LIGHT POWERS THIS LIQUID SEMICONDUCTOR—see p.31

OCTOBER-NOVEMBER 75¢

Science and Electronics

and

Radio-TV EXPERIMENTER

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S/E's UNIVERSAL DARKROOM TIMER

- controls enlarger on time
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- Sn/Fe Moving-Vane Ammeter
- Perpetual-Motion Freq Standard
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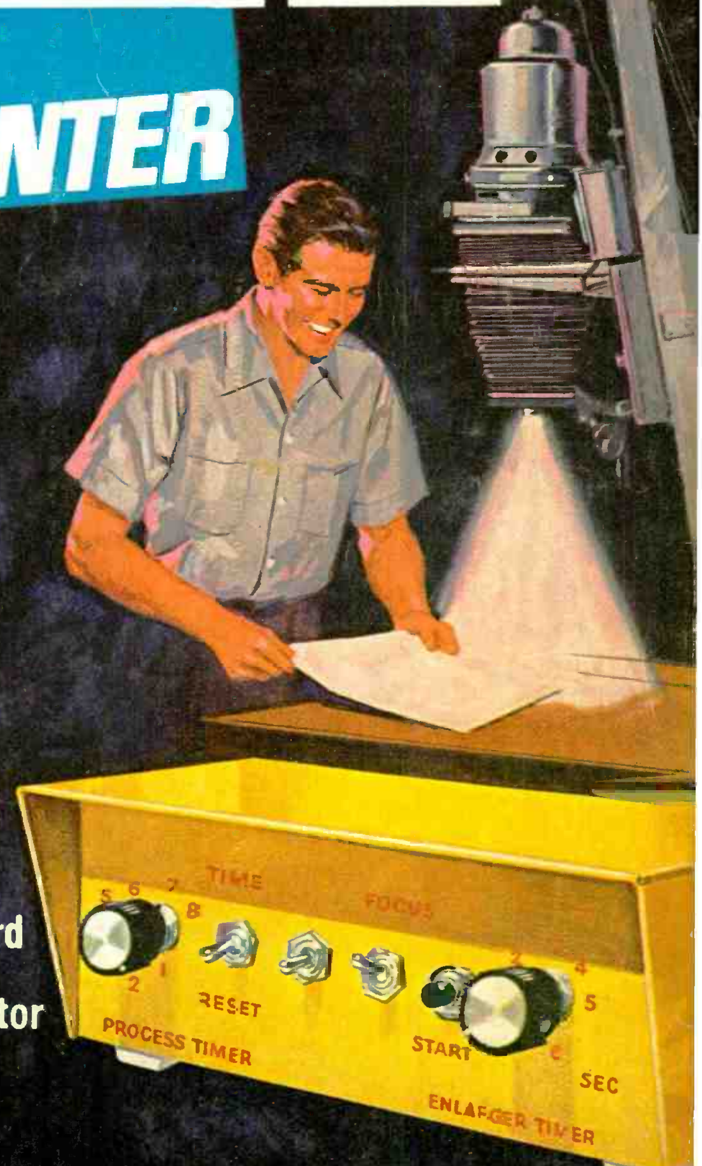

BEGINNING THIS ISSUE

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.

Translators

The electronics you need to create audio-stimulated light displays to your own imagination. Actuates Light Display Units, Strobe Lites, any lamp configuration (Xmas trees, patio lights, etc.) From $24.95 kit, $39.95 wired.

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.

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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.

150-Watt Silicon Solid-State Stereo Amplifier, including cabinet. For the audio perfectionist. Cortina 3150, $149.95 kit, $225 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-1000 TREASURE FINDER $9.95

Shape up your own car/boat with EICO Engine Analyzer

For all 6V/12V systems; 4, 6, 8-cyl. engines. Now you can keep your car or boat engine in tip-top shape with this solid-state, portable, self-powered universal engine analyzer. Completely tests your *total* ignition/electrical system. Complete with comprehensive Tune-up & Trouble-shooting Manual. EICO 888, $49.95 kit, $69.95 wired.

Be a technocrat with EICO® solid-state test equipment

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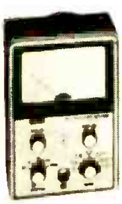
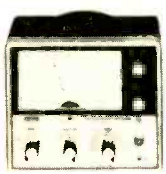
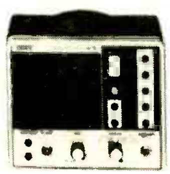


EICO 240 Solid-State FET-TVOM $49.95 kit, $69.95 wired

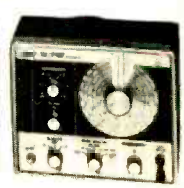
EICO 379 Solid-State Sine/Square Wave Generator $54.95 kit, $74.95 wired



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



EICO 330 Solid-State RF Signal Generator $59.95 kit, $79.95 wired

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October/November 1969

Science and Electronics

★ Cover Highlights

Cover illustration by Len Goldberg

Science and Electronics

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STAMP SHACK

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

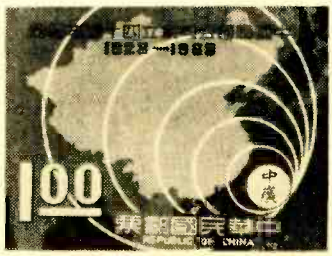
● By June, 1965, Telespazio was ready to make use of the first Early Bird facilities. Equipment which already is outmoded, was installed in a brand new, specifically designed center at Fucino, two miles from Avezzano, in Aquila Province, and once an important source of water in the days of Caesar and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

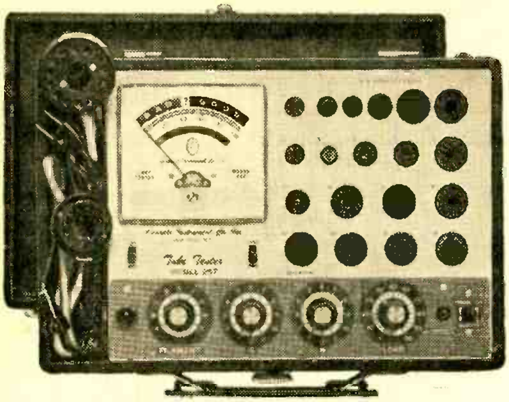
and the populace; it linked government agents in occupied areas, and conveyed China's voice to allied nations. After it moved to Taiwan in 1949, its facilities are being used to transmit programs to the mainland of China, to keep the Chinese there constantly aware of what is happening on Formosa.

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

(Continued on page 105)

The New 1969 Improved Model 257 ***A REVOLUTIONARY NEW***

TUBE TESTING OUTFIT



- **Tests all modern tubes including Novars, Nuvistors, Compactrons and Decals.**
- **All Picture Tubes, Black and White and Color**

ANNOUNCING... for the first time

A complete TV Tube Testing Outfit designed specifically to test all TV tubes, color as well as standard. Don't confuse the Model 257 picture tube accessory components with mass produced "picture tube adapters" designed to work in conjunction with all competitive tube testers. The basic Model 257 circuit was modified to work **compatibly** with our picture tube accessories and those components are not sold by us to be used with other competitive tube testers or even tube testers previously produced by us. They were custom designed and produced to work specifically in conjunction with the Model 257.

COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

STANDARD TUBES:

- ✔ Tests the new Novars, Nuvistors, 10 Pins, Magnovals, Compactrons and Decals.
- ✔ More than 2,500 tube listings.
- ✔ Tests each section of multi-section tubes individually for shorts, leakage and Cathode emission.
- ✔ Ultra sensitive circuit will indicate leakage up to 5 Megohms.
- ✔ Employs new improved 4½" dual scale meter with a unique sealed damping chamber to assure accurate, vibration-less readings.
- ✔ Complete set of tube straighteners mounted on front panel.

BLACK AND WHITE PICTURE TUBES:

- ✔ Single cable used for testing all Black and White Picture Tubes with deflection angles 50 to 114 degrees.
- ✔ The Model 257 tests all Black and White Picture Tubes for emission, inter-element shorts and leakage.

COLOR PICTURE TUBES:

- ✔ The Red, Green and Blue Color guns are tested individually for cathode emission quality, and each gun is tested separately for shorts or leakage between control grid, cathode and heater. Employment of a newly perfected dual socket cable enables accomplishments of all tests in the shortest possible time.

The Model 257 is housed in a handsome, sturdy, portable case. Comes complete with all adapters and accessories, ready to plug in and use. No "extras" to buy. Only **$47.50**

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Please rush me one Model 257. If satisfactory I agree to remit $47.50 plus postage and handling charge. (If you prefer you may use our Easy Payment Plan.) If not satisfactory, I may return for cancellation of account.

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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.

NEW
Kit ID-29
$29^{95}*

NEW Heathkit GD-48 Solid-State Metal Locator

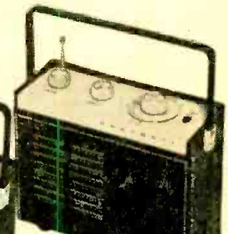
A low cost, versatile, professional metal detector at one-third the cost of comparable detectors. Packed with features for long life, rugged reliability, and dozens of uses. Completely portable, battery operated and weighs only 3 lbs. The GD-48 is highly sensitive, probes to 6 feet, and has an adjustable 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*

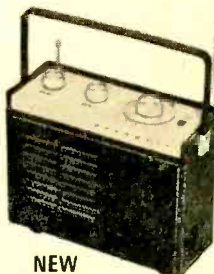
NEW
Kit GD-48
$59^{95}*

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.

NEW
Kit TD-17
$12^{95}*





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

$49^{95}*
each

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.

NEW
Kit GD-28
$59^{95}*

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Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, guitar amplifiers, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

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

Volume I
Soft cover
114 pages
$3.25

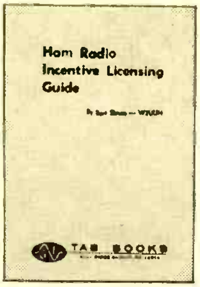
Volume II
Soft cover
104 pages
$3.25

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

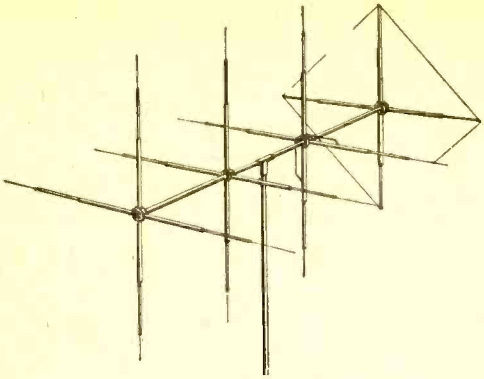
Beep-Beep! Beep-Beep!

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,

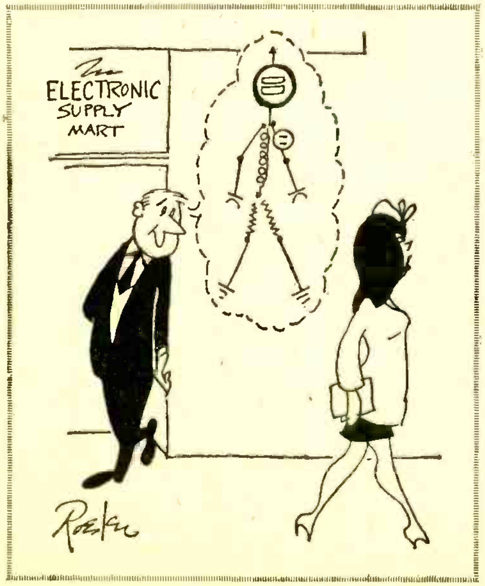


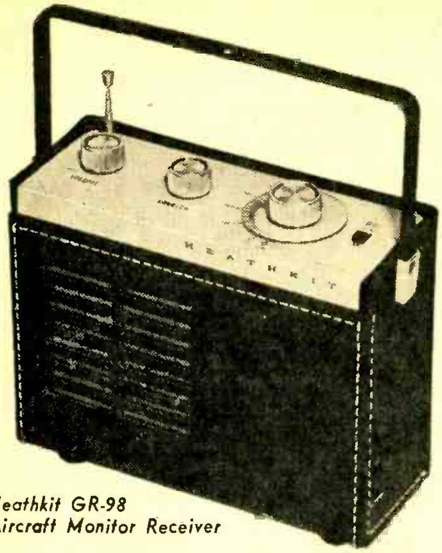
Avanti Moonraker CB Base Station Antenna

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-uV sensitivity for a 10 dB signal-to-noise ratio. Another feature is adjustable squelch control, and, for those



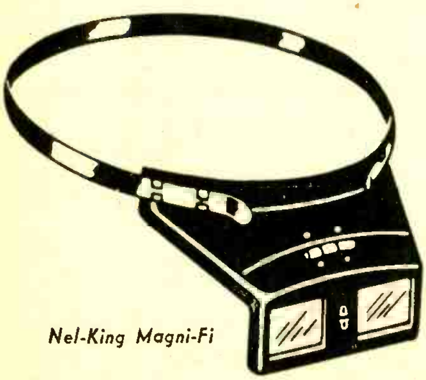


Heathkit GR-98
Aircraft Monitor Receiver

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

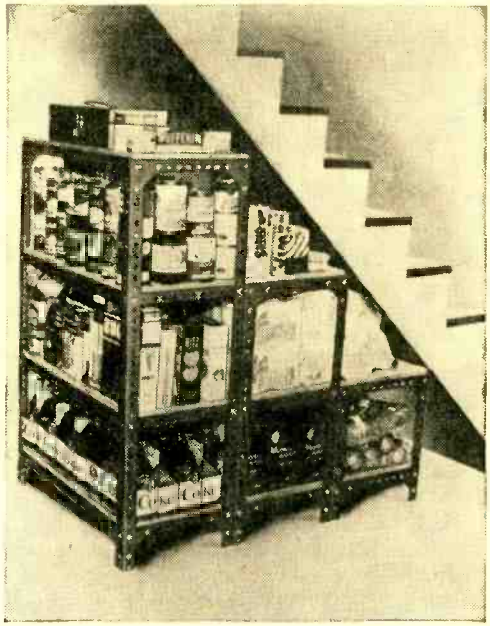


Nel-King Magni-Fi

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.

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

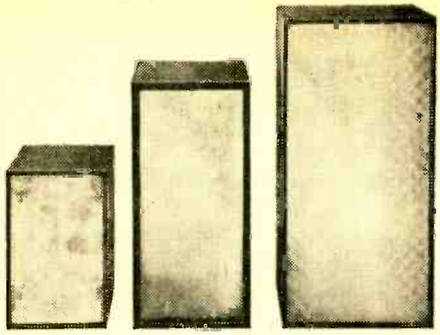


Dexion Slotted Steel Angle

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.

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)

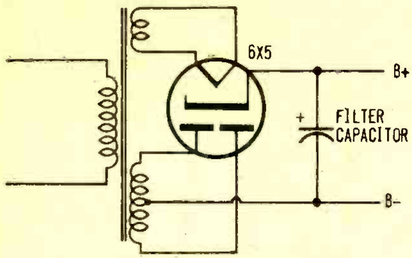
"Sorry, Higgins, you're being replaced but not exactly by a computer."

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?

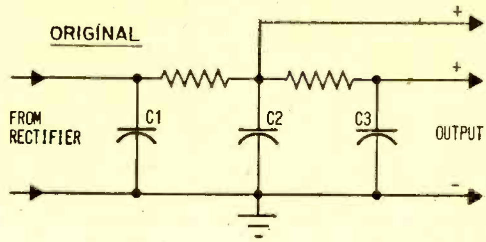
—C. R. B., Amityville, N. Y.

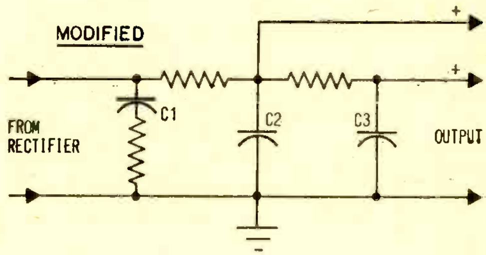
Why? There are several good wired units available on printed circuit boards and modules that are a heck of a lot cheaper than the parts needed to make one. Look through the catalogs of Lafayette Radio, Allied Radio, and Radio Shack for some good buys.

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.

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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

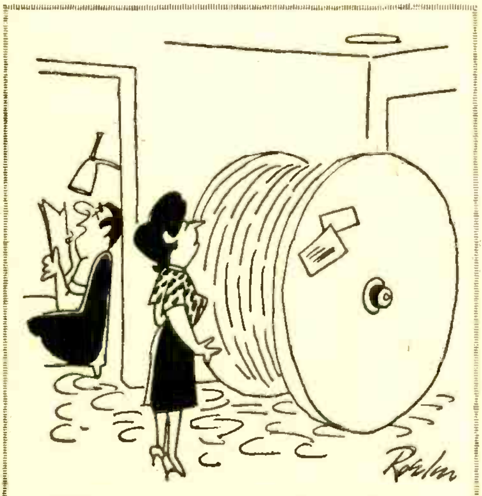
I am not old enough to have a CB license. But I have heard that it does not matter what your age is for ham license. Is this true?

—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?

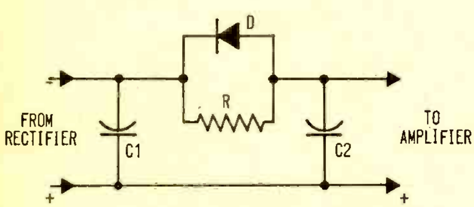
—*C. L., Fredericksburg, Va.*

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

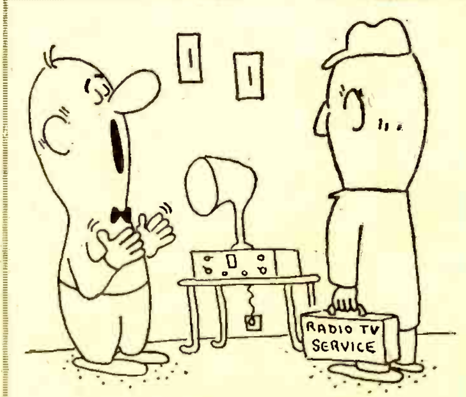
I read somewhere that it is possible to pep up a receiver by replacing the RF amplifier with a tube of higher gain. I decided to do this with my Lafayette HA-63. I replaced the 6BA6 with a 6GM6 (making all socket changes). Now my "S" meter no longer works, there's no increase in sensitivity, but there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

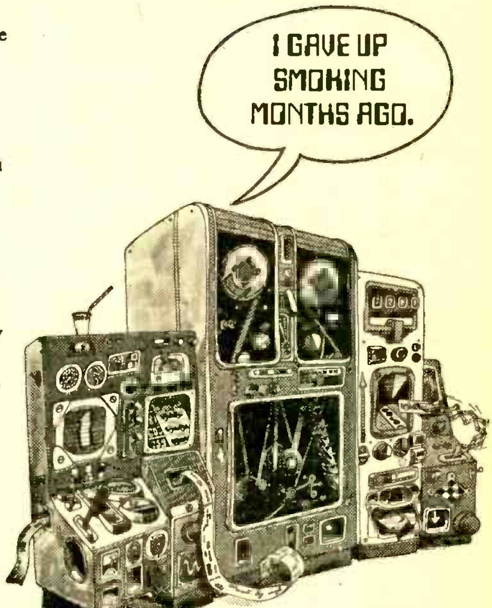
Max is National Car's computer. He knows from minute to minute which of our cars are available.

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.

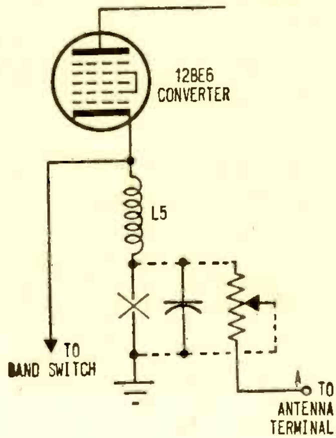


NATIONAL CAR RENTAL

We make the customer No. 1

In Canada and throughout the world it's TILDENinterNATIONAL *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.

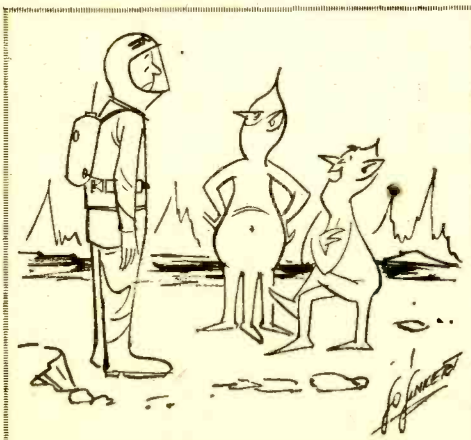
These signals will produce a beat if the first stage of your receiver is non-linear—which would be the case if it has no RF stage ahead of it. If it has one, the RF stage could be overloading or be biased improperly for linear operation.

Cheapy Q Checker

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

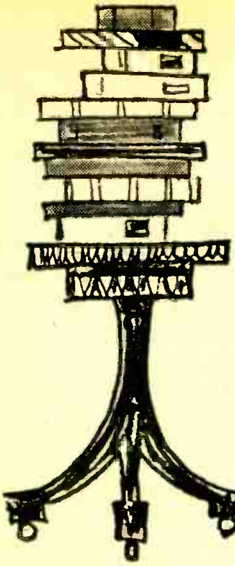
—*T. J., Duluth, Minn.*

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

LIBRARY...

★ Starred items indicate advertisers in this issue. Consult their ads for additional information and specifications.

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!

SCHOOLS AND EDUCATIONAL

★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.

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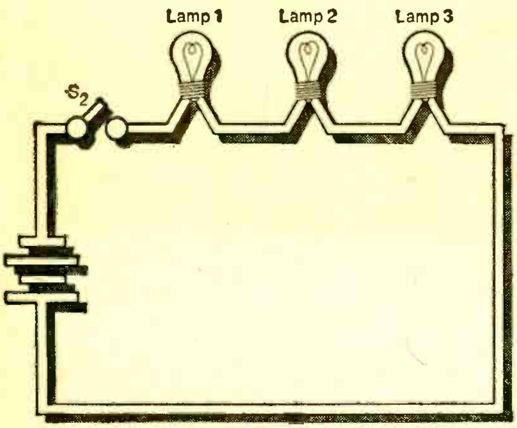
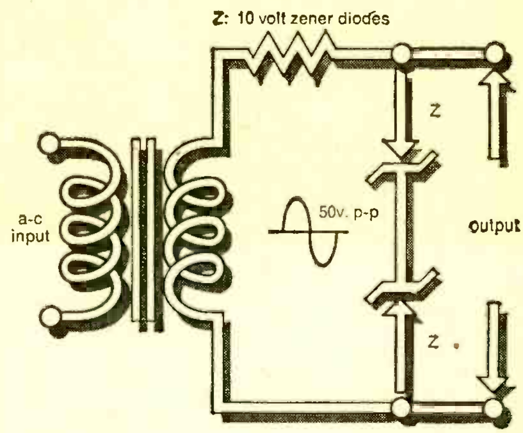
Can you solve these two basic problems in electronics?





This one is relatively simple:

When Switch S_2 is closed, which lamp bulbs light up?

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ANSWERS: Problem 1—they all light up
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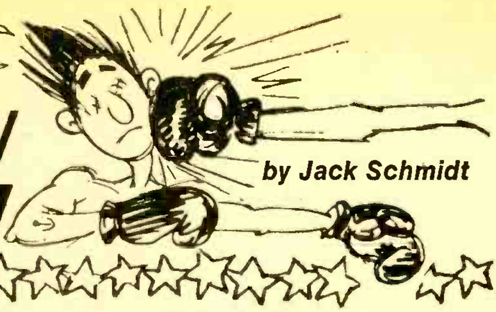
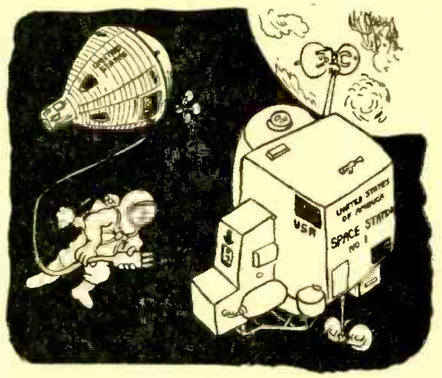
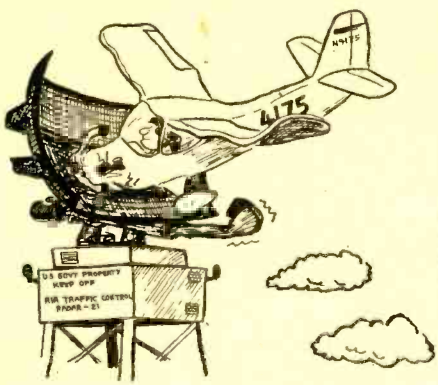
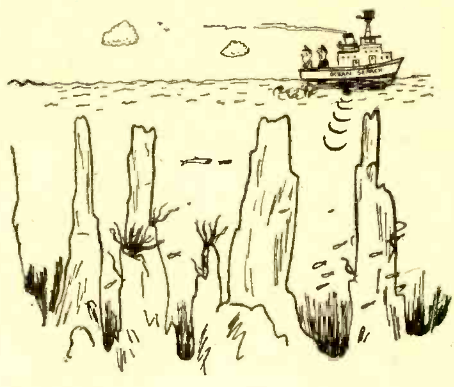


by Jack Schmidt

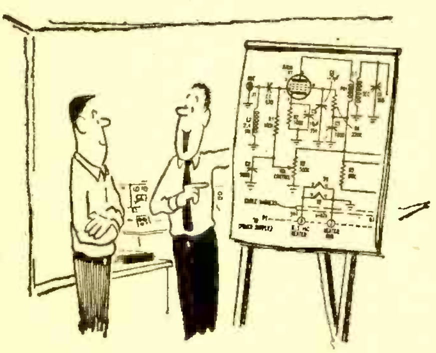




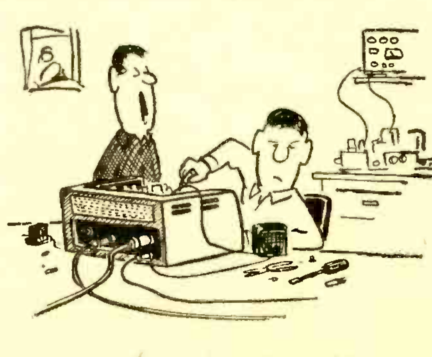
"Roger, 4175, it is confirmed . . .
. . . we have you in radar contact!"



