Nfld.	1480
WAAA	Winston-Salem, N.C.	980
WAAB	Worcester, Mass.	1440
WAAC	Terre Haute, Ind.	1300
WAAF	Chicago, Ill.	950
WAAG	Adel, Ga.	1470
WAAK	Dallas, N.C.	960
WAAM	Ann Arbor, Mich.	1600
WAAO	Andalusia, Ala.	1530
WAAT	Trenton, N.J.	1300
WAAX	Gadsden, Ala.	570
WAAY	Huntsville, Ala.	1550
WABA	Aguadilla, P.Rico	850
WABB	Mobile, Ala.	1480
WABC	New York, N.Y.	770
WABD	Ft. Campbell, Ky.	1370
WABF	Fairhope, Ala.	1220
WABG	Greenwood, Miss.	960
WABH	Deerfield, Va.	1150
WABI	Bangor, Maine	910
WABJ	Adrian, Mich.	1490
WABK	Gardiner, Me.	1280
WABL	Amite, La.	1570
WABO	Waynesboro, Miss.	990
WABQ	Cleveland, Ohio	1540
WABR	Winter Park, Fla.	1440
WABT	Tuskegee, Ala.	580
WABV	Abbeville, S.C.	1590
WABY	Albany, N.Y.	1400
WABZ	Albemarle, N.C.	1010
WACA	Camden, S.C.	1590
WACB	Kittanning, Pa.	1380
WACE	Chicopee, Mass.	730
WACI	The Dalles, Ore.	1300
WACK	Newark, N.Y.	1420
WACL	Waycross, Ga.	570
WACO	Waco, Tex.	1460
WACR	Columbus, Miss.	1050
WACT	Tuscaloosa, Ala.	1420
WACX	Austell, Ga.	1600
WACY	Kissimmee, Fla.	1220
WADA	Shelby, N.C.	1390
WADE	Wadesboro, N.C.	1210
WADK	Newport, R.I.	1540
WADM	Decatur, Ind.	1540
WADO	New York, N.Y.	1280
WADR	Remsen, N.Y.	1480
WADS	Ansonia, Conn.	690
WAEB	Allentown, Pa.	790
WAEL	Mayaguez, P.Rico	600
WAEW	Crossville, Tenn.	1330
WAFC	Staunton, Va.	900
WAFI	Middlesboro, Ky.	1560
WAFT	Grand Rapids, Mich.	1480
WAGC	Centre, Ala.	1550
WAGE	Leesburg, Va.	1290
WAGF	Dothan, Ala.	1320
WAGG	Franklin, Tenn.	950
WAGL	Lancaster, S.C.	1560
WAGM	Presque Isle, Maine	950
WAGN	Menominee, Mich.	1340
WAGO	Oshkosh, Wis.	690
WAGR	Lumberton, N.C.	580
WAGS	Bishopville, S.C.	1380
WAGY	Forest City, N.C.	1320
WAHT	Annville-Cleona, Pa.	1510
WAIK	Galesburg, Ill.	1590
WAIL	Baton Rouge, La.	1260
WAIM	Anderson, S.C.	1230
WAIN	Columbia, Ky.	1270
WAIR	Winston-Salem, N.C.	1340
WAIT	Chicago, Ill.	820
WAJF	Decatur, Ala.	1490
WAJR	Morgantown, W.Va.	1440
WAKE	Valparaiso, Ind.	1500
WAKI	McMinnville, Tenn.	1230
WAKN	Aiken, S.C.	990
WAKO	Lawrenceville, Ill.	910
WAKR	Akron, Ohio	1590
WAKS	Fuquay-Varina, N.C.	1460
WAKX	Superior, Wisc.	1320
WAKY	Louisville, Ky.	790
WALD	Walterboro, S.C.	1060
WALE	Fall River, Mass.	1400
WALG	Albany, Ga.	1590
WALK	Patchogue, N.Y.	1370
WALL	Middletown, N.Y.	1340
WALM	Albion, Mich.	1260
WALO	Humacao, P.R.	1240
WALT	Tampa, Fla.	1110
WALY	Herkimer, N.Y.	1420
WAMA	Selma, Ala	1340
WAMB	Donelson, Tenn.	1190
WAMD	Aberdeen, Md.	970
WAME	Miami, Fla.	1260
WAMG	Gallatin, Tenn.	1130
WAMI	Opp, Ala.	860
WAML	Laurel, Miss.	1340
WAMM	Flint, Mich.	1420
WAMO	Homestead, Pa.	860
WAMR	Venice, Fla.	1320
WAMS	Wilmington, Del.	1380
WAMW	Washington, Ind.	1580
WAMY	Amory, Miss.	1580
WANA	Anniston, Ala.	1490
WANB	Waynesburg, Pa.	1580
WANL	Lineville, Ala.	1540
WANN	Annapolis, Md.	1190
WANO	Pineville, Ky.	1230
WANS	Anderson, S.C.	1280
WANT	Richmond, Va.	990
WANV	Waynesboro, Va.	970
WANY	Albany, Ky.	1390
WAOA	Opelika, Ala.	1520
WAOK	Atlanta, Ga.	1380
WAOP	Ostego, Mich.	980
WAOV	Vincennes, Ind.	1450
WAPA	San Juan, P.R.	680
WAPC	Riverhead, N.Y.	1570
WAPE	Jacksonville, Fla.	690
WAPF	McComb, Miss.	980
WAPG	Arcadia, Fla.	1480
WAPI	Birmingham, Ala.	1070
WAPL	Appleton, Wis.	1570
WAPX	Montgomery, Ala.	1600
WAQI	Ashtabula, Ohio	1600
WAQY	Birmingham, Ala.	1220
WARA	Attleboro, Mass.	1320
WARB	Covington, La.	730
WARD	Johnstown, Pa.	1490
WARE	Ware, Mass.	1250
WARF	Jasper, Ala.	1240
WARI	Abbeville, Ala.	1480
WARK	Hagerstown, Md.	1490
WARM	Scranton, Pa.	590
WARN	Ft. Pierce, Fla.	1330
WARO	Canonsburg, Pa.	540
WART	Moulton, Ala.	1530
WARU	Peru, Ind.	1600
WARV	Warwick-E. Greenwich, R.I.	1590
WASA	Havre de Grace, Md.	1330
WASC	Spartanburg, S.C.	1530
WASK	Lafayette, Ind.	1450
WASP	Brownsville, Pa.	1130
WATA	Boone, N.C.	1450
WATC	Gaylord, Mich.	900
WATE	Knoxville, Tenn.	620
WATH	Athens, Ohio	970
WATI	Indianapolis, Ind.	810
WATK	Antigo, Wis.	900
WATM	Atmore, Ala.	1580
WATN	Watertown, N.Y.	1240
WATO	Oak Ridge, Tenn.	1290
WATP	Marion, S.C.	1430
WATR	Waterbury, Conn.	1320
WATS	Sayre, Pa.	960
WATT	Cadillac, Mich.	1240
WATV	Birmingham, Ala.	900
WATW	Ashland, Wis.	1400
WATZ	Alpena, Mich.	1450
WAUB	Auburn, N.Y.	1590
WAUC	Wauchula, Fla.	1310
WAUD	Auburn, Ala.	1230
WAUG	Augusta, Ga.	1050
WAUK	Waukesha, Wis.	1510
WAVA	Arlington, Va.	780
WAVC	Warner Robins, Ga.	1350
WAVE	Louisville, Ky.	970
WAVI	Dayton, Ohio	1210
WAVL	Apollo, Pa.	910
WAVN	Stillwater, Minn.	1220
WAVO	Avondale Estates, Ga.	1420
WAVP	Avon Park, Fla.	1390
WAVU	Albertville, Ala.	630
WAVZ	New Haven, Conn.	1300
WAWA	West Allis, Wis.	1590
WAWK	Kendallville, Ind.	1140
WAWZ	Zarephath, N.J.	1380
WAXE	Vero Beach, Fla.	1370
WAXK	Superior, Wis.	1320
WAXU	Georgetown, Ky.	1580
WAXX	Chippewa Falls, Wis.	1150
WAYB	Waynesboro, Va.	1490
WAYD	Ozark, Ala.	1190
WAYE	Baltimore, Md.	860
WAYN	Rockingham, N.C.	900
WAYR	Orange Park, Fla.	550
WAYS	Charlotte, N.C.	610
WAYX	Waycross, Ga.	1230
WAYZ	Waynesboro, Pa.	1380
WAZA	Bainbridge, Ga.	1360
WAZE	Clearwater, Fla.	860
WAZF	Yazoo City, Miss.	1230
WAZL	Hazelton, Pa.	1490
WAZS	Summerville, S.C.	980
WAZY	Lafayette, Ind.	1410
WBAA	West Lafayette, Ind.	920
WBAB	Babylon, N.Y.	1440
WBAC	Cleveland, Tenn.	1340
WBAF	Barnesville, Ga.	1090
WBAG	Burlington, N.C.	1150
WBAL	Baltimore, Md.	1090
WBAM	Montgomery, Ala.	740
WBAP	Fort Worth, Tex.	570 & 820
WBAR	Bartow, Fla.	1460
WBAT	Marion, Ind.	1400
WBAW	Barnwell, S.C.	740
WBAX	Wilkes-Barre, Pa.	1240
WBAY	Green Bay, Wis.	1360
WBAZ	Kingston, N.Y.	1550
WBBA	Pittsfield, Ill.	1580
WBBB	Burlington-Graham, N.C.	920
WBBF	Rochester, N.Y.	950
WBBI	Abingdon, Va.	1230
WBBK	Blakely, Ga.	1260
WBBL	Richmond, Va.	1480
WBBM	Chicago, Ill.	780
WBBO	Forest City, N.C.	780
WBBQ	Augusta, Ga.	1340
WBBR	Travelers Rest, S.C.	1580
WBBS	Jacksonville, N.C.	1290
WBBT	Lyons, Ga.	1340
WBBW	Youngstown, Ohio	1240
WBBX	Portsmouth, N.H.	1380
WBBZ	Ponca City, Okla.	1230
WBCA	Bay Minette, Ala.	1150
WBCB	Levittown, Pa.	1490
WBCH	Hastings, Mich.	1220
WBCI	Williamsburg, Va.	740
WBCK	Battle Creek, Mich.	930
WBCM	Bay City, Mich.	1440
WBCO	Bucyrus, Ohio	1540
WBCU	Union, S.C.	1460
WBEC	Pittsfield, Mass.	1420
WBEE	Harvey, Ill.	1570
WBEJ	Elizabethton, Tenn.	1240
WBEL	So. Beloit, Ill.	1380
WBEN	Buffalo, N.Y.	930
WBER	Moncks Corner, S.C.	950
WBET	Brockton, Mass.	1460
WBEU	Beaufort, S.C.	960
WBEV	Beaver Dam, Wis.	1430
WBEX	Chillicothe, Ohio	1490
WBFD	Bedford, Pa.	1310
WBFJ	Woodbury, Tenn.	1540
WBFN	Quitman, Miss.	1500
WBGC	Chipley, Fla.	1240
WBGN	Bowling Green, Ky.	1340
WBGS	Slidell, La.	1560
WBHB	Fitzgerald, Ga.	1240
WBHC	Hampton, S.C.	1270
WBHF	Cartersville, Ga.	1450
WBHM	Birmingham, Ala.	1550
WBHN	Bryson City, N.C.	1590
WBHP	Huntsville, Ala.	1230
WBHT	Brownsville, Tenn.	1520
WBIA	Augusta, Ga.	1230
WBIB	Centreville, Ala.	1110
WBIE	Marietta, Ga.	1080
WBIG	Greensboro, N.C.	1470
WBIP	Booneville, Miss.	1400
WBIR	Knoxville, Tenn.	1240
WBIS	Bristol, Conn.	1440
WBIW	Bedford, Ind.	1340
WBIX	Jacksonville Beach, Fla.	1010
WBIZ	Eau Claire, Wis.	1400
WBJM	Lemmon, S.D.	1400
WBKC	Chardon, O.	1560
WBKH	Hattiesburg, Miss.	950
WBKN	Newton, Miss.	1410
WBKV	West Bend, Wis.	1470
WBLA	Elizabethtown, N.C.	1440
WBLC	Lenoir City, Tenn.	1360
WBLE	Batesville, Miss.	1290
WBLF	Bellefonte, Pa.	1330
WBLG	Lexington, Ky.	1300
WBLJ	Dalton, Ga.	1230
WBLO	Evergreen, Ala.	1470
WBLR	Batesburg, S.C.	1430
WBLT	Bedford, Va.	1350
WBLU	Salem, Va.	1480
WBLY	Springfield, Ohio	1600
WBMA	Beaufort, N.C.	1400
WBMC	McMinnville, Tenn.	960
WBMD	Baltimore, Md.	750
WBME	Belfast, Me.	1230
WBMJ	San Juan, P.R.	1190
WBMK	West Point, Ga.	1310
WBML	Macon, Ga.	1240
WBMS	Black Mountain, N.C.	1350
WBNB	Charlotte Amalie, Virgin Islands	1000
WBNC	Conway, N.H.	1050
WBNL	Boonville, Ind.	1540
WBNO	Bryan, Ohio	1520
WBNR	Beacon, N.Y.	1260
WBNS	Columbus, Ohio	1460
WBNT	Oneida, Tenn.	1310
WBNX	New York, N.Y.	1380
WBOB	Galax, Va.	1360
WBOC	Salisbury, Md.	960
WBOK	New Orleans, La.	1230
WBOL	Bolivar, Tenn.	1560
WBOM	Jacksonville, Fla.	970
WBOO	Baraboo, Wis.	740
WBOP	Pensacola, Fla.	980
WBOW	Terre Haute, Ind.	1230
WBOX	Bogalusa, La.	920
WBOY	Clarksburg, W.Va.	1400
WBPZ	Lock Haven, Pa.	1230
WBRB	Mt. Clemens, Mich.	1430
WBRC	Birmingham, Ala.	960
WBRD	Bradenton, Fla.	1420
WBRE	Wilkes-Barre, Pa.	1340
WBRG	Lynchburg, Va.	1050
WBRI	Indianapolis, Ind.	1500
WBRJ	Marietta, O.	910
WBRK	Pittsfield, Mass.	1340
WBRL	Berlin, N.H.	1400
WBRM	Marion, N.C.	1250
WBRN	Big Rapids, Mich.	1460
WBRT	Bardstown, Ky.	1320
WBRO	Waynesboro, Ga.	1310
WBRV	Boonville, N.Y.	900
WBRX	Berwick, Pa.	1280
WBSA	Boaz, Ala.	1300
WBSC	Bennetsville, S.C.	1550
WBSG	Blackshear, Ga.	1350
WBSM	New Bedford, Mass.	1420
WBSR	Pensacola, Fla.	1450
WBT	Charlotte, N.C.	1110
WBTA	Batavia, N.Y.	1490
WBTC	Uhrichsville, O.	1540
WBTH	Williamson, W.Va.	1400
WBTM	Danville, Va.	1330
WBTN	Bennington, Vt.	1370
WBTO	Linton, Ind.	1600
WBTS	Bridgeport, Ala.	1480
WBUC	Buckhannon, W.Va.	1460
WBUD	Trenton, N.J.	1260
WBUG	Ridgeland, S.C.	1430
WBUT	Butler, Pa.	1050
WBUX	Doylestown, Pa.	1570
WBUY	Lexington, N.C.	1440
WBUZ	Fredonia, N.Y.	1570
WBVM	Utica, N.Y.	1550
WBVP	Beaver Falls, Pa.	1230
WBYB	St. Pauls, N.C.	1060
WBYE	Calera, Ala.	1370
WBYG	Savannah, Ga.	1450
WBYS	Canton, Ill.	1560
WBZ	Boston, Mass.	1030
WBZA	Glens Falls, N.Y.	1410
WBZE	Wheeling, W.Va.	1470
WBZY	New Castle, Pa.	1140
WCAB	Rutherfordton, N.C.	590
WCAI	Fort Myers, Fla.	1350
WCAL	Northfield, Minn.	770
WCAM	Camden, N.J.	1310
WCAO	Baltimore, Md.	600
WCAP	Lowell, Mass.	980
WCAR	Detroit, Mich.	1130
WCAS	Cambridge, Mass.	740
WCAT	Orange, Mass.	1390
WCAU	Philadelphia, Pa.	1210
WCAW	Charleston, W.Va.	680
WCAY	Cayce, S.C.	620
WCAZ	Carthage, Ill.	990
WCBA	Corning, N.Y.	1350
WCBG	Chambersburg, Pa.	1590
WCBI	Columbus, Miss.	550
WCBK	Martinsville, Ind.	1540
WCBL	Benton, Ky.	1290
WCBM	Baltimore, Md.	680
WCBS	New York, N.Y.	880
WCBT	Roanoke Rapids, N.C.	1230
WCBY	Cheboygan, Mich.	1240
WCCC	Hartford, Conn.	1290
WCCF	Punta Gorda, Fla.	1580
WCCM	Lawrence, Mass.	800
WCCN	Neillsville, Wis.	1370
WCCO	Minneapolis-St. Paul, Minn.	830
WCCR	Urbana, Ill.	1580
WCCW	Traverse City, Mich.	1310
WCDJ	Edenton, N.C.	1260
WCDL	Carbondale, Pa.	1440
WCDQ	Hamden, Conn.	1220
WCDS	Glasgow, Ky.	1440
WCDT	Winchester, Tenn.	1340
WCEC	Rocky Mount, N.C.	810
WCED	DuBois, Pa.	1420
WCEF	Parkersburg, W.Va.	1050
WCEH	Hawkinsville, Ga.	610
WCEM	Cambridge, Md.	1240
WCEN	Mt. Pleasant, Mich.	1150
WCER	Charlotte, Mich.	1390
WCFL	Chicago, Ill.	1000
WCFR	Springfield, Vt.	1480
WCFV	Clifton Forge, Va.	1230
WCGA	Calhoun, Ga.	900
WCGB	Pastillo, P.R.	1050
WCGC	Belmont, N.C.	1270
WCGO	Chicago Hghts., Ill.	1600
WCGR	Canandaigua, N.Y.	1550
WCHA	Chambersburg, Pa.	800
WCHB	Inkster, Mich.	1440
WCHE	Westchester, Pa.	1520
WCHI	Chillicothe, Ohio	1350
WCHJ	Brookhaven, Miss.	1470
WCHK	Canton, Ga.	1290
WCHL	Chapel Hill, N.C.	1360
WCHN	Norwich, N.Y.	970
WCHO	Washington Court House, Ohio	1250
WCHS	Charleston, W.Va.	580
WCHV	Charlottesville, Va.	1260
WCIK	Gordon, Ga.	1560
WCIL	Carbondale, Ill.	1020
WCIN	Cincinnati, Ohio	1480