"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!"

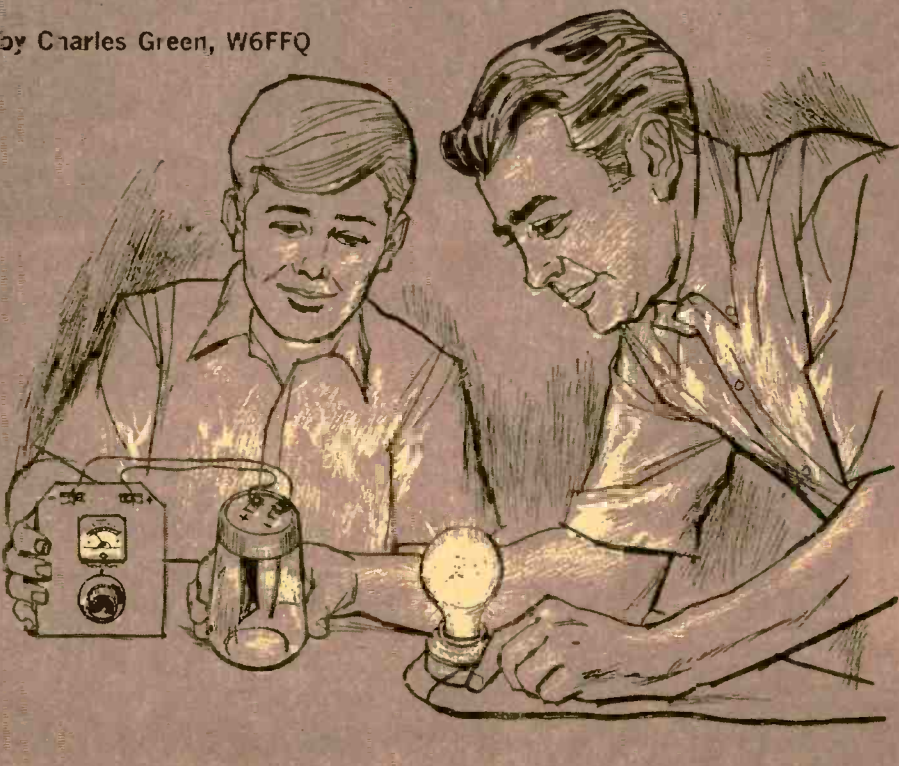
Science and Electronics
OCTOBER-NOVEMBER 1969

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



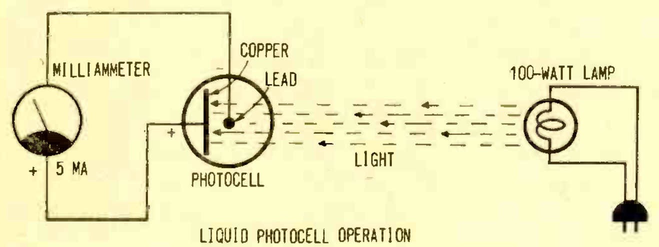
Liquid Semiconductor

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.

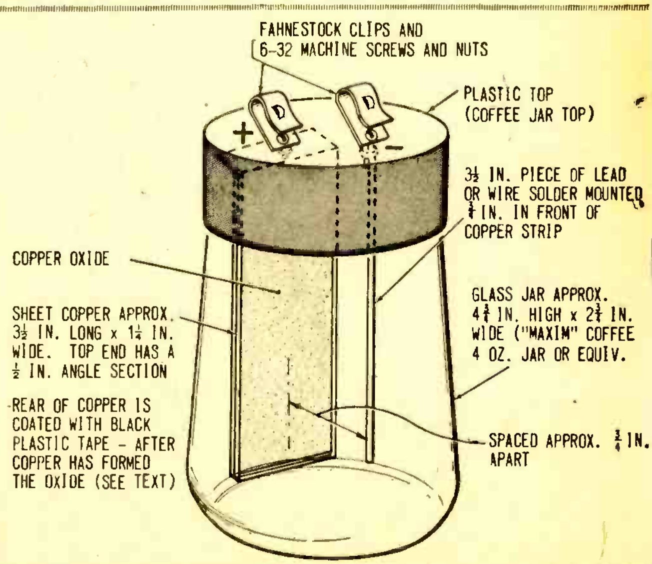
How It Works. When radiant energy, in the form of visible light, strikes a suitably prepared metallic substance, electrons are emitted. In the absence of light, the copper and lead electrodes of this photocell have a small potential difference, as does an electrochemical battery with no load applied. 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



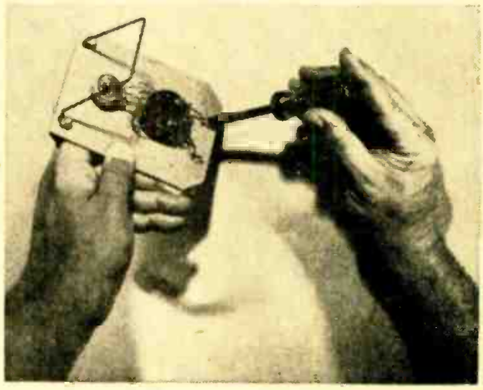
Details of cell's construction appear in drawing (right) and photo (above). We used plastic cap supplied with Maxim coffee jar to insulate electrodes. Be sure to cover rear of copper electrode with plastic tape after oxide forms.

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.

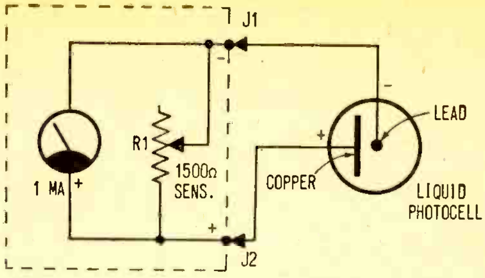
Cover the rear of the copper strip with black plastic tape so that light will strike only the surface facing the lead electrode and the light source.

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

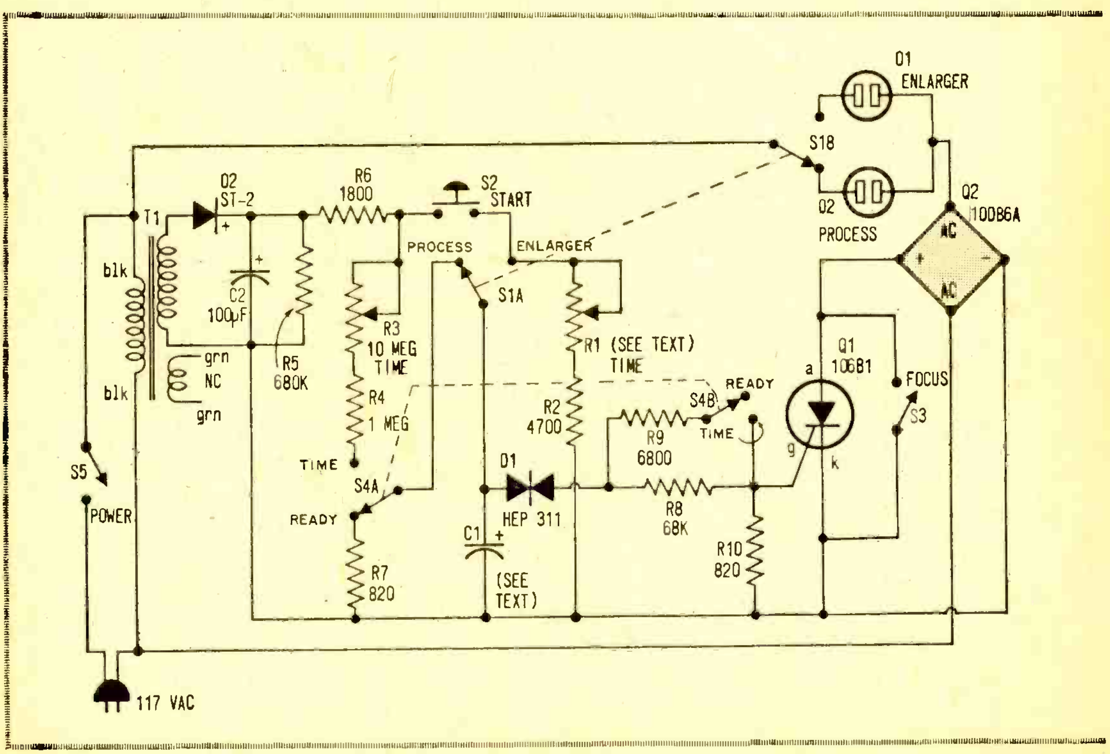
A—For enlarger timing of 0-7 seconds and process timing of 0-7 minutes
R1—50,000-ohm potentiometer
R3—10-megohm potentiometer
C1—200-uF, 350-V electrolytic capacitor

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

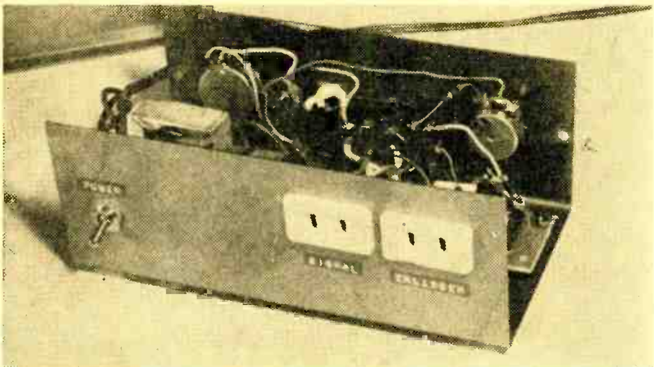


on (and the bridge conducts) whenever a current of more than 200 microamps (1/5 of a milliamp) is fed into the *gate* terminal.

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.

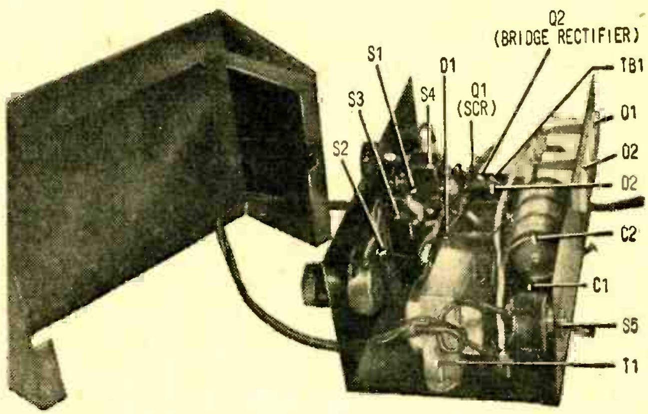
Universal Darkroom Timer

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.

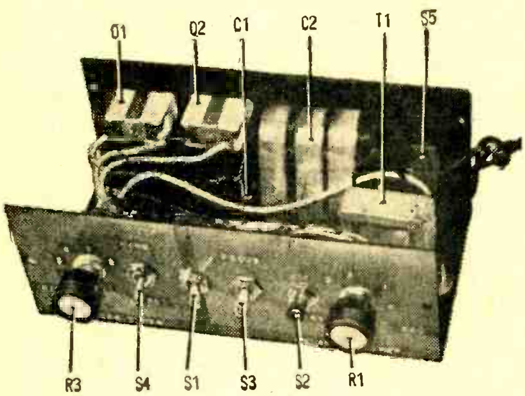
Pushing S2 a second time recharges C1 and recycles the timing circuit. Toggle switch S3 has been added as a bypass switch to enable focusing the enlarger without having to disconnect it from the timer and plug it into wall outlet. When S3 is placed in FOCUS position, the enlarger lamp is turned *on*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

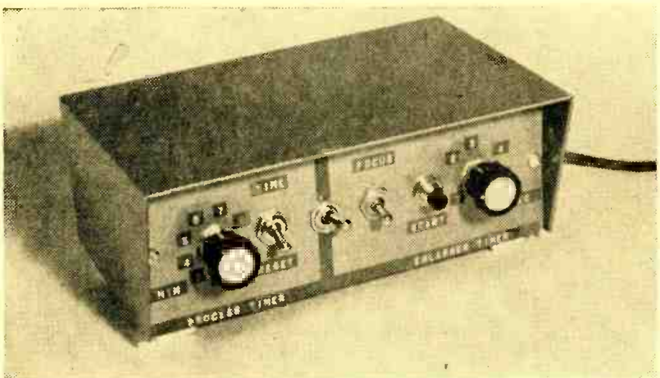
With S1 in the PROCESS position, outlet "O2" is activated through the timer. However, after about 5 seconds, C1's voltage falls below the critical diode breakdown potential, current flow stops, the SCR is turned *off*, and the signaling device stops sounding. The capacitor then again begins building 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.

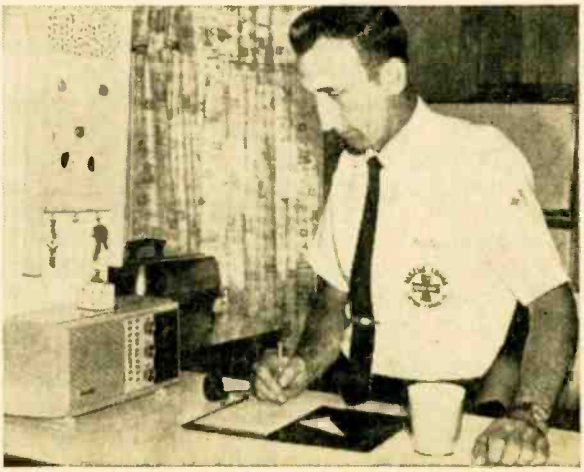
Our Universal Timer has an advantage over commercial units. Should you change your photo processing procedures, which may require a change in timing, this can be easily done by exchanging a few parts. ■

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

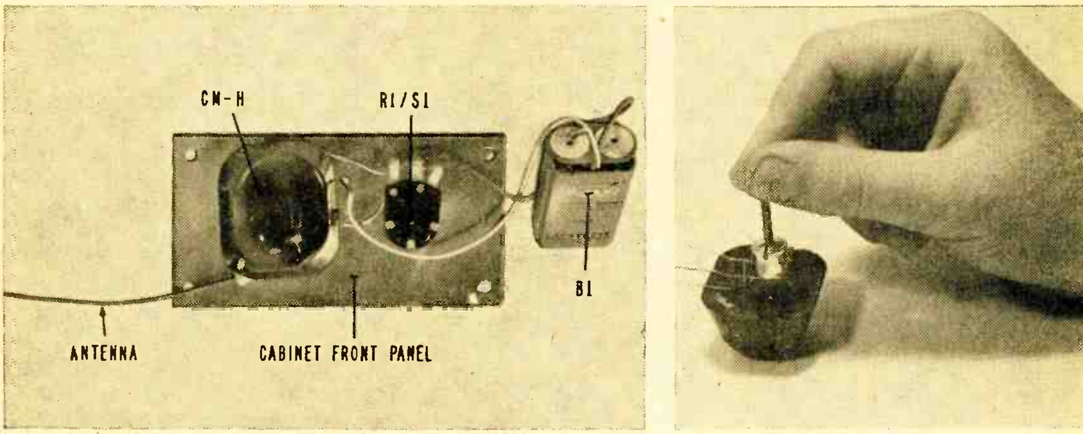
If you don't live so far away from a police or fire transmitter that a strong wind is needed to blow the signal out to you, you can throw together a six-buck vhf converter for listening to these calls in less time than it takes a soldering iron to heat up. By the time the iron is hot you'll have all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

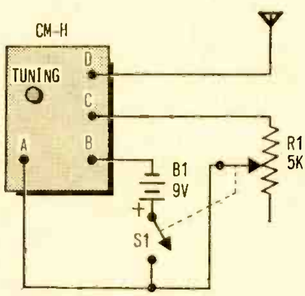
Works With FM. Unlike the more commonly used converters that are operated in conjunction with an AM radio as the basic module's internal oscillator to 52 MHz, the 52 MHz oscillator signal will beat with the 152 MHz received signal and will produce new signals equal to the sum and difference of the oscillator 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 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.



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.

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.

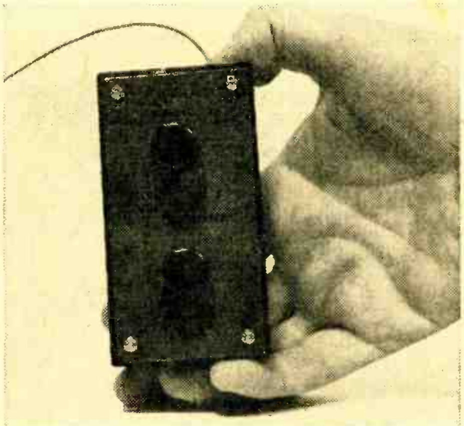
PARTS LIST FOR PENNY PINCHER'S POLICE CONVERTER

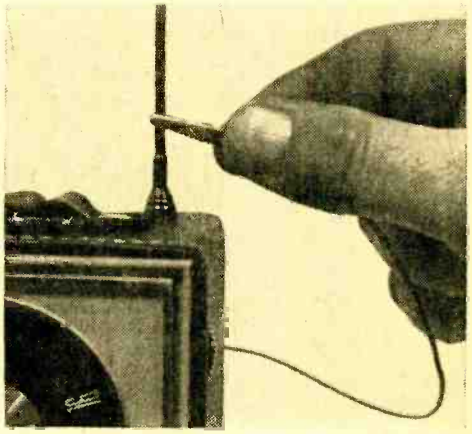
B1—9-V battery (Lafayette 99T6021 or equiv.)
1—CM-H Cordover vhf police and fire converter module (Lafayette 19T5528 or equiv.)
R1—5000-ohm potentiometer with spst switch (S1) (Lafayette 32T7363 or equiv.)
Misc.—Plastic box (Lafayette 99T8078 or equiv.), hardware, hook-up wire, battery terminal (Lafayette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





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.

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.

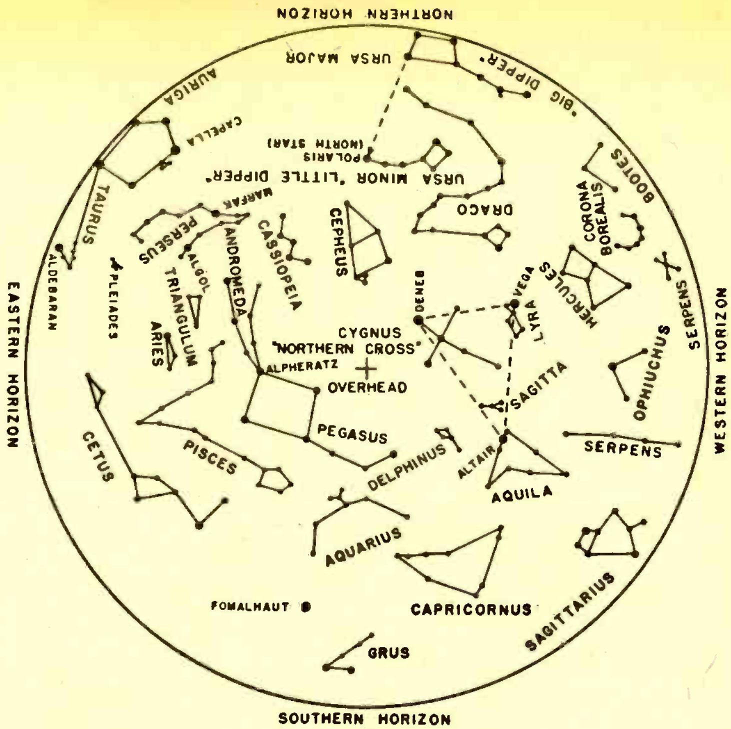
Drill a ⅛-in. hole through the top of the plastic case for the connecting lead from the module to the FM radio (24-in. length of stranded insulated wire). Pass the wire through this hole and then secure the front panel with the screws supplied. Finally, attach a small alligator clip to the radio-connecting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

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.

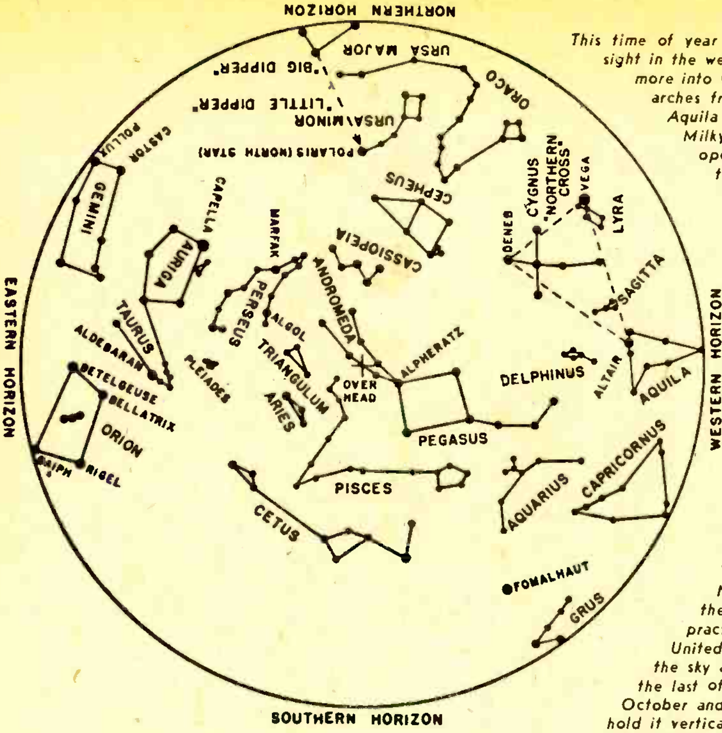
★ The galaxies are interestingly detailed objects as photographed through large telescopes, but disappointing as seen with the eye through the same instruments, because the eye takes only snapshots, while the photograph can be exposed as long as we wish, to build up the strength of the image and reveal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

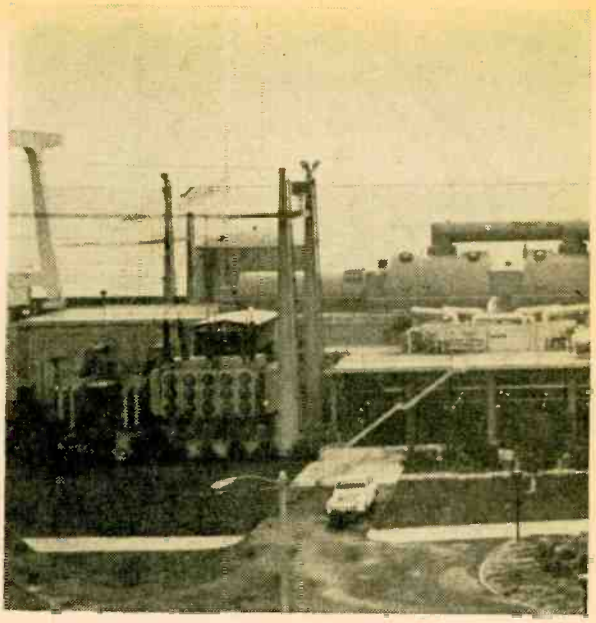
★ The great radio telescopes have been telling us that something in or near the Crab Nebula is sending us radio "beeps" at intervals of one-thirtieth of a second.