Call	Location	kHz
WCIR	Beckley, W. Va.	1060
WCIS	Moss Point, Miss.	1460
WCIT	Lima, Ohio	940
WCJU	Columbia, Miss.	1450
WCKB	Dunn, N.C.	780
WCKD	Ishpenning, Mich.	970
WCKI	Greer, S.C.	1300
WCKL	Catskill, N.Y.	560
WCKM	Winnsboro, S.C.	1250
WCKY	Cincinnati, Ohio	1530
WCLA	Claxton, Ga.	1470
WCLB	Camilla, Ga.	1220
WCLC	Jamestown, Tenn.	1260
WCLD	Cleveland, Miss.	1490
WCLE	Cleveland, Tenn.	1570
WCLG	Morgantown, W.Va.	1300
WCLI	Corning, N.Y.	1450
WCLO	Janesville, Wis.	1230
WCLR	Crystal Lake, Ill.	850
WCLS	Columbus, Ga.	1580
WCLT	Newark, Ohio	1430
WCLU	Covington, Ky.	1320
WCLW	Mansfield, O.	1140
WCMA	Corinth, Miss.	1230
WCMB	Harrisburg, Pa.	1460
WCMC	Wildwood, N.J.	1230
WCME	Brunswick, Maine	900
WCMI	Ashland, Ky.	1340
WCMN	Arecibo, P.R.	1280
WCMP	Pine City, Minn.	1350
WCMR	Elkhart, Ind.	1270
WCMS	Norfolk, Va.	1050
WCMT	Martin, Tenn.	1410
WCMY	Ottawa, Ill.	1430
WCNB	Connersville, Ind.	1580
WCNC	Elizabeth City, N.C.	1240
WCND	Shelbyville, Ky.	940
WCNH	Quincy, Fla.	1230
WCNL	Newport, N. H.	1010
WCNR	Bloomsburg, Pa.	930
WCNU	Crestview, Fla.	1010
WCNW	Fairfield, O.	1560
WCNX	Middletown, Conn.	1150
WCOA	Pensacola, Fla.	1370
WCOC	Meridian, Miss.	910
WCOF	Immokalee, Fla.	1490
WCOG	Greensboro, N.C.	1320
WCOH	Newnan, Ga.	1400
WCOJ	Coatesville, Pa.	1420
WCOK	Sparta, N. C.	1060
WCOL	Columbus, Ohio	1230
WCON	Cornelia, Ga.	1450
WCOP	Boston, Mass.	1150
WCOR	Lebanon, Tenn.	900
WCOS	Columbia, S.C.	1400
WCOU	Lewiston, Maine	1240
WCOV	Montgomery, Ala.	1170
WCOW	Sparta, Wis.	1290
WCOX	Camden, Ala.	1540
WCOY	Columbia, Pa.	1580
WCPA	Clearfield, Pa.	900
WCPC	Houston, Miss.	940
WCPH	Etowah, Tenn.	1220
WCPK	Chesapeake, Va.	1600
WCPM	Cumberland, Ky.	1280
WCPR	Coamo, P. R.	1450
WCPS	Tarboro, N.C.	760
WCRA	Effingham, Ill.	1090
WCRB	Waltham, Mass.	1330
WCRE	Cheraw, S.C.	1420
WCRI	Scottsboro, Ala.	1050
WCRK	Morristown, Tenn.	1150
WCRL	Oneonta, Ala.	1570
WCRM	Clare, Mich.	990
WCRO	Johnstown, Pa.	1230
WCRS	Greenwood, S.C.	1450
WCRT	Birmingham, Ala.	1260
WCRV	Washington, N.J.	1580
WCRW	Chicago, Ill.	1240
WCRY	Macon, Ga.	900
WCSA	Ripley, Mass.	1260
WCSC	Charleston, S.C.	1390
WCSH	Portland, Maine	970
WCSI	Columbus, Ind.	1010
WCSJ	Morris, Ill.	1550
WCSL	Cherryville, N. C.	1590
WCSM	Celina, Ohio	1350
WCSR	Hillsdale, Mich.	1340
WCSS	Amsterdam, N.Y.	1490
WCST	Berkeley Springs, W.Va.	1010
WCSV	Crossville, Tenn.	1520
WCSW	Shell Lake, Wis.	940
WCTA	Andalusia, Ala.	920
WCTC	New Brunswick, N.J.	1450
WCTR	Chestertown, Md.	1530
WCTT	Corbin, Ky.	680
WCTW	New Castle, Ind.	1550
WCUB	Manitowoc, Wis.	980
WCUE	Cuyahoga Falls, Ohio	1150
WCUM	Cumberland, Md.	1230
WCVA	Culpeper, Va.	1490
WCVI	Connellsville, Pa.	1340
WCVL	Crawfordsville, Ind.	1550
WCVP	Murphy, N.C.	600
WCVR	Randolph, Vt.	1320
WCVS	Springfield, Ill.	1450
WCVU	Portsmouth, Va.	1350
WCWA	Toledo, O.	1230
WCWC	Ripon, Wis.	1600
WCWR	Tarpon Springs, Fla.	1470
WCYB	Bristol, Va.	690
WCYN	Cynthiana, Ky.	1400
WDAD	Indiana, Pa.	1450
WDAE	Tampa, Fla.	1250
WDAF	Kansas City, Mo.	610
WDAK	Columbus, Ga.	540
WDAL	Meridian, Miss.	1330
WDAN	Danville, Ill.	1490
WDAR	Darlington, S.C.	1350
WDAS	Philadelphia, Pa.	1480
WDAT	Ormond Beach, Fla.	1380
WDAX	McRae, Ga.	1410
WDAY	Fargo, N. Dak.	970
WDBC	Escanaba, Mich.	680
WDBF	Delray Beach, Fla.	1420
WDBJ	Roanoke, Va.	960
WDBL	Springfield, Tenn.	1590
WDBM	Statesville, N.C.	550
WDBO	Orlando, Fla.	580
WDBQ	Dubuque, Iowa	1490
WDCF	Dade City, Fla.	1350
WDCJ	Arlington, Fla.	1220
WDCR	Hanover, N.H.	1340
WDDT	Greenville, Miss.	900
WDDY	Gloucester, Va.	1420
WDEA	Ellsworth, Me.	1370
WDEB	Jamestown, Tenn.	1500
WDEC	Americus, Ga.	1290
WDEF	Chattanooga, Tenn.	1370
WDEH	Sweetwater, Tenn.	800
WDEL	Wilmington, Del.	1150
WDEN	Macon, Ga.	1500
WDEV	Waterbury, Vt.	550
WDEW	Westfield, Mass.	1570
WDGL	Douglasville, Ga.	1520
WDGY	Minneapolis, Minn.	1130
WDIA	Memphis, Tenn.	1070
WDIC	Clinchco, Va.	1430
WDIG	Dothan, Ala.	1450
WDIX	Orangeburg, S.C.	1150
WDJS	Mt. Olive, N.C.	1430
WDJZ	Bridgeport, Conn.	1530
WDKD	Kingstree, S. C.	1310
WDKN	Dickson, Tenn.	1260
WDLA	Walton, N.Y.	1270
WDLB	Marshfield, Wis.	1450
WDLC	Port Jervis, N.Y.	1490
WDLR	Delaware, Ohio	1550
WDLM	E. Moline, Ill.	960
WDLP	Panama City, Fla.	590
WDLT	Indianola, Miss.	1380
WDME	Dover-Foxcraft, Me.	1340
WDMG	Douglas, Ga.	860
WDMJ	Marquette, Mich.	1320
WDMP	Dodgeville, Wis.	810
WDMV	Pocomoke City, Md.	540
WDNC	Durham, N.C.	620
WDNE	Elkins, W.Va.	1240
WDNG	Anniston, Ala.	1450
WDNL	Warren, O.	1570
WDNT	Dayton, Tenn.	1280
WDOB	Canton, Miss.	1370
WDOC	Prestonsburg, Ky.	1310
WDOD	Chattanooga, Tenn.	1310
WDOE	Dunkirk, N.Y.	1410
WDOG	Allendale, S. C.	1300
WDOL	Athens, Ga.	1470
WDON	Wheaton, Md.	1540
WDOR	Sturgeon Bay, Wis.	910
WDOS	Oneonta, N.Y.	730
WDOT	Burlington, Va.	1400
WDOV	Dover, Del.	1410
WDOW	Dowagiac, Mich.	1440
WDQN	DuQuoin, Ill.	1580
WDRC	Hartford, Conn.	1360
WDSC	Dillon, S.C.	800
WDSG	Dyersburg, Tenn.	1450
WDSK	Cleveland, Miss.	1410
WDSL	Mocksville, N. C.	1520
WDSM	Superior, Wis.	710
WDSP	DeFuniak Springs, Fla.	1280
WDSR	Lake City, Fla.	1340
WDSU	New Orleans, La.	1280
WDTM	Selmer, Tenn.	1130
WDUN	Gainesville, Ga.	1240
WDUX	Waupaca, Wis.	800
WDUZ	Green Bay, Wis.	1400
WDVA	Danville, Va.	1250
WDVH	Gainesville, Fla.	980
WDVL	Vineland, N.J.	1270
WDWD	Dawson, Ga.	990
WDWS	Champaign, Ill.	1400
WDXB	Chattanooga, Tenn.	1490
WDXE	Lawrenceburg, Tenn.	1370
WDXI	Jackson, Tenn.	1310
WDXL	Lexington, Tenn.	1490
WDXN	Clarksville, Tenn.	540
WDXR	Paducah, Ky.	1560
WDXY	Sumter, S.C.	1240
WDYZ	Buford, Ga.	1460
WDZ	Decatur, Ill.	1050
WEAB	Greer, S.C.	800
WEAC	Gaffney, S. C.	1500
WEAD	College Park, Ga.	1570
WEAG	Alcoa, Tenn.	1470
WEAL	Greensboro, N. C.	1510
WEAM	Arlington, Va.	1390
WEAN	Providence, R.I.	790
WEAQ	Eau Claire, Wis.	790
WEAS	Savannah, Ga.	900
WEAT	W. Palm Beach, Fla.	850
WEAV	Plattsburg, N.Y.	960
WEAW	Evanston, Ill.	1330
WEBB	Baltimore, Md.	1360
WEBC	Duluth, Minn.	560
WEBJ	Brewton, Ala.	1240
WEBO	Owego, N.Y.	1330
WEBQ	Harrisburg, Ill.	1240
WEBR	Buffalo, N.Y.	970
WEBS	Calhoun, Ga.	1110
WEBY	Milton, Fla.	1330
WECL	Eau Claire, Wis.	1050
WECP	Carthage, Miss.	1480
WEDC	Chicago, Ill.	1240
WEDO	McKeesport, Pa.	810
WEEB	Southern Pines, N.C.	990
WEED	Rocky Mount, N.C.	1390
WEEE	Rensselaer, N.Y.	1300
WEEF	Highland Park, Ill.	1430
WEEI	Boston, Mass.	590
WEEL	Fairfax, Va.	1310
WEEN	Lafayette, Tenn.	1460
WEEP	Pittsburgh, Pa.	1080
WEER	Warrenton, Va.	1250
WEET	Richmond, Va.	1320
WEEU	Reading, Pa.	850
WEEW	Washington, N.C.	1320
WEEX	Easton, Pa.	1230
WEEZ	Chester, Pa.	1590
WEGO	Concord, N.C.	1410
WEGP	Presque Isle, Maine	1390
WEHH	Elmira Heights-Horseheads, N.Y.	1590
WEHW	Windsor, Conn.	1480
WEIC	Charleston, Ill.	1270
WEIF	Moundsville, W. Va.	1370
WEIM	Fitchburg, Mass.	1280
WEIR	Weirton, W.Va.	1430
WEIS	Centre, Ala.	990
WEJL	Scranton, Pa.	630
WEKG	Jackson, Ky.	810
WEKR	Fayetteville, Tenn.	1240
WEKY	Richmond, Ky.	1340
WEKZ	Monroe, Wis.	1260
WELA	Elizabeth, N.J.	1530
WELB	Elba, Ala.	1350
WELC	Welch, W.Va.	1150
WELD	Fisher, W.Va.	690
WELE	S. Daytona, Fla.	1590
WELF	Tomahawk, Wis.	810
WELI	New Haven, Conn.	960
WELK	Charlottesville, Va.	1010
WELM	Elmira, N.Y.	1410
WELO	Tupelo, Miss.	580
WELP	Easley, S.C.	1360
WELR	Roanoke, Ala.	1360
WELS	Kinston, N.C.	1010
WELV	Ellenville, N. Y.	1370
WELW	Willoughby, O.	1330
WELX	Xenia, O.	1110
WELY	Ely, Minn.	1450
WELZ	Belzoni, Miss.	1460
WEMB	Erwin, Tenn.	1420
WEMD	Easton, Md.	1460
WEMJ	Laconia, N.H.	1490
WEMP	Milwaukee, Wis.	1250
WENC	Whiteville, N.C.	1220
WEND	Ebensburg, Pa.	1580
WENE	Endicott, N.Y.	1430
WENG	Englewood, Fla.	1530
WENK	Union City, Tenn.	1240
WENN	Birmingham, Ala.	1320
WENO	Madison, Tenn.	1430
WENR	Englewood, Tenn.	1090
WENT	Gloversville, N.Y.	1340
WENY	Elmira, N.Y.	1230
WENZ	Highland Springs, Va.	1450
WEOK	Poughkeepsie, N.Y.	1390
WEOL	Elyria, Ohio	930
WEPG	S. Pittsburgh, Tenn.	910
WEPM	Martinsburg, W.Va.	1340
WERA	Plainfield, N.J.	1590
WERD	Atlanta, Ga.	860
WERE	Cleveland, Ohio	1300
WERH	Hamilton, Ala.	970
WERI	Westerly, R.I.	1230
WERK	Muncie, Ind.	990
WERL	Eagle River, Wis.	950
WERT	Van Wert, Ohio	1220
WERX	Wyoming, Mich.	1530
WESA	Charleroi, Pa.	940
WESB	Bradford, Pa.	1490
WESC	Greenville, S.C.	660
WESO	Southbridge, Mass.	970
WESR	Tasley, Va.	1330
WEST	Easton, Pa.	1400
WESX	Salem, Mass.	1230
WESY	Leland, Miss.	1580
WETB	Johnson City, Tenn.	790
WETC	Wendell-Zebulon, N.C.	540
WETH	St. Augustine, Fla.	1420
WETT	Ocean City, Md.	1590
WETU	Wetumpka, Ala.	1250
WETZ	New Martinsville, West Virginia	1330
WEUC	Ponce, P.R.	1420
WEUP	Huntsville, Ala.	1600
WEVA	Emporia, Va.	860
WEVD	New York, N.Y.	1330
WEVE	Eveleth, Minn.	1340
WEVR	River Falls, Wis.	1550
WEW	St. Louis, Mo.	770
WEWO	Laurinburg, N.C.	1080
WEXL	Royal Oak, Mich.	1340
WEXT	W. Hartford, Conn.	1550
WEYE	Sanford, N.C.	1290
WEYY	Talladega, Ala.	1580
WEZE	Boston, Mass.	1260
WEZJ	Williamsburg, Ky.	1440
WEZQ	Winfield, Ala.	1300
WEZY	Cocoa, Fla.	1350
WFAA	Dallas, Tex.	570 & 820
WFAB	Miami, Fla.	990
WFAD	Middlebury, Vt.	1490
WFAG	Farmville, N.C.	1250
WFAH	Alliance, Ohio	1310
WFAI	Fayetteville, N.C.	1230
WFAR	Farrell, Pa.	1470
WFAS	White Plains, N.Y.	1230
WFAU	Augusta, Me.	1340
WFAW	Ft. Atkinson, Wis.	940
WFAX	Falls Church, Va.	1220
WFBA	San Sebastion, P.R.	1460
WFBC	Greenville, S.C.	1330
WFBF	Fernandina Beach, Fla.	1570
WFBG	Altoona, Pa.	1290
WFBL	Syracuse, N.Y.	1390
WFBM	Indianapolis, Ind.	1260
WFBR	Baltimore, Md.	1300
WFBS	Spring Lake, N. C.	1450
WFCG	Franklinton, La.	1110
WFCM	Winston-Salem, N. C.	1550
WFDF	Flint, Mich.	910
WFDR	Manchester, Ga.	1370
WFEA	Manchester, N.H.	1370
WFEB	Sylacauga, Ala.	1340
WFEC	Harrisburg, Pa.	1400
WFFF	Columbia, Miss.	1360
WFFG	Marathon, Fla.	1300
WFGL	Fitchburg, Mass.	960
WFGN	Gaffney, S.C.	1570
WFGW	Black Mountains, N.C.	1010
WFHG	Bristol, Va.	980
WFHK	Pell City, Ala.	1430
WFHR	Wis. Rapids, Wis.	1320
WFIA	Louisville, Ky.	900
WFIF	Milford, Conn.	1500
WFIG	Sumter, S.C.	1290
WFIL	Philadelphia, Pa.	560
WFIN	Findlay, Ohio	1330
WFIS	Fountain Inn, S.C.	1600
WFIV	Kissimmee, Fla.	1080
WFIW	Fairfield, Ill.	1390
WFIX	Huntsville, Ala.	1450
WFKN	Franklin, Ky.	1220
WFKY	Frankfort, Ky.	1490
WFLA	Tampa, Fla.	970
WFLB	Fayetteville, N.C.	1490
WFLI	Lookout Mtn., Tenn.	1070
WFLN	Philadelphia, Pa.	900
WFLO	Farmville, Va.	870
WFLR	Dundee, N.Y.	1570
WFLS	Fredericksburg, Va.	1350
WFLW	Monticello, Ky.	1360
WFMC	Goldsboro, N.C.	730
WFMD	Frederick, Md.	930
WFMH	Cullman, Ala.	1460
WFMJ	Youngstown, Ohio	1390
WFMO	Fairmont, N.C.	860
WFMW	Madisonville, Ky.	730
WFNC	Fayetteville, N.C.	940
WFNL	No. Augusta, S.C.	1600
WFOB	Fostoria, Ohio	1430
WFOM	Marietta, Ga.	1230
WFOR	Hattiesburg, Miss.	1400
WFOY	St. Augustine, Fla.	1240
WFPA	Fort Payne, Ala.	1400
WFPG	Atlantic City, N.J.	1450
WFPM	Fort Valley, Ga.	1150
WFPR	Hammond, La.	1400
WFRA	Franklin, Pa.	1450
WFRB	Frostburg, Md.	560
WFRC	Reidsville, N.C.	1600
WFRM	Coudersport, Pa.	600
WFRO	Fremont, Ohio	900
WFRX	West Frankfort, Ill.	1300
WFSC	Franklin, N.C.	1050
WFSG	Boca Raton, Fla.	740
WFSH	Valparaiso, Fla.	1340
WFSO	Pinellas, Fla.	570
WFSP	Kingwood, W. Va.	1560
WFSR	Bath, N.Y.	1380
WFST	Caribou, Maine	600
WFTC	Kinston, N.C.	960
WFTG	London, Ky.	1400
WFTL	Ft. Lauderdale, Fla.	1400
WFTM	Maysville, Ky.	1240
WFTN	Franklin, N.H.	1240
WFTO	Fulton, Miss.	1330
WFTR	Front Royal, Va.	1450
WFTW	Ft. Walton Beach, Fla.	1260
WFUL	Fulton, Ky.	1270
WFUN	Miami, Fla.	790
WFUR	Grand Rapids, Mich.	1570
WFVA	Fredericksburg, Va.	1230
WFWL	Camden, Tenn.	1220
WFWR	Ft. Wayne, Ind.	1090
WFYC	Alma, Mich.	1280
WGAA	Cedartown, Ga.	1340
WGAC	Augusta, Ga.	580
WGAD	Gadsden, Ala.	1350
WGAF	Valdosta, Ga.	910
WGAI	Elizabeth City, N.C.	560
WGAL	Lancaster, Pa.	1490
WGAN	Portland, Maine	560