(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

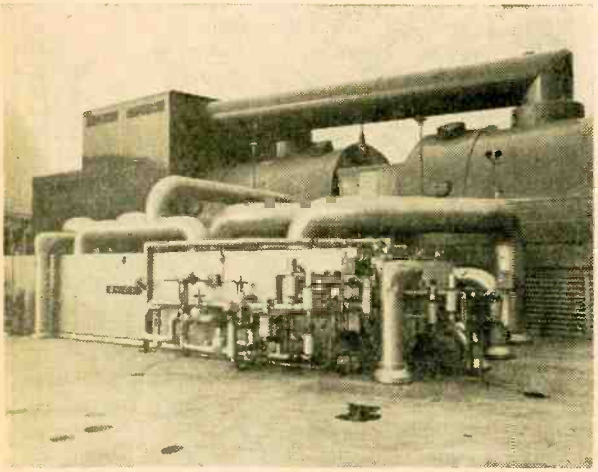


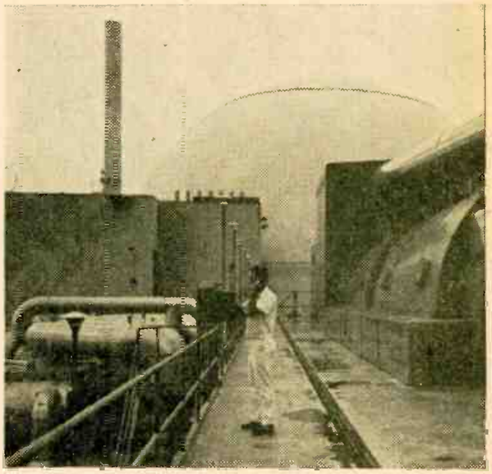
One of San Onofre's five watch engineers, Pat Riley is empowered with making go/no-go decisions in event of trouble. His job: to make sure that everything remains AOK.

SAN ONOFRE'S

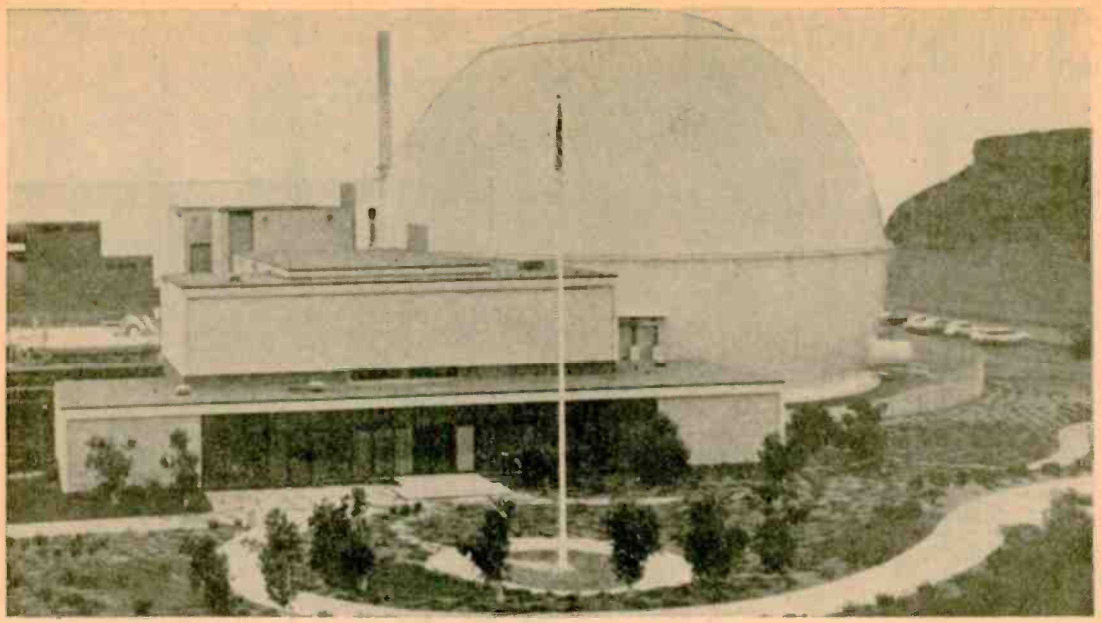
☐ Set beside the Pacific Ocean in a man-made cavity 90 ft. below the cliffs, the San Onofre nuclear-powered generating station is located roughly 60 miles south of Los Angeles. In operation since January of last year, the station is capable of generating 450 megawatts of electrical power, 80% of which 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.

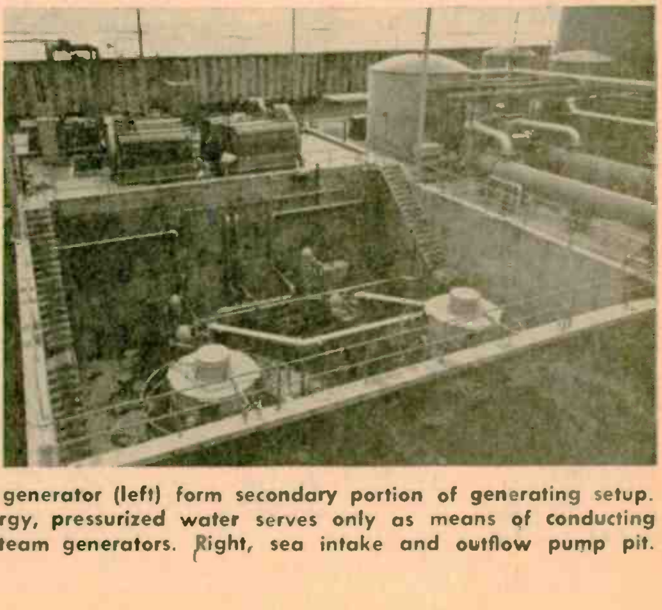


FABULOUS 450

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

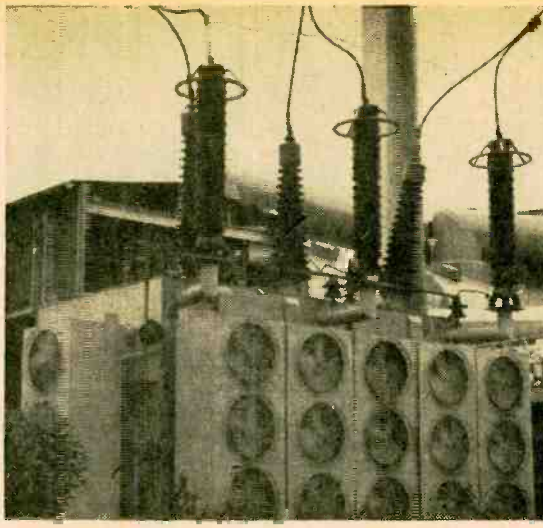


Steam generators and turbine generator (left) form secondary portion of generating setup. Though heated by nuclear energy, pressurized water serves only as means of conducting energy between reactor and steam generators. Right, sea intake and outflow pump pit.

SAN ONOFRE'S FABULOUS 450

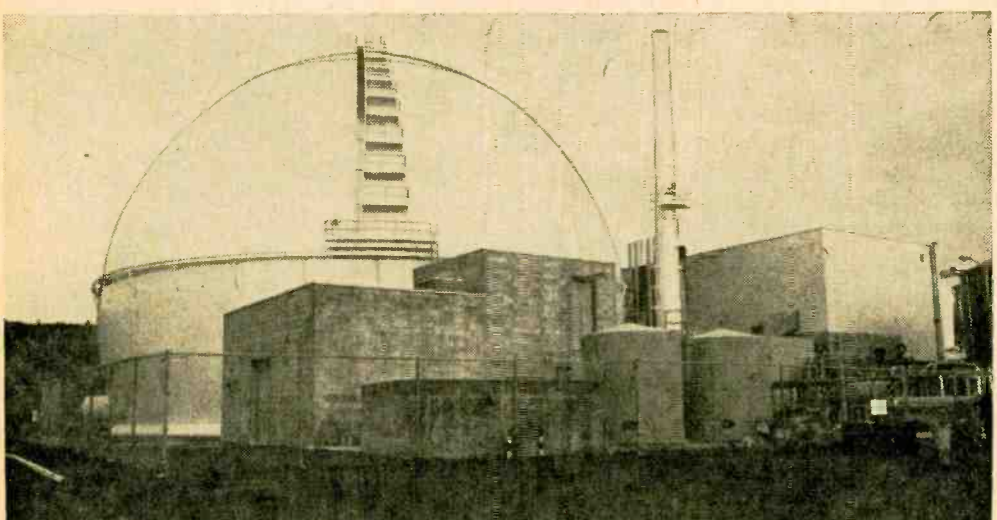
system operating temperature of 575 F —hence the term, pressurized water reactor.

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. ■

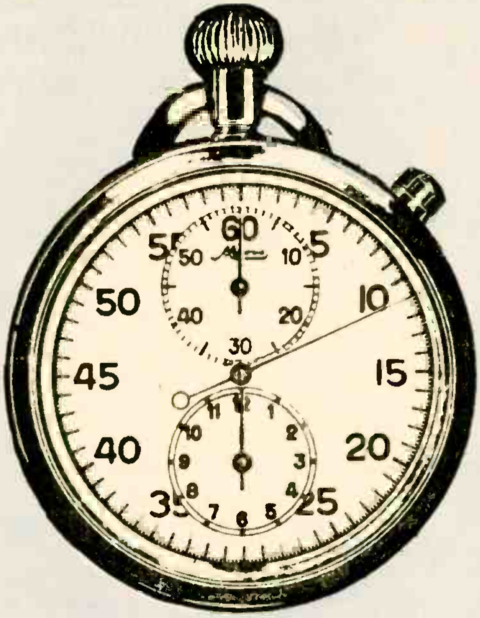


Above, output transformer at San Onofre; below, master control room. Indicator panels continuously flash status of instruments and equipment to engineer in charge; levers control position of rods in core.

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.

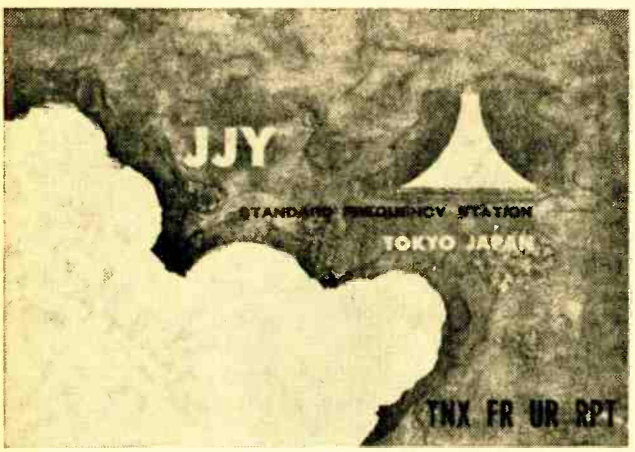
Little-Known DX. There are several reasons why many SWLs don't realize the DX potential of these services. Some share the standard frequencies with WWV and WWVH, which usually dominate the channels. Others have mini-skeds, transmitting just a few minutes each week. Then, too, some use off-beat wavelengths,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

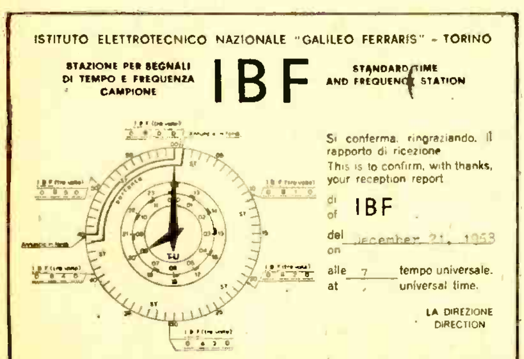
Some identify only in International Morse Code, causing problems for SWLs who can't read CW. Way to get around this is to tape the signals, then play them back at half-speed to decipher the individual di-dah combinations.

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)

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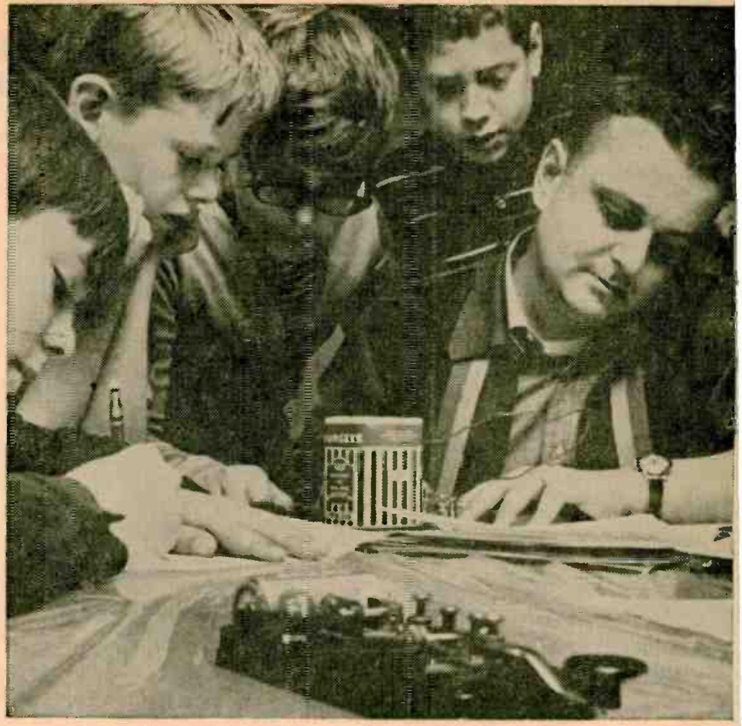
Code practice occupies sizable portion of Saturday morning sessions. Informal gatherings normally begin with Joe tapping telegrapher's key while boys jot down letters they hear. To earn FCC Novice license, boys must pass test showing they can send and receive code at 5 wpm.



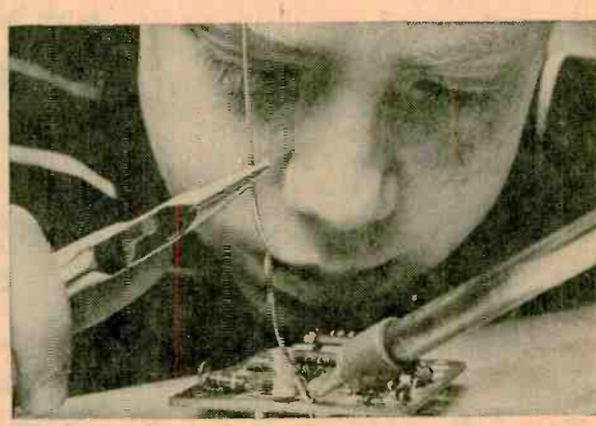
Saturday Morning

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

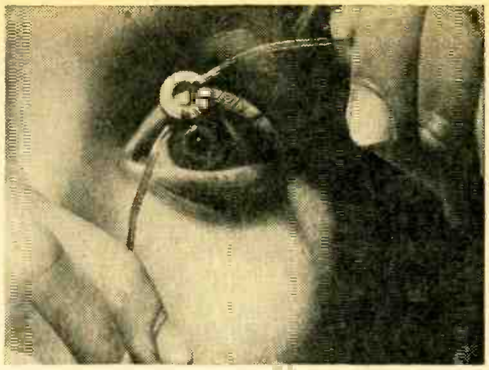
he has some provocative theories about education as well as a mutual love for his hobby and "his boys."

"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*



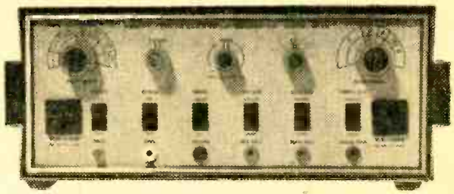
Two toroids are required for receivers boys are building, and they wind them themselves. Below, boy samples signals from Joe's rig.

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).

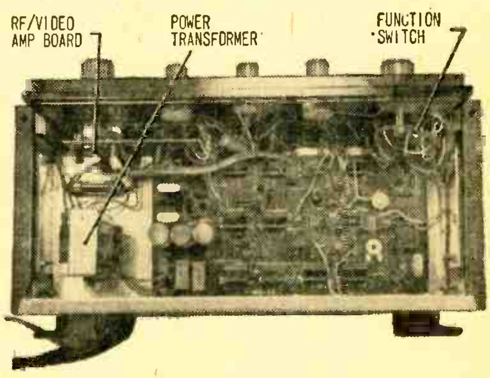
Even the RF oscillator is made trouble-free through use of a printed "tank coil." Rather than rely on the usual type of wire coil, which can be damaged, the IG-28's oscillator coil is part of the printed foil on the RF printed circuit board. And though it appears to be a "wavy foil," it's actually a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

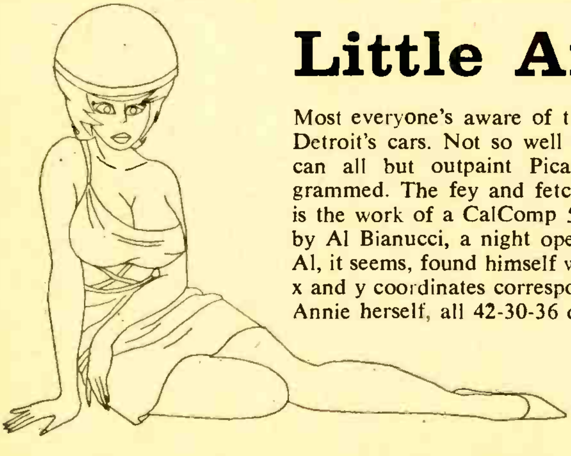
A 4.5-MHz sound carrier is also just what it says—a sound carrier for adjustment of sound traps. It also aids in correct frequency adjustment of the color bar generator. The sound carrier beats with the color carrier in the TV set to produce a herringbone pattern in the color bars. When the receiver 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.

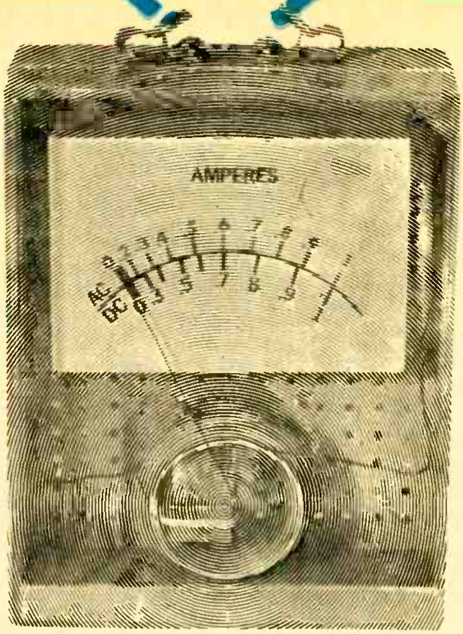
A notable feature of the IG-28, by the way, is the assembly/instruction manual, with perhaps the best written, illustrated, and thorough color adjustment procedure we have seen to date.

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

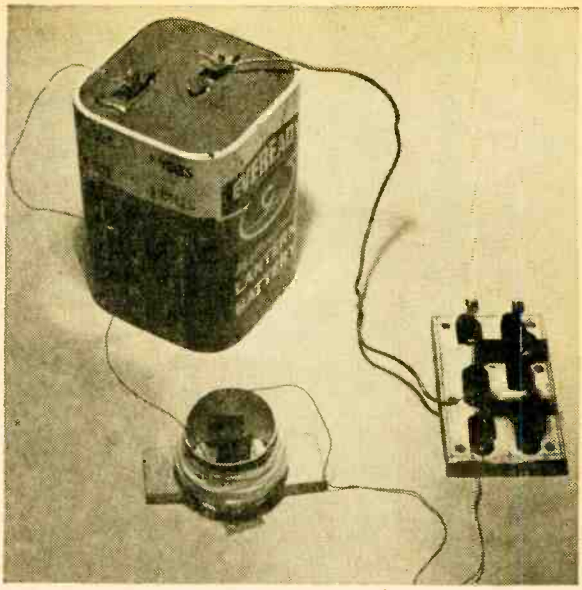


Fig. 1. Vane repulsion experiments demonstrate basic operation of moving-vane ammeter. Circuit works with 6-V battery or filament transformer.

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.

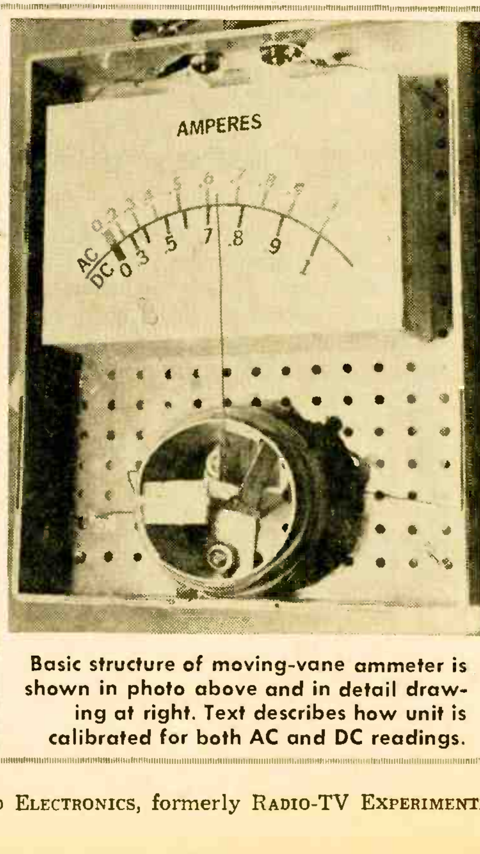
Repeat the experiment, but hold one of the vanes with a wood pencil (or other nonmagnetic item) so that it does not move. Observe that the free vane is still repelled by the fixed vane. It is this action, with one fixed, and one moving vane, that is used in iron vane meters.

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.

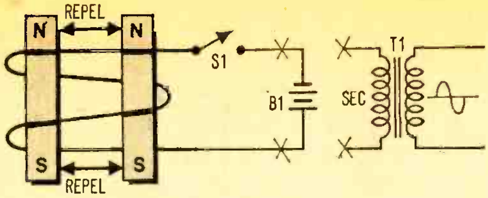


Fig. 2. Because of nature of hookup, iron vanes will always repel one another regardless of battery polarity. If desired, 6.3-V filament transformer (T1) can replace B1.

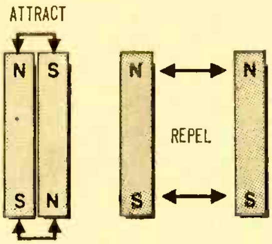


Fig. 3. Vanes can attract one another only when polarities differ. Here, polarities are always same, so vanes repel.

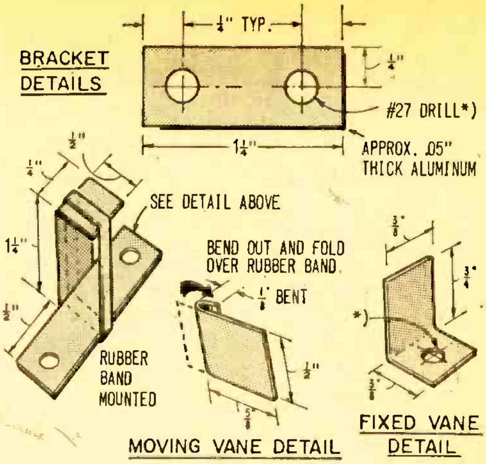
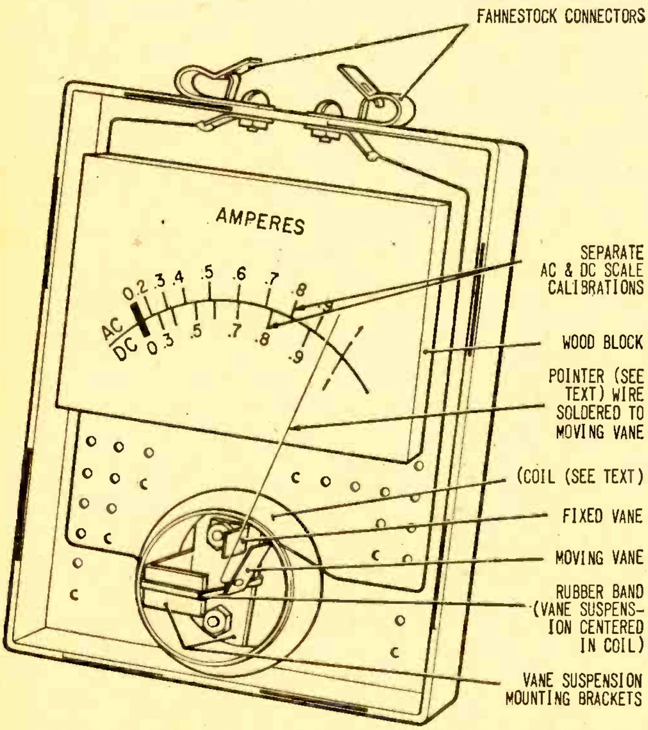


Fig. 4. Details of bracket, moving vane, and fixed vane. Bracket is made of 0.05-in. aluminum strip, vanes from tin can.

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, 1¼-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, 4⅝ x 3⅝ x 1½-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.

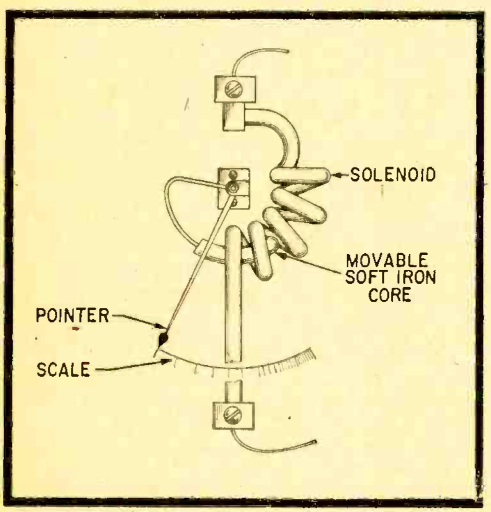
MOVING VANE AMMETER

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.