WHITE'S RADIO LOG

Call	Location	kHz
WGAP	Maryville, Tenn.	1400
WGAR	Cleveland, Ohio	1220
WGAS	S. Gastonia, N.C.	1420
WGAT	Gate City, Va.	1050
WGAU	Athens, Ga.	1340
WGAW	Gardner, Mass.	1340
WGBB	Freeport, N.Y.	1240
WGBC	Chipley, Fla.	1240
WGBF	Evansville, Ind.	1280
WGBG	Greensboro, N.C.	1400
WGBI	Scranton, Pa.	910
WGBR	Goldsboro, N. C.	1150
WGBS	Miami, Fla.	710
WGCB	Red Lion, Pa.	1440
WGCD	Chester, S.C.	1490
WGCH	Greenwich, Conn.	1490
WGCM	Gulfport, Miss.	1240
WGEA	Geneva, Ala.	1150
WGEE	Indianapolis, Ind.	1590
WGEN	Geneseo, Ill.	1500
WGEM	Quincy, Ill.	1440
WGEN	Genesco, Ill.	1500
WGET	Gettysburg, Pa.	1320
WGEZ	Beloit, Wis.	1490
WGFA	Watseka, Ill.	1360
WGFS	Covington, Ga.	1430
WGGA	Gainesville, Ga.	550
WGGG	Gainesville, Fla.	1230
WGGH	Marion, Ill.	1150
WGGO	Salamanca, N.Y.	1590
WGH	Newport News, Va.	1310
WGHC	Clayton, Ga.	1570
WGHM	Skowegan, Maine	1150
WGHN	Grd. Haven, Mich.	1370
WGHQ	Kingston, N.Y.	920
WGIC	Xenia, O.	1500
WGIG	Brunswick, Ga.	1440
WGIL	Galesburg, Ill.	1400
WGIR	Manchester, N.H.	610
WGIV	Charlotte, N.C.	1600
WGKA	Atlanta, Ga.	1190
WGKR	Perry, Fla.	1310
WGL	Fort Wayne, Ind.	1250
WGLB	Port Wash., Wis.	1560
WGLC	Mendota, Ill.	1090
WGLI	Babylon, N.Y.	1290
WGMA	Hollywood, Fla.	1320
WGMF	Watkins Glen, N.Y.	1500
WGML	Hinesville, Ga.	990
WGMS	Bethesda, Md.	570
WGN	Chicago, Ill.	720
WGNC	Gastonia, N.C.	1450
WGNE	Panama City Beach, Fla.	1480
WGNI	Wilmington, N.C.	1450
WGNP	Indian Rocks Beach, Fla.	1520
WGNS	Murfreesboro, Tenn.	1450
WGNU	Granite City, Ill.	920
WGNY	Newburgh, N.Y.	1220
WGOC	Kingsport, Tenn.	1090
WGOE	Richmond, Va.	1590
WGOG	Walhalla, S. C.	1000
WGOH	Grayson, Ky.	1370
WGOK	Mobile, Ala.	900
WGOL	Goldsboro, N.C.	1300
WGON	Munising, Mich.	1400
WGOV	Valdosta, Ga.	950
WGOW	Chattanooga, Tenn.	1150
WGPA	Bethlehem, Pa.	1100
WGPC	Albany, Ga.	1450
WGR	Buffalo, N.Y.	550
WGRA	Cairo, Ga.	790
WGRD	Grand Rapids, Mich.	1410
WGRI	Griffin, Ga.	1410
WGRM	Greenwood, Miss.	1240
WGRO	Lake City, Fla.	960
WGRP	Greenville, Pa.	940
WGRT	Chicago, Ill.	950
WGRV	Greeneville, Tenn.	1340
WGSA	Ephrata, Pa.	1310
WGSB	Geneva, Ill.	1480
WGSM	Huntington, N.Y.	740
WGSR	Millen, Ga.	1570
WGST	Atlanta, Ga.	920
WGSV	Guntersville, Ala.	1270
WGSW	Greenwood, S.C.	1350
WGTA	Summerville, Ga.	950
WGTC	Greenville, N.C.	1590
WGTL	Kannapolis, N.C.	870
WGTM	Wilson, N.C.	590
WGTN	Georgetown, S.C.	1400
WGTO	Cypress Gardens, Fla.	540
WGTR	Natick, Mass.	1060
WGUL	New Port Richey, Fla.	1500
WGUN	Atlanta-Decatur, Ga.	1010
WGUS	North Augusta, S.C.	1380
WGUY	Bangor, Maine	1250
WGVA	Geneva, N.Y.	1240
WGVM	Greenville, Miss.	1260
WGWC	Selma, Ala.	1340
WGWR	Asheboro, N.C.	1260
WGY	Schenectady, N.Y.	810
WGYV	Greenville, Ala.	1380
WHA	Madison, Wis.	970
WHAG	Halfway, Md.	1410
WHAI	Greenfield, Mass.	1240
WHAK	Rogers City, Mich.	960
WHAL	Shelbyville, Tenn.	1400
WHAM	Rochester, N.Y.	1180
WHAN	Haines City, Fla.	930
WHAP	Hopewell, Va.	1340
WHAR	Clarksburg, W.Va.	1340
WHAS	Louisville, Ky.	840
WHAT	Philadelphia, Pa.	1340
WHAV	Haverhill, Mass.	1490
WHAW	Weston, W.Va.	980
WHAZ	Troy, N.Y.	1330
WHB	Kansas City, Mo.	710
WHBB	Selma, Ala.	1490
WHBC	Canton, Ohio	1480
WHBF	Rock Island, Ill.	1270
WHBG	Harrisonburg, Va.	1360
WHBL	Sheboygan, Wis.	1330
WHBN	Harrodsburg, Ky.	1420
WHBO	Tampa, Fla.	1050
WHBQ	Memphis, Tenn.	560
WHBT	Harriman, Tenn.	1600
WHBU	Anderson, Ind.	1240
WHBY	Appleton, Wis.	1230
WHCC	Waynesville, N.C.	1400
WHCO	Sparta, Ill.	1230
WHCQ	Spartanburg, S.C.	1400
WHCU	Ithaca, N.Y.	870
WHDF	Houghton, Mich.	1400
WHDH	Boston, Mass.	850
WHDL	Olean, N.Y.	1450
WHDM	McKenzie, Tenn.	1440
WHEB	Portsmouth, N.H.	750
WHEC	Rochester, N.Y.	1460
WHEE	Martinsville, Va.	1370
WHEL	New Albany, Ind.	1570
WHEN	Syracuse, N.Y.	620
WHEO	Stuart, Va.	1270
WHEP	Foley, Ala.	1310
WHER	Memphis, Tenn.	1430
WHFB	Benton Harbor-St. Joseph, Mich.	1060
WHGR	Houghton L., Mich.	1290
WHHH	Warren, Ohio	1440
WHHM	Henderson, Tenn.	1580
WHHO	Hornell, N.Y.	1320
WHHV	Hillsville, Va.	1400
WHHY	Montgomery, Ala.	1440
WHIC	Hardinsburg, Ky.	1520
WHIE	Griffin, Ga.	1320
WHIH	Portsmouth, Va.	1400
WHIL	Medford, Mass.	1430
WHIM	Providence, R.I.	1110
WHIN	Gallatin, Tenn.	1010
WHIO	Dayton, Ohio	1290
WHIP	Mooresville, N.C.	1350
WHIR	Danville, Ky.	1230
WHIS	Bluefield, W.Va.	1440
WHIT	New Bern, N.C.	1450
WHIZ	Zanesville, Ohio	1240
WHJB	Greensburg, Pa.	620
WHJC	Matawan, W.Va.	1360
WHK	Cleveland, Ohio	1420
WHKP	Hendersonville, N.C.	1450
WHKY	Hickory, N.C.	1290
WHLB	Virginia, Minn.	1400
WHLD	Niagara Falls, N.Y.	1270
WHLF	South Boston, Va.	1400
WHLI	Hempstead, N.Y.	1100
WHLL	Wheeling, W.Va.	1600
WHLM	Bloomsburg, Pa.	550
WHLN	Harlan, Ky.	1410
WHLO	Akron, Ohio	640
WHLP	Centerville, Tenn.	1570
WHLS	Port Huron, Mich.	1450
WHLT	Huntington, Ind.	1300
WHMA	Anniston, Ala.	1390
WHMC	Gaithersburg, Md.	1150
WHMI	Howell, Mich.	1350
WHMP	Northampton, Mass.	1400
WHN	New York, N.Y.	1050
WHNC	Henderson, N.C.	890
WHNY	McComb, Miss.	1250
WHO	Des Moines, Iowa	1040
WHOA	San Juan, P.R.	870
WHOC	Philadelphia, Miss.	1490
WHOD	Jackson, Ala.	1290
WHOK	Lancaster, Ohio	1320
WHOL	Allentown, Pa.	1600
WHOM	New York, N.Y.	1480
WHON	Centerville, Ind.	930
WHOO	Orlando, Fla.	990
WHOP	Hopkinsville, Ky.	1230
WHOS	Decatur, Ala.	800
WHOT	Campbell, Ohio	1330
WHOU	Houlton, Maine	1340
WHOW	Clinton, Ill.	1520
WHOY	Salinas, P. R.	1210
WHP	Harrisburg, Pa.	580
WHPB	Belton, S.C.	1390
WHPE	High Point, N.C.	1070
WHPL	Winchester, Va.	610
WHRF	Riverhead, N.Y.	1570
WHRN	Herendon, Va.	1440
WHRT	Hartselle, Ala.	860
WHRY	Elizabethtown, Pa.	1600
WHSC	Hartsville, S.C.	1450
WHSL	Wilmington, N.C.	1490
WHSM	Hayward, Wis.	910
WHSY	Hattiesburg, Miss.	1230
WHTC	Holland, Mich.	1450
WHTG	Eatontown, N.J.	1410
WHUB	Cookeville, Tenn.	1400
WHUC	Hudson, N.Y.	1230
WHUM	Reading, Pa.	1240
WHUN	Huntington, Pa.	1150
WHUT	Anderson, Ind.	1470
WHVL	Hendersonville, N.C.	1600
WHVR	Hanover, Pa.	1280
WHVW	Hyde Park, N.Y.	950
WHWB	Rutland, Vt.	1000
WHWH	Princeton, N.J.	1350
WHYD	Columbus, Ga.	1270
WHYL	Carlisle, Pa.	960
WHYN	Springfield, Mass.	560
WHYP	North East, Pa.	1530
WHYZ	Greenville, S. C.	1070
WIAC	San Juan, P.R.	740
WIAM	Williamston, N.C.	900
WIBA	Madison, Wis.	1310
WIBB	Macon, Ga.	1280
WIBC	Indianapolis, Ind.	1070
WIBG	Philadelphia, Pa.	990
WIBM	Jackson, Mich.	1450
WIBR	Baton Rouge, La.	1300
WIBU	Poynette, Wis.	1240
WIBV	Belleville, Ill.	1260
WIBW	Topeka, Kans.	580
WIBX	Utica, N.Y.	950
WICC	Bridgeport, Conn.	600
WICE	Providence, R.I.	1290
WICH	Norwich, Conn.	1310
WICK	Scranton, Pa.	1400
WICO	Salisbury, Md.	1320
WICY	Malone, N.Y.	1490
WIDE	Biddeford, Maine	1400
WIDD	Elizabethton, Tenn.	1520
WIDG	St. Ignace, Mich.	940
WIDU	Fayetteville, N.C.	1600
WIEL	Elizabethtown, Ky.	1400
WIFE	Indianapolis, Ind.	1310
WIFF	Auburn, Ind.	1150
WIFM	Elkin, N.C.	1540
WIGG	Wiggins, Miss.	1420
WIGM	Medford, Wis.	1490
WIGO	Atlanta, Ga.	1340
WIGS	Gouverneur, N.Y.	1230
WIII	Homestead, Fla.	1430
WIIN	Atlanta, Ga.	970
WIKB	Iron River, Mich.	1230
WIKC	Bogalusa, La.	1490
WIKE	Newport, Vt.	1490
WIKI	Chester, Va.	1410
WIKY	Evansville, Ind.	820
WIL	St. Louis, Mo.	1430
WILA	Danville, Va.	1580
WILD	Boston, Mass.	1090
WILE	Cambridge, Ohio	1270
WILI	Willimantic, Conn.	1400
WILK	Wilkes-Barre, Pa.	980
WILL	Urbana, Ill.	580
WILM	Wilmington, Del.	1450
WILO	Frankfort, Ind.	1570
WILS	Lansing, Mich.	1320
WILY	Centralia, Ill.	1210
WILZ	St. Petersburg Beach, Fla.	1590
WIMA	Lima, Ohio	1150
WIMO	Winder, Ga.	1300
WIMS	Michigan City, Ind.	1420
WINA	Charlottesville, Va.	1070
WINC	Winchester, Va.	1400
WIND	Chicago, Ill.	560
WINE	Brookfield, Conn.	940
WINF	Manchester, Conn.	1230
WING	Dayton, Ohio	1410
WINH	Georgetown, S. C.	1470
WINI	Murphysboro, Ill.	1420
WINK	Fort Myers, Fla.	1240
WINN	Louisville, Ky.	1240
WINQ	Tampa, Fla.	1010
WINR	Binghamton, N.Y.	680
WINS	New York, N.Y.	1010
WINT	Winter Haven, Fla.	1360
WINU	Highland Park, Ill.	1510
WINW	Canton, O.	1520
WINX	Rockville, Md.	1600
WINY	Putnam, Conn.	1350
WINZ	Miami, Fla.	940
WINU	Highland, Ill.	1510
WINW	Canton, Ohio	1520
WIOD	Miami, Fla.	610
WIOI	New Boston, Ohio	1010
WIOK	Normal, Ill.	1440
WION	Ionia, Mich.	1430
WIOO	Carlisle, Pa.	1000
WIOS	Tawas City-East Tawas, Mich.	1480
WIOU	Kokomo, Ind.	1350
WIP	Philadelphia, Pa.	610
WIPC	Lake Wales, Fla.	1280
WIPR	San Juan, P.R.	940
WIPS	Ticonderoga, N.Y.	1250
WIQT	Horseheads, N. Y.	1000
WIRA	Ft. Pierce, Fla.	1400
WIRB	Enterprise, Ala.	600
WIRC	Hickory, N.C.	630
WIRD	Lake Placid, N.Y.	920
WIRE	Indianapolis, Ind.	1430
WIRJ	Humboldt, Tenn.	740
WIRK	W. Palm Beach, Fla.	1290
WIRL	Peoria, Ill.	1290
WIRO	Ironton, Ohio	1230
WIRV	Irvine, Ky.	1550
WIRY	Plattsburg, N.Y.	1340
WIS	Columbia, S.C.	560
WISA	Isabella, P.R.	1390
WISE	Asheville, N.C.	1310
WISK	Americus, Ga.	1390
WISL	Shamokin, Pa.	1480
WISM	Madison, Wis.	1480
WISN	Milwaukee, Wis.	1130
WISO	Ponce, P.R.	1260
WISP	Kinston, N.C.	1230
WISR	Butler, Pa.	680
WISS	Berlin, Wis.	1090
WIST	Charlotte, N.C.	1240
WISV	Viroqua, Wis.	1360
WISZ	Glen Burnie, Md.	1590
WITA	San Juan, P.R.	1140
WITH	Baltimore, Md.	1230
WITL	Lansing, Mich.	1010
WITN	Washington, N.C.	930
WITY	Danville, Ill.	980
WITZ	Jasper, Ind.	990
WIVE	Ashland, Va.	1430
WIVK	Knoxville, Tenn.	850
WIVV	Vieques, P.R.	1370
WIVY	Jacksonville, Fla.	1050
WIXE	Monroe, N.C.	1190
WIXI	Lancaster, Ky.	1280
WIXK	New Richmond, Wis.	1590
WIXN	Dixon, Ill.	1460
WIXX	Oakland Park, Fla.	1520
WIXY	Cleveland, O.	1260
WIXZ	McKeesport, Pa.	1360
WIYN	Rome, Ga.	1360
WIZE	Springfield, Ohio	1340
WIZO	Franklin, Tenn.	1380
WIZR	Johnstown, N. Y.	930
WIZS	Henderson, N.C.	1450
WIZZ	Streator, Ill.	1250
WJAB	Westbrook, Me.	1440
WJAC	Johnstown, Pa.	850
WJAG	Norfolk, Nebr.	780
WJAK	Jackson, Tenn.	1460
WJAM	Marion, Ala.	1310
WJAR	Providence, R.I.	920
WJAS	Pittsburgh, Pa.	1320
WJAT	Swainsboro, Ga.	800
WJAX	Jacksonville, Fla.	930
WJAY	Mullins, S.C.	1280
WJAZ	Albany, Ga.	960
WJBB	Haleyville, Ala.	1230
WJBC	Bloomington, Ill.	1230
WJBD	Salem, Ill.	1350
WJBE	Knoxville, Tenn.	1430
WJBK	Detroit, Mich.	1500
WJBL	Holland, Mich.	1260
WJBM	Jerseyville, Ill.	1480
WJBO	Baton Rouge, La.	1150
WJBS	DeLand, Fla.	1490
WJBY	Gadsden, Ala.	930
WJCD	Seymour, Ind.	1390
WJCM	Sebring, Fla.	960
WJCO	Jackson, Mich	1510
WJCW	Johnson City, Tenn.	910
WJDA	Quincy, Mass.	1300
WJDB	Thomasville, Ala.	630
WJDX	Jackson, Miss.	620
WJDY	Salisbury, Md.	1470
WJEF	Grand Rapids, Mich.	1230
WJEH	Gallipolis, Ohio	990
WJEJ	Hagerstown, Md.	1240
WJEM	Valdosta, Ga.	1150
WJER	Dover, Ohio	1450
WJES	Johnston, S.C.	1570
WJET	Erie, Pa.	1400
WJFC	Jefferson City, Tenn.	1480
WJGA	Jackson, Ga.	1540
WJHO	Opelika, Ala.	1400
WJIC	Salem, N. J.	1510
WJIG	Tullahoma, Tenn.	740
WJIL	Jacksonville, Ill.	1550
WJIM	Lansing, Mich.	1240
WJJC	Commerce, Ga.	1270
WJJD	Chicago, Ill.	1160
WJJJ	Christiansburg, Va.	1260
WJJL	Niagara Falls, N.Y.	1440
WJJM	Lewisburg, Tenn.	1490
WJJZ	Mt. Holly, N. J.	1460
WJKM	Hartsville, Tenn.	1090
WJKY	Jamestown, Ky.	1060
WJLB	Detroit, Mich.	1400
WJLD	Homewood, Ala.	1400
WJLE	Smithville, Tenn.	1480
WJLK	Asbury Park, N. J.	1310
WJLS	Beckley, W.Va.	560
WJMA	Orange, Va.	1340
WJMB	Brookhaven, Miss.	1340
WJMC	Rice Lake, Wis.	1240
WJML	Petoskey, Mich.	1110
WJMO	Cleveland Hgts., Ohio	1490
WJMR	New Orleans, La.	990
WJMS	Ironwood, Mich.	590
WJMW	Athens, Ala.	730
WJMX	Florence, S.C.	970
WJNC	Jacksonville, N.C.	1240
WJNO	W. Palm Beach, Fla.	1230
WJOB	Hammond, Ind.	1230
WJOE	Port St. Joe, Fla.	1080
WJOI	Florence, Ala.	1340

Call	Location	kHz
WJOL	Joliet, Ill.	1340
WJON	St. Cloud, Minn.	1240
WJOR	South Haven, Mich.	940
WJOT	Lake City, S.C.	1260
WJOY	Burlington, Vt.	1230
WJPA	Washington, Pa.	1450
WJPD	Ishpeming, Mich.	1240
WJPF	Herrin, Ill.	1340
WJPR	Greenville, Miss.	1330
WJPS	Evansville, Ind.	1330
WJPW	Rockford, Mich.	810
WJQS	Jackson, Miss.	1400
WJR	Detroit, Mich.	760
WJRC	Joliet, Ill.	1510
WJRD	Tuscaloosa, Ala.	1150
WJRI	Lenoir, N.C.	1340
WJRL	Calhoun City, Miss.	1530
WJRM	Troy, N.C.	1390
WJRZ	Hackensack, N.J.	970
WJSB	Crestview, Fla.	1050
WJSM	Martinsburg, Pa.	1110
WJSO	Jonesboro, Tenn.	1590
WJSW	Maplewood, Minn.	1010
WJTN	Jamestown, N.Y.	1240
WJTO	Bath, Me.	730
WJTS	Jupiter, Fla.	1000
WJUN	Mexico, Pa.	1220
WJVA	South Bend, Ind.	1580
WJW	Cleveland, Ohio	850
WJWL	Georgetown, Del.	900
WJWS	South Hill, Va.	1370
WJXN	Jackson, Miss.	1450
WJZM	Clarksville, Tenn.	1400
WKAC	Athens, Ala.	1080
WKAI	Macomb, Ill.	1510
WKAJ	Saratoga Springs, N.Y.	900
WKAL	Rome, N.Y.	1450
WKAM	Goshen, Ind.	1460
WKAN	Kankakee, Ill.	1320
WKAP	Allentown, Pa.	1320
WKAQ	San Juan, P.R.	580
WKAR	East Lansing, Mich.	870
WKAT	Miami Beach, Fla.	1360
WKAU	Kaukanna, Wis.	1050
WKAY	Glasgow, Ky.	1490
WKAZ	Charleston, W.Va.	950
WKBA	Vinton, Va.	1550
WKBC	N. Wilkesboro, N.C.	810
WKBH	La Crosse, Wis.	1410
WKBJ	Milan, Tenn.	1600
WKBK	Keene, N.H.	1220
WKBL	Covington, Tenn.	1250
WKBN	Youngstown, Ohio	570
WKBO	Harrisburg, Pa.	1230
WKBQ	Garner, N.C.	1000
WKBR	Manchester, N.H.	1250
WKBV	Richmond, Ind.	1490
WKBW	Buffalo, N.Y.	1520
WKBX	Winston-Salem, N.C.	1500
WKBY	Chatham, Va.	1080
WKBZ	Muskegon, Mich.	850
WKCT	Bowling Green, Ky.	930
WKCU	Corinth, Miss.	1350
WKCW	Warrenton, Va.	1420
WKCY	Harrisonburg, Va.	1300
WKDA	Nashville, Tenn.	1240
WKDE	Altavista, Va.	1000
WKDK	Newberry, S.C.	1240
WKDL	Clarksdale, Miss.	1600
WKDO	Liberty, Ky.	1560
WKDR	Plattsburgh, N.Y.	1070
WKDX	Hamlet, N.C.	1250
WKDZ	Cadiz, Ky.	1110
WKEE	Huntington, W.Va.	800
WKEI	Kewanee, Ill.	1450
WKEN	Dover, Del.	1600
WKER	Pompton Lakes, N.J.	1500
WKEU	Griffin, Ga.	1450
WKEX	Blackburg, Va.	1430
WKEY	Covington, Va.	1340
WKFD	Wickford, R.I.	1370
WKFE	Yauco, P.R.	1550
WKFR	Battle Creek, Mich.	1400
WKGN	Knoxville, Tenn.	1340
WKGX	Lenoir, N.C.	1080
WKHM	Jackson, Mich.	970
WKIC	Hazard, Ky.	1390
WKIG	Glenville, Ga.	1580
WKIK	Leonardtown, Md.	1370
WKIN	Kingsport, Tenn.	1320
WKIP	Poughkeepsie, N.Y.	1450
WKIS	Orlando, Fla.	740
WKIX	Raleigh, N.C.	850
WKIZ	Key West, Fla.	1500
WKJB	Mayaguez, P.R.	710
WKJG	Fort Wayne, Ind.	1380
WKJK	Granite Falls, N.C.	900
WKJR	Muskegon, Mich.	1520
WKKD	Aurora, Ill.	1580
WKKO	Cocoa, Fla.	860
WKKR	Pickens, S.C.	1540
WKKS	Vanceburg, Ky.	1570
WKLA	Ludington, Mich.	1450
WKLC	St. Albans, W.Va.	1300
WKLF	Clanton, Ala.	980
WKLK	Cloquet, Minn.	1230
WKLM	Wilmington, N.C.	980
WKLO	Louisville, Ky.	1080
WKLP	Keyser, W. Va.	1390
WKLV	Blackstone, Va.	1440
WKLY	Hartwell, Ga.	980
WKMC	Roaring Sprgs., Pa.	1370
WKMF	Flint, Mich.	1470
WKMK	Blountstown, Fla.	1000
WKMT	Kings Mtn., N.C.	1220
WKNE	Keene, N.H.	1290
WKMG	Newberry, S.C.	1520
WKNR	Dearborn, Mich.	1310
WKNT	Kent, Ohio	1520
WKNX	Saginaw, Mich.	1210
WKNY	Kingston, N.Y.	1490
WKOA	Hopkinsville, Ky.	1480
WKOK	Sunbury, Pa.	1070
WKOL	Amsterdam, N.Y.	1570
WKOP	Binghamton, N.Y.	1360
WKOR	Starkville, Miss.	980
WKOV	Wellston, Ohio	1330
WKOW	Madison, Wis.	1070
WKOX	Framingham, Mass.	1190
WKOY	Bluefield, W.Va.	1240
WKOZ	Kosciusko, Miss.	1340
WKPA	New Kensington, Pa.	1150
WKPM	Princeton, Minn.	1300
WKPO	Prentiss, Miss.	1510
WKPR	Kalamazoo, Mich.	1420
WKPT	Kingsport, Tenn.	1400
WKQH	Chiefland, Fla.	940
WKQV	Sullivan, Ind.	1550
WKQW	Spring Valley, N.Y.	1300
WKRA	Holly Springs, Miss.	1110
WKRC	Cincinnati, Ohio	550
WKRG	Mobile, Ala.	710
WKRK	Murphy, N.C.	1320
WKRM	Columbia, Tenn.	1340
WKRO	Cairo, Ill.	1490
WKRS	Waukegan, Ill.	1220
WKRT	Cortland, N.Y.	920
WKRW	Cartersville, Ga.	
WKRZ	Oil City, Pa.	1340
WKSC	Kershaw, S.C.	1300
WKSK	W. Jefferson, N.C.	1600
WKSN	Jamestown, N.Y.	1340
WKSP	Kingstree, S.C.	1090
WKSR	Pulaski, Tenn.	1420
WKST	New Castle, Pa.	1280
WKTC	Charlotte, N.C.	1310
WKTE	King, N.C.	1090
WKTG	Thomasville, Ga.	730
WKTJ	Farmington, Maine	1380
WKTQ	South Paris, Maine	1450
WKTS	Sheboygan, Wis.	950
WKTX	Atlantic Beach, Fla.	1600
WKTY	LaCrosse, Wis.	580
WKUL	Cullman, Ala.	1340
WKVA	Lewistown, Pa.	920
WKVM	San Juan, P.R.	810
WKVO	Havelock, N.C.	1330
WKVT	Brattleboro, Vt.	1490
WKWF	Key West, Fla.	1600
WKWK	Wheeling, W.Va.	1400
WKWS	Rocky Mount, Va.	1290
WKXL	Concord, N.H.	1450
WKXR	Exeter, N.H.	1540
WKXV	Knoxville, Tenn.	900
WKXY	Sarasota, Fla.	930
WKY	Oklahoma City, Okla.	930
WKYB	Hemingway, S.C.	1000
WKYC	Cleveland, Ohio	1100
WKYE	Bristol, Tenn.	1550
WKYK	Burnsville, N.C.	1540
WKYO	Caro, Mich.	1360
WKYX	Paducah, Ky.	570
WKYZ	Madisonville, Tenn.	1250
WKZA	Kane, Pa.	960
WKZI	Casey, Ill.	800
WKZO	Kalamazoo, Mich.	590
WLAC	Nashville, Tenn.	1510
WLAD	Danbury, Conn.	800
WLAF	LaFollette, Tenn.	1450
WLAG	La Grange, Ga.	1240
WLAK	Lakeland, Fla.	1430
WLAM	Lewiston, Maine	1470
WLAN	Lancaster, Pa.	1390
WLAP	Lexington, Ky.	630
WLAQ	Rome, Ga.	1410
WLAR	Athens, Tenn.	1450
WLAS	Jacksonville, N.C.	910
WLAT	Conway, S.C.	1330
WLAU	Laurel, Miss.	1430
WLAV	Grand Rapids, Mich.	1340
WLAW	Lawrenceville, Ga.	1360
WLAY	Muscle Shoals, Ala.	1450
WLBB	Carrollton, Ga.	1100
WLBC	Muncie, Ind.	1340
WLBE	Leesburg, Fla.	790
WLBG	Laurens, S.C.	860
WLBH	Mattoon, Ill.	1170
WLBI	Denham Springs, La.	1220
WLBJ	Bowling Green, Ky.	1410
WLBK	DeKalb, Ill.	1360
WLBL	Auburndale, Wis.	930
WLBN	Lebanon, Ky.	1590
WLBR	Lebanon, Pa.	1280
WLBS	Centreville, Miss.	1580
WLBZ	Bangor, Maine	620
WLCB	Moulton, Ala.	1530
WLCK	Scottsville, Ky.	1250
WLCM	Lancaster, S.C.	1360
WLCN	Laurensburg, N.C.	1300
WLCO	Eustis, Fla.	1240
WLCS	Baton Rouge, La.	910
WLCX	LaCrosse, Wis.	1490
WLCY	St. Petersburg, Fla.	1380
WLDB	Atlantic City, N.J.	1490
WLDS	Jacksonville, Ill.	1180
WLDY	Ladysmith, Wis.	1340
WLEA	Hornell, N.Y.	1480
WLEC	Sandusky, Ohio	1450
WLEE	Richmond, Va.	1480
WLEF	Greenwood, Miss.	1540
WLEH	Lehigh Acres, Fla.	1440
WLEM	Emporium, Pa.	1240
WLES	Lawrenceville, Va.	580
WLET	Toccoa, Ga.	1420
WLEW	Bad Axe, Mich.	1340
WLEY	Cayey, P.R.	1080
WLFA	Lafayette, Ga.	1590
WLFH	Little Falls, N.Y.	1230
WLGM	Lynchburg, Va.	1320
WLGN	Logan, O.	1510
WLIB	New York, N.Y.	1190
WLIJ	Shelbyville, Tenn.	1580
WLIK	Newport, Tenn.	1270
WLIL	Lenoir City, Tenn.	730
WLIP	Kenosha, Wis.	1050
WLIQ	Mobile, Ala.	1360
WLIS	Old Saybrook, Conn.	1420
WLIV	Livingston, Tenn.	920
WLIX	Islip, N. Y.	540
WLIZ	Lake Worth, Fla.	1380
WLKE	Waupun, Wis.	1170
WLKM	Three Rivers, Mich.	1510
WLKN	Lincoln, Me.	1450
WLKR	Norwalk, O.	1510
WLKS	W. Liberty, Ky.	1450
WLKW	Providence, R.I.	990
WLLE	Raleigh, N.C.	570
WLLH	Lowell, Mass.	1400
WLLL	Lynchburg, Va.	930
WLLS	Hartford, Ky.	1600
WLLY	Wilson, N.C.	1350
WLMD	Laurel, Md.	900
WLMS	Leominster, Mass.	1000
WLNC	Laurinburg, N.C.	1300
WLMJ	Jackson, Ohio	1280
WLNA	Peekskill, N.Y.	1420
WLNC	Laurinburg, N.C.	1300
WLNG	Sag Harbor, N.Y.	1600
WLNH	Laconia, N.H.	1350
WLOA	Braddock, Pa.	1550
WLOB	Portland, Maine	1310
WLOC	Munfordville, Ky.	1150
WLOD	Pompano Beach, Fla.	980
WLOE	Leaksville, N.C.	1490
WLOF	Orlando, Fla.	950
WLOG	Logan, W.Va.	1230
WLOH	Princeton, W.Va.	1490
WLOI	LaPorte, Ind.	1540
WLOK	Memphis, Tenn.	1340
WLOL	Minneapolis, Minn.	1330
WLON	Lincolnton, N.C.	1050
WLOP	Jesup, Ga.	1370
WLOR	Thomasville, Ga.	730
WLOS	Asheville, N.C.	1380
WLOT	Marinette, Wis.	1300
WLOU	Louisville, Ky.	1350
WLOV	Washington, Ga.	1370
WLOW	Aiken, S.C.	1300
WLOX	Biloxi, Miss.	1490
WLPH	Irondale, Ala.	1480
WLPM	Suffolk, Va.	1450
WLPO	LaSalle, Ill.	1220
WLPS	Lehighton, Pa.	1150
WLQH	Chiefland, Fla.	940
WLRC	Whitehall, Mich.	1490
WLS	Chicago, Ill.	890
WLSB	Copper Hill, Tenn.	1400
WLSC	Loris, S.C.	1570
WLSD	Big Stone Gap, Va.	1220
WLSE	Wallace, N.C.	1400
WLSH	Lansford, Pa.	1410
WLSI	Pikeville, Ky.	900
WLSM	Louisville, Miss.	1270
WLST	Escanaba, Mich.	600
WLSV	Wellsville, N.Y.	790
WLTC	Gastonia, N.C.	1370
WLTH	Gary, Ind.	1370
WLTN	Littleton, N. H.	1400
WLTO	Miami, Fla.	1220
WLUV	Loves Park, Ill.	1520
WLUX	Baton Rouge, La.	1550
WLUZ	Bayamon, P. R.	1600
WLVA	Lynchburg, Va.	590
WLW	Cincinnati, Ohio	700
WLWO	(V.O.A.) Marathon, Fla.	1180
WLYB	Albany, Ga.	1250
WLYC	Williamsport, Pa.	1050
WLYN	Lynn, Mass.	1360
WLYO	New Orleans, La.	940
WLYV	Ft. Wayne, Ind.	1450
WMAB	Munising, Mich.	1400
WMAC	Netter, Ga.	1360
WMAD	Madison, Wis.	1550
WMAF	Madison, Fla.	1230
WMAG	Forest, Miss.	860
WMAJ	State College, Pa.	1450
WMAK	Nashville, Tenn.	1300
WMAL	Washington, D.C.	630
WMAM	Marinette, Wis.	570
WMAN	Mansfield, Ohio	1400
WMAP	Monroe, N.C.	1060
WMAQ	Chicago, Ill.	670
WMAS	Springfield, Mass.	1450
WMAT	Lansing, Mich.	1010
WMAY	Springfield, Ill.	970
WMAZ	Macon, Ga.	940
WMBA	Ambridge, Pa.	1460
WMBD	Peoria, Ill.	1470
WMBH	Joplin, Mo.	1450
WMBI	Chicago, Ill.	1110
WMBL	Morehead City, N.C.	740
WMBM	Miami Beach, Fla.	1490
WMBN	Petoskey, Mich.	1340
WMBO	Auburn, N.Y.	1340
WMBR	Jacksonville, Fla.	1460
WMBS	Uniontown, Pa.	590
WMBT	Shenandoah, Pa.	1530
WMC	Memphis, Tenn.	790
WMCA	New York, N.Y.	570
WMCH	Church Hill, Tenn.	1260
WMCL	McLeansboro, Ill.	1060
WMCP	Columbia, Tenn.	1280
WMCR	Oneida, N.Y.	1600
WMCS	Machias, Me.	1400
WMCT	Mountain City, Tenn.	1390
WMCW	Harvard, Ill.	1600
WMDC	Hazlehurst, Miss.	1220
WMDD	Fajardo, P.R.	1480
WMDN	Midland, Mich.	1490
WMEG	Eau Gallie, Fla.	920
WMEK	Chase City, Va.	980
WMEL	Pensacola, Fla.	610
WMEN	Tallahassee, Fla.	1330
WMEV	Marion, Va.	1010
WMEX	Boston, Mass.	1510
WMFC	Monroeville, Ala.	1360
WMFD	Wilmington, N.C.	630
WMFG	Hibbing, Minn.	1240
WMFJ	Daytona Beach, Fla.	1450
WMFR	High Point, N.C.	1230
WMGA	Moultrie, Ga.	1130
WMGR	Bainbridge, Ga.	930
WMGS	Bowling Green, Ohio	730
WMGW	Meadville, Pa.	1490
WMGY	Montgomery, Ala.	800
WMIA	Arecibo, P. R.	1070
WMIC	Sandusky, Mich.	1560
WMID	Atlantic City, N.J.	1340
WMIK	Middlesboro, Ky.	560
WMIL	Milwaukee, Wis.	1290
WMIM	Mt. Carmel, Pa.	1590
WMIN	Mpls.-St. Paul, Minn.	1400
WMIQ	Iron Mountain, Mich.	1450
WMIR	Lake Geneva, Wis.	1550
WMIS	Natchez, Miss.	1240
WMIX	Mt. Vernon, Ill.	940
WMJL	Marion, Ky.	1010
WMJM	Cordele, Ga.	1490
WMKR	Millinocket, Me.	1240
WMKT	S. St. Paul, Minn.	1370
WMLO	Beverly, Mass.	1570
WMLP	Milton, Pa.	1380
WMLS	Sylacauga, Ala.	1290
WMLT	Dublin, Ga.	1330
WMMB	Melbourne, Fla.	1240
WMMH	Marshall, N.C.	1460
WMMJ	Lancaster, N.Y.	1300
WMMM	Westport, Conn.	1260
WMMN	Fairmont, W.Va.	920
WMMW	Meriden, Conn.	1470
WMNA	Gretna, Va.	730
WMNB	No. Adams, Mass.	1230
WMNC	Morganton, N.C.	1430
WMNE	Menomonie, Wis.	1360
WMNI	Columbus, Ohio	920
WMNS	Olean, N.Y.	1360
WMNT	Manati, P.R.	1500
WMNZ	Montezuma, Ga.	1050
WMOA	Marietta, Ohio	1490
WMOB	Mobile, Ala.	840
WMOC	Chattanooga, Tenn.	1450
WMOG	Brunswick, Ga.	1490
WMOH	Hamilton, Ohio	1450
WMOK	Metropolis, Ill.	920
WMON	Montgomery, W.Va.	1340
WMOO	Mobile, Ala.	1550
WMOP	Ocala, Fla.	900
WMOR	Morehead, Ky.	1330
WMOU	Berlin, N.H.	1230
WMOV	Ravenswood, W.Va.	1360
WMOX	Meridian, Miss.	1240
WMOZ	Mobile, Ala.	960
WMPA	Aberdeen, Miss.	1240
WMPC	Lapeer, Mich.	1230
WMPL	Hancock, Mich.	920
WMPM	Smithfield, N.C.	1270
WMPO	Middleport-Pomeroy, Ohio	1390
WMPP	Chicago Heights, Ill.	1470
WMPS	Memphis, Tenn.	680
WMPT	So. Williamsport, Pa.	1450
WMQM	Memphis, Tenn.	1480
WMRB	Greenville, S.C.	1490
WMRC	Milford, Mass.	1490
WMRE	Monroe, Ga.	1490
WMRF	Lewistown, Pa.	1490
WMRI	Marion, Ind.	860
WMRN	Marion, Ohio	1490
WMRO	Aurora, Ill.	1280
WMRP	Flint, Mich.	1570
WMSA	Massena, N.Y.	1340
WMSG	Oakland, Md.	1050
WMSJ	Sylva, N.C.	1480
WMSK	Morganfield, Ky.	1550
WMSL	Decatur, Ala.	1400
WMSR	Manchester, Tenn.	1320
WMST	Mt. Sterling, Ky.	1150
WMT	Cedar Rapids, Iowa	600
WMTA	Central City, Ky.	1380

WHITE'S RADIO LOG

Call	Location	kHz
WMTC	Vancleve, Ky.	730
WMTD	Hinton, W. Va.	1380
WMTE	Manistee, Mich.	1340
WMTL	Leitchfield, Ky.	1580
WMTM	Moultrie, Ga.	1300
WMTN	Morristown, Tenn.	1300
WMTR	Morristown, N.J.	1250
WMTS	Murfreesboro, Tenn.	810
WMUS	Muskegon, Mich.	1090
WMUU	Greenville, S.C.	1260
WMVA	Martinsville, Va.	1450
WMVB	Millville, N.J.	1440
WMVG	Milledgeville, Ga.	1450
WMVO	Mt. Vernon, Ohio	1300
WMVR	Sidney, Ohio	1080
WMWM	Wilmington, O.	1090
WMYB	Myrtle Beach, S.C.	1450
WMYN	Mayodan, N.C.	1420
WMYR	Ft. Myers, Fla.	1410
WNAB	Bridgeport, Conn.	1450
WNAD	Norman, Okla.	640
WNAE	Warren, Pa.	1310
WNAG	Grenada, Miss.	1400
WNAH	Nashville, Tenn.	1360
WNAK	Nanticoke, Pa.	730
WNAL	Nelsonville, O.	940
WNAM	Neenah, Wis.	1280
WNAR	Norristown, Pa.	1110
WNAU	New Albany, Miss.	1470
WNAV	Annapolis, Md.	1430
WNAX	Yankton, S.Dak.	570
WNBC	New York, N.Y.	660
WNBF	Binghamton, N.Y.	1290
WNBH	New Bedford, Mass.	1340
WNBI	Park Falls, Wis.	980
WNBP	Newburyport, Mass.	1470
WNBS	Murray, Ky.	1340
WNBT	Wellsboro, Pa.	1490
WNBY	Newberry, Mich.	1450
WNBZ	Saranac Lake, N.Y.	1240
WNCA	Siler City, N.C.	1570
WNCC	Barnesboro, Pa.	950
WNCG	N. Charleston, S.C.	910
WNCO	Ashland, Ohio	1340
WNCT	Greenville, N.C.	1070
WNDB	Daytona Beach, Fla.	1150
WNDR	Syracuse, N.Y.	1260
WNDU	South Bend, Ind.	1490
WNEB	Worcester, Mass.	1230
WNEG	Taccoa, Ga.	630
WNEL	Caguas, P. R.	1430
WNER	Live Oak, Fla.	1250
WNES	Central City, Ky.	1050
WNEW	New York, N.Y.	1130
WNEX	Macon, Ga.	1400
WNFL	Green Bay, Wis.	1440
WNGA	Nashville, Ga.	1600
WNGO	Mayfield, Ky.	1320
WNHC	New Haven, Conn.	1340
WNHV	White River Jct., Vt.	910
WNIA	Cheektowaga, N.Y.	1230
WNIK	Arecibo, P.R.	1230
WNIL	Niles, Mich.	1290
WNIO	Niles, Ohio	1540
WNJH	Hammonton, N.J.	1580
WNKY	Neon, Ky.	1480
WNLC	New London, Conn.	1510
WNLK	Norwalk, Conn.	1350
WNMP	Evanston, Ill.	1590
WNMT	Garden City, Ga.	1520
WNNC	Newton, N.C.	1230
WNNJ	Newton, N.J.	1360
WNNT	Warsaw, Va.	690
WNOG	Naples, Fla.	1270
WNOK	Columbia, S.C.	1230
WNOO	Chattanooga, Tenn.	1260
WNOP	Newport, Ky.	740
WNOR	Norfolk, Va.	1230
WNOS	High Point, N.C.	1590
WNOV	Milwaukee, Wis.	860
WNOW	York, Pa.	1250
WNOX	Knoxville, Tenn.	990
WNPS	New Orleans, La.	1450
WNPT	Tuscaloosa, Ala.	1280
WNPV	Lansdale, Pa.	1440
WNRG	Grundy, Va.	940
WNRI	Woonsocket, R.I.	1380
WNRJ	Gainsville, Ga.	1580
WNRK	Newark, Del.	1260
WNRV	Narrows-Pearisburg, Va.	990
WNSL	Laurel, Miss.	1260
WNTN	Newton, Mass.	1550
WNTT	Tazewell, Tenn.	1250
WNTY	Southington, Conn.	990
WNUE	Ft. Walton Bch., Fla.	1400
WNUS	Chicago, Ill.	1390
WNUZ	Talladega, Ala.	1230
WNVA	Norton, Va.	1350
WNVL	Nicholasville, Ky.	1250

Call	Location	kHz
WNVY	Pensacola, Fla.	1230
WNWI	Valparaiso, Ind.	1080
WNXT	Portsmouth, Ohio	1260
WNYC	New York, N.Y.	830
WNYN	Canton, O.	900
WNYR	Rochester, N.Y.	680
WOAI	San Antonio, Tex.	1200
WOAP	Owosso, Mich.	1080
WOAY	Oak Hill, W.Va.	860
WOBS	Jacksonville, Fla.	1360
WOBT	Rhinelander, Wis.	1240
WOC	Davenport, Iowa	1420
WOCB	W. Yarmouth, Mass.	1240
WOCH	North Vernon, Ind.	1460
WOCN	Miami, Fla.	1450
WOCO	Oconto, Wis.	1260
WODI	Brookneal, Va.	1230
WODY	Bassett, Va.	900
WOGA	Sylvester, Ga.	1540
WOGO	New Smyrna Beach, Fla.	1550
WOHI	E. Liverpool, Ohio	1490
WOHO	Toledo, Ohio	1470
WOHS	Shelby, N.C.	730
WOI	Ames, Iowa	640
WOIB	Saline, Mich.	1290
WOIC	Columbia, S.C.	1320
WOIO	Canton, O.	1060
WOKA	Douglas, Ga.	1310
WOKB	Winter Garden, Fla	1600
WOKC	Okeechobee, Fla.	1570
WOKE	Charleston, S.C.	1340
WOKJ	Jackson, Miss.	1550
WOKK	Meridian, Miss.	1450
WOKL	Eau Claire, Wis.	1050
WOKO	Albany, N.Y.	1460
WOKS	Columbus, Ga.	1340
WOKW	Brockton, Mass.	1410
WOKY	Milwaukee, Wis.	920
WOKZ	Alton, Ill.	1570
WOL	Washington, D.C.	1450
WOLD	Marion, Va.	1330
WOLF	Syracuse, N.Y.	1490
WOLS	Florence, S. C.	1230
WOMI	Owensboro, Ky.	1490
WOMN	Decatur, Ga.	1310
WOMP	Bellaire, Ohio	1290
WOMT	Manitowoc, Wis.	1240
WONA	Winona, Miss.	1570
WOND	Pleasantville, N.J.	1400
WONE	Dayton, Ohio	980
WONN	Lakeland, Fla.	1230
WONS	Tallahassee, Fla.	1410
WONW	Defiance, Ohio	1280
WOOD	Grand Rapids, Mich.	1300
WOOF	Dothan, Ala.	560
WOOK	Washington, D.C.	1340
WOOO	Deland, Fla.	1310
WOOW	Greenville, N.C.	1340
WOPA	Oak Park, Ill.	1490
WOPI	Bristol, Tenn.	1490
WOR	New York, N.Y.	710
WORA	Mayaguez, P.R.	760
WORC	Worcester, Mass.	1310
WORD	Spartanburg, S.C.	910
WORG	Orangeburg, S.C.	1580
WORJ	Orlando, Fla.	1270
WORK	York, Pa.	1350
WORM	Savannah, Tenn.	1010
WORV	Hattiesburg, Miss.	1580
WORX	Madison, Ind.	1270
WOSC	Fulton, N.Y.	1300
WOSH	Oshkosh, Wis.	1490
WOSU	Columbus, Ohio	820
WOTR	Corry, Pa.	1370
WOTT	Watertown, N.Y.	1410
WOTW	Nashua, N.H.	900
WOUB	Athens, Ohio	1340
WOVE	Welch, W.Va.	1340
WOW	Omaha, Nebr.	590
WOWL	Florence, Ala.	1240
WOWO	Ft. Wayne, Ind.	1190
WOWW	Naugatuck, Conn.	1380
WOWY	Clewiston, Fla.	1590
WOXF	Oxford, N.C.	1340
WOZK	Ozark, Ala.	900
WPAB	Ponce, P.R.	550
WPAC	Patchogue, N.Y.	1580
WPAD	Paducah, Ky.	1450
WPAG	Ann Arbor, Mich.	1050
WPAL	Charleston, S.C.	730
WPAM	Pottsville, Pa.	1450
WPAQ	Mount Airy, N.C.	740
WPAR	Parkersburg, W.Va.	1450
WPAS	Zephyrhills, Fla.	1400
WPAT	Paterson, N.J.	930
WPAW	E. Syracuse, N.Y.	1540
WPAX	Thomasville, Ga.	1240
WPAY	Portsmouth, Ohio	1400
WPAZ	Pottstown, Pa.	1370
WPBC	Richfield, Minn.	980
WPCC	Clinton, S.C.	1400
WPCF	Panama City, Fla.	1430
WPCO	Mt. Vernon, Ind.	1590
WPDE	Paris, Ky.	1440
WPDF	Corydon, Ind.	1550
WPDM	Potsdam, N.Y.	1470
WPDQ	Jacksonville, Fla.	600
WPDR	Portage, Wis.	1350
WPDX	Clarksburg, W.Va.	750
WPED	Crozet, Va.	810
WPEH	Louisville, Ga.	1420
WPEL	Montrose, Pa.	1250

Call	Location	kHz
WPEN	Philadelphia, Pa.	950
WPEO	Peoria, Ill.	1020
WPEP	Taunton, Mass.	1570
WPET	Greensboro, N.C.	950
WPFA	Pensacola, Fla.	790
WPFB	Middletown, Ohio	910
WPGA	Perry, Ga.	980
WPGC	Bradbury Hghts., Md.	1580
WPGF	Burgaw, N. C.	1470
WPGM	Danville, Pa.	1570
WPGW	Portland, Ind.	1440
WPHB	Philipsburg, Pa.	1260
WPHC	Waverly, Tenn.	1060
WPHM	Port Huron, Mich.	1380
WPIC	Sharon, Pa.	790
WPID	Piedmont, Ala.	1280
WPIK	Alexandria, Va.	730
WPIP	Collierville, Tenn.	1590
WPIT	Pittsburgh, Pa.	730
WPKE	Pikeville, Ky.	1240
WPKO	Waverly, Ohio	1380
WPKY	Princeton, Ky.	1580
WPLA	Plant City, Fla.	910
WPLB	Greenville, Mich.	1380
WPLK	Rockmart, Ga.	1220
WPLM	Plymouth, Mass.	1390
WPLO	Atlanta, Ga.	590
WPLY	Plymouth, Wis.	1420
WPMB	Vandalia, Ill.	1500
WPME	Punxsutawney, Pa.	1540
WPMH	Portsmouth, Va.	1010
WPMP	Pascagoula, Miss.	1580
WPNC	Plymouth, N.C.	1470
WPNF	Brevard, N.C.	1240
WPNH	Plymouth, N. H.	1300
WPNO	Auburn, Me.	1530
WPNX	Columbus, Ga.	1460
WPOK	Pontiac, Ill.	1080
WPON	Pontiac, Mich.	1460
WPOP	Hartford, Conn.	1410
WPOR	Portland, Maine	1490
WPOW	New York, N.Y.	1330
WPPA	Pottsville, Pa.	1360
WPRA	Mayaguez, P.R.	990
WPRC	Lincoln, Ill.	1370
WPRE	Prairie Du Chien, Wis.	980
WPRJ	Parsippany-Troy Hills, N.J.	1310
WPRN	Butler, Ala.	1240
WPRO	Providence, R.I.	630
WPRP	Ponce, P.R.	910
WPRS	Paris, Ill.	1440
WPRT	Prestonsburg, Ky.	960
WPRV	Wauchula, Fla.	1600
WPRW	Manassas, Va.	1460
WPRY	Perry, Fla.	1400
WPSL	Monroeville, Pa.	1510
WPTF	Raleigh, N.C.	680
WPTL	Canton, N.C.	920
WPTN	Cookeville, Tenn.	1500
WPTR	Albany, N.Y.	1540
WPTS	Pittston, Pa.	1540
WPTW	Piqua, Ohio	1570
WPTX	Lexington Pk., Md.	920
WPUL	Bartow, Fla.	1130
WPUT	Brewster, N.Y.	1510
WPUV	Pulaski, Va.	1580
WPVA	Colonial Hghts., Va.	1290
WPVL	Painesville, Ohio	1460
WPXC	Prattville, Ala.	1410
WPXE	Starke, Fla.	1490
WPXI	Roanoke, Va.	910
WPXY	Greenville, N. C.	1550
WPYB	Benson, N.C.	1130
WQAM	Miami, Fla.	560
WQBA	Miami Fla.	1140
WQBC	Vicksburg, Miss.	1420
WQBS	San Juan, P.R.	650
WQDY	Calais, Maine	1230
WQIC	Meridian, Miss.	1390
WQIK	Jacksonville, Fla.	1090
WQIZ	St. George, S.C.	810
WQMR	Silver Spring, Md.	1050
WQOK	Greenville, S.C.	1440
WQSN	Charleston, S.C.	1450
WQTC	Two Rivers, Wis.	1590
WQTE	Monroe, Mich.	560
WQTW	Latrobe, Pa.	1570
WQTY	Montgomery, Ala.	1500
WQUA	Moline, Ill.	1230
WQVA	Quantico, Va.	1530
WQXI	Atlanta, Ga.	790
WQXL	Columbia, S.C.	1320
WQXQ	Ormond Bch., Fla.	1380
WQXR	New York, N.Y.	1560
WQXT	Palm Beach, Fla.	1340
WRAA	Luray, Va.	1330
WRAB	Arab, Ala.	1380
WRAC	Racine, Wis.	1460
WRAD	Radford, Va.	1460
WRAG	Carrollton, Ala.	590
WRAI	San Juan, P.R.	1520
WRAJ	Anna, Ill.	1440
WRAK	Williamsport, Pa.	1400
WRAM	Monmouth, Ill.	1330
WRAN	Dover, N.J.	1510
WRAP	Norfolk, Va.	850
WRAW	Reading, Pa.	1340
WRAY	Princeton, Ind.	1250
WRBC	Jackson, Miss.	1300
WRBD	Pompano Beach, Fla.	1470
WRBE	Lucedale, Miss.	1440
WRBJ	St. Johns, Mich.	1580