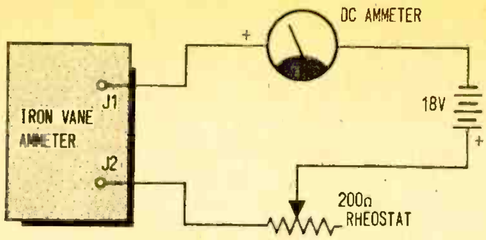


Fig. 6. Hookup for calibrating moving-vane ammeter for DC. See text for details.

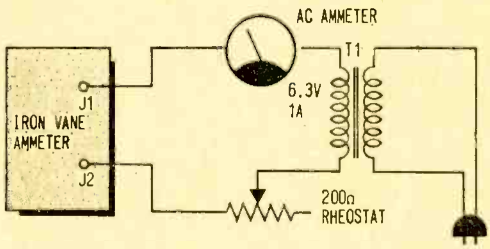


Fig. 7. Filament transformer and AC ammeter are required for easy AC calibration.

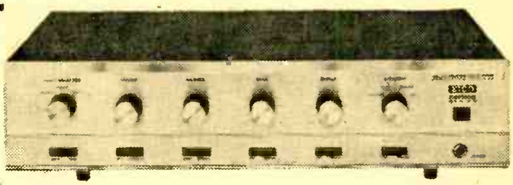
Adjust the rheostat to maximum resistance and connect it in series with the calibrated DC ammeter, 18-volt battery and the iron vane meter as shown in the circuit of Fig. 6. Adjust the rheostat and calibrate the iron vane meter according to the DC ammeter readings. Note that the iron vane meter will 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. ■

Science and Electronics LAB CHECK

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.)

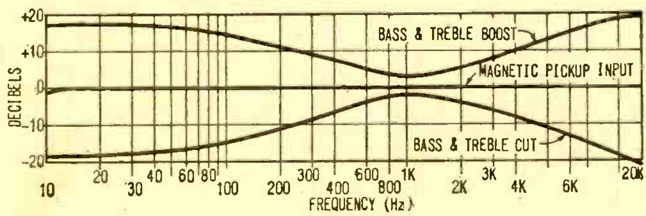
In addition to packing more punch, the 3150 *Cortina* also utilizes the latest in high-power solid-state technology for rock-bottom distortion. The new *Cortina* offers four inputs: a selector switch handles magnetic phono, tuner, and auxiliary; a tape-monitor switch provides the tape-recorder input.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

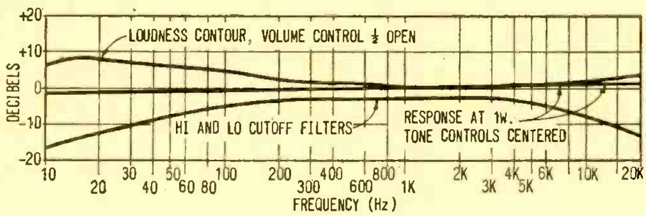
Panel switches provide for loudness contour, mono/stereo, lo-cut, hi-cut, and power; the rear apron contains both switched and non-switched AC outlets.

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.



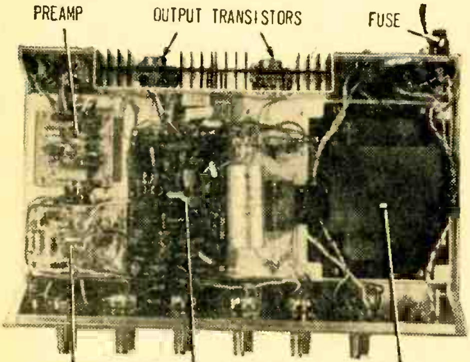
Response at 1-watt output with tone controls centered was also pretty much ruler flat. High filter was effective, though low filter proved somewhat broad.

LAB CHECK

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

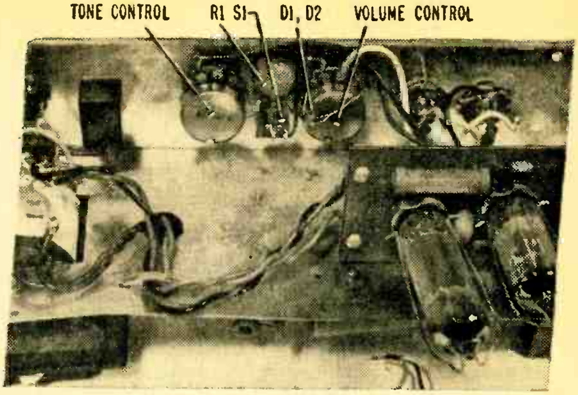
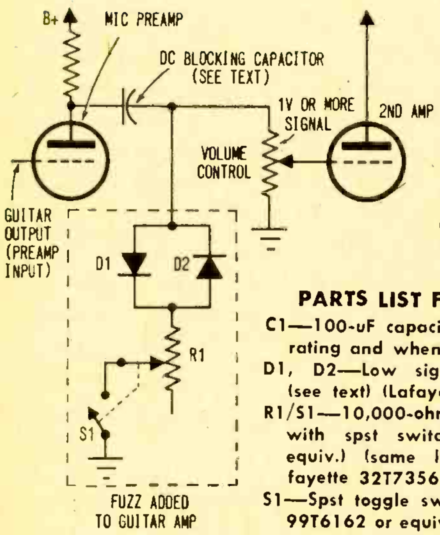


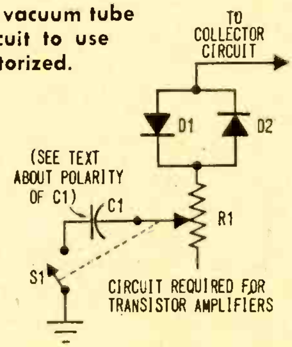
Fig. 1. Parts for fuzz circuit mounted on amplifier panel surrounding existing controls.

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)

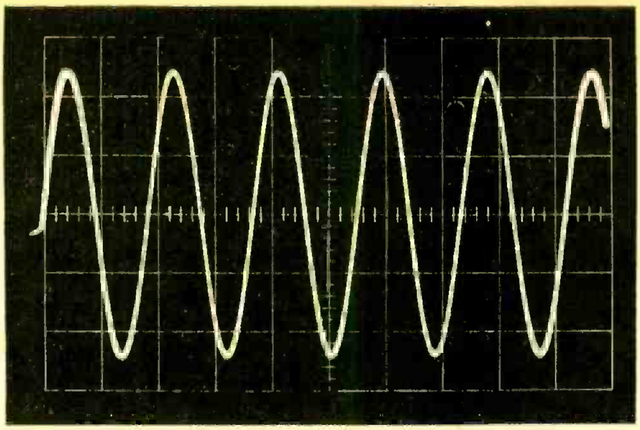


Fig. 2. Undistorted sine wave output of guitar amplifier simulating guitar sound with no fuzz added.

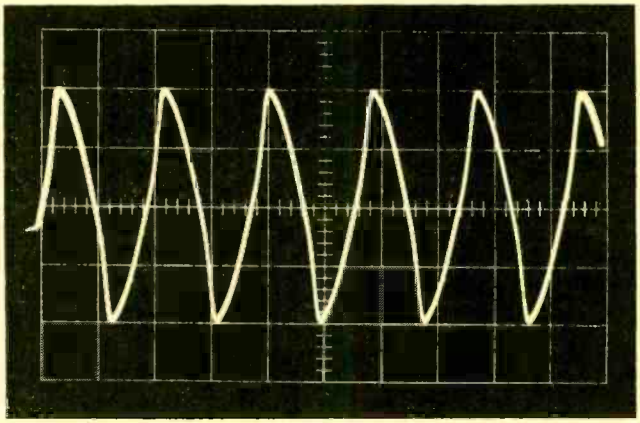


Fig. 3. Output of guitar amplifier with fuzz in, R1 at nearly full resistance. Note waveform slightly distorted.

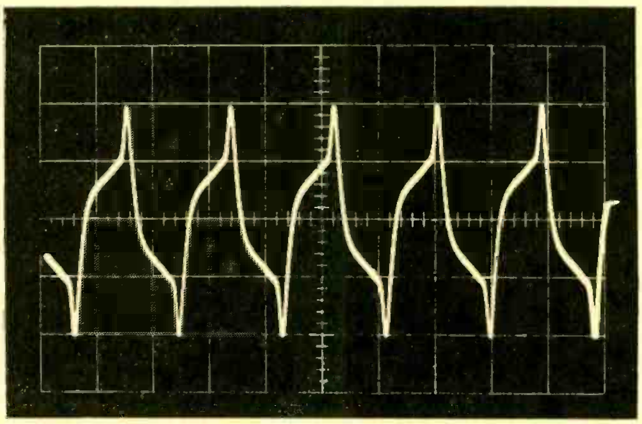


Fig. 4. Output of guitar amplifier with maximum fuzz, R1 set to 0 resistance. Note high degree of distortion.

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.

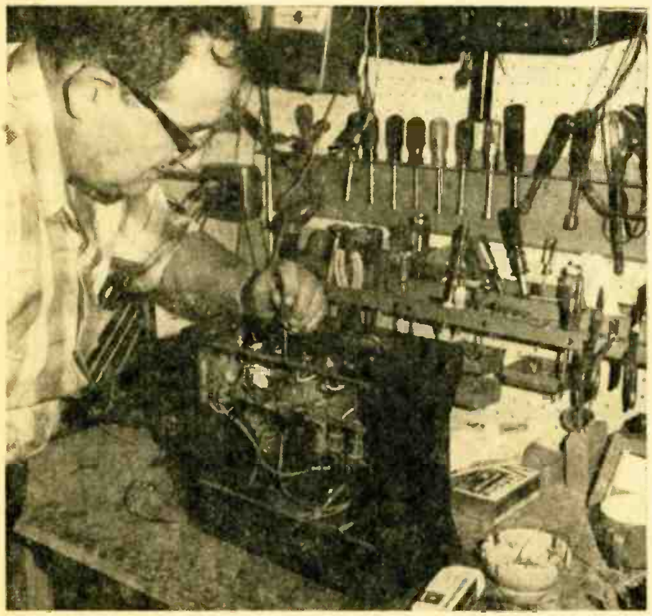
Where to Connect. The fuzz circuit must be connected into the amplifier at some point where the signal level exceeds 1 V. This is normally after the microphone preamplifier, across the volume control. (If tone controls are also connected across the volume control they are ignored.) If the volume control 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

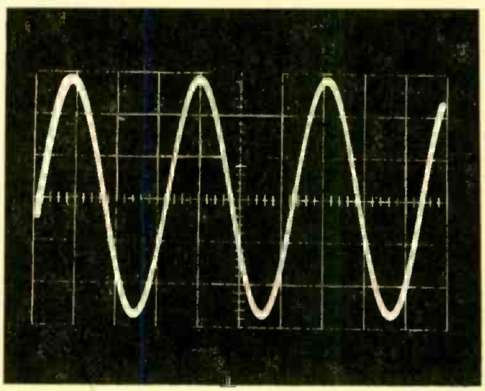


Fig. 1. Pure, 600-Hz sine-waveform.

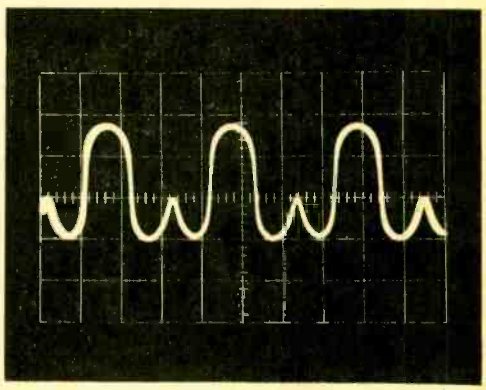


Fig. 2. With No. 1 fuzz slightly open.

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!

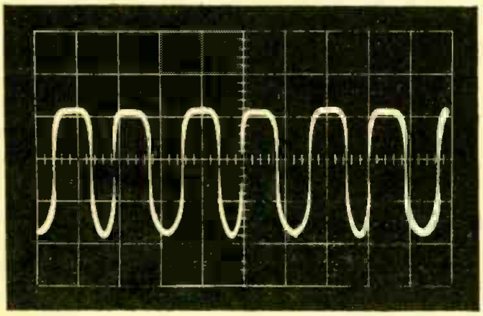


Fig. 3. With No. 1 fuzz more open.

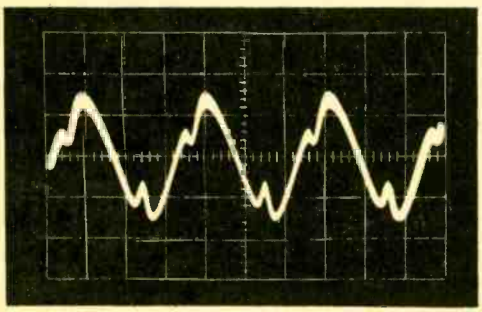


Fig. 4. With No. 1 fuzz fully open.

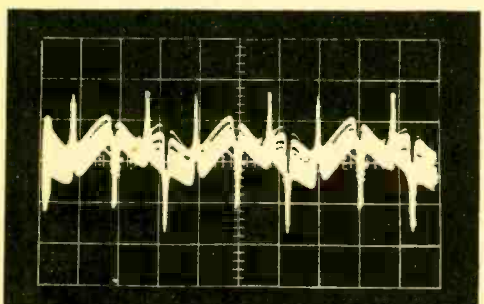


Fig. 5. With No. 2 fuzz slightly open.

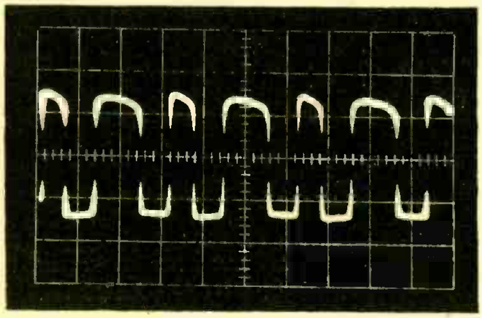


Fig. 6. With No. 2 fuzz more open.

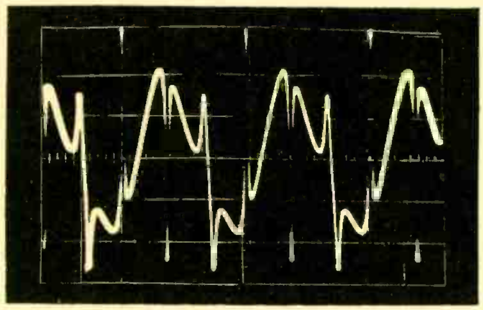


Fig. 7. With No. 2 fuzz fully open.

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.

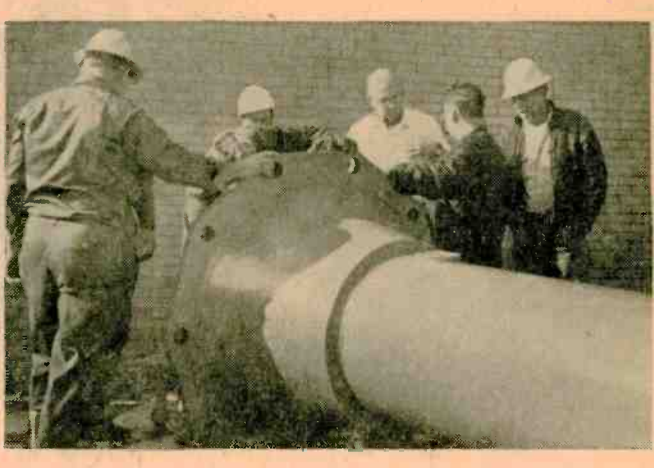
Interestingly enough, the Union Metal Manufacturing Company in Canton, Ohio has fabricated a series of monotube self-supporting antenna poles from 25 feet through 200 feet since 1941. But the 225-ft antenna pole in our photos is the first to be manufactured in this series and the first one erected in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

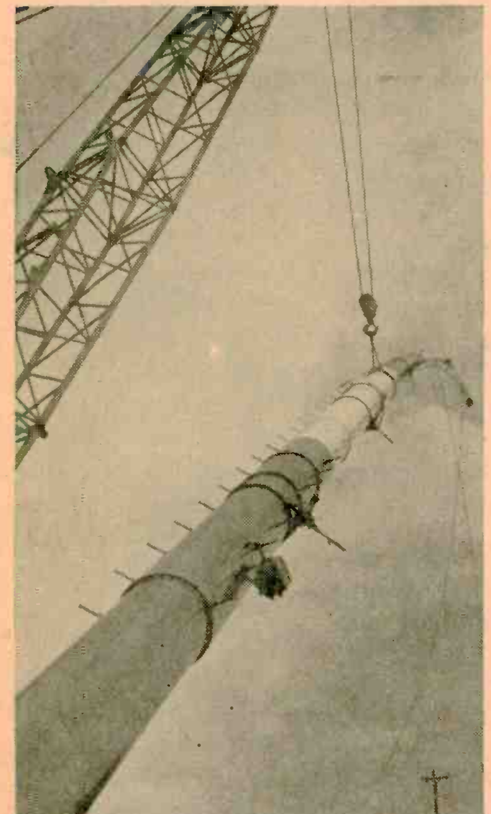
L.V. Hard, manager of the Cooperative, said this pole was ordered to complete his excellent communications hookup. His system consists of a Motorola base station and six Motorola mobile units, broadcasting on 158.78 MHz and covering three counties with a range of 35 miles.

Prior to its erection, the antenna

TALLEST TOWER

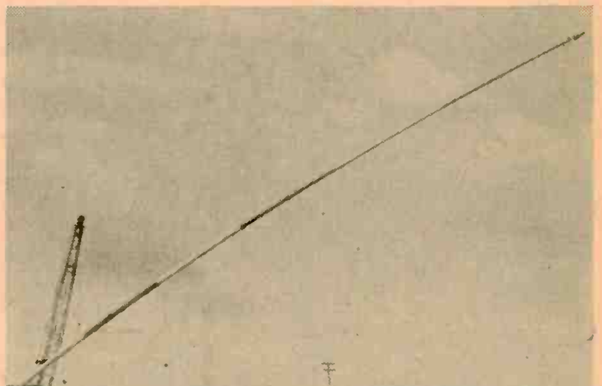
Below, left, ten 80-in. anchor rods made up pole's anchorage. Below, right, Alois Luhr (no hat) checks pole's 16-ft-deep foundation.





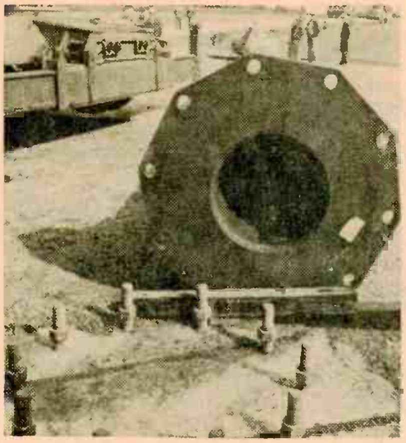
pole was assembled and painted, and the aircraft warning lights installed and wired. The three lower sections had the wire rope slings in place with the come-a-longs (coffin hoists) in tension. Before raising the pole into position, a tag line was fastened at the top of the pole and another one about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

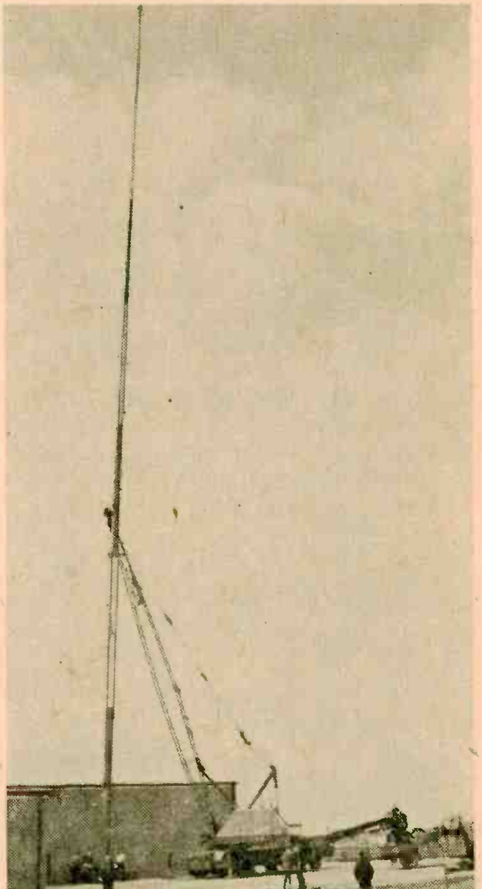
Wire rope slings with come-alongs and heavy copper wire around joints were in place at start. At first lift, entire antenna pole was carefully checked. Crew of Monroe Coop took special care to guard aircraft warning beacon at top of pole.



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.

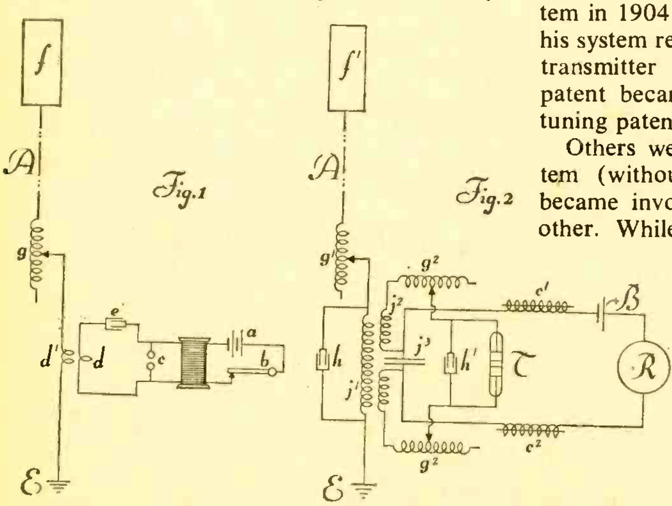
The pessimistic predictions of the turn-of-the-century scientists were based on the *line-of-sight theory*. According to that theory, radio waves, which travel in a straight line, would *not* follow the curve of the earth, but would go off into space. Despite the gloomy forecasts of failure, Marconi 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)

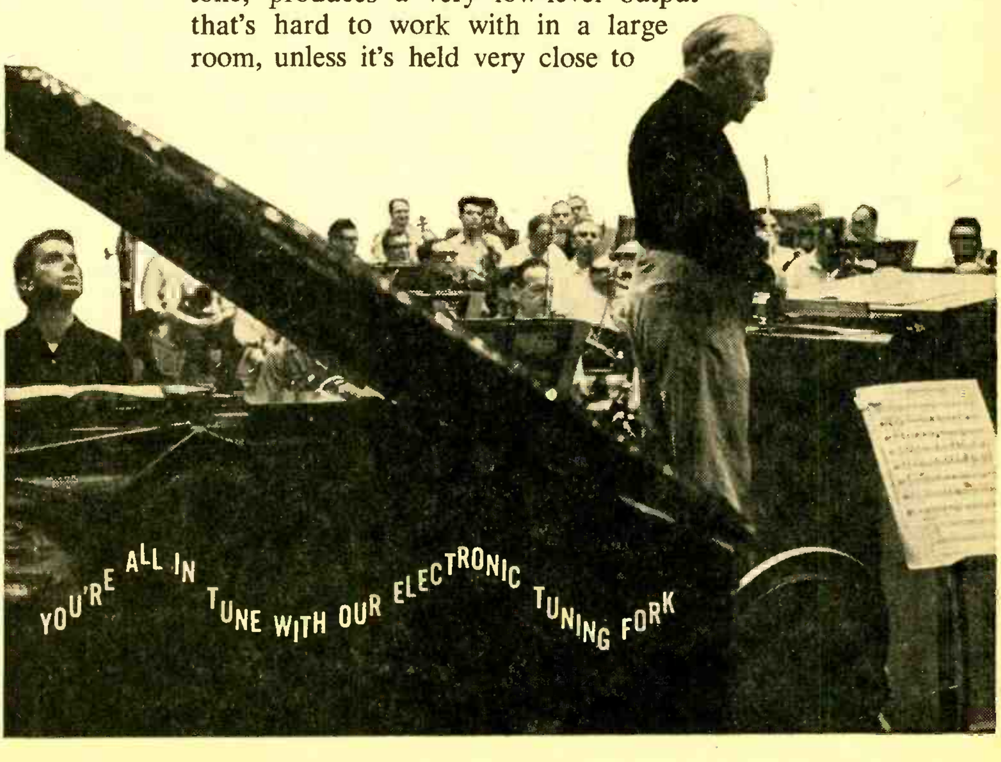


Marconi's four-circuit tuning patent filed on June 28, 1904 illustrated circuits for both his transmitter (Fig. 1) and his long-wave receiver (Fig. 2).