Call	Location	kHz
WRBL	Columbus, Ga.	1420
WRBN	Warner Robins, Ga.	1600
WRC	Washington, D.C.	980
WRCD	Dalton, Ga.	1430
WRCH	New Britain, Conn.	910
WRCK	Tuscumbia, Ala.	1410
WRCO	Richland Center, Wis.	1450
WRCP	Philadelphia, Pa.	1540
WRCS	Ahoskie, N.C.	970
WRDB	Reedsburg, Wis.	1400
WRDN	Durand, Wis.	1430
WRDO	Augusta, Maine	1400
WRDS	S. Charleston, W.Va.	1410
WRDW	Augusta, Ga.	1480
WREB	Holyoke, Mass.	930
WREC	Memphis, Tenn.	600
WREL	Lexington, Va.	1450
WREN	Topeka, Kans.	1250
WREO	Ashtabula, Ohio	970
WREV	Reidsville, N.C.	1220
WREX	Grand Junction, Colo.	920
WREY	New Albany, Ind.	1290
WRFC	Athens, Ga.	960
WRFD	Worthington, Ohio	880
WRFS	Alexander City, Ala.	1050
WRGA	Rome, Ga.	1470
WRGM	Richmond, Va.	1540
WRGS	Rogersville, Tenn.	1370
WRHC	Jacksonville, Fla.	1400
WRHI	Rock Hill, S.C.	1340
WRHL	Rochelle, Ill.	1060
WRIB	Providence, R.I.	1220
WRIC	Richlands, Va.	540
WRIE	Erie, Pa.	1330
WRIG	Wausau, Wis.	1400
WRIM	Pahokee, Fla.	1250
WRIN	Rensselaer, Ind.	1560
WRIP	Rossville, Ga.	980
WRIS	Roanoke, Va.	1410
WRIT	Milwaukee, Wis.	1340
WRIV	Riverhead, N.Y.	1390
WRIZ	Coral Gables, Fla.	1550
WRJC	Mauston, Wis.	1270
WRJN	Racine, Wis.	1400
WRJS	San German, P. R.	1060
WRJW	Picayune, Miss.	1320
WRKB	Kannapolis, N.C.	1460
WRKD	Rockland, Maine	1450
WRKH	Rockwood, Tenn.	580
WRKL	New City, N. Y.	910
WRKM	Carthage, Tenn.	1350
WRKN	Brandon, Miss.	970
WRKO	Boston, Mass.	680
WRKT	Cocoa Beach, Fla.	1300
WRKV	Rockville, Conn.	800
WRLD	Lanett, Ala.- W. Point, Ga.	1490
WRMA	Montgomery, Ala.	950
WRMF	Titusville, Fla.	1050
WRMG	Red Bay, Ala.	1430
WRMN	Elgin, Ill.	1410
WRMS	Beardstown, Ill.	790
WRMT	Rocky Mount, N.C.	1490
WRNB	New Bern, N.C.	1490
WRNC	Raleigh, N.C.	1240
WRNG	N. Atlanta, Ga.	680
WRNL	Richmond, Va.	910
WRNY	Rome, N.Y.	1350
WROA	Gulfport, Miss.	1390
WROB	West Point, Miss.	1450
WROC	Rochester, N.Y.	1280
WROD	Daytona Beach, Fla.	1340
WROK	Rockford, Ill.	1440
WROL	Fountain City, Tenn.	1490
WROM	Rome, Ga.	710
WRON	Ronceverte, W.Va.	1400
WROS	Scottsboro, Ala.	1330
WROV	Roanoke, Va.	1240
WROW	Albany, N.Y.	590
WROX	Clarksdale, Miss.	1450
WROY	Carmi, Ill.	1460
WROZ	Evansville, Ind.	1400
WRPL	Charlotte, N.C.	1540
WRPM	Poplarville, Miss.	1530
WRR	Dallas, Tex.	1310
WRRR	Rockford, Ill.	1330
WRRZ	Clinton, N.C.	880
WRSA	Saratoga Sprgs., N.Y.	1280
WRSC	State College, Pa.	1390
WRSJ	Bayamon, P. R.	1560
WRSL	Stanford, Ky.	1520
WRSW	Warsaw, Ind.	1480
WRTA	Altoona, Pa.	1240
WRTH	Wood River, Ill.	590
WRTL	Rantoul, Ill.	250d
WRUF	Gainesville, Fla.	850
WRUM	Rumford, Maine	790
WRUN	Utica, N.Y.	1150
WRUS	Russellville, Ky.	610
WRVA	Richmond, Va.	1140
WRVK	Mt. Vernon, Ky.	1460
WRWD	Augusta, Ga.	1480
WRWH	Cleveland, Ga.	1380
WRXO	Roxboro, N.C.	1430
WRYM	New Britain, Conn.	840
WRYT	Boston, Mass.	950
WSAC	Fort Knox, Ky.	1470
WSAF	Sarasota, Fla.	1220
WSAI	Cincinnati, Ohio	1360
WSAJ	Grove City, Pa.	1340
WSAL	Logansport, Ind.	1230
WSAM	Saginaw, Mich.	1400

Call	Location	kHz
WSAN	Allentown, Pa.	1470
WSAO	Senatobia, Miss.	1550
WSAR	Fall River, Mass.	1480
WSAT	nr. Salisbury, N.C.	1280
WSAU	Wausau, Wis.	550
WSAV	Savannah, Ga.	630
WSAY	Rochester, N.Y.	1370
WSAZ	Huntington, W.Va.	930
WSB	Atlanta, Ga.	750
WSBA	York, Pa.	910
WSBB	New Smyrna Beach, Fla.	1230
WSBC	Chicago, Ill.	1240
WSBR	Boca Raton, Fla.	740
WSBS	Gt. Barrington, Mass.	860
WSBT	South Bend, Ind.	960
WSBP	Chattahoochee, Fla.	1580
WSCM	Panama City Beach, Fla.	1290
WSCO	Taylorsville, Miss.	1280
WSCR	Scranton, Pa.	1320
WSCV	Peterborough, N.H.	1050
WSDR	Sterling, Ill.	1240
WSDS	Ypsilanti, Mich.	1480
WSEB	Sebring, Fla.	1340
WSEL	Pontotoc, Miss.	1440
WSEM	Donaldsonville, Ga.	1500
WSEN	Baldwinsville, N.Y.	1050
WSER	Elkton, Md.	1550
WSET	Glen Falls, N.Y.	1410
WSEV	Sevierville, Tenn.	930
WSEW	Selinsgrove, Pa.	1240
WSFB	Quitman, Ga.	1490
WSFC	Somerset, Ky.	1240
WSFR	Sanford, Fla.	1300
WSFT	Thomaston, Ga.	1220
WSFW	Seneca Falls, N.Y.	1110
WSGA	Savannah, Ga.	1400
WSGB	Sutton, W.Va.	1490
WSGC	Elberton, Ga.	1400
WSGN	Birmingham, Ala.	610
WSGO	Oswego, N.Y.	1440
WSGW	Saginaw, Mich.	790
WSHB	Raeford, N.C.	1400
WSHF	Sheffield, Ala.	1290
WSHN	Fremont, Mich.	1550
WSHO	New Orleans, La.	1230
WSHP	Shippenburg, Pa.	1480
WSIB	Beaufort, S.C.	1490
WSIC	Statesville, N.C.	1400
WSID	Baltimore, Md.	1010
WSIG	Mount Jackson, Va.	790
WSIP	Paintsville, Ky.	1490
WSIR	Winter Haven, Fla.	1490
WSIV	Pekin, Ill.	1140
WSIX	Nashville, Tenn.	980
WSJC	Magee, Miss.	810
WSJM	St. Joseph, Mich.	1400
WSJR	Modawaska, Me.	1230
WSJS	Winston-Salem, N.C.	600
WSJW	Woodruff, S.C.	1510
WSKE	Everett, Pa.	1050
WSKI	Montpelier-Barre, Vt.	1240
WSKT	Knoxville, Tenn.	1580
WSKY	Asheville, N.C.	1230
WSLB	Ogdensburg, N.Y.	1400
WSLC	Clermont, Fla.	1340
WSLG	Donaldsonville, La.	1090
WSLI	Jackson, Miss.	930
WSMA	Marine City, Mich.	1590
WSLM	Salem, Ind.	1220
WSLR	Akron, Ohio	1350
WSLS	Roanoke, Va.	610
WSLT	Ocean City-Somers Pt., N.J.	1520
WSLV	Ardmore, Tenn.	1520
WSM	Nashville, Tenn.	650
WSMB	New Orleans, La.	1350
WSMD	La Plata, Md.	1560
WSME	Sanford, Maine	1220
WSMG	Greeneville, Tenn.	1450
WSMI	Litchfield, Ill.	1540
WSML	Graham, N.C.	1190
WSMN	Nashua, N.H.	1590
WSMT	Sparta, Tenn.	1050
WSMY	Weldon, N. C.	1400
WSNE	Cumming, Ga.	1410
WSNJ	nr. Bridgeton, N.J.	1240
WSNO	Barre, Vt.	1450
WSNT	Sandersville, Ga.	1490
WSNW	Seneca, S. C.	1150
WSNY	Schenectady, N.Y.	1240
WSOC	Charlotte, N.C.	930
WSOK	Savannah, Ga.	1230
WSOL	Tampa, Fla.	1300
WSOM	Salem, Ohio	600
WSON	Henderson, Ky.	860
WSOO	Slt. Ste. Marie, Mich.	1230
WSOQ	No. Syracuse, N.Y.	1220
WSOY	Decatur, Ill.	1340
WSPA	Spartanburg, S.C.	950
WSPB	Sarasota, Fla.	1450
WSPD	Toledo, Ohio	1370
WSPF	Hickory, N.C.	1000
WSPR	Springfield, Mass.	1270
WSPT	Stevens Pt., Wis.	1010
WSRA	Milton, Fla.	1490
WSRC	Durham, N.C.	1410
WSRF	Ft. Lauderdale, Fla.	1580
WSRO	Marlborough, Mass.	1470
WSRW	Hillsboro, Ohio	1590
WSSA	College Park, Ga.	1570
WSSB	Durham, N.C.	1490
WSSC	Sumter, S.C.	1340
WSSO	Starkville, Miss.	1230
WSSV	Petersburg, Va.	1240
WSTC	Stamford, Conn.	1400
WSTH	Taylorsville, N.C.	860
WSTK	Woodstock, Va.	1230
WSTL	Eminence, Ky.	1600
WSTP	Salisbury, N.C.	1490
WSTR	Sturgis, Mich.	1230
WSTU	Stuart, Fla.	1450
WSTV	Steubenville, Ohio	1340
WSTX	Christiansted, V.I.	970
WSUB	Groton, Conn.	980
WSUH	Oxford, Miss.	1420
WSUI	Iowa City, Iowa	910
WSUN	St. Petersburg, Fla.	620
WSUX	Seaford, Del.	1280
WSUZ	Palatka, Fla.	800
WSVA	Harrisonburg, Va.	550
WSVL	Shelbyville, Ind.	1520
WSVN	Valdese, N.C.	1490
WSVM	Valdese, N.C	1490
WSVP	West Warwick, R.I.	1450
WSVS	Crewe, Va.	800
WSWN	Belle Glade, Fla.	900
WSWV	Pennington Gap, Va.	1570
WSWW	Platteville, Wis.	1590
WSYB	Rutland, Vt.	1380
WSYD	Mt. Airy, N.C.	1300
WSYL	Sylvania, Ga.	1490
WSYR	Syracuse, N.Y.	570
WTAB	Tabor City, N.C.	1370
WTAC	Flint, Mich.	600
WTAD	Quincy, Ill.	930
WTAE	Pittsburgh, Pa.	1250
WTAG	Worcester, Mass.	580
WTAI	Eau Gallie, Fla.	1560
WTAK	Garden City, Mich.	1090
WTAL	Tallahassee, Fla.	1450
WTAN	Clearwater, Fla.	1340
WTAP	Parkersburg, W.Va.	1230
WTAQ	LaGrange, Ill.	1300
WTAR	Norfolk, Va.	790
WTAW	Bryan, Tex.	1150
WTAX	Springfield, Ill.	1240
WTAY	Robinson, Ill.	1570
WTBC	Tuscaloosa, Ala.	1230
WTBF	Troy, Ala.	970
WTBO	Cumberland, Md.	1450
WTBY	Waterbury, Conn.	1590
WTCA	Plymouth, Ind.	1050
WTCB	Flomaton, Ala.	990
WTCH	Shawano, Wis.	960
WTCJ	Tell City, Ind.	1230
WTCM	Traverse City, Mich.	1400
WTCO	Campbellsville, Ky.	1450
WTCR	Ashland, Ky.	1420
WTCS	Fairmont, W.Va.	1490
WTCW	Whitesburg, Ky.	920
WTEL	Philadelphia, Pa.	860
WTGA	Thomaston, Ga.	1590
WTGR	Myrtle Beach, S. C.	1520
WTHB	Augusta, Ga.	1550
WTHD	Milford, Del.	930
WTHE	Mineola, N.Y.	1520
WTHI	Terre Haute, Ind.	1480
WTHM	Lapeer, Mich.	1530
WTHN	Thomaston, Ga.	1500
WTHT	Hazleton, Pa.	1300
WTHU	Thurmont, Md.	1450
WTIC	Hartford, Conn.	1080
WTID	Newport News, Va.	1270
WTIF	Tifton, Ga.	1340
WTIG	Massillon, Ohio	990
WTIK	Durham, N.C.	1310
WTIL	Mayaguez, P.R.	1300
WTIM	Taylorville, Ill.	1410
WTIP	Charleston, W.Va.	1240
WTIQ	Manistique, Mich.	1490
WTIV	Titusville, Pa.	1230
WTIX	New Orleans, La.	690
WTJH	East Point, Ga.	1260
WTJS	Jackson, Tenn.	1390
WTKM	Hartford, Wis.	1540
WTKO	Ithaca, N.Y.	1470
WTKY	Tompkinsville, Ky.	1370
WTLB	Utica, N.Y.	1310
WTLK	Taylorsville, N.C.	1570
WTLN	Apopka, Fla.	1520
WTLO	Somerset, Ky.	1480
WTLS	Tallasee, Ala.	1300
WTMA	Charleston, S.C	1250
WTMB	Wisconsin Rapids, Wis.	1460
WTMC	Ocala, Fla.	1290
WTNE	Trenton, Tenn.	1500
WTMJ	Milwaukee, Wis.	620
WTMP	Tampa, Fla.	1150
WTMR	Camden, N.J.	800
WTMT	Louisville, Ky.	620
WTNC	Thomasville, N.C.	790
WTND	Orangeburg, S.C.	920
WTNN	Millington, Tenn.	1380
WTNS	Coshocton, Ohio	1560
WTNT	Tallahassee, Fla.	1270
WTOB	Winston-Salem, N.C.	1380
WTOC	Savannah, Ga.	1290
WTOD	Toledo, Ohio	1560
WTOE	Spruce Pine, N.C.	1470
WTON	Staunton, Va.	1240
WTOO	Bellefontaine, O.	1390
WTOP	Washington, D.C.	1500
WTOR	Torrington, Conn.	610
WTOT	Marianna, Fla.	980
WTOW	Towson, Md.	1580
WTPR	Paris, Tenn.	710
WTPS	Portage, Mich.	1560
WTOW	Towson, Md.	1570
WTOX	Selma, Ala.	1570
WTOY	Roanoke, Va.	910
WTRA	Latrobe, Pa.	1480
WTRB	Ripley, Tenn.	1570
WTRC	Elkhart, Ind.	1340
WTRE	Greensburg, Ind.	1330
WTRI	Brunswick, Md.	1520
WTRL	Bradenton, Fla.	1490
WTRN	Tyrone, Pa.	1340
WTRO	Dyersburg, Tenn.	1330
WTRP	LaGrange, Ga.	620
WTRR	Sanford, Fla.	1400
WTRU	Muskegon, Mich.	1600
WTRX	Flint, Mich.	1330
WTRY	Troy, N.Y.	980
WTSA	Brattleboro, Vt.	1450
WTSB	Lumberton, N.C.	1340
WTSL	Hanover-Lebanon, New Hampshire	1400
WTSN	Dover, N.H.	1270
WTSV	Claremont, N.H.	1230
WTTB	Vero Beach, Fla.	1490
WTTC	Towanda, Pa.	1550
WTTF	Tiffin, Ohio	1600
WTTI	Dalton, Ga.	1530
WTTL	Madisonville, Ky.	1310
WTTM	Trenton, N.J.	920
WTTN	Watertown, Wis.	1580
WTTO	Toledo, Ohio	1520
WTTR	Westminster, Md.	1470
WTTS	Bloomington, Ind.	1370
WTTT	Amherst, Mass.	1430
WTUG	Tuscaloosa, Ala.	790
WTUP	Tupelo, Miss.	1490
WTUX	Wilmington, Del.	1290
WTVB	Coldwater, Mich.	1590
WTVL	Waterville, Maine	1490
WTVN	Columbus, Ohio	610
WTVR	Richmond, Va.	1380
WTWA	Thomson, Ga.	1240
WTWB	Auburndale, Fla.	1570
WTWN	St. Johnsbury, Vt.	1340
WTXL	W. Spgfd., Mass.	1490
WTYC	Rock Hill, S.C.	1150
WTYL	Tylertown, Miss.	1290
WTYM	East Longmeadow, Mass.	1600
WTYN	Tryon, N.C.	1550
WTYS	Marianna, Fla.	1340
WTZE	Tazewell, Va.	1470
WUBE	Cincinnati, O.	1230
WUDO	Lewisburg, Pa.	1010
WUFE	Baxley, Ga.	1260
WUFF	Eastman, Ga.	710
WUFO	Amherst, N.Y.	1080
WULA	Eufaula, Ala.	1240
WULF	Alma, Ga.	1400
WUMU	Gainesville, Fla.	1390
WUNA	Aquadilla, P. R.	1340
WUNE	Baton Rouge, La.	1550
WUNI	Mobile, Ala.	1410
WUNN	Mason, Mich.	1110
WUNO	Rio Piedras, P.R.	1320
WUNR	Brookline, Mass.	1600
WUOK	Cumberland, Md.	1270
WUPR	Utado, P.R.	1530
WUSJ	Lockport, N.Y.	1340
WUST	Bethesda, Md.	1120
WUWU	Gainsville, Fla.	1390
WVAB	Virginia Bch., Va.	1550
WVAK	Paoli, Ind.	1560
WVAL	Sauk Rapids, Minn.	800
WVAM	Altoona, Pa.	1430
WVAP	Burnettown, S.C.	1510
WVAR	Richwood, W. Va.	600
WVCB	Shallotte, N. C.	1410
WVCF	Windermere, Fla.	1480
WVCG	Coral Gables, Fla.	1080
WVCH	Chester, Pa.	740
WVEC	Hampton, Va.	1490
WVGT	Mt. Dora, Fla.	1580
WVIC	E. Lansing, Mich.	730
WVIM	Vicksburg, Miss.	1490
WVIP	Mt. Kisco, N.Y.	1310
WVJP	Caguas, P.R.	1110
WVJS	Owensboro, Ky.	1420
WVKO	Columbus, Ohio	1580
WVLD	Valdosta, Ga.	1450
WVLK	Lexington, Ky.	590
WVLN	Olney, Ill.	740
WVLY	Water Valley, Miss.	1320
WVMC	Mt. Carmel, Ill.	1360
WVMG	Cochran, Ga.	1440
WVMI	Biloxi, Miss.	570
WVMT	Burlington, Vt.	620
WVNA	Tuscumbia, Ala.	1590
WVNJ	Newark, N.J.	620
WVOB	Bel Air, Md.	1520
WVOC	Battle Creek, Mich.	1500
WVOE	Chadburn, N.C.	1590
WVOH	Hazelhurst, Ga.	920
WVOJ	Jacksonville, Fla.	1320
WVOK	Birmingham, Ala.	690
WVOL	Berry Hill, Tenn.	1470
WVOM	Iuka, Miss.	1270
WVON	Cicero, Ill.	1450
WVOP	Vidalia, Ga.	970
WVOS	Liberty, N.Y.	1240
WVOT	Wilson, N.C.	1420
WVOV	Huntsville, Ala.	1000
WVOW	Logan, W.Va.	1290
WVOX	New Rochelle, N.Y.	1460
WVOZ	Carolina, P.R.	1400
WVPO	Stroudsburg, Pa.	840
WVRC	Spencer, W. Va.	1400
WVSA	Vernon, Ala.	1380
WVSC	Somerset, Pa.	990
WVSM	Rainsville, Ala.	1500
WVVW	Grafton, W.Va.	1260
WWAB	Lakeland, Fla.	1330
WWAM	Cadillac, Mich.	1370
WWBA	St. Petersburg, Fla.	680
WWBC	Cocoa, Fla.	1510
WWBD	Bamberg-Denmark, S.C.	790
WWBR	Windber, Pa.	1350
WWBZ	Vineland, N.J.	1360
WWCA	Gary, Ind.	1270
WWCC	Bremen, Ga.	1440
WWCH	Clarion, Pa.	1300
WWCM	Brazil, Ind.	1380
WWCO	Waterbury, Conn.	1240
WWDA	Wisconsin Dells, Wis.	990
WWDC	Washington, D.C.	1260
WWDR	Murfreesboro, N. C.	1080
WWGM	Nashville, Tenn.	1560
WWGO	Erie, Pa.	1450
WWGP	Sanford, N.C.	1050
WWGS	Tifton, Ga.	1430
WWHG	Hornell, N.Y.	1320
WWHY	Huntington, W.Va.	1470
WWIN	Baltimore, Md.	1400
WWIS	Black River Falls, Wis.	1260
WWIT	Canton, N.C	970
WWJ	Detroit, Mich.	950
WWJB	Brooksville, Fla.	1450
WWJC	Superior, Wis.	1270
WWKE	Ocala, Fla.	1370
WWKO	Fair Bluff, N.C.	1480
WWKY	Winchester, Ky.	1380
WWL	New Orleans, La.	870
WWLE	Cornwall, N.Y.	1170
WWML	Portage, Pa.	1470
WWNC	Asheville, N.C.	570
WWNH	Rochester, N.H.	930
WWNR	Beckley, W.Va.	620
WWNS	Statesboro, Ga.	1240
WWNY	Watertown, N.Y.	790
WWOD	Lynchburg, Va.	1390
WWOK	Charlotte, N.C.	1480
WWOL	Buffalo, N.Y.	1120
WWOM	New Orleans, La.	600
WWON	Woonsocket, R.I.	1240
WWOW	Conneaut, Ohio	1360
WWPA	Williamsport, Pa.	1340
WWPF	Palatka, Fla.	1260
WWRL	New York, N.Y.	1600
WWSC	Glens Falls, N.Y.	1450
WWSD	Monticello, Fla.	1090
WWSF	Loretto, Pa.	1400
WWSR	St. Albans, Vt.	1420
WWST	Wooster, Ohio	960
WWSW	Pittsburgh, Pa.	970
WWTC	Minneapolis, Minn.	1280
WWUN	Jackson, Miss.	1590
WWVA	Wheeling, W.Va.	1170
WWWB	Jasper, Ala.	1360
WWWF	Fayette, Ala.	990
WWWR	Russellville, Ala.	920
WWXL	Manchester, Ky.	1450
WWYN	Erie, Pa.	1260
WWYO	Pineville, W.Va.	970
WXAL	Demopolis, Ala.	1400
WXCL	Peoria, Ill.	1350
WXCO	Wausau, Wis.	1230
WXGI	Richmond, Va.	950
WXIT	Charleston, W.Va.	1490
WXKW	Troy, N. Y.	1600
WXLI	Dublin, Ga.	1230
WXLL	Big Delta, Alaska	980
WXLW	Indianapolis, Ind.	950
WXOK	Baton Rouge, La.	1460
WXOX	Bay City, Mich.	1250
WXPQ	Eatonton, Ga.	1520
WXMT	Merrill, Wis.	730
WXRF	Guayama, P.R.	1590
WXTN	Lexington, Miss.	1000
WXTR	Pawtucket, R.I.	550
WXUR	Media, Pa.	690
WXVA	Charles Town, W.Va.	1550
WXVI	Riviera Bch. Fla.	1600
WXVW	Jeffersonville, Ind.	1450
WXXX	Hattiesburg, Miss.	1310
WXYC	Ft. Myers, Fla.	1350
WXYZ	Detroit, Mich.	1270
WYAL	Scotland Neck, N.C.	1280
WYAM	Bessemer, Ala.	1450
WYBG	Massena, N. Y.	1050
WYCL	York, S.C.	980
WYDE	Birmingham, Ala.	850
WYDK	Yadkinville, N.C.	1480
WYFE	Rockford, Ill.	1150
WYGO	Corbin, Ky.	1330
WYHE	Bristol, Tenn.	1550
WYLD	New Orleans, La.	940
WYLO	Jackson, Wis.	540
WYMB	Manning, S.C.	1410
WYNA	Raleigh, N. C.	1550
WYND	Sarasota, Fla.	1280

WYNK	Baton Rouge, La.	1380	WYRU	Red Springs, N.C.	1510	WYZE	Atlanta, Ga.	1480
WYNN	Florence, S.C.	540	WYSE	Inverness, Fla.	1560	WZAM	Prichard, Ala.	1270
WYNR	Brunswick, Ga.	790	WYSH	Clinton, Tenn.	1380	WZBN	Zion, Ill.	1500
WYNS	Leighton, Pa.	1150	WYSL	Buffalo, N.Y.	1400	WZEP	DeFuniak Sprgs., Fla.	1460
WYNX	Smyrna, Ga.	1550	WYSR	Franklin, Va.	1250	WZIP	Cincinnati, Ohio	1050
WYNZ	Ypsilanti, Mich.	1520	WYTH	Madison, Ga.	1250	WZKY	Albemarie, N.C.	1580
WYOQ	Wyoming, Mich.	1530	WYTI	Rocky Mount, Va.	1570	WZOB	Ft. Payne, Ala.	1250
WYOU	Tampa, Fla.	1550	WYVE	Wytheville, Va.	1280	WZOE	Princeton, Ill.	1490
WYPR	Danville, Va.	970	WYWY	Barbourville, Ky.	950	WZST	Leesburg, Fla.	1410
WYRE	Annapolis, Md.	810	WYXI	Athens, Tenn.	1390	WZUM	Carnegie, Pa.	1590
WYRN	Louisburg, N.C.	1480	WYYY	Kalamazoo, Mich.	1470	WZYX	Cowan, Tenn.	1440

A THANK YOU NOTE FROM THE EDITORS

Thank you! The Editors of SCIENCE AND ELECTRONICS would like to thank all readers who offered information on station changes, additions, and deletions during the past few months. Though many of the letters overlapped, each aided us considerably in the task of making *White's Radio Log* as current as possible at press time. If we left your name out, please forgive us!

Donald A. Blesse, Rumson, N.J.
Elmer C. Carlson, Cocoa, Fla.
Charles Ekstrom, Chicago, Ill.
John Garofano, Framingham, Mass.
WWR. Garrett, Augusta, Ga.
Tom Kneitel, Commack, N.Y.
David Moore, Jr., Little Rock, Ark.
Lars Nielsen, Dundas, Ontario
Sydney Osgood, Suncock, N.H.
A. Pace, Toronto, Ontario
R.L.A. New England, Sharon, Mass.
John N. Ramsey, W. Hartford, Conn.
Jerry Robertson, Croswell, Mich.
Gladys Sienkiewicz, Brooklyn, N.Y.
Mark Wirtz, Evansville, Ind.
Jerry Yacuzzi, W. Hartford, Conn.

White's World-Wide Shortwave Stations

Many of you who read White's Radio Log's Shortwave Listings have written to ask for further information on the stations you hear which do not fit into the categories of either broadcasting or amateur stations. They include ships, aircraft, military, police, fire, etc.

To DXers, such stations are generally classified as *utility stations* and they constitute a fascinating aspect of the hobby; so interesting in fact, that a great many DXers specialize in logging and QSLing them.

While very few utilities stations have their own printed QSL cards, many will gladly complete and return to you a prepared card for this purpose. Just enclose the card with your reception report and ask them to sign it and return it—include on the card spaces for the station to fill in their power, antenna type, and any other data of interest.

If you would like to take a whack at this off-beat DX fare, all you have to do is tune your communications receiver around to their favorite nesting places. Look between 2 and 3.5 MHz, from 4 to 4.8 MHz, from 5.1 to 5.9 MHz, from 6.2 to 7 MHz, from 7.3 to 9 MHz, from 10 to 11.5 MHz, from 12 to 14 MHz and you'll hear them pouring in from all over the world. For police and fire monitoring, you'll need a special receiver covering the 30 to 50, or 150 to 174 MHz bands—these are readily available at a wide range of prices from most dealers.

If you like, send in some of your reception results to us here at White's, and we'll probably run them.

Propagation Forecast. The noise level will now start to fall off sharply as cooler weather arrives. This means not only improved reception (except from south of the Tropic of Capricorn) on the lower SW bands like 60 and 90 Meters, but also on the medium wave BCB—535 to 1605 kHz. No broadcast DXer should neglect the latter in his quest for new countries. Here, depending upon your receiver, patience, and luck, you can log such stations as ZNS at Nassau, Bahamas (1540 kHz) ZBM1 Pembroke (1235) and ZFB1 St. George's, (960), Bermuda, R. Jamaica (720 and 770 kHz), R. Barbados and ZBV1 Tortola, British Virgin Islands (both currently on 780). None of these countries have SWBC stations and all, with the possible exception of Bermuda, will be best when ionospheric disturbances knock out upper latitude QRM.

By the way, and contrary to what some old timers may try to tell you, the noise level is the only real DX factor (between .3 and 30 MHz) that tropospheric weather conditions will affect.

Meanwhile it seems that no one knows for certain what the sunspot count will do next but this may be the last really good winter

Oct./Nov. 1969 LISTENER'S STANDARD TIME	ASIA (except Near East)	EUROPE, NEAR EAST & AFRICA (N. of the Sahara)	AFRICA (S. of the Sahara)	SOUTH PACIFIC	LATIN AMERICA
0000-0300	(19), 25, (31)	41, 49	49, 60e	31, 41w	49, 60
0300-0600	31, 41, (49)	(19w), (31)	19w	41, 49	49, 60
0600-0900	25, 49w	13, 16, 19	19	25, 31	49
0900-1200	16, 19	13, 16, 19	19, 25	25	25, 31
1200-1500	16, 19	13, 16, 19	19, 25	(19)	25, 31
1500-1800	16, 19	25, 31, (49)	31w, 49, 60e	(19)	31, 49
1800-2100	16, 19	31, 49	25, 31, (60w)	16, 19	(49), 60
2100-2400	16, 19	31, 49	60	16, 19	(49), 60, 90

To use the table put your finger on the region you want to hear and log, move your finger down until it is alongside the local standard time at which you will be listening and lift your finger. Underneath your pointing digit will be the shortwave band or bands that will give the best DX results. The time in the above propagation table is given in *standard time* at the listener's location, which effectively compensates for differences in propagation characteristics between the East and West Coasts of North America. Abbreviations: w—Western North America and e—Eastern North America. When w or e follow a band listing, it means the band is only good for that part of the continent. The shortwave bands in brackets are suggested as possible second choices. Refer to White's Radio Log for our world-wide Shortwave list.

for 13 Meters. This band is particularly for European and, to a much lesser extent, African propaganda watchers during daylight hours. Major African 13-Meter outlets (South of the Sahara) are the Voice of Nigeria on 21455 kHz and Radio RSA on 21500 and 21535 kHz. The same midday period may also produce improved Latin American prospects as compared with last fall and winter, not because of any significant change in propagation, but due to that increased activity on the international bands.

kHz	Call	Name	Location
2200	—		Fukien, China
2360	—	R. Parintins	Parintins, Brazil
2410	4VU	R. Lumiere	Port au Prince, Haiti
2437	YDG4	RRI	Surakarta, Indonesia
2475	—		Hangchow, China
2600	—		Fukien, China

90-Meter Band—3200 to 3400 kHz

kHz	Call	Name	Location
3205	VUD	All India R.	Lucknow, India
3230	VRH8	Fiji BC	Suva, Fiji Is.
3241	YDR3	RRI	Ambon, Indonesia
3255	HIMP	R. Ocoa	Sto. Domingo, Dom. Rep.
3265	HCMZ6	V. del Dorado	Pelileo, Ecuador
3285	—	R. Lubumbashi	Lubumbashi, Congo
3295	ZYM22	R. Cultural Sergipe	Sergipe, Brazil
3315	VUD	All India R.	Bhopal, India
3325	ZYJ21	R. Borborema	Campina Grande, Brazil
3335	ZYR59	R. Marajoara	Belem, Brazil
3350	—	R-TV Gabonaise	Franceville, Gabon
3360	TGVN	V. Nahuala	Solola, Guatemala
3375	YDK7	RRI	Djambi, Indonesia
3380	—	W. Nigerian BC	Ibadan, Nigeria
3391	YDK7	RRI	Djambi, Indonesia
3450	—	R. Peking	Peking, China
3824	7PA22	7PA22	Maseru, Lesotho
4055	—	Gorovit Petropavlovsk	Petropavlovsk, USSR

kHz	Call	Name	Location
4273	—	R. Pyongyang	Pyongyang, N. Korea
4500	VNG		Lyndhurst, Australia
4680	HCWEI	R. Nacional Espejo	Quito, Ecuador

60-Meter Band—4750 to 5060 kHz

kHz	Call	Name	Location
4760	—	Gorovit Dzambul	Dzambul, USSR
4765	—	R-TV Congolaise	Congo
4775	—	R. Afghanistan	Kabul, Afghanistan
4785	—	Gorovit Baku	Baku, USSR
4790	YVON	Ondenas Portenas	Pt. La Cruz, Venezuela
4800	HCSV5	R. Amazonas	Cuenca, Ecuador
4810	HCLS3	R. Coro Sta Cecilia	Loja, Ecuador
4820	OAX7K	R. Puno	Puno, Ecuador
4830	HSKB	R. Thailand	Bangkok, Thailand
4840	VUB	All India R.	Bombay, India
4850	V3USE	Mauritius BC	Forest Side, Mauritius
4860	—	R. Moscow	Moscow, USSR
4870	OCX4T	R. Obispado	Peru
4880	OCX4E	R. Once Sesenta	Lima, Peru
4890	HRVL	R. Lux	Tegucigalpa, Honduras
4895	OAZ4T	R. Chanchamayo	Lima, Peru
4908	—		Shanghai, China
4915	CP8B	R. Amboro	La Paz, Bolivia
4923	HCRQI	R. Quito	Quito, Ecuador
4935	CR5RE	R. Club de Malanje	Malanje, Angola
4940	OAZ4R	R. San Juan	San Juan, Peru
4950	OAX7I	R. Madre de Dios	Lima, Peru
4960	—	R. Peking	Peking, China
4968	—	R. Ceylon	Colombo, Ceylon

WHITE'S SHORTWAVE STATION LISTINGS

kHz	Call	Name	Location
4980	HIKZ	R. Popular	Santo Domingo, Dom. Rep.
4985	ZYR89	R. Aparaceida	Aparaceida, Brazil
4995	OAZ4C	R. Andina	Andina, Peru
5010	—	R. Garoua	Garoua, Cameroon
5020	—	R. Ceylon	Colombo, Ceylon
5025	ZYK41	Emis Rural	San Francisco Petrolina, Brazil
5035	—	Gorovit Alma Ata	Alma Ata, USSR
5041	—	Emis de Guine	Portuguese Guinea
5055	CP87	R. San Rafael	La Paz, Bolivia
5075	—	R. Peking	Peking, China
5180	OAX8F	R. Atlantida	Lima, Peru
5535	—	R. Peking	Peking, China
5860	—	R. Peking	Peking, China
5925	—	Gorovit Tashkent	Tashkent, USSR

49-Meter Band—5950 to 6200 kHz

kHz	Call	Name	Location
5955	—	R-TV Francaise	Paris, France
	ZYR226	R. Gazeta	Rio de Janeiro, Brazil
5960	HRHR	V. de Occidente	Tegucigalpa, Honduras
5970	—	RFE	Munich, Germany
5975	ZYT44	R. Guaraja	Guaraja, Brazil
5980	BED30	V. Free China	Taipei, Formosa
5985	WNYW	R. New York	New York, NY
5995	—	R. Andorra	Andorra
6000	—	R. Moscow	Moscow, USSR
6005	CFCW	CFCW	Montreal, PQ
6010	CE601	R. Norte	Santiago, Chile
6020	—	V. America	Greenville, NC
6025	CR6RZ	Emis Official	Luanda, Angola
6030	—	V. America	Greenville, NC
6040	VUD	All India R.	Delhi, India
6055	DYH4	Nat'l Council Churches	Dumaguete City, Phil.
6060	HCACI	V. de Democracia	Quito, Ecuador
6070	—	R. Universite	Tananarive, Malagsay Rep.
6075	DMQ6	Deutsche Welle	Cologne, W. Germany
6078	4VSC	V. de St. Marc	Port au Prince, Haiti
6080	HRME	R. El Patio	Tegucigalpa, Honduras
6090	—	BBC	London, England
6095	HJIW	V. del Centro	Bogota, Colombia
6105	—	R. Free Europe	Munich, W. Germany
6110	—	Trans World R.	Bonaire, Neth. Ant.
6115	XEUDS	R. Univ. de Sonora	Hermosillo, Mex.
6120	DZF4	Call of Orient	Manila, Philippines
6125	HJKE	R. Continental	Bogota, Colombia
6130	CHNX	CHNX	Halifax, NS
6140	—	BBC	London, England
6145	PRL9	R. Nacional	Rio de Janeiro, Brazil
6155	OE121	Viennese BC	Vienna, Austria
	—	Far East Network	Tokyo, Japan
6165	—	Gorovit Kiev	Kiev, USSR
6170	—	Army Station	Seoul, S. Korea
6175	—	R. Malaysia	Kuala Lumpur, Malaysia
6185	CSA29	R. Nacional	Lisbon, Portugal
6190	—	V. America	Greenville, NC
6200	—	R. Sudamericana	Lima, Peru
6234	—	R. Budapest	Budapest, Hungary
6330	—	R. Peking	Peking, China
6480	—	R. Pyongyang	Pyongyang, N. Korea
6644	—	R. Peking	Peking, China
7060	—	R. Peking	Peking, China

41-Meter Band—7100 to 7300 kHz

kHz	Call	Name	Location
7155	—	R. Nationale	Tananarive, Malagsay Rep.
7165	—	R. Free Europe	Munich, W. Germany
7180	—	R. Liberty	Spain
7190	HLK30	V. Free Korea	Seoul, S. Korea
7200	—	V. America Relay	Wooferton, England
7230	—	R. Peking	Peking, China
7260	VUM	All India R.	Madras, India
7280	—	R. Moscow	Moscow, USSR
7290	—	RAI	Rome, Italy
7295	—	R. Liberty	Spain
7305	—	R. Peking	Peking, China
7443	—	UN Radio	Geneva, Switz.
9009	4XB31	Kol Zion	Tel Aviv, Israel

31-Meter Band—9500 to 9775 kHz

kHz	Call	Name	Location
9500	—	R. Peking	Peking, China
9510	—	R. Bucharest	Bucharest, Rumania
9515	TAT	R. Ankara	Ankara, Turkey
9525	PCJ	R. Nederland	Hilversum, Neth.
9530	—	R. Moscow	Moscow, USSR
9535	CR6RZ	Emis Official	Luanda, Angola
9545	HVJ	Vatican R.	Vatican City
9555	—	V. America Relay	Poro, Philippines
9565	—	Deutsche Welle Relay	Kigali, Rwanda
9570	—	BBC Relay	Tebrau, Malaysia
9575	BED91	V. Free China	Taipei, Formosa
9585	—	R. Nacional	Lisbon, Portugal
9590	—	R. Peking	Peking, China
9595	—	Swiss BC	Berne, Switz.
9600	OAX3E	R. Huaraz	Huaraz, Peru
9610	—	R. Mauritania	Nouakchott, Muretania
9618	OBX7E	R. El Sol	Lima, Peru
9620	CXA6	SODRE	Montevideo, Uruguay
9630	—	R. Nacional	Lisbon, Portugal
9640	—	BBC	London, England
9645	TIFC	Faro del Caribe	San Jose, CR
9655	—	R. Free Europe	Munich, W. Germany
9660	BED42	V. Free China	Taipei, Formosa
9675	ZYT9	R. Diario de Manha	Manha, Brazil
9685	—	R. Moscow	Moscow, USSR
9690	—	BBC Relay	Limassol, Cyprus
9700	—	R-TV Francaise	Paris, France
9710	—	RAI	Rome, Italy
9720	CR6RZ	Emis Official	Luanda, Angola
9725	—	V. America	Greenville, NC
9735	—	Deutsche Welle Relay	Kigali, Rwanda
9745	BEC62	Chinese Air Force	Formosa
9755	PCJ	R. Nederland	Hilversum, Neth.
9760	—	R. Hanoi	Hanoi, N. Vietnam
9770	—	BBC	London, England
9912	VUD	All India R.	Delhi, India
10000	LOL	(time signals)	Buenos Aires, Arg.
10650	—	R. Ulan Bator	Ulan Bator, Mongolia
11515	—	R. Peking	Peking, China
11685	CR6RR	R. Diamang	Luanda, Angola

25-Meter Band—11700 to 11975 kHz

kHz	Call	Name	Location
11700	—	W18S	Windward Islands
11710	—	V. America Relay	Tangiers, Morocco
11720	—	BBC Relay	Limassol, Cyprus
11730	—	V. America Relay	Poro, Philippines
11740	ZAA	R. Tirana	Tirana, Albania
11745	HJV	Vatican Radio	Vatican City
11755	—	R. Hanoi	Hanoi, N. Vietnam
11760	VUD	All India R.	Delhi, India
11775	ETLF	R. Voice Gospel	Addis Ababa, Ethiopia
11785	—	Deutsche Welle	Kigali, Rwanda
11790	WNYW	R. New York	New York, NY
11800	—	RAI	Rome, Italy
11805	—	V. America Relay	Poro, Philippines
11815	VUD	All India R.	Delhi, India
11820	—	R. Peking	Peking, China
11830	—	V. America	Greenville, NC
11845	VUD	All India R.	Delhi, India
11855	ETLF	R. Voice Gospel	Addis Ababa, Ethiopia
11860	—	R. Peking	Peking, China
11870	—	Viennese R.	Vienna, Austria
11875	DZH6	National Council Churches	Dumaguete City, Phil.
11880	LRS	R. Splendid	Buenos Aires, Argentina
11890	DZE9	Call of Orient	Manila, Philippines

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kHz	Call	Name	Location
11905	ZAA	R. Tirana	Tirana, Albania
11910	VUD	All India R.	Delhi, India
11920	ZAA	R. Tirana	Tirana, Albania
11925	—	BBC	London, England
11935	—	R. Nacional	Lisbon, Portugal
11945	—	BBC	London, England
11955	CR6RZ	Emis Official	Luanda, Angola
11965	—	R. Japan	Tokyo, Japan
11975	ELWA	R. Village	Monrovia, Liberia

19-Meter Band—15100 to 15450 kHz

kHz	Call	Name	Location
15115	HCJB	V. Andes	Quito, Ecuador
15130	ETLF	R. V. Gospel	Addis Ababa, Ethiopia
15140	—	BBC	London, England
15150	CE1515	R. Corporacion	Santiago, Chile
15160	—	R. Budapest	Budapest, Hungary
15170	LKV	R. Norway	Oslo, Norway
15180	—	BBC Relay	Ascension Island
15195	—	V. America Relay	Monrovia, Liberia
15210	—	V. America Relay	Poro, Philippines
15225	—	R. Liberty	Spain
15240	—	R. Berlin International	Berlin, E. Germany
15250	VUD	All India R.	Delhi, India
15285	—	R. Habana	Havana, Cuba
15320	—	R. Australia	Melbourne, Australia
15385	DZF3	Call of Orient	Manila, Philippines
15435	DMQ15	Deutsche Welle	Cologne, W. Germany

16-Meter Band—17700 to 17900 kHz

kHz	Call	Name	Location
17715	VUD	All India R.	Delhi, India
17765	DMQ17	Deutsche Welle	Cologne, W. Germany
17780	—	R. Liberty	Greece
17820	TAV	R. Ankara	Ankara, Turkey
17850	VUD	All India R.	Delhi, India
17860	—	BBC	London, England

13-Meter Band—21450 to 21750 kHz

kHz	Call	Name	Location
21450	—	R. Prague	Prague, Czech.
21495	CSA67	R. Nacional	Lisbon, Portugal
21540	—	R. Berlin International	Berlin, E. Germany
21590	—	BBC	London, England
21615	—	BBC	London, England
21640	—	R. Japan	Tokyo, Japan

White's Emergency Radio Station Listings for the Philadelphia Area

☐ SCIENCE AND ELECTRONICS and RADIO-TV EXPERIMENTER furnishes this exclusive listing of emergency radio stations as an aid to our many readers now engaged in the fascinating and rapidly growing hobby of monitoring emergency radio communications. We have and will be publishing similar lists devoted to different metropolitan areas in forthcoming issues so that you'll be able to accumulate a sizable array of this difficult-to-obtain data. Refer to the index on page 83 for our 1969 program.

If you desire to obtain similar lists from other areas in the United States that have not or will not be published in this magazine in 1969, then we suggest you write to Communications Research Bureau, Box 56, Commack, N. Y. 11725. They may have a list of emergency radio services that covers your locality. Include a stamped, self-addressed envelope with your request.

PHILADELPHIA POLICE DEPT.

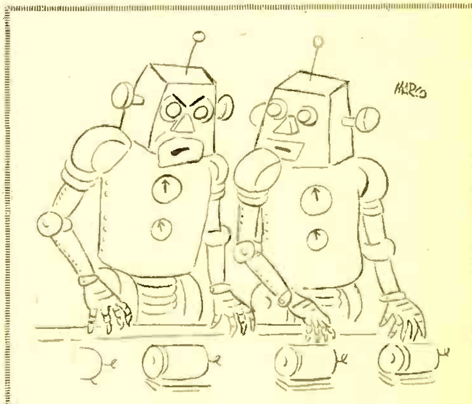
KEX220	154.65 154.71
KGF587	453.15 453.20 453.25 453.30 453.35 453.40 453.55 453.55 453.75 453.80 453.95

PHILADELPHIA FIRE DEPT.

KGB476	153.95 154.235 170.15

PENNSYLVANIA MUNICIPAL, TOWN, & BORO POLICE/FIRE STATIONS

Station	Police		Fire	
Abington Twp.	KGA260	39.18	KGC774	154.13
			KGC368	154.13
Ardmore			KGC984	33.70
Aston Twp.			KEO364	46.42
Bally			KDU489	33.94
Bensalem Twp.	KAU696	155.37	KBQ387	46.10
		155.55		
Berwyn	KGF305	45.62	KGB827	33.90
Bethel Twp.			*	46.42
Boothwyn			*	46.42
Booths Corner			KGE909	46.42
Boyertown			KGD390	33.94
Bridgeport Boro			KGE756	33.70
Bristol	KFF353	155.37	KGD366	46.10
		155.55	KGF733	46.10
	KGB960	155.37		
		155.55		
Bristol Twp.	*	155.37	KGD367	46.10
		155.55	KGH408	46.10
Briston			KGD829	46.10
Brookhaven			KGT620	46.42
Bryn Mawr			KGB861	33.70
				33.90
			mobiles	33.42
Center Point			KEU993	33.70
Center Square			KGD513	33.70
Chalfont			KGE263	46.10
Cheltenham Twp.	*	155.85	KGE615	154.13
Chester	KFA484	154.725	KGB398	154.43
Chester Hts.			mobiles	46.42
Collegeville			KGG324	33.70
Colmar			KGF244	154.13
			KJD313	154.13
Conshohocken			KGC902	33.70
			KGD760	33.70
Cornwells			KGE437	46.10
Cornwells Hts.			KBQ387	46.10
			KGD988	46.10
			KGE873	46.10
			KGH700	46.10
Croydon	KBH352	155.55	KGE379	46.10
				46.14



"I don't care what they say, Marvin —I'm bored!"