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

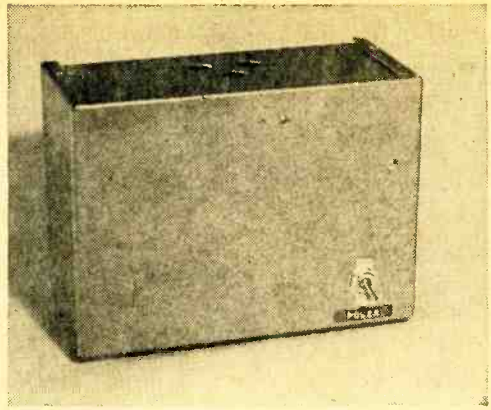


FREQ STANDARD

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

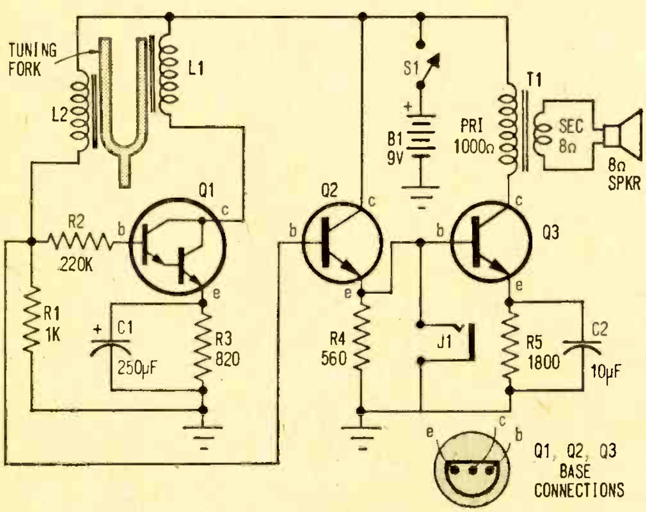
Our amplified electronic tuning fork oscillator will lick this problem. The heart of this unit is a conventional tuning fork, that produces a pure sine wave output that is absolutely accurate. Its electronic circuitry is arranged so that the tone output is continuous and at sufficient volume from the 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.

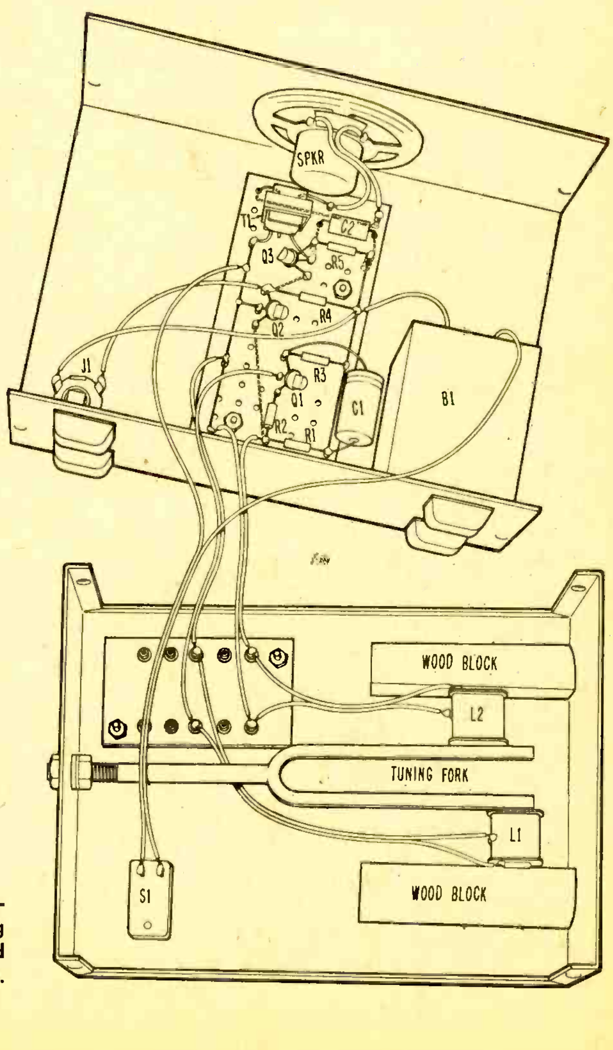
If you desire greater output volume, the oscillator output can be fed from J1 to any external audio amplifier.

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 probability, 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



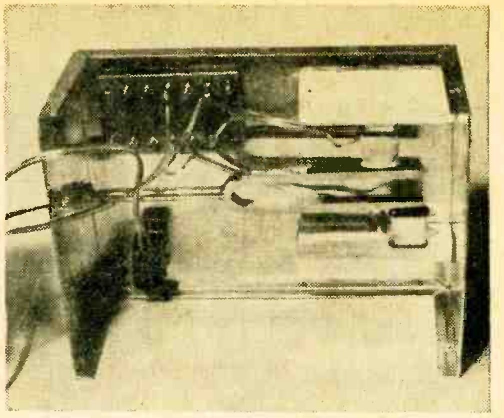
Freq Standard's mechanical construction is simplified by placing tuning fork in bottom of minibox, perfboard and most related components in top.

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.

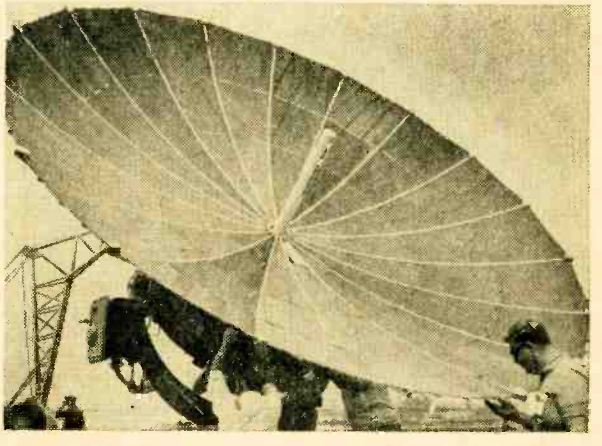
The balance of the components are mounted and wired on a piece of perfboard, using push-in terminals as soldering points.

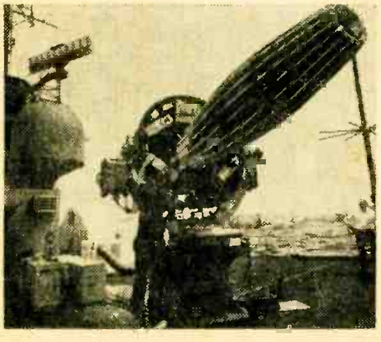


View of bottom portion of Freq Standard, showing tuning fork, coils L1 and L2, and wooden blocks which hold them. See text for recommendations re placement of coils.

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.Oak.	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, Dkla.	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
KDDA	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	Conrõe, 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

Call	Location	kHz
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

Call	Location	kHz
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

Call	Location	kHz
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.	1590
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	Virouqua, 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

Call	Location	kHz
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

Call	Location	kHz
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

Call	Location	kHz
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	Pampano 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

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

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	HCAC1	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.

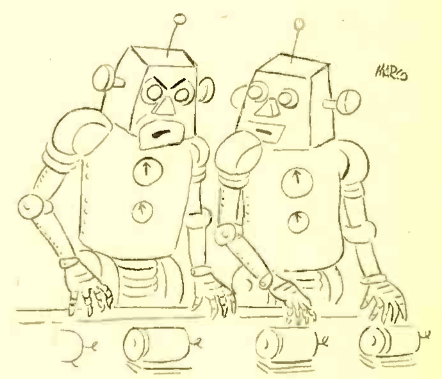
KEX220	154.65 154.71
KGF587	453.15 453.20 453.25 453.30 453.35 453.40 453.55 453.55 453.75 453.80 453.95

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 Twp.	KGA853	155.09	KGA346	154.19
Upper Moreleland Twp.	*	39.28		
Upper Pottsgrove			KGF463	33.70
Upper Southampton Twp.	*	155.37		
		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 Boro	KGA612	45.42	KGD665	33.90
	Call	mHz	Call	mHz
West Conshohocken			KGD343	33.70
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	KG1257	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
			KE1808	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	KE1436	155.37		
Collingswood	KEB356	156.21		
Delanco Twp.	KEE393	155.49		
Delran Twp.	KFG450	155.49		
Deptford Twp.	*	158.97		
E. Greenwich Twp.			*	154.13
Edgewater Park Twp.	*	155.49		
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. Boro	KEB374	155.37	KDG375	154.43
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			KB1956	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 Twp.	KEB870	155.49	KBT211	154.13
				154.43
Medford Twp.	KJD335	155.49	KBR240	154.13
			KDK703	154.13
Merchantville Boro	KFD660	156.61	KEG600	154.385
				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 Boro	KCK314	158.97		
Oaklyn Boro	KEG942	156.21	KEG643	154.43
			KF1597	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
			KE1930	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
			KDL822	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."

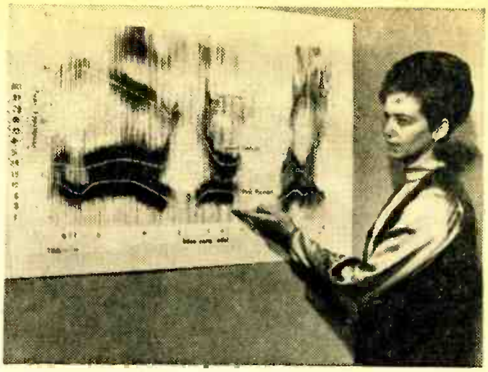
"Hi There, Big Boy!", said in a sexy voice may mean nothing more to an IBM engineer than the punch card that programmed it. It's all because some IBM engineers developed an experimental device that helps improve the naturalness of synthesized human speech.

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."

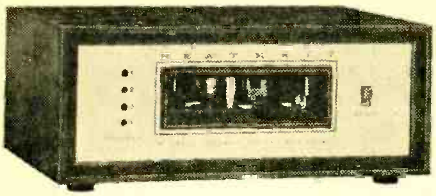
● ● What's New?

● 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 Headphone 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

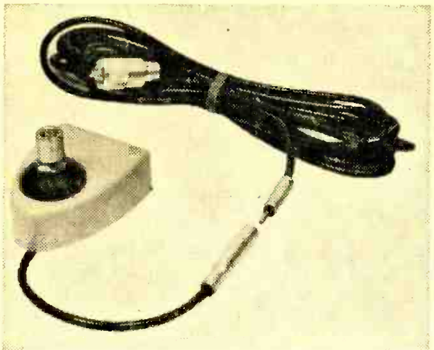
Pro Transceiver for Hams

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!

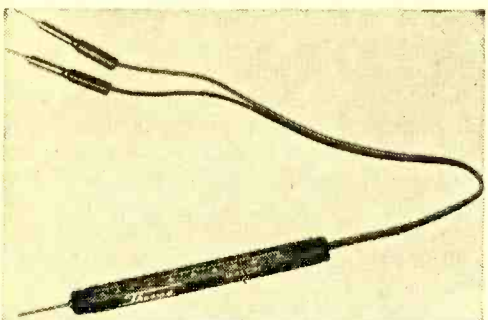
Model TLM is an antenna trunk lip mount which requires neither drilling nor defacing of your vehicle. The clamp and antenna base support are constructed from ⅛-in. carborized plated steel and the mount cover is grey Cycolac plastic. Easily installed in seconds on the rear or side of any automobile trunk 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

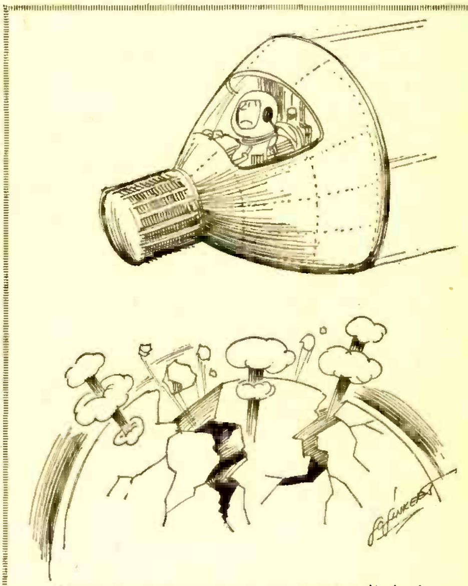
Take Your Component's Temp?

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



Mura Corp. Thermy

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.



"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.

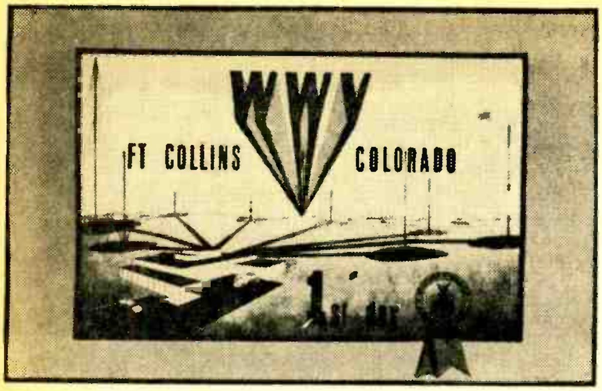
This story brings up the question: why don't hams have more emergency monitoring frequencies set aside for just such occurrences? Actually, this is an old idea which has been tried many times, but it has only been a success over a wide area since these 40-Meter groups got interested.

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.

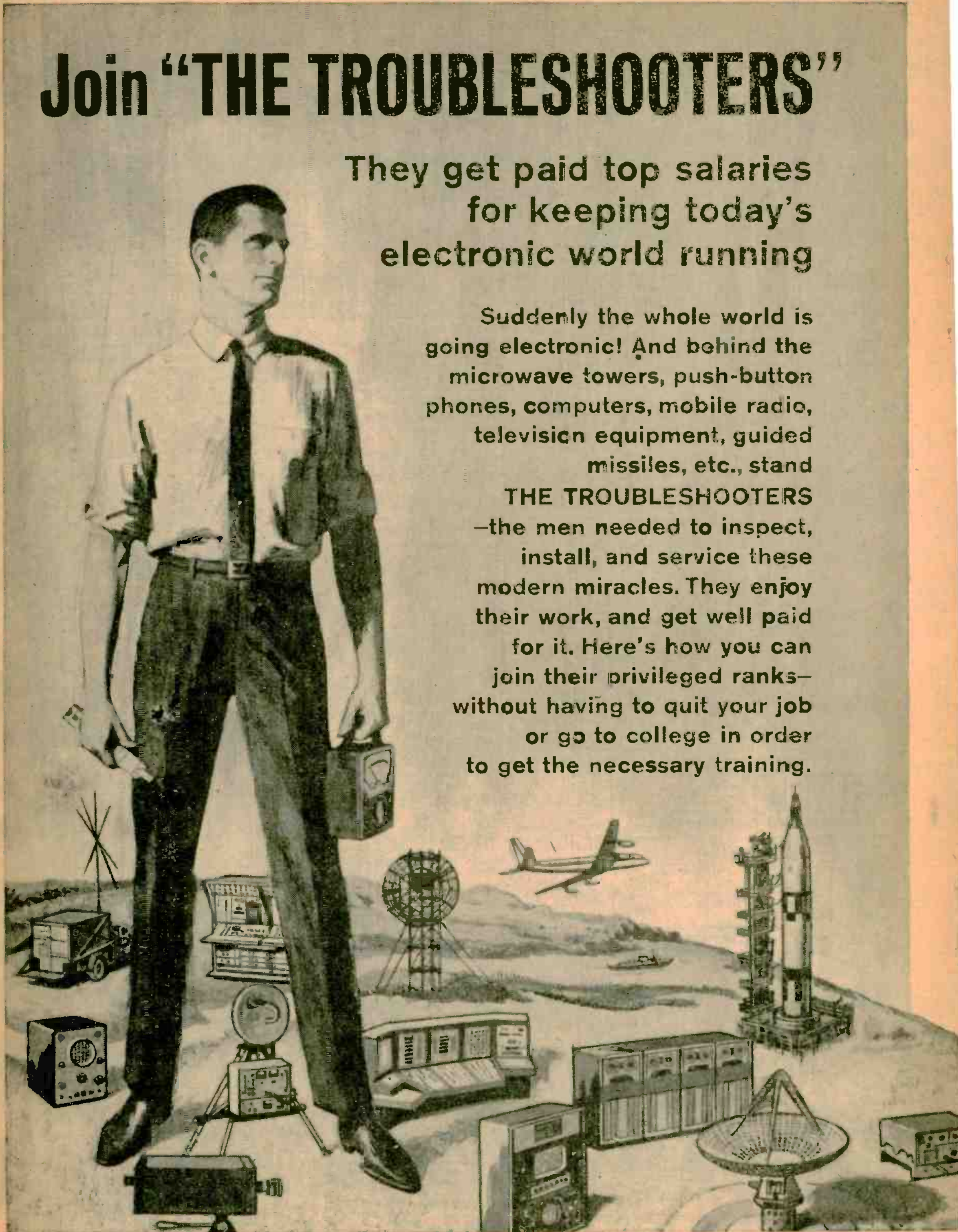
★ Why don't the youngsters in astronomy wait, before they rush into print, for at least one second thought—about lunar surface dust, quasars, pulsars, and so on—so they can sacrifice immediate notoriety in favor of possible studiously-studied chance for immortality?

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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see page 55

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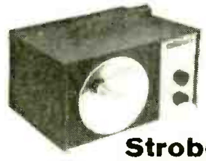

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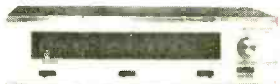

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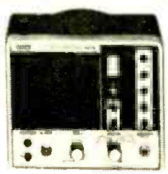

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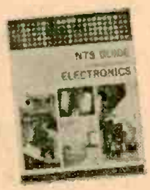

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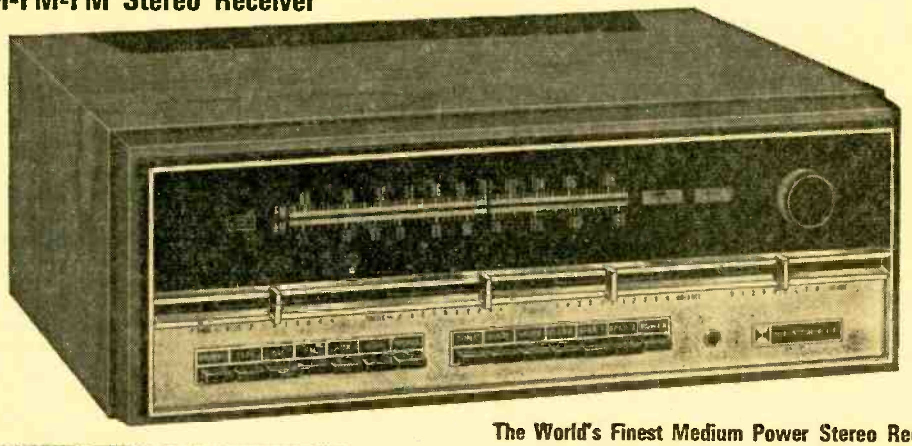

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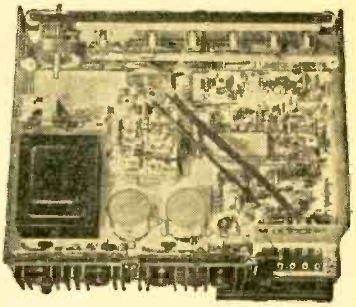

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Kit AR-29, (less cabinet), 33 lbs. $285.00*

Assembled AE-19, oiled pecan cabinet, 10 lbs. $19.95*

PARTIAL AR-29 SPECIFICATIONS — AMPLIFIER: Continuous power output per channel: 35 watts, 8 ohms. **IHF Power output per channel:** 50 watts, 8 ohms. **Frequency response:** —1 dB, 7-60,000 Hz, 1 watt level. **Power Bandwidth for constant 0.25% THD:** Less than 5 Hz to greater than 30 kHz. **Total harmonic distortion:** (Full power output on both channels) Less than 0.25%, 20-20,000 Hz; less than 0.1% @ 1000 Hz. **IM Distortion:** Less than 0.2% (full output, both channels). Less than 0.1% (1 watt output, both channels). **Hum and noise:** (phono input) —65 dB relative to 100 uV signal. **Phono input sensitivity:** 2.2 millivolts (overload 155 millivolts). **FM: Sensitivity:** 1.8 uV or better. **Volume sensitivity:** Below measurable level. **Selectivity:** Greater than 70 dB. **Image rejection:** 90 dB. **IF Rejection:** 90 dB. **Capture ratio:** 1.5 dB. **Total harmonic distortion:** 0.5% or less. **IM Distortion:** 0.4% or less. **Spurious rejection:** Greater than 90 dB. **FM STEREO: Separation:** 40 dB min. @ mid-frequencies; 30 dB @ 50 Hz; 25 dB @ 10 kHz; 20 dB @ 15 kHz. **Frequency response:** ±1 dB, 20-15,000 Hz. **Total harmonic distortion:** 0.5% or less @ 1000 Hz, 100% modulation. 19 kHz & 38 kHz. **Suppression:** 55 dB. **SCA Suppression:** 55 dB. **AM SECTION: Sensitivity:** (using built-in rod antenna): 200 uV/M @ 600 kHz; 300 uV/M @ 1400 kHz (IHF rated). **Selectivity:** Greater than 40 dB alternate channel. **Image rejection:** 60 dB @ 600 kHz; 45 dB @ 1400 kHz. **IF Rejection:** Greater than 50 dB. **Harmonic distortion:** Less than 2%. **Hum & Noise:** —35 dB.

Leader In Electronic Kits

HEATHKIT

HEATHKIT AR-15 Deluxe Solid-State Receiver

The Heathkit AR-15 has been highly praised by every leading audio and electronics magazine, every major testing organization and thousands of owners as THE stereo receiver. Here's why. The powerful solid-state circuit delivers 150 watts of music power, 75 watts per channel, at ±1 dB, 8 Hz to 40 kHz response. Harmonic & IM distortion are both less than 0.5% at full rated output. The world's most sensitive FM tuner includes these advanced design features . . . Cascode 2-stage FET RF amplifier and an FET mixer for high overload capability, excellent cross modulation and image rejection . . . Sensitivity of 1.8 uV or better . . . Harmonic & IM distortion both less than 0.5% . . . Crystal Filters in the IF section give a selectivity of 70 dB under the most adverse conditions. Adjustable Phase Control for maximum separation . . . elaborate noise operated squelch . . . stereo only switch . . . stereo indicator light . . . two front panel stereo headphone jacks . . . front panel input level controls, and much more. Easy circuit board construction. For the finest stereo receiver you can buy anywhere, order your AR-15 now. 34 lbs. Optional walnut cabinet, AE-16. 10 lbs. . . $24.95*

Kit AR-15
$349.95*
(less cabinet)

Assembled ARW-15
$540.00*
(less cabinet)

HEATHKIT AD-27 "Component Compact"

Heath engineers combined the circuitry of the famous Heath AR-14 Stereo Receiver with the precision BSR McDonald 500A Automatic Turntable and put them both in a sliding door walnut cabinet. The result is a stereo compact with component performance: a solid 30 watts music power output . . . 12-60,000 Hz frequency response . . . less than 1% IM & Harmonic Distortion at full output . . . effortless flywheel tuning . . . excellent sensitivity & selectivity . . . adjustable phase control for perfect stereo separation . . . automatic stereo indicator light. The BSR 500A includes features such as cueing/pause control . . . stylus pressure adjustment . . . anti-skate control . . . and comes with a famous Shure diamond stylus magnetic cartridge. Put the top performing, attractively styled Heathkit AD-27 "Component Compact" in your home now. 41 lbs.

Kit AD-27
$179.95*

These Kits Make Excellent Gifts For Beginners

HEATHKIT GR-88 VHF-FM Monitor Receiver

• Tunes narrow & wide band FM from 152-174 MHz for police, fire and weather broadcasts • Highly sensitive • Very selective • 6-to-1 vernier tuning plus single-channel crystal control • Noise-operated squelch • All solid-state design • Battery operated • Built-in whip antenna and external antenna jack • Easy assembly with preassembled tuner • 5 lbs.

Kit GR-88
$49.95*

HEATHKIT GD-48 Metal Locator

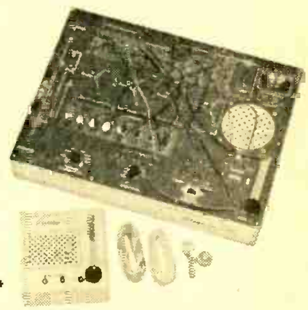
• All solid-state circuitry for long, trouble-free life, low current drain and light weight • High sensitivity from the Induction Balance circuitry • Detects metal accurately down to 6 ft. • Built-in speaker signals presence of metal • Headphone jack • Telescoping shaft & swivel search head • Rugged, lightweight construction — weighs just 3 lbs. • Fast 6-8 hour assembly • 4 lbs.

Kit GD-48
$59.95*

Kit GD-107
$54.95*

HEATHKIT GD-107 Portable Stereo Phonograph

• Automatic or manual stereo and mono play of all speeds and sizes • All solid-state • Includes ceramic cartridge • Twin 4 x 6" speakers for wide response • Handsome avocado green & ivory styling • Easy 3-4 hour assembly • 29 lbs.