WHITE'S PHILADELPHIA EMERGENCY STATIONS

Station		Police		Fire
Doylestown Boro	KGF340	155.37	KGD655	46.10
		155.43	KGF318	46.10
	*	155.55		46.14
Dublin			KGD774	46.10
Eagleville			KGE954	33.70
E. Coventry Twp.			KCT207	33.70
				33.90
E. Greenville			KGC818	33.70
Eddington			KGD831	46.10
Edgemont Twp.				46.42
Elkins Park	KGA404	158.85	KGC240	154.13
			KGC995	154.13
Exton			KGE515	33.90
Fairless Hills			KDX425	46.10
Fairview Village			KGC900	33.98
Fallsington			KGD937	46.10
Falls Twp.	*	37.26		46.10
Feasterville	KGE414	155.37		
		155.55	KGC892	46.10
Folsom			KFT582	46.42
Fort Washington			KGC299	33.70
Garden City			KGF810	46.42
Gladwyne	KGB325	158.73		
Glenside			KGC476	154.13
			KGE979	154.13
Gradyville			KDK642	46.42
Green Lane			KGD336	33.70
Green Ridge			KFO909	46.42
Harmonville			KGB857	33.70
Hartsville			KGF437	46.10
Hatboro			KGC577	154.13
Hatfield			KGF309	154.13
Haverford Twp.	*	39.90		46.42
Havertown	KG8239	39.90	KGC512	46.42
			KGD544	46.42
Holmes			KEY935	46.42
			KEY936	46.42
			KGF717	46.42
Horsham			KCV398	154.13
			KGF350	154.13
Hulmeville			KGD494	46.10
Huntington Valley	mobiles	39.19	KGC271	154.13
Ivyland			mobiles	46.10
Jamison	KDG637	155.43	KFA426	46.10
			mobiles	33.70
Jeffersonville			KGE477	33.70
Jenkintown Boro	mobiles	39.18	KGC640	154.13
Kennett Square			KGE294	33.90
Kennett Twp.			KGE405	33.90
Kimberton			KHJ665	33.90
King of Prussia			KET243	33.70
Kulpsville			KCR921	33.70
Lacey Park			KCQ242	46.10
Lafayette Hill			KGH341	33.70
Lahaska			KGD477	46.10
			KDZ403	46.14
La Mott			KGC995	154.13
Langhorne			KGD542	46.10
Lansdale Boro	KGK647	154.755	KGE438	154.13
Levittown	mobiles	155.37	KEU921	46.10
		155.55	KGH406	46.10
				46.14
			KGH407	46.10
				46.14
Lima			KBE610	46.42
Limerick			KEO230	33.70
Line Lexington			KFT248	46.10
Linfield			KEO362	33.70
Linwood			KGE581	46.42
Lower Makefield Twp.	KFF299	155.37		
Lower Merion Twp.	*	158.73		33.70
Lower Moreland Twp.	*	39.18		
Lower Southampton Twp.	*	155.37		
		155.55		
Malvern			KGE327	33.90
Marcus Hook			KGC873	46.42
Marshallton			KGG344	33.90
Media			KBK293	46.42
Middletown Twp.	KGE363	45.22	KGD321	33.90
			KGD414	46.10
Milford Square			KDG803	46.10
Morrisville Boro	mobiles	37.26	KGE827	46.10
		39.06	KGF561	46.10
Morton			mobiles	46.42
Neshaminy	KGE489	155.79		
Nether Providence Twp.	*	39.82	*	46.42
New Hope			KGF391	46.14
Newportville			KGH405	46.10
Newtown			KGF224	46.10
				154.13
Norristown Boro	KCA484	37.18	KGE336	154.37
			KGF983	33.70
Northampton Twp.	*	155.37	*	46.10
		155.43		
North Hills			KGC298	154.13
North Wales			KGC935	33.70
Nottingham			KGH700	46.10
Oakmont			KB8835	46.42
Oaks			mobiles	33.70
Ogontz			mobiles	154.13
Oreland			KGB993	154.13
Ottsville			mobiles	46.10
Paoli			KGC513	33.90
Parkland			KGD467	46.10
Parkside			KCN702	46.42
Penndel			KGD512	46.10
Pennsburg			KGC549	33.70
Penns Park	KDZ425	155.37		
		155.43		
Perkasie			KGD586	46.10
Perkiomenville			KFY403	33.70
				33.94
Plumsteadville			KGD813	46.10
Plymouth Twp.			*	33.70
Point Pleasant			KGE687	46.10
Pottstown Boro			KGF392	33.70
Prospect Park			KGG370	46.42
Quakertown Boro	KGE452	155.13	KGD616	46.10
		155.37		
Radnor Twp.	KGB330	45.50		
Red Hill			KGD272	33.70
Richboro	KCI715	155.37	KFZ814	46.10
		155.43	KGE378	46.10
Richlandtown			KDV811	46.10
Ridley Twp.			*	46.42
Riegelsville			KGE754	46.10
Ringing Hill			mobiles	33.70
Rockledge			KGC529	154 13
Roslyn			KGD226	154 07
				154 13
Royersford			KGC999	33.70
Schwenkville			KGD372	33.70
Sellersville			KGS852	46.10
Sharon Hill Boro	KGB367	45.54	KGD775	46.42
Shinglehouse			KFX406	46.10
Skippack			KGG930	33.70
Solebury Twp.	KGF419	155.43		
Souderton			KFF291	33.70
Southampton	KDZ451	155.37	KGE802	46.10
		155.43		
South Media			KGD349	46.42
Springfield			KBA863	46.42
Swarthmore Boro	KGA378	39.82		
Telford			KEG833	33.70
Tinicum Twp.	mobiles	45.74		
Trappe			KBX384	33.70
Tredyffrin Twp.	*	45.62		
Trevose			KGE421	46.10
				46.14

"The machine did it by itself!"

Station	Police		Fire	
Trevose Hts.			KGE452	46.10
				46.14
			KDO246	47.46
Trumbauersville			mobiles	46.10
Tullytown	*	155.55	KGE638	46.10
				46.14
Tylersport			KEM672	33.70
Upper Darby	KGA853	155.09	KGA346	154.19
Twp.				
Upper Morele-	*	39.28		
land Twp.				
Upper Pottsgrove			KGF463	33.70
Upper Southamp-	*	155.37		
ton Twp.		155.43		
Valley Forge			KBB521	33.90
Wallingford	KGD796	39.82		
Warminster Twp.	KDZ470	155.37	KCQ242	46.10
		155.43	KGD741	46.10
				46.14
Warrington Twp.	KDA390	155.79	KGD891	46.10
			KGE910	46.10
Warwick Twp.	*	155.43	*	46.10
Wayne			KGB393	33.70
				33.90
			mobiles	46.42
West Chester	KGA612	45.42	KGD665	33.90
Boro				
	Call	mHz	Call	mHz
West Consho-			KGD343	33.70
hocken				
West Park			KCO285	33.70
			KJP390	33.70
West Point			KJD313	154.13
Whitehall Twp.			*	154.13
Willow Grove	KFR636	39.28	KBS490	154.13
			KGC578	154.13
			mobiles	33.90
				46.10
				46.14
Wrightstown Twp.	*	155.37		
		155.43		
Wycombe			KGD959	46.14
Wyndmoor			KGD485	154.13
Yeadon Boro	KGB242	39.42	KGI257	46.36

N.J. MUNICIPAL, TOWNSHIP, BORO POLICE & FIRE

Station	Police		Fire	
Allentown			KDA357	154.43
			KEH800	154.43
Atco	KFR678	155.37	KJB229	154.385
				154.43
Audubon Boro	KEB362	155.37	KEE390	46.18
				154.43
			mobiles	154.385
Barrington Boro	KEF872	155.37	KBT810	154.43
Belmar Boro	*	155.37		
Bellmawr	KEB473	155.37	KCY548	154.43
			KEV433	154.43
Berlin Boro	KEX298	155.37		
Beverly	KEE941	155.49		
Blackwood			KDX508	154.385
			KEI808	154.385
				154.43
Blackwood Terr.			KEG955	154.43
			KFA473	154.13
Blawenburg			KJK804	154.31
			mobiles	154.13
Bridgeport			KCQ270	154.43
Burlington Twp.	mobiles	155.49		
Camden	KEB210	159.03	KEG405	153.77
				154.43
Cherry Hill	KEA395	155.52	KDO312	154.43
Chews Landing			KJH233	154.385
				154.43
Cinnaminson	KEB418	155.49		
Clarksboro			KAY257	154.13
Clementon Boro	KEI436	155.37		
Collingswood	KEB356	156.21		
Delanco Twp.	KEE393	155.49		
Delran Twp.	KFG450	155.49		
Deptford Twp.	*	158.97		
E. Greenwich			*	154.13
Twp.				
Edgewater Park	*	155.49		
Twp.				
Ewing Twp.	*	37.26	*	154.43
Gibbstown	KED374	158.97	KFR552	154.13
Glendale	KDB419	155.37	KDQ337	154.43
Glendora	KEG297	155.37	KEE544	154.385
				154.43

Station	Police		Fire	
Gloucester Twp.	KEA788	155.37	KEH660	154.43
			*	154.385
Greenwich Twp.	*	158.97	*	154.13
				154.385
Groveville			KDL820	154.43
			KED409	154.43
Haddon Twp.	*	156.21	*	154.385
				154.43
Haddonfield	KEB467	155.43	KEC380	154.43
Haddon Hts.	KEB374	155.37	KDG375	154.43
Boro				
Hamilton Twp.	*	37.26	KEE555	154.43
Hamilton Sq.			KEA517	154.43
Hightstown			KDL923	154.43
			KDL924	154.43
			KEC839	154.43
Hopewell			KEB588	154.13
Jobstown			KBI956	154.13
Juliustown			KEH309	154.13
Lambertville			KEF750	33.74
Laurel Spgs. Boro	KED296	155.37	KEG971	154.385
				154.43
Lawrence Twp.	*	37.26	*	154.43
Lawrenceville	mobiles	37.26	KEF543	154.43
Levittown	*	155.49		
Lindenwold Boro	KDY440	155.37		
	KED790	155.37		
Magnolia			KDA708	155.43
Maple Shade	KEB870	155.49	KBT211	154.13
Twp.				154.43
Medford Twp.	KJD335	155.49	KBR240	154.13
			KDK703	154.13
Merchantville	KFD660	156.61	KEG600	154.385
Boro				154.43
			KUA762	154.385
				154.43
Montgomery Twp.			*	154.13
				154.31
Moorestown Twp.	KEB309	155.49	KBR647	154.13
Mt. Airy			KEE967	33.74
Mt. Ephraim Boro			KDJ512	154.385
				154.43
			KDJ513	154.385
				154.43
			KDJ514	154.385
				143.43
Mt. Holly Twp.	KEB452	155.49	KAQ261	154.13
Mt. Laurel Twp.	KDK775	155.49		
National Park	KCK314	158.97		
Boro				
Oaklyn Boro	KEG942	156.21	KEG643	154.43
			KFI597	154.43
Palmyra Boro	KEB346	155.49		
	KEE554	155.49		
Paulsboro Boro	KEB327	158.97	KEJ883	154.13
Pemberton			KED825	154.13
Pennington			KED824	154.13
			KEI930	154.13
Pennsauken Twp.	KEB345	155.61	KEE490	154.13
			KEU999	154.13
Princeton Univ.	KDV709	155.415		
Riverside Twp.	KEA415	155.49		
Rocky Hill			KIZ210	155.31

"Say, 'Green cheese.'!"

WHITE'S PHILADELPHIA EMERGENCY STATIONS

Station		*Police*		*Fire*
Runnemede Boro	KEC963	155.37	KEF932	154.43
			KFT567	154.43
Sergeantsville			KCU294	33.74
Sewell			KFO890	154.13
Somerdale Boro	KED959	155.37		
Springfield Twp.			*	154.13
Stockton			KDN919	33.74
Tewksbury Twp.			*	33.74
Thorofare			KJD911	154.13
Titusville			KEB973	154.13
			KGL510	154.13
Trenton	KEB276	37.26	KDG330	154.43
	KGV253	37.26	KEA739	154.43
			KED796	46.38
			KEG274	154.43
			KEG513	154.43
			KFK665	154.43
			KJD337	154.43
			KJE251	155.16
Vincentown			KEE921	154.13
Voorhees Twp.	*	155.37	*	154.43
Waterford Twp.	*	155.37	*	154.385
W. Amwell Twp.			*	33.74
Westmont	KEB484	156.21	KEE719	154.385
				154.43
Westville Boro	KEE405	155.37	KED463	154.43
White Horse			KEE593	154.43
Willingboro Twp.	KEI693 •	155.49		
Woodbury	KEA936	158.97	KAQ657	154.13
	KEJ871	158.97		
Woodbury Hts.			KEG635	154.13
Yardville			KDL821	154.43
			KDLB22	154.43

DELAWARE RIVER PORT COMMISSION P.D.

KEA651	Camden, N.J.	158.79
KEF977	Camden, N.J.	154.89
KGA518	Philadelphia, Pa.	158.79
KGE905	Philadelphia, Pa.	154.89

BUCKS COUNTY (Pa.) AGENCIES

KC1570	Doylestown (police)	155.13 155.37 155.43 155.55*
KGF318	Doylestown (fire)	46.14

* Main channel

CHESTER COUNTY (Pa.) POLICE/SHERIFF

KIZ567	W. Chester	154.785

DELAWARE COUNTY (Pa.) AGENCIES

KDK667	Media (fire)	46.36 46.42
KGA905	Media (police)	39.82

MONTGOMERY COUNTY (Pa.) POLICE/SHERIFF

KGA243	Eagleville	45.26 45.46
KGA243	Norristown	45.26 45.46

BURLINGTON COUNTY (N.J.) AGENCIES

Police—		
Marlton	KFT545	155.49
Mt. Holly	KEE508/KFR662	155.49
Riverside	KFR660	155.49
Willingboro	KFR661	155.49
Fire—		
Beverly	KDG405	154.22
Bondentn. Twp.	KDA705	154.22
Bordentown	KDN521/KEY873/KJR346	154.22
Burlington	KEG961	154.22
Burlngtn. Twp.	KDN522	154.22
Crosswicks	KDK771	154.22
Delanco	KDK631	154.22
Levittown	KDB501	154.22
Lumberton	KDK740	154.22
Maple Shade	KBZ425	154.22
Marlton	KF1496	154.265
	KFT603	154.22
Masonville	KJJ445	154.22
Medford	KDK632	154.22
Moorestown	KFO815/KJJ446/KJJ447	154.22
Palmyra	KBW792/KDZ359	154.22
Riverside	KDB499/KDF563/KDX465	154.22
Riverton	KDK741	154.22
Willingboro	KEP638	154.22

CAMDEN COUNTY (N.J.) AGENCIES

Police—		
Lakeland	KBM912	155.37
Fire—		
Lakeland	KBK523	154.265 154.385 154.43 154.43
	KEM667	154.43
Runnemede	KEM666	154.385 154.43
	KFT567	154.43

GLOUCESTER COUNTY (N.J.) AGENCIES

KAV708	Woodbury (fire)	154 13 154.265
KBC661	Woodbury (police)	158.97

PENNSYLVANIA STATE POLICE

KDN502	Philadelphia	42.62
KFM497	Trevose	42.62
KGA990	Philadelphia	42.62
KGA992	Lionville	42.62
KGA999	Quakertown	42.62
KGD352	Spring City	45.14
KGD369	Media	42.62
KGD370	Buckingham Mtn.	42.62

Turnpike: 155.67 155.91 159.21

NEW JERSEY STATE POLICE

KEA810	Voorhees Twp.	44.62 44.66 44.94 154.68 154.92
KEA814	Hightstown	44.62 44.66 44.94 154.68 155.445
KEA818	Mantua Twp.	44.62 44.66 44.94 154.68 154.92
KEF823	S. Hampton Twp.	44.62 44.66 44.94 154.68 154.92
KEA826	Edgewater Twp.	44.62 44.66 44.94 154.68 155.445
KEA832	Trenton	44.62 44.66 44.94 154.68 155.445
KEA833	Woodstown	44.62 44.66 44.94 154.68 154.92
KEA834	N. Hanover Twp.	44.62 44.66 44.94 154.68 155.445
KEC848	Plainsboro	44.62 44.66 44.94 154.68 155.445
KEC877	Bordentown Twp.	44.62 44.66 44.94 154.68 155.445
KED722	Washington Twp.	44.62 44.66 44.94 154.68 154.92
KFX347	Hopewell	44.62 44.66 44.94 154.68 155.445

(N.J. Turnpike: 154.83 155.19)

Positive Feedback

Continued from page 10

In the construction field, calculating the amount of concrete needed to resurface a road becomes as simple as tracing an aerial photo of the route, eliminating the extensive ground surveying normally required.

As the operator of the breadbox-size instrument traces the blueprint or photo, 264 of the latest Texas Instruments integrated circuits (ICs) within the unit translate straight and curved movements of the plotting cross hairs into computerized number codes. The numbers are displayed as illuminated digits on the control console and are transmitted to a computer card punch or an incremental tape deck.

"Before the new, low-cost TI integrated cir-

Converting graphic material like this electronic circuit into computer language is as easy as tracing lines with MicroMetric Corporation's new digitizer system. As the operator traces the drawing on the plotting table, 264 Texas Instruments integrated circuits within the scaler cabinet (left) convert drawing coordinates into digital language for storage on computer cards or tapes. MicroMetric's innovative use of recent TI circuits resulted in a scaler which is 25 percent less expensive, less than a third as heavy and less than a fourth as large as less-capable scaling equipment formerly available.

cuits were available, a comparable digitizer would have been too expensive, too slow, too large and too unreliable for most users," Mr. Elisher, a spokesman for MicroMetric, said. "The scaler we've developed is 25 percent less expensive, less than a third as heavy and a fourth as large as less-capable two-dimension scalers which preceded it.

"In addition, the higher speed of the new TI transistor-transistor logic (TTL) microcircuits open up a wider range of possible applications," he said. "For example, interferometer systems for measuring large precision-machined metal parts can now count at rates exceeding 300,000 cycles per second.

"Older systems could not count above 50,000 cycles per second. But the high-speed TI circuits easily operate at 5 million cps—well above the requirement for this application. This high speed means greater accuracy and shorter production times for interferometer users.

"There's a common computer practice called 'time sharing'," Mr. Elisher said. "In most instances, it means several companies sharing a single computer whose calculating speed is so great that ownership of the computer could not be justified by one company alone.

"Time-sharing as applied to the MicroMetric scaler, however, refers to the sharing of certain circuits among the three rows of illuminated numericals on the scaler's front panel. The circuitry computes one axis, then the second, then the third, and repeats—all so quickly that to the human eye, the three rows of numerals seem to be changing simultaneously.

"This time-sharing of circuitry gives equipment designers an important new area for cost-saving," he said. In MicroMetric's case, time-sharing cuts many logic circuits by a factor of 17, and failure-prone connections within the system by a factor of three.

Reader Mail Department. This Editor receives considerable mail requesting a source for vintage tubes of the pre-war era. (Naturally, I mean World War II.) Well, Arcturus Electronics Corp. has been lucky enough to acquire over 9800 obsolete tubes of 1925-1930 vintage. These tubes have been added to their inventory of other hard-to-obtain types, which, on the evidence, many of our readers would be interested in obtaining. Does Arcturus have the vacuum tube you want? There's only one way to find out —write, requesting a listing of available tubes plus prices. Both appear in their mid-1969 catalog, and it's yours for the asking. Just drop a postcard to Arcturus Electronics Corp., Dept. JS, 502 22nd St., Union City, N.J. 07087. Be sure to say that you read about it in SCIENCE AND ELECTRONICS.

Oil Down There! A helicopter-transported oil prospecting device developed by Sinclair Oil's Tulsa Research Center has been used successfully in the muskeg areas of the Arctic North Slope of Canada where conventional methods are both slow and costly. The device, mounted on a quadrapod, is known as the Helicopter Dinoseis system. It is used in locating underground geologic structures which may contain oil or gas.

Resembling moon vehicles in appearance, the Dinoseis quadrapods are sturdily constructed yet light enough to be transported from one shot point to another by helicopter.

The Helicopter Dinoseis system is composed of a 24-inch diameter expandable seismic energy generator chamber suspended between the legs of a quadrapod and resting on the ground. A confined mixture of oxygen and propane is exploded in the chamber by an electrical spark, driving the bottom steel plate against the ground and imparting high-frequency seismic waves into the earth to subsurface rock formations.

Reflected waves were recorded on analog seismic equipment in the Canadian operations, but the same could be recorded on digital seismic gear.

A control module, equipped to serve five exploder units, carries propane and oxygen which fuel the seismic generators, a compressor to provide air used in a recoil system and a generator for power for the control system and radios. *(Turn page)*

Positive Feedback

Continued from previous page

The eight seismic energy generators are fired simultaneously by radio from the recording unit, and may be pulsed each 10 seconds.

In the Canadian operations, the helicopter moved eight quadrapods and their Dinoseis exploders, two control modules, recording equipment, and personnel one-half mile from one shot point to another in 17 minutes.

"We are extremely gratified by results on these initial operations," F. R. Fisher, head of the Research Center, said. "Mechanical operations were excellent, data quality was comparable and cost was significantly lower than the conventional dynamite and shot-hole method. We are encouraged to believe the Helicopter Dinoseis seismic exploration system will provide the answer to the logistical and economic problems of conducting seismic work in the remote areas of the world."

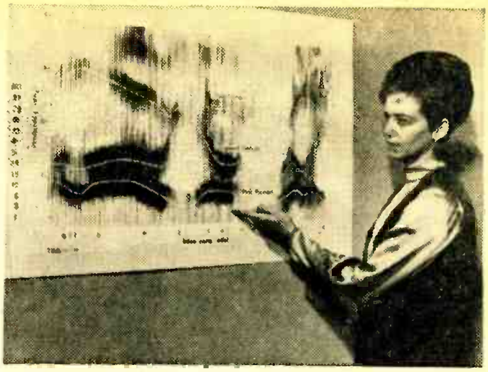
"Hi There, Big Boy!", said in a sexy voice may mean nothing more to an IBM engineer than the punch card that programmed it. It's all because some IBM engineers developed an experimental device that helps improve the naturalness of synthesized human speech.

The new device—called a formant generator—has application in machine-to-man voice communication devices. Computer-based systems using formant generators could be used to provide stock market quotations, telephone information assistance and satellite commands.

The formant generator is a digitally tunable filter which simulates resonances in the human vocal tracts (formants) during speech. Three of the formant generators, each covering a specific frequency range, are used to simulate the three lowest resonances of the human vocal tract. These devices are also modified and used in the same speech synthesizer to simulate nasal (such as "m" and "n") and fricative (such as "f", "v" and "sh") sounds. (Fricative—that's a word you don't fool with!)