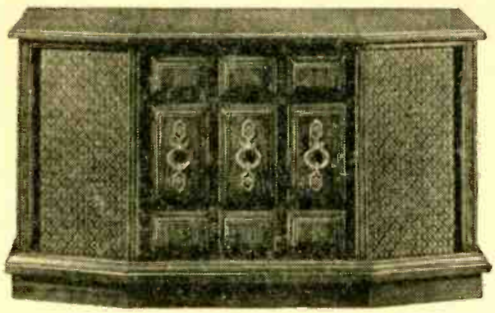
Kit JK-18
$19.95*

New HEATHKIT JR.® JK-18 Electronic Workshop

• 35 easy-to-build, fun-to-use experiments that teach basic electronic circuits • Safe — battery operated • No soldering • Builds radios, transmitters, alarms and dozens more circuits • Simple instructions any youngster can follow • 10 lbs.

There's a Heathkit® Gift

New Heathkit® "Component Credenza"



Mediterranean Styling ... 30-Watt FM-Stereo Receiver ... 4-Speed Automatic Turntable ... Full-Range Speaker Systems

• Combines all solid-state FM stereo receiver, 4-speed automatic turntable with diamond stylus and two full-range, two-way speaker systems into a luxurious Mediterranean cabinet • 15 watts per channel music power output • Full range tone controls • Very low Harmonic & IM Distortion • Excellent channel separation • Transformerless output circuit for minimum phase shift, wide response • Electronically filtered power supply • Stereo headphone jack • Auxiliary input • Filtered tape output • Excellent FM tuner selectivity & sensitivity • 4-stage IF • AFC • Stereo indicator light • SCA filter • High quality BSR McDonald 500A Automatic Turntable with low mass counterbalanced aluminum tone arm plays up to 6 records • Comes with Shure diamond stylus magnetic cartridge • Vernier stylus pressure adjustment • Anti-Skate control • Cue/Pause control • Two ducted-port reflex 2-way speaker systems for performance comparable to fine component-type separate speaker systems • Each system contains 10" high compliance woofer & 3½" ring-damped tweeter for 60-16,000 Hz response • Complete system housed in a magnificent factory assembled Mediterranean cabinet of beautiful oak veneers with solid oak trim • Easy assembly with the famous Heathkit Manual ... build only the receiver & install the components • The finest value anywhere in quality stereo consoles

Real Stereo Performance Demands Real Stereo Components ... the kind used for custom-designed systems. The new "Component Credenza", as the name implies, integrates separate components into a single functional unit. Here are those components ...

Component-Quality FM Stereo Receiver. The heart of the new AD-19 is the famous Heathkit AR-14 FM-FM-Stereo Receiver circuitry. The amplifier produces a solid 30 watts IHF music power. The FM Stereo tuner features 5 uV sensitivity, excellent separation and flywheel tuning. The AR-14 has been rated as the best value obtainable in a medium power receiver.

Component-Quality 4-Speed Automatic Turntable with such professional features as Cue/Pause control, Anti-Skate control, adjustable stylus pressure and famous Shure diamond stylus magnetic cartridge.

Component-Quality Speaker Systems. Two independent, ported speaker systems, each with a 10" woofer and 3½" tweeter deliver 60-16,000 Hz response for remarkable fidelity.

Elegant Mediterranean Oak Cabinet ... a fine example of cabinet-making, flawlessly executed in oak veneer with solid oak trim. Rigidly constructed using fine-furniture techniques.

The New Heathkit AD-19 "Component Credenza". . . A Masterpiece in sight and sound. Put it in your home now.

Kit AD-19, 158 lbs. **$299.95***

NEW Heathkit GR-78 Solid-State General Coverage Receiver... Tunes 190 kHz To 30 MHz In Six Bands

The new GR-78 combines wide coverage, superior performance and portability with sharp styling to provide a remarkable value in general coverage receivers. Tunes AM, CW & SSB signals from 190 kHz to 30 MHz in six switch-selected bands. The all solid-state circuit employs modern FET's in the RF section and 4 ceramic filters in the IF to deliver maximum sensitivity and sharp selectivity. Bandspread Tuning is built-in, and can be calibrated for either Shortwave Broadcast or Amateur Bands. Completely portable . . . comes with a nickel-cadmium rechargeable battery pack and built-in charger that operates from 120 or 240 VAC and 12 VDC. Many built-in features ... 500 kHz crystal calibrator ... switchable Automatic Noise Limiter ... switchable Automatic Volume Control . . . Receiver Muting . . . Headphone Jack and many more. Order yours today. 14 lbs.

NEW Heathkit Deluxe Radio-Controlled Screw-Drive Garage Door Opener Semi-Kit

The next best thing to a personal doorman. The "wireless" factory assembled transmitter operates up to 150 feet away. Just push the button and your garage door opens and the light turns on . . . and stays on until you're safely inside your home. The giant 7 ft. screw mechanism coupled with the ¼ HP motor mean real power and reliability and the adjustable spring-tension clutch automatically reverses the door when it meets any obstruction . . . extra safety for kids, pets, bikes, even car tops. Assembles completely without soldering in just one evening. Easy, fast installation on any 7' overhead track (and jamb & pivot doors with accessory adapter). Order yours now. 66 lbs.

Adapter arm for jamb & pivot doors, Model GDA-209-2, $7.95*

Idea For Every Budget

Heathkit "681" Color TV... AFT... New Brighter Picture Tube For More Vivid Colors, Better Resolution

The new Heathkit GR-681 is the world's most advanced Color TV with more built-in features than any other set on the market. Automatic Fine Tuning on all 83 channels ... power push button VHF channel selection, built-in cable-type remote control ... or you can add the optional GRA-681-6 Wireless Remote Control any time ... plus the built-in self-servicing aids that are standard on all Heathkit color TV's. Other features include high & low AC taps to insure that the picture transmitted exactly fits the "681" screen, automatic degaussing, 2-speed transistor UHF tuner, hi-fi sound output, two VHF antenna inputs, top quality American brand color tube with 2-year warranty. With optional new RCA Matrix picture tube that doubles the brightness, Model GR-681MX only $535.00.

GRA-295-4, Mediterranean Cabinet shown **$124.95***

Heathkit "295" Color TV... New Picture Tube For Brighter, Sharper Pictures

With Optional RCA Matrix Tube ... with the same high performance features and built-in servicing facilities as GR-681 above ... less AFT, VHF power tuning and built-in cable-type remote control. You can add the optional GRA-295-6 Wireless Remote Control at any time. New optional RCA Matrix tube doubles the brightness, Model GR-295MX, $485.00.

GRA-295-1, Contemporary Walnut Cabinet shown **$64.95***

Both the GR-681 and GR-295 fit into the same Heath factory assembled cabinets; not shown Early American style at $109.95*

Heathkit "581" Color TV... Sharper, Brighter Viewing With New Picture Tube... AFT

The new Heathkit GR-581 will add a new dimension to your TV viewing. Brings you color pictures so beautiful, so natural, so real ... puts professional motion picture quality right into your living room. Has the same high performance features and exclusive self-servicing facilities as the GR-681, except with 227 sq. inch viewing area, and without power VHF tuning or built-in cable-type remote control. The optional GRA-227-6 Wireless Remote Control can be added any time you wish. And like all Heathkit Color TV's you have a choice of different installations ... mount it in a wall, your own custom cabinet, your favorite B&W TV cabinet, or any one of the Heath factory assembled cabinets.

GRA-227-2, Mediterranean Oak Cabinet shown **$109.95***

Heathkit "227" With New Picture Tube For Increased Brightness & Better Resolution

Same as the GR-581 above, but without Automatic Fine Tuning ... same superlative performance, same remarkable color picture quality, same built-in servicing aids. Like all Heathkit Color TV's you can add optional Wireless Remote Control at any time (GRA-227-6). And the new Table Model TV Cabinet and roll around Cart is an economical way to house your "227" ... just roll it anywhere, its rich appearance will enhance any room decor.

GRS-227-5, New Cart and Cabinet combo shown **$54.95***

Both the GR-581 and GR-227 fit into the same Heath factory assembled cabinets; not shown, Contemporary cabinet $64.95*

Heathkit "481" Color TV with AFT

The new Heathkit GR-481 has all the same high performance features and exclusive self-servicing aids as the new GR-581, but with a smaller tube size ... 180 sq. inches. And like all Heathkit Color TV's it's easy to assemble ... no experience needed. The famous Heathkit Color TV Manual guides you every step of the way with simple to understand instructions, giant fold-out pictorials ... even lets you do your own servicing for savings of over $200 throughout the life of your set. If you want a deluxe color TV at a budget price the new Heathkit GR-481 is for you.

GRA-180-1, Contemporary Walnut Cabinet shown **$49.95***

Heathkit "180" Color TV

Feature for feature the Heathkit "180" is your best buy in color TV viewing ... has all the superlative performance characteristics of the GR-481, but less Automatic Fine Tuning. For extra savings, extra beauty and convenience, add the table model cabinet and mobile cart. Get the value-packed GR-180 today.

GRS-180-5, Table Model Cabinet & Cart combo **$42.50***

Both the GR-481 and GR-180 fit the same Heath factory assembled cabinets; GRA-180-2, Early American Cabinet $94.95*.

Add the Comfort And Convenience Of Full Color Wireless Remote Control To Any Rectangular Tube Heathkit Color TV ... New Or Old!

Kit GRA-681-6, for Heathkit GR-681 Color TV's **$64.95***
Kit GRA-295-6, for Heathkit GR-295 & GR-25 TV's **$69.95***
Kit GRA-227-6, for Heathkit GR-581; GR-481 & GR-180 Color TV's **$69.95***

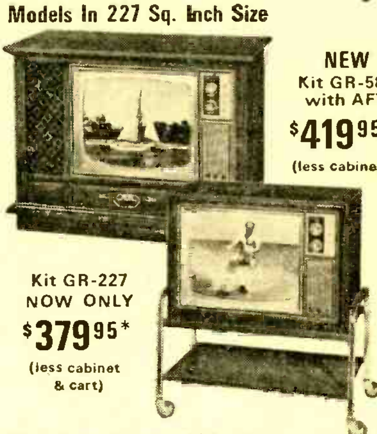
Now There Are 6 Heathkit® Color TV's To Choose From

2 Models In 295 Sq. Inch Size

NEW Kit GR-681 With AFT **$499.95*** (less cabinet)

Kit GR-295 **$449.95*** (less cabinet)

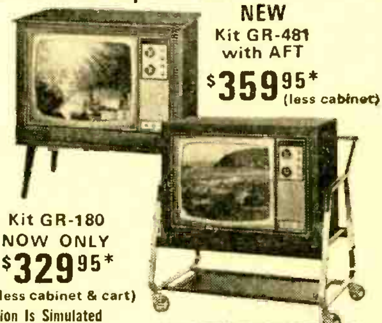
2 Models In 227 Sq. Inch Size



NEW Kit GR-581 with AFT **$419.95*** (less cabinet)

Kit GR-227 NOW ONLY **$379.95*** (less cabinet & cart)

2 Models In 180 Sq. Inch Size



NEW Kit GR-481 with AFT **$359.95*** (less cabinet)

Kit GR-180 NOW ONLY **$329.95*** (less cabinet & cart)

Reception Is Simulated On All Sets Shown

HEATHKIT

a Schlumberger subsidiary

NEW

FREE 1970 CATALOG!

Now with more kits, more color. Fully describes these along with over 300 kits for stereo/hi-fi, color TV, electronic organs, electric guitar & amplifier, amateur radio, marine, educational, CB, home & hobby. Mail coupon or write Heath Company, Benton Harbor, Michigan 49022.

HEATH COMPANY, Dept. 19-12
Benton Harbor, Michigan 49022

☐ Enclosed is $__________, plus shipping.

Please send model (s)__________

☐ Please send FREE Heathkit Catalog. ☐ Please send Credit Application.

Name__________

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Science and Electronics

Volume 28 Number 1

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POSITIVE FEEDBACK

Julian M. Sienkiewicz
EDITOR-IN-CHIEF

By now almost everyone has had the opportunity to visually inspect the color quality of several television receivers of different manufacturers in their homes and the homes of friends. So much so that the average consumer has enough savvy to criticize one brand vs. another, or even damn one, some, or all. Therefore, you can expect the Editor to have even more savvy than most consumers in the color TV marketplace. Without further ado about my credentials as an expert on color TV, I'd like to make the following statements to my readers with all candor and honesty.

It's a rather universally accepted fact among many color TV experts—and that includes anyone who has lived with it—that Heathkit color TV sets have always had the best color pictures. Naturally, I have to mention that this statement is based on an informal survey conducted by myself during the past several years and that I am in full agreement with it. So, naturally, I was surprised to discover Heath has gone three steps better in their upcoming color TV kit program.

The 1970 Heathkit color TV line has three improvements—two of them contribute to picture quality and the third is a safety touch.

A change in circuit parameters in the video amplifier has resulted in a broader bandpass which provides greater detail in the pictures. This is clearly evident in increased test pattern resolution and also can be noted in sharper broadcast pictures. The change has been made in all production of Heath color TVs—and, as is typical of how Heath takes care of its own, a modification kit has been offered free by Heath to any Heathkit color TV owner.

The second improvement involves the picture tube itself. Heath has continued its policy of offering the latest in picture tube advances by now including as standard equipment the new brighter tube you've read about. The new tube is brighter and gives more vivid colors as well as increased resolution.

The third change involves an added AC interlock to all future Heathkit color TV cabinet production. The interlock also is available free to any Heathkit color TV cabinet owner.

One final note should be mentioned about the Heath color TV kit. The Heathkit set used by my family is over six years old and serviced by yours truly. Through the years this set has had its normal shares of tube failures as compared to other color sets and two black-and-white sets in my house. As a gag, I have always billed myself for service calls to prove to my wife how valuable I am to have around the house. Also, once a year, I readjust the set following the procedure outlined in the Heath manual supplied with the kit. Conservatively estimated, I have saved over $250.00 in service calls, had a down time measured in hours and not days or weeks (you have to wait for TV servicemen to show up), and had a superior picture throughout this period than other sets could have even when covered by "service contracts."

What's New? We published a few good news items in earlier columns and our readers want more. So, here it comes:

- Louisville—It was Loose Juice, America's most famous three-year-old Mylar, in the lead all the way as thousands of racing fans filled the stands at Churchill Downs in the 95th Annual Kentucky Derby. A full field of the country's top race horses competed. The winning jockey was Skip Zone, who just last year extinguished himself after being fired by rich stable owner Jojo Vasterbulge, as Rider of the Decade.

Jockey Shortz was disqualified after a saliva test disclosed that his plug had been doped. An official became suspicious when, he said, "I detected his mount with a Blonder-Tongue." On several other occasions Shortz has been suspected of checking his horse with a cheater cord.

- Baltimore—A battery of smart lawyers was unable to keep Elsie Philter, notorious student striker, from resting in a cell today. While she claimed responsibility for smoothing the flow of current campus thought, school authorities demanded that she be jailed on the grounds that she intended to short out higher education with a girlcott.

University officials maintained that she had used improper channels of communication and appealed to the courts for a uni-junction.

Her brother, Infra-Red, a low voltage drop-out, was also picked up as an accessory to the charge. Red, a violent speaker, citing Ohm's Law, insisted that the judge was prejudiced and called the entire case a "bench frame." Declared the judge, "Your sentence is thirty days in prison. Watts more, keep talking and I'll Triplett."

Let Us Know. Okay, you got some good ideas on how to run a magazine. So what, if you don't tell the Editor, it's down the ol' drain. So put on your thinking cap and send us your story ideas. Man, if you don't clue us in, we're in No-man'sville without a street guide. ■

BY ERNEST A. KEHR

● ● On March 29, 1968, the tiny Caribbean island of Antigua released a quartet of orange and black stamps to commemorate the dedication of the Dow Hill Tracking Station by local officials and the National Space Administration.

The success of early Space exploration culminated by Mercury and Gemini Projects, made it mandatory for NASA to find a spot in the eastern Caribbean to assure adequate tracking and communications coverage during the critical phases of lift-off of future Apollo flights. After carefully investigating many islands of the area, NASA's Site Selection Committee chose Antigua for its many advantages. Negotiations were undertaken and agreement signed on Jan. 23, 1967, to build and operate Dow Hill.

Located in a valley surrounded by low mountains, Dow Hill is ideal for the Apollo missions: locally generated radio signals do not interfere with the weak ones of the Spacecraft; it is relatively immune from automobile and airplane ignition noises.

● Heart of the station is the unified S-band equipment and its immense antenna, which is depicted on the four-cent denomination of the stamp set. This USB is an unique tracking system. It utilizes a single carrier frequency to transmit and receive all information between ground and Spacecraft. In other words, it "unifies" the measurement of range and velocity of the Spacecraft, the transmissions of radio commands and voice communications with the vehicle, and the reception of hundreds of Spacecraft measurements onto a single carrier frequency. It was adopted to reduce the amount of equipment required aboard Apollo and, more important, to reduce the amount of electrical power necessary to transmit information to the ground.

Behind the 30-foot diameter of the antenna but not visible in the stamp's design, is an expansive shack packed with the most modern, sophisticated electronics and computer equipment in existence today.

And to eliminate dependence upon any outside sources, Dow Hill Tracking Station has its own generating plant for electricity and a water pumping and storage complex.

● The other three stamps of the set are related to the Apollo project rather than to the tracking station, the dedication of which they commemorate. The 15-cent shows a Spacecraft rising above the clouds immediately after lift-off and headed for the moon, while the Dow Hill antenna is in the foreground.

● During the Apollo 7, the first manned mission, and Apollo 9, Dow Hill was extremely active since both of these were earth orbital missions. During Apollo 8, 10 and 11, the Station served in a back-up posture to the 85-foot antenna stations at Gladstone, Calif., Madrid and Australia's Honeysuckle Creek installation. During Apollo 12's launch it became particularly important because of the momentary difficulties when power systems aboard the Spacecraft went out and had to be augmented by batteries.

● The 25-cent shows the nose cone of an Apollo mission in orbit around the moon, its Lunar Module still attached prior to landing.

● The 50-cent shows the nose cone leaving the moon and headed for re-entry to the earth's atmosphere and final landing on the high seas.

WHAT'S NEW?

● With more and more postal administrations of the world issuing special stamps for the various phases of the conquest of Space, it is increasingly difficult for collectors to mount their specimens in normal stamp albums. The Western Publishing Company, Racine, Wisc. 53404, has solved this problem.

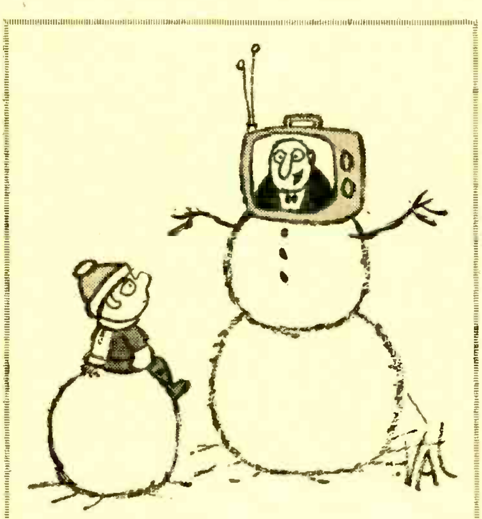
The firm, which publishes many useful philatelic accessories, has just released special "do it yourself" pages. The pages, which will fit into any standard three-ring binder, are captioned

Antigua 1968 Tracking Station 4¢ and 15¢; lettering reading "15¢" failed to reproduce on engraving.

Antigua 1968 Tracking Station 50¢ and 25¢

by a picture of a Lunar Module about to land on the moon, and an inscription, "Conquest of Space." The rest of the page is blank, enabling the owner to mount his Space stamps to suit his individual taste. The pages come in packets of 15 and cost $1, postpaid. A sample page will be sent without charge upon request if the *Stamp Shack* is mentioned.

● That stamp collecting is still the world's most popular hobby and that the demand for stamps is greater than ever is evidenced by the new "Scott's Standard Postage Stamp Catalogue." This annual guide to current market conditions has upped its price quotations throughout. The increases are conspicuous in the older issues that have been put into service by responsible governments, and the classics of the 19th century. More recent stamps—especially those that have come in for speculative cornering and those produced by emerging nations more for sale to the uninformed stamp market than for genuine postal usage—had their value untouched or actually reduced. ■



Cheap is Cheap

Numerous times I have seen you mention that a standard FM receiver could not be used for the reception of AM aircraft frequencies. I have had three different FM receivers here at the store and all have picked up aircraft on an image frequency 21.4 MHz above my dial setting. How come AM on FM?

—J. H., St. Clairsville, Ohio

Obviously, they're not very good FM receivers, or the aviation band signals, picked up on an image basis, are too weak to saturate the receivers' limiter, if they have limiters.

Fussy, Fussy, Fussy

I am interested in buying a general coverage communications receiver (0.54 to 30MHz) with accurate frequency calibration. The Collins 51S-1 would be perfect if it were not for its $2000 price tag. Can you recommend a receiver in the $300 price class that has good frequency calibration? For example, I would like to be able to dial 10.0 MHz on the receiver and expect to find WWV there—not at 9.9 or 10.1 MHz.

—V. M. S., Dover, N.J.

Drive into New York City to Harrison Radio or some other equipment dealer and look over some of the fine receivers that are available, such as the Hammarlund HQ-200. Getting WWV at 9.9 or 10.1 MHz is not so bad. It's hard to get better than 1% accuracy with a tunable receiver. That's why some include a frequency calibrator.

Flash!

Where can a circuit for a strobe light with a 400 watt second output be obtained that has a continuous flash output adjustable from one to ten flashes per second? From what manufacturers could the components be obtained?

—J. M., Bremerton, Wash.

Write to Amglo Corp., 4333 N. Ravenswood, Chicago. Amglo makes the lamps and should have application information available.

He's Up, They're Down

Recently I bought myself a five-band radio. On one of the bands I can pick up messages from police, fire, taxis, etc., in the 144 to 172-MHz range. Later, I found that our fire department is on a 34-MHz frequency which I cannot pick up. Is there any way I can change my receiver to cover the low mobile radio band?

—*C. C., Federalsburg, Md.*

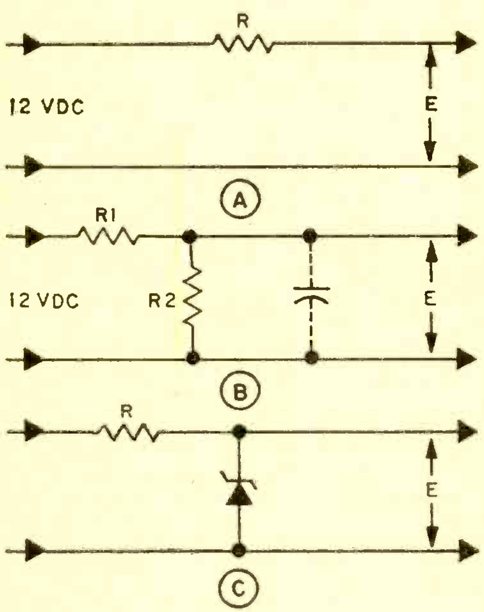
It would be a messy job and you might not be happy with it. Instead, get an outboard converter and use it with your set when it is set for AM on the BCB. Better still, pick up a pocket-portable unit. They're available with the broadcast band and the price is right.

No Coils at All

I want to know how to reduce 12 volts DC to 6.3 volts DC without using a transformer, only resistors, capacitors, etc.

—*A. M. C., Chatham, Va.*

You can use a series resistor as shown in diagram A if the load current is constant. The value of R is equal to 5.7 divided by load current (in amperes). If it's 57 ma, R would be 100 ohms. If the load current varies a little bit, you can use a voltage divider as shown in diagram B. If R2 is 220 ohms and the load current is 28 ma, R1 should be 100 ohms. To get steady output voltage, you can use a Zener diode rated at the voltage closest to 6.3 volts and for adequate power. Refer to a Zener diode manual for se-



lecting a Zener and determining value of R. You must know maximum load current.

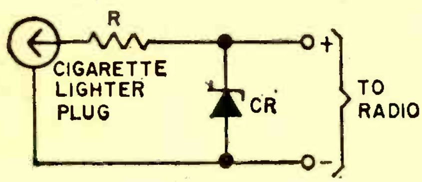
In diagram A, output voltage (E) will be 12 volts regardless of the value of R if load current is zero. In B, the ratio of R1 and R2 determines E with zero load current. In B, E remains steady as long as maximum load current does not exceed design value.

Needs 9, Not More

How can I operate a portable transistor radio, which employs a 9-volt battery, from my car battery?

—C. H., Chicago, Ill.

With the engine off, the voltage is 12.6. With the engine running, it can rise to 14.4 volts, sometimes as high as 15. Your radio needs 9 volts, but "might" stand more. It can be done, but you will need a voltage regulator such as a



Zener diode. You can rig up a device that plugs into the cigarette lighter socket, using the circuit shown in the diagram. Use a 1-watt, 9.1 volt Zener diode for CR. Only the value of series resistance R is critical. For R start with a 1000-ohm resistor and measure the DC voltage across the Zener with the radio connected, turned on and the volume up (so it will draw maximum current), and the car engine not running. Reduce the value of R, but not to less than 600 ohms until you get 9.1 volts with the engine off or running, and with the radio on or off, and at all volume levels. The diagram shows Zener polarity for negative ground vehicles. If positive battery terminal is grounded, reverse the Zener connections.