Information on the components of speech is used to design the controls for the formant generators. These are initially fluctuating waveforms—subsequently converted to digital data—which determine the frequencies and amplitude of the sounds produced. One source of such information is sound spectrograms.

This information, after digitizing, is stored by a computer. It is then used to vary the frequencies of the three formant generators in complex combinations to simulate the rapidly shifting formants of human voice. These formants are combined with the output of other speech sound generators and filters—fricative, nasal, hiss and "buzz"—to produce recognizable, "spoken" sounds.



A member of the IBM Speech Synthesis Laboratory showing a sound spectrogram of the phrase "allow young Willie." The spectrogram illustrates the three lowest formants of speech, indicated by the dark, horizontal bars. The addresses for the three formants are stored by a computer and used to vary the three formant generators required for speech synthesis.

The formant generators filter the complex waveforms obtained from a broadband source. Each consists of an attenuator between two amplifier-type integrators, plus a feedback circuit. Attenuation, determined by the digital address from a computer, is obtained by turning on different transistors which modify amplifier gain. All frequencies, however, are not attenuated equally, and the frequencies selected vary with the amount of attenuation. The least-attenuated frequencies, returned to the input by the feedback circuit, determine the frequency range of the generated formant.

It'll be a long time before the female operator's voice at the other end of a telephone line is computerized. So dream on, lads, while our dreams may still be real.

Pure H_2O. A water purification system utilizing ozone has been developed for the millions of homeowners, farmers and small commercial businesses who derive their water from the 15-million wells in America and other private sources. Many of these wells contain undesirable impurities and as time goes by the situation gets worse.

Ozone reportedly oxidizes from water harmful pollutants such as sulphur, bacteria, virus, and many other kinds of impurities. It is also reputed to keep pipes and plumbing free of blackening and damaging corrosion, and it eliminates the tastes and odors of sulphur and other unpleasant substances. Ozonator Corporation of Batavia, N. Y., creators of the system, also maintains that water purified with ozone contains no residual taste or odor that is the case with conventional chlorine or other chemical equipment.

Ozone is an activated oxygen molecule, formed when air is charged by electricity. It is familiar in nature as that fresh smell after a lightning storm. Ozone is unstable, and when bubbled through a household water supply it readily combines with and oxidizes existing impurities.

Ozone's purification properties have been known for hundreds of years. Paris and many other cities in France and Germany have used ozone to purify municipal water since the early 1900s. Until the development of the Ozonator Corporation system, however, ozone was too expensive to produce for application to household water purification.

Ozonator Corporation reports the purifier to be completely automatic and self-regulating. There are no chemicals to add or replace, nó backwashing is necessary, and it is unconditionally guaranteed. Since air and electricity are the only raw materials, there is a minimum of maintenance. The Ozonator unit is compact, easy to install, and operates inexpensively from standard household electrical outlets.

This water purification system is fine, if all you need is a glass of water. However, industry needs can only be solved with major sea-water purification plants. ■

Bookmark

Continued from page 13

both the usual everyday color TV troubles, as well as those tough dogs run into once in a blue moon. Here are common sense service bench approaches for solving all sorts of color TV troubleshooting problems, many of them adapted from well-established B&W techniques.

Definitely not a textbook, *On the Color TV Service Bench* tells how to tackle specific problems in a logical, professional way. Moreover, the author clearly explains how the operation of each circuit is affected by specific faulty components. One doesn't have to be an engineer to understand and use the information; it's all boiled down to essentials, including clear-cut facts evolved from numerous case histories. The reader will find the step-by-step alignment instructions—RF, IF, chroma, demodulators, etc.—greatly simplify those mysterious techniques that all too many technicians shy away from. The author shows how to really get that dusty alignment gear to work—even how to use it for troubleshooting purposes.

The book starts right out by unscrambling those tough "brightness" problems, revealing cures for dozens of elusive troubles in a number of familiar chassis. Following the same style of treatment, the content progresses through horizontal deflection systems, horizontal oscillators, high-voltage regulator systems (shunt, feedback, and pulse-controlled), vertical deflection systems, video amplifiers, chroma IF circuits, color sync circuits, color killers and burst amplifiers, and color demodulators. The final chapter describes a number of post-repair techniques which make the difference between simple "patching up" and restoring a receiver to like-new operation. To get your copy, write directly to the publisher. Tab Books, Blue Ridge Summit, Pa. 17214 and tell him the ol' Bookworm sent you. ■

Stamp Shack

Continued from page 8

blue waves emanate to cover the entire area of the vignette. These represent stereo FM, a service that was introduced to China on the anniversary occasion.

China 40th Anniversary Postal Administration Issue 1968

● BCC today transmits 556½ hours of radio programs each day, the various ones intended for domestic, international and particularly mainland China reception. This is possible by the use of ten 50-KW transmitters. In addition to the stations in Taipeh, BCC operates facilities in ten other Formosan cities to form what is called "The Mandarin Network."

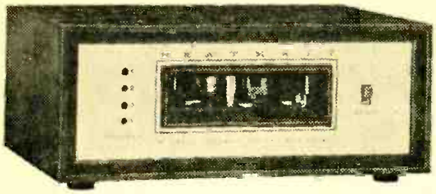
● ● What's New?

● The Space City Cover Society, Box 53545, Houston, Tex. 77052, has been preparing and processing commemorative covers in connection with the liftoff and landing of virtually every NASA Spacecraft. Collectors interested in such souvenir covers may write to M. Allen Banks, the society's director, for details.

● One of the more useful books which collectors should own is "Identify Your Stamps," by Ervin J. Felix. It is available from the Whitman Publishing Co., Racine, Wis. 53404, at $2.50. Its 260-pages are packed with answers to questions which constantly confound beginners (and some veterans). ■

New Products

Continued from page 17



Heathkit GD-28 8-Track Stereo Tape Player

Heath says it should only take about 6 hours to put together. The GD-28 comes with a walnut-grained polyurethane cabinet and necessary connecting cables and operates from 120 volts. Price in kit form is $59.95 from the Heath Co., Benton Harbor, Mich. 49022.

Lazy Private Listening

If you're just too tired to get up and cross the room to adjust controls while enjoying your stereo headset, Allied has a unit for you. The Allied Stereo Headphone Remote Control, Model H-879, permits a listener to adjust the volume of one or two headphones from his chair. The unit has an *on-off* switch for speakers, two volume controls and standard ¼-in. headphone jacks. The headphones plug into the remote control which connects with low-priced cable to the amplifier or receiver. Size of Allied's H-879 is 2¾ x 4 x 2 in. and the price is $9.95. A 25-ft. roll of cable costs $1.60. In all Allied stores or by mail from Allied Radio Corp., 100 No. Western Ave., Chicago, Ill. 60680.

Allied Stereo Heodphone Remote Control H-879

Just Give Us the FAX

Distributed by Martel Electronics, this is the Rotel 550 AM/FM/Multiplex receiver, which gets a rating of 70 watts IHF. The 550 has front-end tuning, individual bass and treble controls for each channel, loudness control for boosting extreme highs and lows at moderate listening level, and a wide power bandwidth. The tuner is designed for both AM and FM and will lock onto a station even in low reception areas. There is a smoked-glass dial and brushed gold face plate. Price is $299.50 and you can write for further specs to Martel Electronics, 2339 S. Cotner Ave., Los Angeles, Calif. 90064.

Rotel 550 AM/FM/Multiplex Receiver

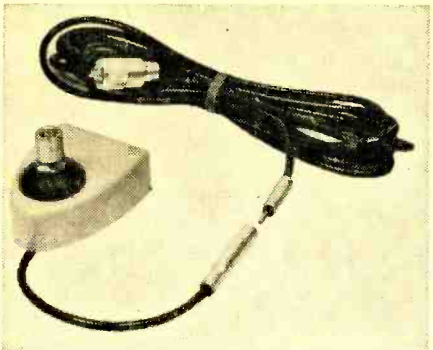
Pro Transceiver for Hams

Here is a brand-new transceiver from Galaxy, the GT-550, complete with a line of accessories. The Galaxy GT-550 is a 5-band SSB unit designed for either mobile or fixed station use by amateur radio operators. Really compact, 11¼ x 12⅜ x 6 in., and weighing only 17 lb., it has 550 watts SSB power, 360 watts CW. Price of the GT-550 is $449.00. The Galaxy accessories include: the LA amplifier at $495.00, the RF console at $69.00, the remote VFO at $75.00, and the speaker console at $19.95. Available optional accessories are: AC power supply, mobile power supply, phone patch, CW filter, VOX accessory, calibrator, mobile mounting bracket, and a floor-board adapter. For a brochure with complete specs on the line write Galaxy Electronics, 10 S. 34th St., Council Bluffs, Iowa 51501.

Galaxy GT-550 Transceiver

Antennas, to the Rear!

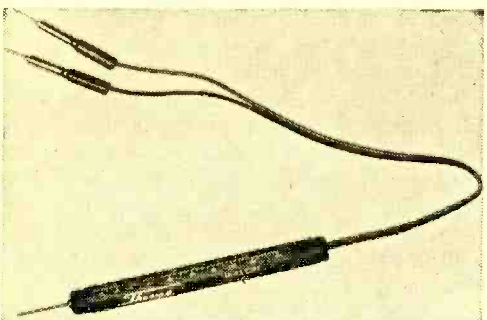
Model TLM is an antenna trunk lip mount which requires neither drilling nor defacing of your vehicle. The clamp and antenna base support are constructed from ⅛-in. carborized plated steel and the mount cover is grey Cycolac plastic. Easily installed in seconds on the rear or side of any automobile trunk lip, TLM will give lowest SWR and minimum noise. The assembly includes New-Tronics' break-cable adaptor with all connections factory soldered plus a special coax cable retainer to protect it when the trunk lid is closed. Model TLM will accommodate a wide selection of antennas with the standard ⅜-in. base. No special tools required. Price is $8.95 and inquiries should be directed to Sales Dept., New-Tronics Corp., 15800 Commerce Park Dr., Brookpark, Ohio 44142.



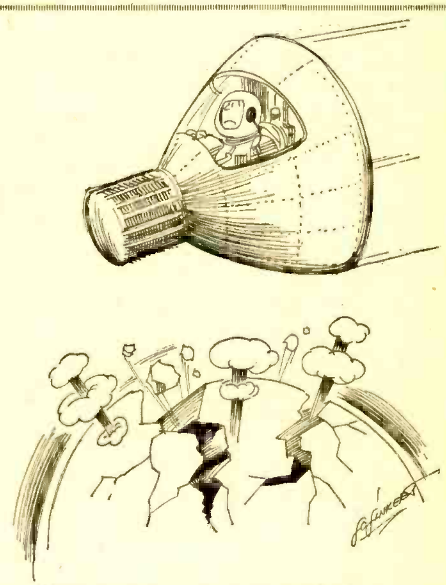
New-Tronics TLM Trunk Lip Mount

Take Your Component's Temp?

Just a mite bigger than a fountain pen, Thermy is a handy new sensing device that quickly gives accurate temperature readings of any solid or liquid with which it is placed in contact. Thermy will electronically measure temperatures from −60°F to 400°F or from −50°C to 200°C, used in conjunction with a quality voltmeter or multitester. You get temperature data beyond the capabilities of ordinary mercury thermometers because its two 40-in. long leads and its 1½-in. long steel probe tip permit entry into heretofore inaccessible areas. A sensitive thermal unit inside the probe increases in resistance as it cools, lowers in resistance as it heats. When you use Thermy with a multitester, hold the probe tip against an object for a quick resistance read-out. A conversion scale is provided to translate ohms to F or C degrees. In a protective case, Thermy is priced at $14.95, and for more info write Mura Corp., 355 Great Neck Rd., Great Neck, N.Y. 11021.



Mura Corp. Thermy



"Sorry, the number you have dialed is permanently out of order!"

Univox Super Fuzz Box

Continued from page 72

For example, Fig. 1 is EXPANDER *off*; Fig. 2, about ¼ EXPAND; Fig. 3, ½ EXPAND and Fig. 4, ¾ EXPAND. (Full expansion is bearable only by Martians.) The two-position TONE switch provides either the basic type of fuzz effects such as represented in Figs. 1 to 4, or the impulse effects as in Figs. 5 to 7.

How It Works. Since the circuit types and schematic of the Univox is one of the world's best kept secrets, and since we could not crack the circuit in a reasonable time, we must make an educated guess. First off, there is a clipper such as found in all fuzz-boxes. Then there appears to be self-oscillation triggered by positive feedback above a predetermined level, as set by the EXPANDER control. Finally (and this is a far-out guess), a multivibrator triggered by the positive and negative peaks of the basic waveform provides the impulses.

The Univox *Super-Fuzz* is priced at $24.95, including one connecting cable and a 9-V battery. For additional information write Lafayette Radio Electronics Corp., Dept. S, 111 Jericho Tpke., Syosset, N.Y. 11791. ■

Ham Traffic

Continued from page 77

erating privileges, each of us should do a share of getting rid of the hooligan ham who has become noteworthy enough to be mentioned in the FCC's official report. And condemnation on the air won't do it—that's merely stooping to this alley cat trend which we're trying to wipe out. But total ostracism of any ham who doesn't behave himself on the air can be effective. Make a firm resolution to have nothing to do with a fellow whose behavior on the air is open to question. Once he runs out of people to talk to, he will mend his ways.

Instant Emergency Network. Some scoffers say that hams no longer can be really effective in providing emergency communications. But an ever-growing group on 40-Meter phone is proving this just isn't so!

These fellows and gals have set up a full-time emergency net that spans the U.S. from coast to coast. And they keep it operating every day of the week and almost around the clock! The beauty of the thing is that the net is organized so it can be strictly an easy-going-type operation. However, it can be instantly switched into a brisk, efficient emergency net when the need arises.

At a time when idle rag chewing seems to be taking over the low phone bands, these operators are showing the world they have a serious interest in using their ham rigs for work, not just for play.

You've read about the West Coast Amateur Radio Service (WCARS) in this column before. That net has been operating since 1963 on 7255 kHz. Its main function has been to provide the system for mobiles encountering traffic accidents, fires, or other emergencies to be able to notify the proper authorities through operators who monitor this frequency at home. Western highways carry a lot of traffic, and sometimes help is quite a ways away in the wide open spaces. Result is that this net has helped a lot of people in trouble over the years.

Last year, the Mid-Western Amateur Radio Service (MWARS) went into operation to serve the same function in the middle of the country. Now this year the East Coast Amateur Radio Service (ECARS) went into operation. All three nets operate on 7255 kHz except when propagation conditions cause them to interfere with each other. Then MWARS moves to 7258 and ECARS moves to 7253.

The practical value of this nation-wide emergency setup was first proved when a mobile in Georgia encountered a serious automobile accident and couldn't raise anyone in his area to call the police. The West Coast group heard his calls, however, and an Arizona station called that state's Highway Patrol, which had hot-line communications with Georgia authorities.

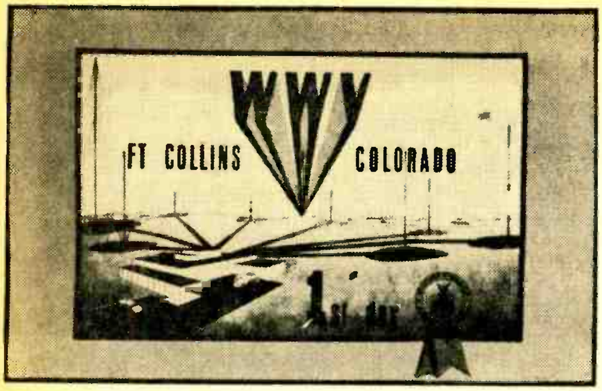
This story brings up the question: why don't hams have more emergency monitoring frequencies set aside for just such occurrences? Actually, this is an old idea which has been tried many times, but it has only been a success over a wide area since these 40-Meter groups got interested.

For many years in the past, the ARRL designated a frequency in each band, both phone and CW, for "National Calling and Emergency Frequencies." For a while, the League's Official Observer corps was requested to send post cards to casual users of these frequencies, notifying them of the voluntary plan to keep these frequencies clear for emergency calls.

However, the idea never really caught on. Everybody agreed it sounded good, but few operators made the effort to make the idea work. Now, though, with the leadership and enthusiasm shown by these three regional emergency nets, the idea of full-time emergency frequencies is gathering momentum again.

Maybe you're interested? If so, listen in on 7255 kHz for a while to learn how they operate. They'll be glad to have you join them. And if you're on a trip with a 40-Meter mobile rig in your car, try monitoring this frequency as you drive along. ■

"High voltage was my problem."



Just about everyone has heard the "tock, tock, tock" of WWV—the big U.S. time station. Tune 'em in and send a report today.

Their Time Is Your Time

Continued from page 51

As with most Down Under stations, listeners will find our early morning hours best. Generally, its 10-kW transmitters on 5.425 and 7.515 MHz are audible after 1200 GMT. Before that, your best bet is 12.005 MHz.

Our list shows a broad cross section of some of the standard time stations now on the air. Some are sure bets; others will really try your skill, patience, and—you guessed it—luck. With the time services you can never be sure what will pop up next. But whatever it is, you're in for a good time! ■

Famous Patents

Continued from page 78

The court battle dragged on for years, finally reaching the Supreme Court in 1943. Nearly 40 years after the patent was granted, the highest court in the land found Marconi's patent claims invalid.

But even the wise old men of the Supreme Court couldn't agree completely. In a split decison, three of the judges strongly disagreed with the majority.

One dissenting judge, Mr. Justice Rutledge, attacked the decision of his colleagues with the statement:

"Before his (Marconi's) invention . . . ether borne communication traveled some eighty miles. He lengthened the arc to 6000. Whether or not this was 'inventive' legally, it was a great and beneficial achievement. Today, forty years after the event, the Court's decision reduces it to an electrical mechanic's application of mere skill . . .

"By present (1943) knowledge it would be no more. School boys and mechanics now could perform what Marconi did in 1901. But before then wizards had tried and failed." ■

Copies of Marconi's Four-Circuit Tuning patent are available for fifty cents each from the U.S. Patent Office, Washington, D.C. 20231. In ordering, give the number of the patent—No. 763,772.

Police Convertor

Continued from page 43

and hunt for the stations—and hope they come on while you're tuning.

Sometimes better reception may be obtained on different parts of the FM band; for example, you may get better reception with the radio tuned to 90 MHz than to any other frequency slot in the band. Once you have the vhf band tuned in, experiment with the radio's tuning and R1's adjustment.

Using the Converter. Keep in mind that police and fire calls, are not broadcast continuously as are the broadcasts from AM radio stations. These FM transmissions are of short duration and then the carrier goes off. If you try to adjust the converter during a slack part of the day, it may be minutes or even an hour between calls—for all intents and purposes the band might appear dead. Just because you can't tune in a signal don't assume the converter isn't working. ■

The Skies Above Us

Continued from page 45

Now, astronomers have discovered that a star close to the center of the Crab Nebula is changing in brightness at the rate of once in a thirtieth of a second. This star must be the "villain of the piece." This is the remnant of the star which, about four thousand years ago, "blew its top."

Almost everyone today knows that an atom consists of positively-charged particles (protons) plus an equal number of negatively-charged particles (electrons) to make the atom electrically neutral. If the electrons and the protons are smashed together because of intense gravitational attraction, they make neutrons. These neutrons will not give off visible light but, around them, compressed into a hard ball, may be a few normal atoms.

These "neutron stars" may be much heavier and denser than our sun or any matter we know or can imagine, yet be only 10 miles or so in diameter. Such an unbelievably dense ball may spin on its axis in a fraction of a second and, if one side is brighter than any other part, the flickering of a pulsar may be explained, say the experts.

★ The crux of the matter is: have we found in the faint star near the middle of the Crab Nebula an example of these collapsed, exceedingly-condensed, hypothetical neutron stars?

There were the "quasars," objects which, like the pulsars, were discovered by radio telescopes. Instantly, some astronomers, especially the younger and young middle-aged ones, had instant explanations for these new-found objects, and their "explanations" fell, one-by-one, by the wayside. After several years, we don't yet know whether the quasars are near-by objects of reasonable radiation or enormously distant objects violating all of our previously-derived laws of nature, including impossibly-high emission of energy and impossibly-fast apparent velocities of recession—faster than the velocity of light.

Too many young astronomers and physicists want to get too quickly into the act. We might compare this with what Dr. Thomas Gold, a few years ago, said about the surface of the moon—that it was an ocean of dust, and any man who stepped on it would be drowned and smothered by dust. We have landed many Surveyor probes on the moon, and they have not been swallowed by dust.

★ Why don't the youngsters in astronomy wait, before they rush into print, for at least one second thought—about lunar surface dust, quasars, pulsars, and so on—so they can sacrifice immediate notoriety in favor of possible studiously-studied chance for immortality?

The history of all sciences points up the necessity of plodding along until no "bugs" remain in the theory and its fulfillment. If Isaac Newton could wait more than 20 years before announcing his law of gravitation in 1686, our modern astronomers can wait a year or two before cluttering up our technical journals with fast-judgment pronouncements, later to be demolished.

It was Kepler who demolished, once for all, the Ptolemaic (earth-centered) hypothesis of planetary motions, which had been the law from 1500 years earlier.

There are many mysteries awaiting our explanation in this universe of ours. Let no one think that, from a few miscellaneous observations, he can arrive at a complete explanation, especially when it blithely overthrows reasonably-established physical laws derived from decades or even a lifetime of observations, correlations, and conclusions. How incompetent will seem many would-be geniuses when their snap-judgment rushings into print will be demolished by those who come after. ■

"The die is cast, the book is written, to be read now or by posterity, I care not which. It can well await its reader. Has not God waited six thousand years for an observer?" The words of John Kepler from his last book.

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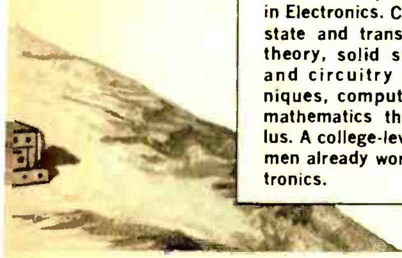

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The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools, a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator, in addition to F.C.C. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

Progressive "Edu-Kits" Inc., 1186 Broadway, Dept. 556 NN, Hewlett, N. Y. 11557

FREE EXTRAS

• SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic Radio & Electronics Tester. While you are learning in this practical way, you will be able to do many a repair job for your friends and neighbors, and charge fees which will far exceed the price of the "Edu-Kit." Our Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va.: "Thought I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Trouble-shooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

UNCONDITIONAL MONEY-BACK GUARANTEE

Please rush my Progressive Radio "Edu-Kit" to me, as indicated below:
Check one box to indicate choice of model

- ☐ Regular model $26.95.
- ☐ Deluxe model $31.95 (same as regular model except with superior parts and tools plus valuable Radio & TV Tube Checker).

Check one box to indicate manner of payment

- ☐ I enclose full payment. Ship "Edu-Kit" post paid.
- ☐ I enclose $5 deposit. Ship "Edu-Kit" C.O.D. for balance plus postage.
- ☐ Send me FREE additional information describing "Edu-Kit."

Name ....

Address ....

City & State .... Zip ....

PROGRESSIVE "EDU-KITS" INC.
1186 Broadway, Dept. 556 NN, Hewlett, N. Y. 11557

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing instrument that can detect many Radio and TV troubles. This revolutionary new technique of radio construction is now becoming popular in commercial radio and TV sets.

A Printed Circuit is a special insulated chassis on which has been deposited a conducting material which takes the place of wiring. The various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.