Oh, for a Pair of Cans

I am an SWLer and my little National receiver conked out. I am now looking for something pretty up-to-date. When I started looking, I was unfamiliar with what was available. I am now convinced that I want an SSB receiver. I would appreciate your comments and advice. First off, I can't make up my mind whether I want to go portable or non-portable. The advantages of the portable models are obvious, especially when the rest of the family wants to watch TV. But would I be losing something in a portable compared to non-portable? I want frequency coverage at least to 30 MHz and would like to have LW, 150 to 400 kHz.

—A. I. L., Annville, Pa.

A professional table model communications receiver should be superior to a portable, but costs more. On SSB you will hear hams, commercial stations and marine communications. If you really want good SSB reception, pick a receiver designed for SSB, employing a product detector, not just an AM receiver with a BFO. And don't worry about the family—use a headset!

Trucks, Trucks, Trucks

I have an Allied KN-2580 citizens band transceiver which works very well until heavy trucks or any heavy duty vehicle passes in front of my house. When that happens my CB sounds as if it is shifting gears with the vehicle. Do you have any solution for this problem?

—M. J. G., Chicago, Ill.

Sounds like ignition noise which can carry quite far when severe. If possible, move your antenna farther away from the street. It may help some.

Need Wire

I have an old Majestic wire recorder. I can't find any wire for the thing. I ordered some from a company that specializes in magnetic recording wire and found that the wire didn't work on my recorder. It seems to be too small for the recording head. My machine requires a 2¼" diameter spool (inside diameter). I was wondering if you or any of your readers could help me find some wire of the right size.

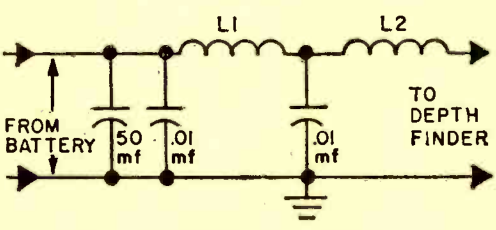
—L. D., Onslow, Iowa

Wire recording went out when tape came in because tape is better and cheaper. Any reader knowing where L. D. can get the right wire can reach him at P.O. Box 12 in Onslow, Iowa.

Noise Killer

Can you give me a design for a filtering system which will permit me to eliminate a separate 12-volt dry cell for running a depth finder on my boat? There is too much electronic noise in my boat wiring system to get accurate readings when the depth finder is hooked up to it. The boat power system consists of a 12-volt storage battery, alternator charger, and transistorized ignition.

—A. M. K., South Natick, Mass.



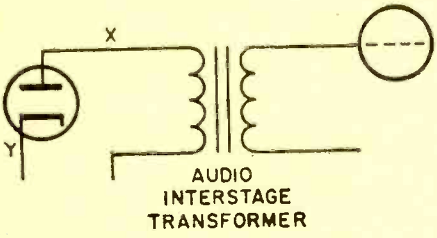
You can try a low-pass filter, connected as shown in the diagram. Use radio frequency chokes for L1 and L2 and put all the components in a metal box. Values are not critical!

Hiss

I have an old Crosley radio, model number 7V2. Every once in a while it starts to make a hissing and cracking noise. I was wondering if you could give me some information on where to get a schematic diagram for it. Also I was wondering if you could tell me how old it is.

—M. K., Belvedere, Ill.

Sorry, we don't have a schematic diagram nor do we recall that model's vintage. Your trouble sounds like an AF transformer giving up. Temporarily short point X in the diagram to Y (cathode). If the noise gets worse replace the transformer with a standard interstage type. Because of the age of the set, it would pay to replace all fixed capacitors.



Don't Ask Why

Without having to modify the power supply of an old Majestic radio which uses type 27 triode tubes, can you suggest a 2.5-volt filament tube I can use in place of 27s?

—J. K., Teaneck, N.J.

The 2HA5/2HM5 is a triode tube with a 2.4-
(Continued on page 106)

Pencil in that Design

A slim, 3-oz. instant heat pencil iron that will do the work of much heavier pistol-type guns has been brought out by Wall Mfg. as their Model IDL. Its slimness came about by using a dual heat element controlled by a thermal time delay relay, nixing the need for a transformer. When a switch on the handle is depressed, a high-wattage element brings the tip temperature up to operating heat in seconds. The relay then cuts in a lower wattage element that maintains the proper sol-

(Continued on page 106)

Wall Soldering Pencil

By ARTHUR S. COOKFAIR

FAMOUS PATENTS

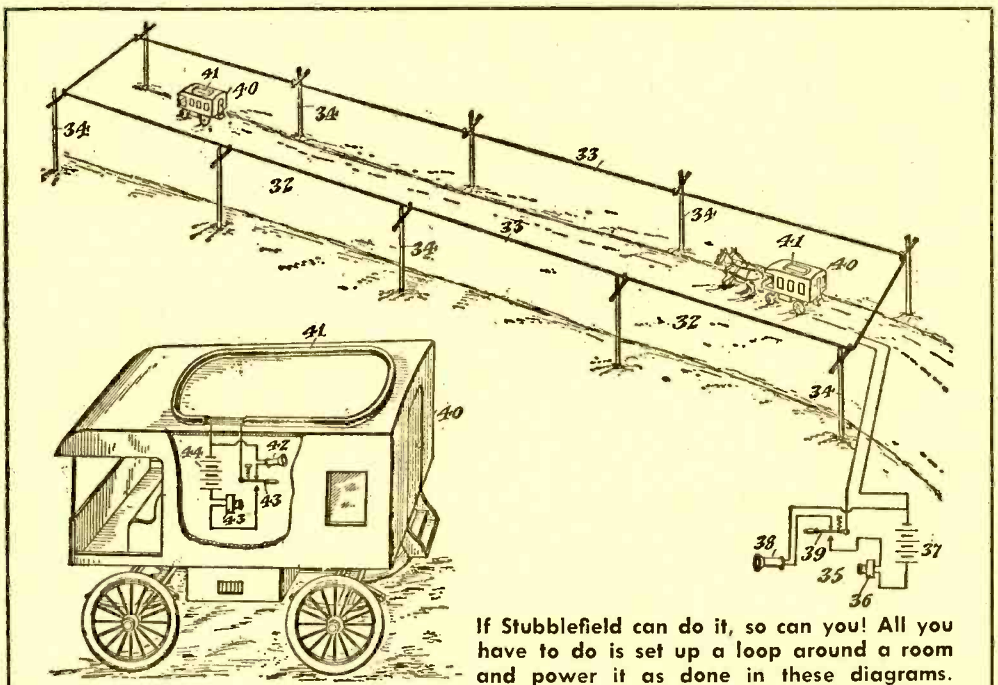
No. 887,357

NATHAN STUBBLEFIELD'S WIRELESS TELEPHONE

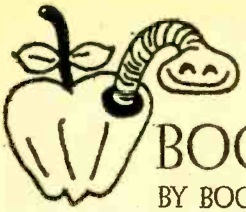
In 1902, radio (dots and dashes variety) was just beginning. The year before, Marconi had astounded the world by transmitting the single letter "S" in Morse code, from England to Newfoundland. Years were to pass before Fessenden would add voice to radio.

Yet on March 20, 1902, an unknown inventor from Kentucky actually made a ship-to-shore wireless telephone transmission to a small group of astonished scientists in Washington, D. C. Reports of his earlier experiments in Kentucky had led the scientists to invite Nathan B. Stubblefield to demonstrate his discoveries in the Capital. He operated his transmitter from the deck of the steamship "Bartholdi" in the Potomac River. The witnesses on shore heard his voice from a mysterious box that housed—and concealed—the receiving apparatus. Fearful of having his secrets stolen, the in-

(Continued on page 110)



If Stubblefield can do it, so can you! All you have to do is set up a loop around a room and power it as done in these diagrams.

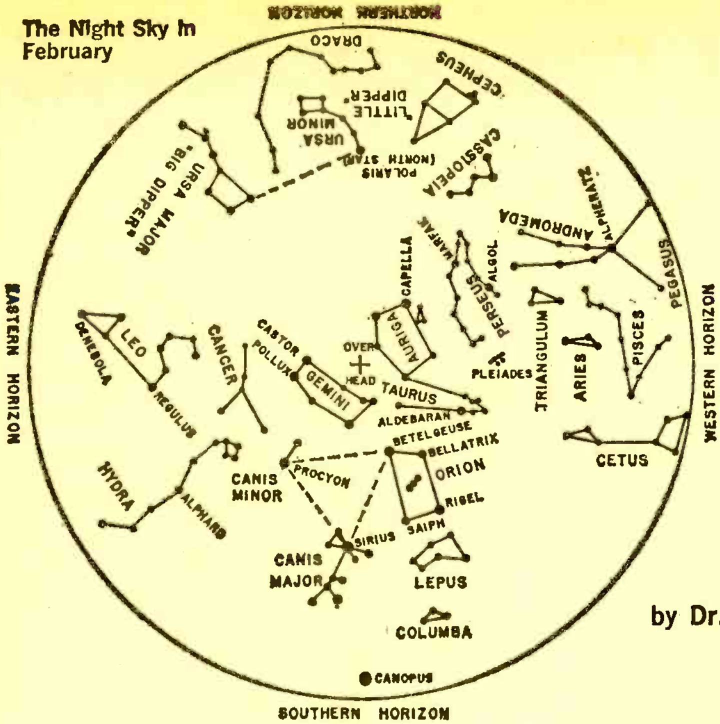


BOOKMARK
BY BOOKWORM

Hint of Tint. A brand-new full-size color service manual, covering 23 RCA Color chassis has been written by Carl Babcoke. The book includes complete schematic diagrams for 12 chassis, from the CTC12 to the CTC40 all-transistor model. Here in one compact, handy manual is everything needed to quickly and completely repair any RCA color set. RCA expert Carl Babcoke has put together an all-in-one reference manual, encompassing both general and specific trouble-shooting data applicable to all RCA chassis. The profusely illustrated text delves into each section (video, chroma, vertical, horizontal, etc.), and points out specific problems based on the author's extensive experience, plus valuable information gained through contact with literally hundreds of technicians throughout the country. Trouble-shooting tips on *each* chassis, including circuit changes and factory modifications, are thoroughly covered so the reader can solve many otherwise tough problems in short order. While this material is related directly to RCA sets, much of it is applicable to other sets patterned after RCA designs, under licensing agreements; so this book is not limited strictly to RCA. Not only does the book include 12 *complete* schematic diagrams, covering every basic chassis manufactured since 1963, but also all the setup data, alignment procedures, and meaningful trouble cures applicable to practically *all* color receivers. Variations from the 12 basic sche-

(Continued on page 30)

Soft cover
212 pages
$7.95



The Night Sky In February

The Skies Above Us

by Dr. Roy K. Marshall

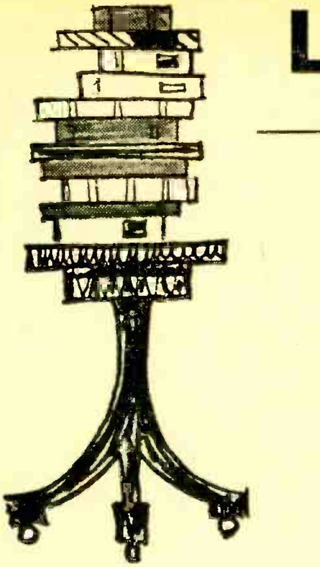
WHEN THE MOON GETS IN THE WAY

★★ Early in the evenings in February we find the full blazing beauty of the winter sky. The great triangle of Sirius, Procyon, and Betelgeuse is due south about 9 p.m. Almost directly overhead are Castor and Pollux as the heads of the Twins; red Aldebaran in the eye of Taurus, the Bull; and golden Capella as the little She-Goat on the shoulder of Auriga. Sliding westward from the zenith are the Hyades and Pleides (see our illustration above).

★ If you're one of those who are bothered by a far from dark sky because of city lights, I'll give you a trick taught to me by one of my teachers, long ago, so you can enjoy some fainter objects that you might otherwise miss. Find a small mailing tube or similar device, like the core of a roll of paper towels, and use it as a hand-held spy-glass without any lenses in it. When you settle one end down on your eye-socket and look through the tube, the diffuse sky light will be shielded from your vision. As a result, you'll be able to see fainter objects, such as more stars in the Pleides, the Hyades, and the area of the Orion nebula, below the three stars marking the Belt of the Giant Hunter-Warrior. With this scheme, or, better still, with binoculars, you might try to see the Double Cluster in Perseus, between the star Marfak and the "W" of Cassiopeia.

★ In February, look for red Mars in Pisces, moving into Aries, where Saturn will be found as a fair star not on the map. Later at night, bright golden Jupiter will be found in Virgo. Find it and follow it on through the winter and spring. And, speaking of spring, it will arrive officially as the sun again crosses the celestial equator, moving northward, at about 8 p.m., EST, on March 20.

★★ If you haven't anything more important to do on Saturday, March 7, why not keep a date with a total eclipse of the sun? If you don't try this time, you'll have to wait until July 10, 1972, when the next one occurs in North America. That one will begin in Alaska, sweep eastward across northern Canada and finally over Nova Scotia before jumping off into the Atlantic. Better shoot for the earlier one, on March 7, 1970. *(Continued on page 26)*



LITERATURE

ELECTRONIC PARTS

★2. Now, get the all-new 512-page, fully illustrated *Lafayette Radio* 1970 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 1970 *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. *RCA* Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable building, creating, experimenting and learning. Find out for yourself by circling 135 now!

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 1970 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* specialty 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 1970 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'* 1970 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 "SS5." Also, CB accessories that add versatility to their 5-watters.

TOOLS

★78. Do more jobs with fewer tools! Double-duty *Xcelite* sets contain midget nut and screwdrivers plus special "piggy-back" handle that gives power and reach of standard drivers. Three sets are described in *Xcelite's* Catalog 166. Get copy today!

118. Secure coax cables, speaker wires, phone wires, etc., with *Arrow* staple gun tackers. 3 models for wires and cables from 3/16" to ½" 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* 1970 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. *Heath's* new 1970 full-color catalog is a shopper's dream. Its 116 pages are chuck full of gadgets and goodies everyone would want to own. Mostly kits are shown but many factory-wired products are available. Get your catalog today!

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

LIBRARY...

★ Starred items indicate advertisers in this issue. Consult their ads for additional information and specifications.

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!

SCHOOLS AND EDUCATIONAL

★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

26. Get with today's hi-fi jet set. *H. H. Scott* sets the pace with their fantastic line of audio components, some in kit form, too! *Scott* will send you all the poop if you circle 26!

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 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.

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 their free 1970 catalog. 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. The all new Heathkit 1970 catalog is jammed with 7 color TV kits, plus buys on antennas, rotors, towers and other accessories, and TV test gear. Get your copy by circling item 70 below.

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
Dept. 370
229 Park Avenue South
New York, N.Y. 10003

Please arrange to have the literature whose numbers I have circled at right sent to me as soon as possible. I am enclosing 25¢ to cover handling. (No stamps, please.)

Sorry, only 20 circled items maximum.

☐ Indicate total number of booklets requested

1	2	3	4	5	6	7	8	9	10
11	12	14	17	23	26	30	31	34	35
42	44	45	46	48	70	74	78	96	99
100	101	102	103	104	106	107	109	111	114
116	118	119	123	126	127	129	130	135	136
137	140	141	142	143	144	145	146		

NAME____________________

ADDRESS____________________

CITY____________________

STATE__________ ZIP__________

The Skies Above Us

(Continued from page 23)

★ Don't hold me to it, but the statistical probability of clear sky (less than 0.3 cloud cover) along the eclipse path from near Tallahassee, Fla., to Norfolk, Va., runs between 40 and 50 percent at midday in early March. At Bangor, Me., on July 20, 1963, the last time I hoped to see a total solar eclipse by traveling about 400 miles away from home, the statistics were all on my side—until about 30 minutes before totality when the clouds and the rain came!

★ An eclipse occurs, of course, because the moon sometimes can pass between the Earth and the sun and cast a shadow on an area of the Earth. Sometimes the shadow's center doesn't fall on the Earth; then the eclipse is only partial and only a bite, large or small, appears to have been taken out of the edge of the sun. Sometimes the moon is too far from the Earth and its black disk is too small to cover all of the sun but appears as a black hole in it, so the uncovered part of the sun appears to be a bright ring; this is called an annular eclipse. But when the tip of the moon's shadow does reach the Earth and sweeps across sea and land, those who are in the path will see a total eclipse and those on either side will see a partial eclipse—a big bite if they are close to the total path, diminishing in importance as they are farther from it.

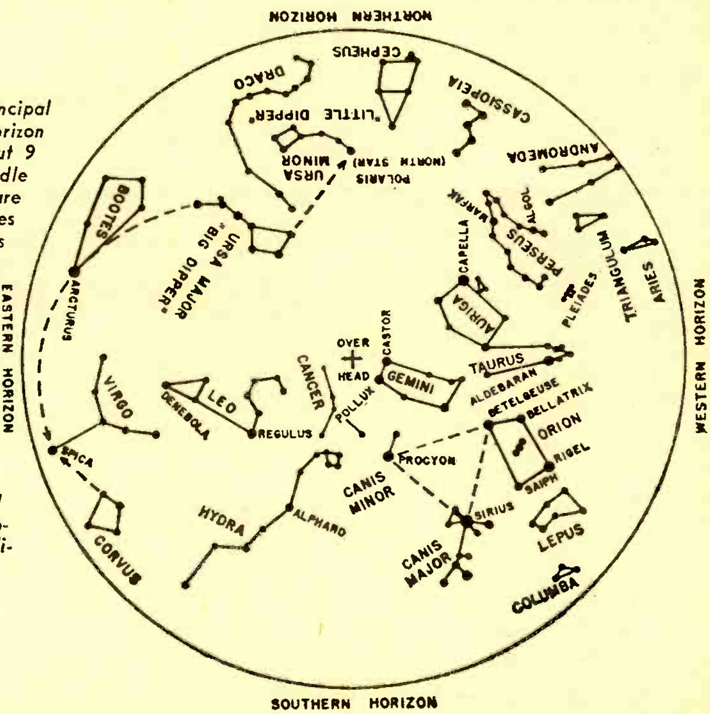
★ The path may be about as long as half the circumference of the Earth. But it can be no wider than 169 miles and, as the shadow sweeps along, it can not take longer than 7 minutes 31 seconds to pass over a given point. But this can occur only when the Earth is closest to the moon and farthest from the sun at the same time, a rare circumstance which will *almost* occur on July 16, 2186 (it will fall two seconds short!).

★ Our total eclipse this year is wasted for the first 5000 miles of its path, from the point where the moon's shadow first touches the Earth just south of the equator, far out in the Pacific, until it has curved northeastward to come ashore on Mexico's Pacific coast at the Isthmus of Tehuantepec, south of Oaxaca, where the real shadow, called the umbra, is 95 miles wide and moves at 1500 miles an hour. At any given point on its central line, it requires 3 minutes 28 seconds to pass, during which time the sun's disk will be entirely hidden by the moon.

Even today, there may be natives there, descendants of the ancient Olmec, Zapotec, Mixtec, and Aztec cultures, who will revert to their traditional fears that the great god,

(Continued on page 107)

☆☆☆ The maps show the principal stars 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 February and March, 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. ☆☆☆



You can pay $600 and still not get professionally approved TV training.

Get it now for $99.

Before you put out money for a home study course in TV Servicing and Repair, take a look at what's new.

National Electronic Associations did. They checked out the new TV training package being offered by ICS. Inspected the six self-teaching texts. Followed the step-by-step diagrams and instructions. Evaluated the material's practicality, its fitness for learning modern troubleshooting (including UHF and Color).

Then they approved the new course for use in their own national apprenticeship program.

They went even further and endorsed this new training as an important step for anyone working toward recognition as a Certified Electronic Technician (CET).

This is the first time a self-taught training program has been approved by NEA.

The surprising thing is that this is not a course that costs hundreds of dollars and takes several years to complete. It includes no kits or gimmicks. Requires no experience, no elaborate shop setup.

All you need is normal intelligence and a willingness to learn. Plus an old TV set to work on and some tools and equipment (you'll find helpful what-to-buy and where-to-buy-it information in the texts).

Learning by doing, you should be able to complete your basic training in six months. You then take a final examination to win your ICS diploma and membership in the ICS TV Servicing Academy.

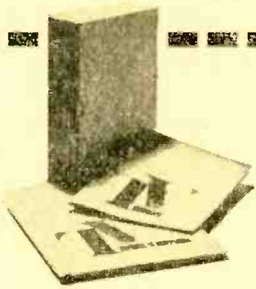
Actually, when you complete the first two texts, you'll be able to locate and repair 70% of common TV troubles. You can begin taking servicing jobs for money or start working in any of a number of electronic service businesses as a sought-after apprentice technician.

Which leads to the fact that this new course is far below the cost you would expect to pay for a complete training course. Comparable courses with their Color TV kits cost as much as six times more than the $99 you'll pay for this one.

But don't stop here. Compare its up-to-dateness and thoroughness. Find out about the bonus features—a dictionary of TV terms and a portfolio of 24 late-model schematics.

Get all the facts. Free. Fast. Mail the reply card or coupon below.

ICS® Dept. M5589M
Scranton, Penna. 18515



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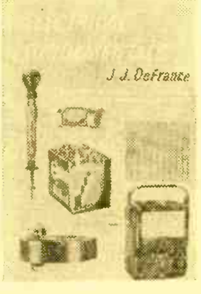
Continued from page 22

matic diagrams are illustrated and described in the sections on each of the 23 chassis covered. You can get your copy by writing directly to the publisher, Tab Books, Blue Ridge Summit, Pa. 17214.

Getting Started Right! Once you have decided to discover the world of electronics, you should kick-off the building of your reference library with *Electrical Fundamentals* by J. J. DeFrance. Although it's a great reference book after you are well advanced, it is a sound and excellent text for a beginner to read and from which to study. To make the subject matter "live" and easy to understand, a conversational style is used, and emphasis is placed on concept rather than mathematical derivations. However, sufficient quantitative information is given to meet the realistic needs of practicing technicians. In this respect, a sound working knowledge of high school basic algebra, and skill in the use of a slide rule are assumed. Numerous "small bit" review questions are given at the end of each chapter to provide a programmed learning. No book teaches everything about any subject. Much remains for the beginner to



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learn on the job or the practice of his hobby. *Electrical Fundamentals* does a great deal in preparing the reader for the practical job ahead. Available at local and college bookstores, or direct from the publisher, Prentice-Hall, Inc., Englewood Cliffs, N. J.

Meters. Here, in one single volume, is the most important and useful tool you can find for working with electronic meters. It's a new book entitled *Handbook of Electronic Meters*. Designed for electronics engineers and technicians, the text provides not only the "how-to" of a great variety of electronic test procedures, but offers detailed, easy-to-follow explanations of the reasoning behind each test. If you have need of any type of electronic meter, this is a handbook without which you cannot afford to be.

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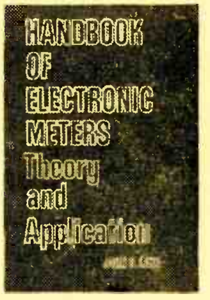

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this handbook is the self-contained aspects of each meter procedure and application, thus eliminating any need for cross-checking data elsewhere in the book. And since every practical, experience-proven application for modern meters is included, this handbook represents not only the most complete one available, but virtually the only one you will need to master the full range of basic modern electronic meter theory and procedure. You can get a copy by writing to Prentice-Hall, Inc., Englewood Cliffs, N. J. 07632.

magnetic BEAM BALANCE

How much does the wing of that fly in the window weigh?

by Thomas R. Sear WA6HOR

How many times have you wondered about that statement that the lowly ant can tote a load more than twenty times greater than his own weight? And, still on that theme, just how much does an ant weigh? Or, as a matter of interest, how does one go about weighing an ant without having to invest a lot of hard-earned cash in a delicate chemical balance? If not the ant, perhaps you have been curious about the weight of a fly's wing, or the weight of one whisker from your new mustache, or, for that matter, any number of things that, for most practical purposes, are so

Magnetic Beam Balance

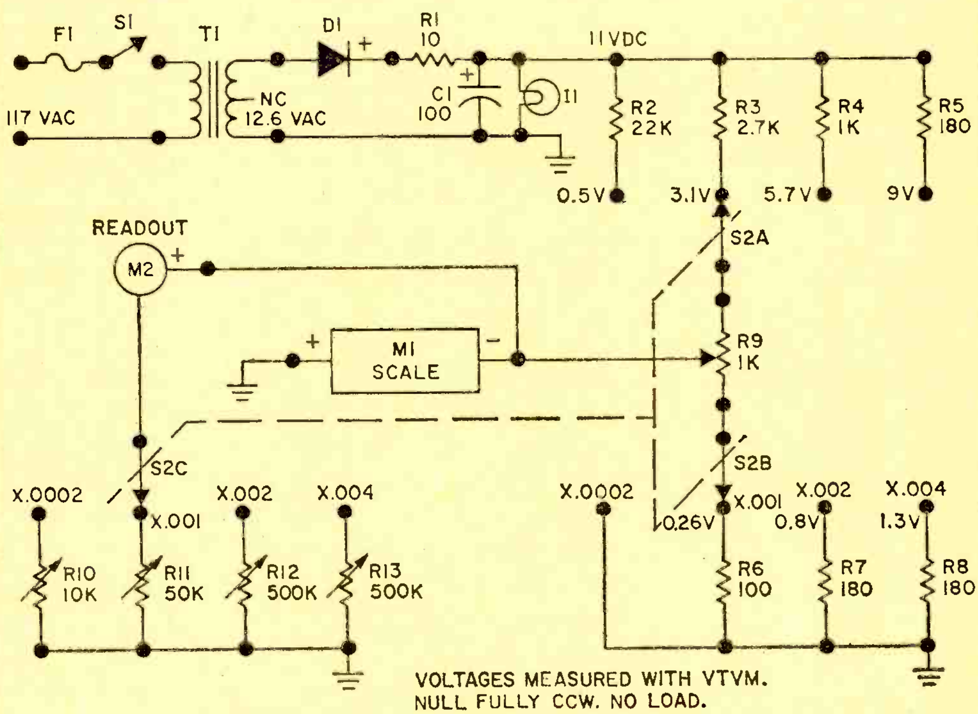
infinitesimally light in weight that they simply can't be weighed on standard scales.

What is needed to weigh items with such small mass is a very expensive, very sensitive and delicate laboratory beam balance. However, sensitive electrical meters and reliable current sources are relatively low in cost and within easy reach of the average experimenter. And, with just a little mechanical dexterity and ingenuity, you can produce an ultra-sensitive device to meet your needs for weighing extremely lightweight objects at a modest cost.

How It Weighs. Our Magnetic Beam Balance or MBB, though quite sensitive, is really a very simple device. If you're familiar with the conventional moving-coil meter movement, you know that its pointer is deflected in direct proportion to the amount of current flowing through its mov-

PARTS LIST FOR MBB

C1—100-uF, 15-VDC electrolytic capacitor (Allied 46A6633 or equiv.)
D1—200-PIV, 750-mA silicon rectifier (Allied 24A9692 or equiv.)
F1—Panel-mounting fuse holder (Allied 57A-3001 or equiv.) with type 3AG, ¼-A, 250-V fuse (Allied 57A3111 or equiv.)
I1—Panel mounting pilot lamp assembly (Allied 60A7781 or equiv.) with 12-V, bayonet base lamp (Allied 60A7361 or equiv.)
M1—0-100-uA, DC meter (Allied 52E8197 or equiv—see text.)
M2—0-50-uA, DC meter (Lafayette 99E50429 or equiv.)
R1—10-ohm, ½-watt resistor
R2—22,000-ohm, ½-watt resistor
R3—2700-ohm, ½-watt resistor
R4—1000-ohm, ½-watt resistor
R5, R7, R8—180-ohm, ½-watt resistor
R6—100-ohm, ½-watt resistor
R9—1000-ohm, 2-watt potentiometer, linear taper (Lafayette 30E80082 or equiv.)
R10—10,000-ohm, 2-watt potentiometer, linear taper (Lafayette 30E80140 or equiv.)
R11—50,000-ohm, 2-watt potentiometer, linear taper (Lafayette 30E80181 or equiv.)
R12, R13—50,000-ohm, 2-watt potentiometer, linear taper (Lafayette 30E80249 or equiv.)
S1—Spst toggle switch (Lafayette 34E33026 or equiv.)
S2—3-pole, 4-position rotary switch (Lafayette 30E40185 or equiv.)
T1—Filament transformer: primary 117-V, 50-60-Hz; secondary 12.6-V @ 1.5-A (Allied 54A4136 or equiv.)
1—8 x 12 x 3-in. aluminum chassis (Lafayette 12E82128 or equiv.)
1—8 x 12-in. aluminum chassis base (Lafayette 12E83050 or equiv.)
Misc.—Hookup wire, hardware, solder, knob, rubber feet, etc.

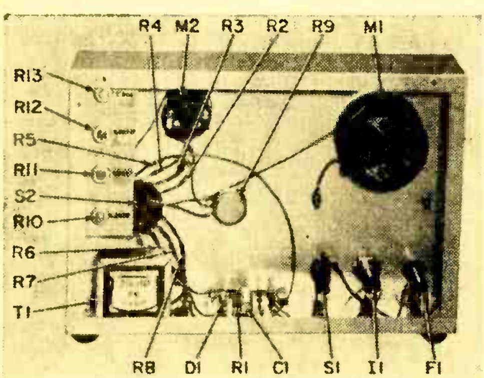


ing coil, which is attached to the pointer. The coil is suspended in a fixed magnetic field and is mounted on jeweled pivot bearings to reduce friction to a minimum. Except for the pull of the hair-spring, used to return the pointer-and-coil assembly to an established zero point when no current is flowing, this assembly has very little mass. As a result, it's easily deflected from the zero position by small increments of current flowing through the coil.

What we have done is to mount a moving-coil meter movement (M1) 90 deg. off its normal mounting axis so that the pointer is in a horizontal rather than the normal vertical position. The tip of the pointer has been modified so that it can serve as a platform on which the object to be weighed can be placed. In addition, we added limit pins to restrict movement of the pointer over a narrow range after first mechanically adjusting the normal zero-rest position to mid scale. An arbitrary true zero is established by placing a mark on the meter face plate that is midway between these two limit pins.

This meter movement is wired in series with a relatively constant source of DC, a potentiometer to adjust the current flow, and a microammeter which acts as a voltmeter to measure the amount of voltage developed by the flow of current during the weighing process.

Standard Weighing Charts. The fly's wing, mustache hair, or whatever low-mass object is to be weighed, is placed on the weighing platform. This, of course, causes physical displacement of the pointer below the newly established zero rest point. When the null potentiometer (R9) is adjusted to restore the pointer to the arbitrary true zero point, a reading is taken on M2. What actually has occurred is that the electromagnetic force, created by the current flowing through the moving coil, is adjusted so that when the pointer (weighing platform) is back to the zero point, it just balances the mass of the material being weighed. By correlating current readings with standard weights a chart can be prepared so you know exactly what weighs what.



View of MBB innards showing simple layout. There's plenty of room here to make a neat wiring job; note that most resistors and capacitors are supported by their own leads.

You can purchase sets of standard weights having very small mass from most laboratory supply houses (e.g., Edmund Scientific, Fisher Scientific). These can be used to establish your weighing chart. Tabulate the current reading you get for each increment of the standard weights in creating your chart. You can, of course, combine individual weights to arrive at a weight equal to the unit increment you have established for your chart. The MBB is designed to be adapted to many weight ranges by changing the range of the electrical readout. The range switch switches the appropriate multiplier into the circuit to permit higher current readings. These represent heavier weights, as read on meter M2.

Building the MBB. We housed our MBB in an 8 x 12 x 3-in. aluminum chassis fitted with a bottom plate. We used aluminum to make it easier to cut out the openings for the two meters. The overall layout isn't critical. The one we used, however, is very convenient for interwiring the components, so we suggest you follow it—unless you feel that you would prefer to design a layout more adaptable to your specific applications of the MBB.

The only part of the construction that does test your dexterity is the modification to the moving-coil meter movement to convert it to a weighing platform.

Making the Weighing Platform. Once all of the holes have been drilled in the chassis, the parts have been mounted and wired and you have completed everything but the installation and hookup of M1, you should proceed to modify the meter so that it can be used as your weighing platform.

We purposely selected a meter that has the protective glass cover mounted separately in the bezel in order that it could be removed easily without destroying the bezel. The glass must be permanently removed to provide access to the weighing platform.

Incidentally, the cost of the meter specified in the Parts List is quite high when pur-

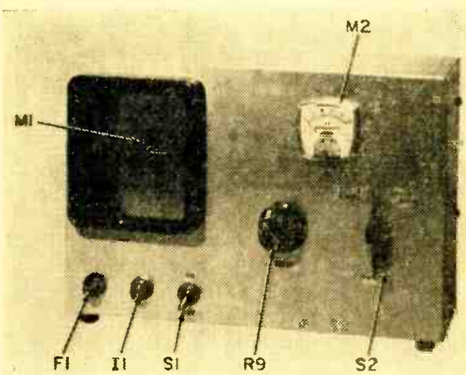
Magnetic Beam Balance

chased new and used just for this one project. Since you'll have to remove the protective glass from the meter bezel and also bend the pointer, the instrument will probably be unsatisfactory for any other project you may want to try. Therefore, we suggest you try to pick up a used one in order to hold the cost of the project down.

Since the calibrated scale that comes with the meter is meaningless for our MBB, we suggest you remove the scale and replace it with a blank piece of metal or plastic of the same thickness and shape as the original; alternatively, you can reverse the original scale so that its blank side is facing out. Make a mark in the center of the arc that the pointer follows when moving across the scale. Cut two pieces about ½-in. long from an ordinary straight pin and cement one about ½ in. above and below the center mark.

Before replacing the bezel on the meter case, move the lever that controls the zero positioning of the pointer assembly until the pointer rests mid-scale when no current is flowing. Incidentally, when putting the scale back onto the meter movement take care that the pointer can move freely between the two limit pins that have been installed on the face plate.

The final step before mounting and wiring this meter is to bend the pointer so that the arrow head on its free end is perpendicular to the face plate. This then becomes the platform on which material to be weighed is placed. Make certain that the arrowhead platform doesn't rub against the face plate, otherwise any readings you make will be inaccurate.



Business side of MBB shows M1 containing platform to hold material to be weighed. Always make certain that platform and material do not rub against M1's faceplate.

Adjusting the MBB. Now that you've completed construction and checked for any wiring errors, you're ready to adjust the assembly to ensure accuracy in weighing. A VTVM (or the Hi-Fet Voltmeter described in the January/February 1970 ELEMENTARY ELECTRONICS) should be used for these adjustments as you will be dealing with critical circuits that could be affected by the relatively low resistance of a conventional VOM. Before applying power to the MBB, place the null control (R9) in a full counterclockwise position and set potentiometers R10, R11, R12, and R13 at midpoint. Remember, always begin every new range adjustment with the null control in the full counterclockwise position.

Connect the VTVM between the arm of R9 (+) and the chassis (−) of the MBB. Use a low voltage scale of the VTVM. Set the range switch (S2) to the X.0002 position, turn *on* the power and adjust the null control until the VTVM reads 0.29 VDC. Then adjust R10 until M2, the 50-μA meter, reads full scale. You may find some interaction between R9 and R10; if so juggle the two until you get the VTVM reading of 0.29 V with M2 reading full scale.

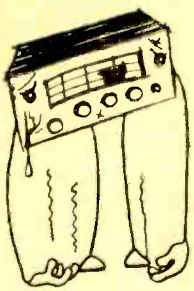
Once you've adjusted this range, proceed to the X.001 range and follow the same steps—except that the VTVM should now read 2.0 V and you will adjust R11 along with R9 instead of R10. You can expect the same possible interaction between R9 and R11 that you experienced between R9 and R10.

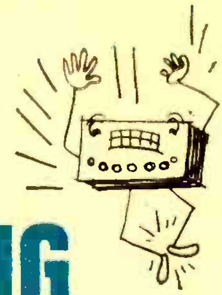
The other two positions of the range switch are adjusted in exactly the same manner. When adjusting the X.002 range the VTVM should read 4.1 volts and when adjusting the X.004 range it should read 8 volts. R12 is used for the X.002 range and R13 is used for the X.004 range. Once each range has been adjusted and the VTVM has been disconnected, it's a good idea to move the range switch to each position to make certain that M2 can be set to full scale by rotating R9, the null control, for each range switch setting.

Using MBB. Now that you have adjusted the various ranges, how do you use MBB to weigh a fly's wing or an ant or any other

(Continued on page 108)

Rejuvenate that old rig for a SHACK ON A SHOESTRING





Old communications receivers often go abegging. And wise is the man who knows a bargain when he sees one.

by Joseph J. Carr

☐ Even a quick, nonchalant glance through electronics catalogs often nips novice SWL and ham aspirants in the bud. Prices generally range from $200.00 up for a decent, general-coverage shortwave receiver. The fellow on a limited budget (and who isn't these days?) will have to make a substantial sacrifice if he wants to break into the amateur radio or SWL fields—or will he? Though little can be done for the newcomer absolutely lacking in electronics knowledge, the person with a few basics under his belt (or perhaps, a lot of self-confidence) can save himself a pile of money by reconditioning an old receiver.

The receivers under consideration are those that were, in their day, the mainstays of amateur, commercial, and military communications. The three main manufacturers of communications receivers during the 1935-1950 era were Hallicrafters, Hammarlund, and National. There is still a surprisingly large number of receivers by these firms stuffed under workbenches, lying in attics, or just gathering dust in somebody's ham station; they surface but rarely, and then only for an occasional hamfest auction or classified listing.

Except for a few units subject to a form of "my first . . ." nostalgia, most can be purchased for under $50.00. It is even possible to find one available on a "get-the-darn-thing-outa-my-way" basis. Quite often, the only reason for them being discarded was the much more exacting requirements of modern, single-sideband operation, or possibly the snob appeal of a shiny, new Super Inhaler Mark X. Thing is, the National HRO and NC series, the Hammarlund Super Pro line, and the venerable Hallicrafters SX-28 can all be given a new lease on life (plus additional years of service) by following the procedures we're about to outline.

During the preliminary stages of buying an old receiver, it's wise to look into several aspects of its condition. Of course, if it works and isn't beaten half to death, it's probably in reasonably good shape. However, look for . . .

√ Mechanical Condition. You probably wouldn't want to attempt to repair a rig that's been rolled down the side of a mountain, so be wary of a "bargain" that is badly bent up or otherwise mutilated. Look at the paint job for signs of excessively rough handling. Be aware, however, that you aren't likely to find one in factory-new condition. Even so, it's sort of a truism that a well-taken-care-of unit will appear to have been well taken care of.

√ Missing Parts. It may prove impossible to locate replacements for some of these, so beware! Missing components may indicate either a prior repair attempt that was aborted, or the fact that the piece has been cannibalized. Either case is liable to make restoration a lot bigger headache, perhaps bigger than the receiver is worth.

√ Evidence of Burning. Nobody who has been exposed to the acrid stench of an overworked or shorted transformer is ever likely to forget it. This stench, which is noticeable even to the uninitiated, is often faintly detectable for years after the burning took place.

SHACK ON A SHOESTRING

Another clue to a burned-out transformer is the presence of a dark brown to black mess congealed on surfaces close to or beneath the suspect part. If either clue is present, use your own judgment. Transformers can usually be replaced with a new substitute, even if an original replacement is no longer available.

Once you have your set, hold off on restoration until you're at least partially familiar with it. If the previous owner failed to supply an instruction manual, try a few other sources. A letter to the manufacturer (plus a nominal fee) may be all that's necessary to acquire a manual. If this fails, try Sams Photofacts, the Rider books, or (in the case of military sets) the various surplus conversion books on the market. A lot of aggravation can be saved by this procedure.

After all is readied, try and work up a plan of action. If the work is layed out in advance, there is less possibility of skipping some vital portion of the process.

✓ Getting Started. First, take the receiver out of its cabinet and set it on the work bench or table. Place all screws and other small hardware in a paper bag or other suitable container, and put it in a safe place. When this is accomplished, remove all the dust and accumulated crud with a small paint brush or vacuum cleaner.

Second, remove all tubes for testing. If you have a tester available, this should be done on a one-by-one basis. Otherwise, mark each tube and make a diagram showing where each tube came from. Don't overlook the possibility that they may have been placed in the wrong sockets during a previous repair attempt. Some receivers have the tube numbers printed or stamped on the chassis close to the sockets. Sometimes a tube layout chart can be found on the chassis, cabinet, or covers. If a manual is available, it will probably contain such a chart. In most instances, the emission—type tube testers found in drug stores, etc., will suffice, though the mutual-conductance grid-emission type tester is generally far superior. Most TV repair shops will test your tubes on such equipment either free or for a small fee. When this test is completed, and bad tubes replaced, return all tubes to their respective sockets.

Next, obtain an aerosol can of control/switch contact cleaner, and a tube of white grease such as *Lubriplate*. Squirt cleaner into all potentiometers (AF gain, RF gain, etc.) and rheostats. After spraying a control, run it vigorously back and forth through its range several times. When the controls are finished, start on the switches. On the rotary types (the main rotary switch may be hidden inside a metal shield box), spray each wafer on both sides. As with the controls, run switches through their range several times.

Switch bearings, shafts, and bearing plates should be cleaned thoroughly and lubricated with white grease. Variable capacitors often have a leaf-spring grounding wiper at one or both ends of the rotor shaft. These and their respective contact surfaces should be cleaned to a bright luster. They should be free of dust, dirt, corrosion, and grease because this is often the only method for grounding the rotor shaft.

When this preliminary maintenance has been performed, the set will be ready for ar "air test." If the receiver operates properly, there is, of course, no cause for any furt ıer

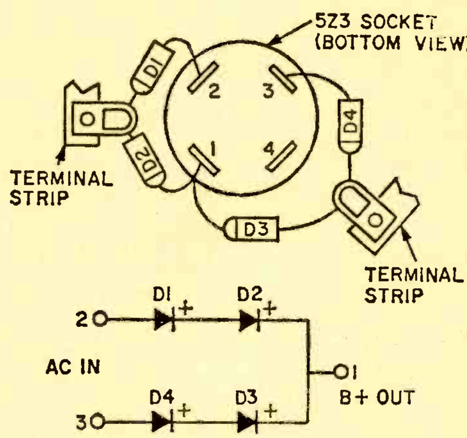


Fig. 1. Above and right, two ways to use silicon diodes to replace obsolete 5Z3 rectifier. All diodes are 800 PIV, 1 A types; resistors R1, R2, R3, and R4 at right are 470k, ½-watt units; resistors R5 and R6 are 1-ohm, 2-watt units; capacitors C1, C2, C3, C4 are standard .001-uF, 1000-V ceramics.

RECOMMENDED RECEIVERS FOR REJUVENATION

Hallicrafters: S-40, SC-28*, SX71
Hammarlund: HQ-120, HQ-129*, HQ-140XA*, SP-600* ("Super Pro" line)
Military: BC-342*, BC-348*, BC-779, BC-794, BC-1004, SP-600
National: HRO-5, HRO-7, HRO-50*, NC-183D*

* Indicates preferred types

troubleshooting. Even so, there is probably pressing need for a substantial amount of preventive maintenance to eliminate the necessity for troubleshooting in the near future.

√ Wires and Leads. Wires that are excessively corroded or whose insulation is dry rotted, cracked, or brittle should be replaced. Good quality hookup wire of the same gauge as the original should be used.

√ Electrolytic Capacitors. These components have an ornery reputation for age-induced failure. Because of this, they should be replaced as a standard procedure. Get a top-quality universal replacement as close as possible to the original. Note of caution: Capacitors can store a charge for lengths of time sufficient to induce carelessness into the unwary worker. Always bleed off a capacitor with a suitable resistor (say 47k) touched between positive and negative leads *before* starting work.

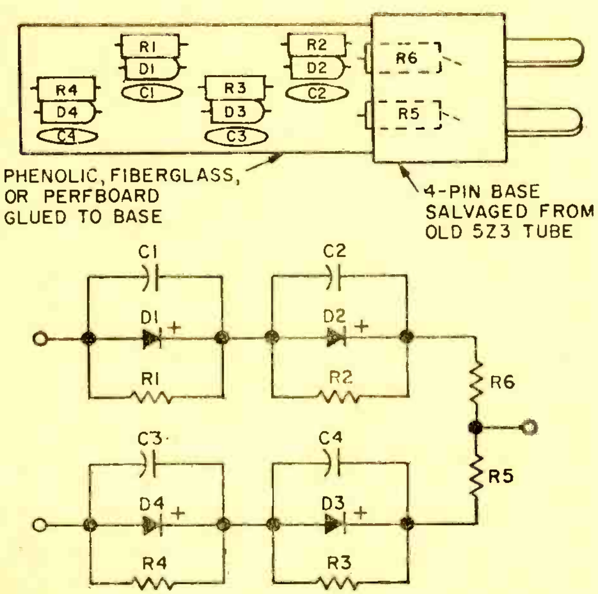
√ Small Capacitors. Any capacitor can develop leakage resistance or short out entirely. If DC voltage is passing through the capacitor, or if an ohmmeter indicates leakage resistance, then the capacitor should be replaced. If the capacitor is swollen, or has the ends broken out, replace it regardless of what a leakage check shows. Mica and ceramic capacitors should be replaced with equivalent parts; paper capacitors, however, are best replaced with the more modern mylar units.

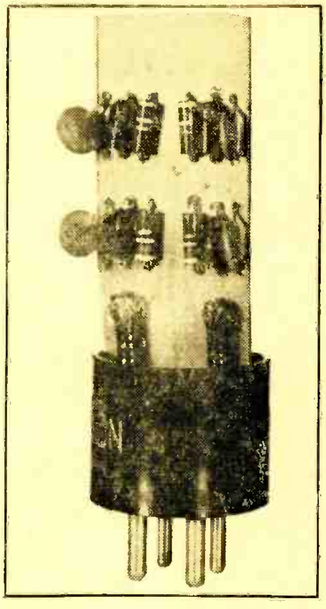
√ Fixed Resistors. Heat, humidity, and (so say wizened old pros) the occult powers cause carbon composition resistors to change value. An old resistor color coded for, say, 100,000 ohms may actually be closer to 1,000,000 ohms after all these stresses have taken place. Discolored, swollen, burned, or cracked resistors are best replaced, as any resistor that causes a voltage drop larger than is called for by the schematic. It's quite possible for a resistor to change value and still give no outward signs.

√ Controls and Switches. Any control or switch that fails to operate properly after cleaning is a prime candidate for replacement. The most common symptom is an unusual amount of noise or static when the part is operated. Fortunately, switches of all kinds are normal stock items at most electronics parts stores.

As for controls, even the most odd-ball units can be made up by using one of universal assembly kits put out by most of the resistor manufacturers. A good parts store will carry these items, and most will assemble them for you. Rotary switches will probably have to be specially ordered. As for the master bandswitch, better let a person with loads of experience handle this one.

√ Obsolete Parts. One of the things that is likely to make you want to throw in the towel is finding, after all that work, that a bad part is obsolete and no longer available. For instance, have you tried lately to find a 5Z3 rectifier for an SX-28 receiver? Some dealers still carry them, but they are a precious few. (*Turn page*)

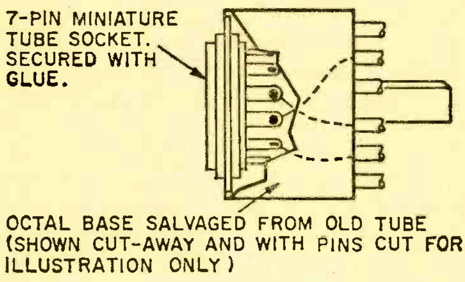




SHACK ON A SHOESTRING

Two alternatives present themselves in this case: change the socket of the obsolete rectifier with the type socket used by a more modern type (a 5U4-GB, say), or use silicone diode rectifiers. Figure 1 shows two ways to use silicon diodes in place of a 5Z3 tube rectifier. The version on the right is to be preferred because of the extra protection it affords the diodes.

Fig. 2. Best way to deal with problem of old, obsolete tubes is to replace them with new, miniature types. As pointed out in text, most octal tubes have 7- or 9-pin miniature equivalents, so finding a replacement is ordinarily duck soup (just consult a tube manual or, better yet, a tube substitution guide). Home-made adaptor, pictured here works fine.



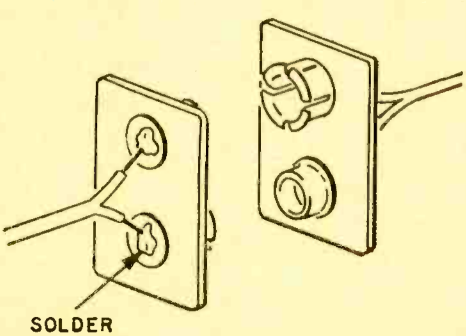
Other tube types can be replaced either by finding a direct substitute (consult one of the guides published for this purpose), or by using a newer type. This may require changing the socket or using an adapter. Figure 2 shows an adapter for replacing the old-fashioned octal socket with a standard 7-pin miniature socket. Consulting a tube manual will often reveal which still available type is electrically similar to the type you wish to replace. For example, the octal-base 6SG7 remote cutoff pentode is close to the 6BA6, just as the 6SA7 pentagrid converter is close to the 6BE6. Such equivalent types can be used interchangeably in most applications.

IF transformers can be particularly sticky problems. If they have one of the standard configurations, however, the coil/transformers manufacturers may still supply them. Several of these companies still list the old, large-style IF transformers in their current catalogs. If the price is too high, or a particular type is simply not available, then try using one of the smaller ("miniature") types that have become standard. Most manufacturers can supply adapter plates already cut for the newer IF's. These can be bolted or soldered over the gapping hole left when the old transformer was removed.

Naturally, you'll have to watch terminal connections carefully to ensure the new unit is hooked up properly.

As we've already cautioned, most power and audio transformers can be replaced with standard substitutes. Even if the mechanical arrangement isn't the exactly the same, it should produce few problems. This type of substitution is often only a matter of matching up specifications and mounting styles in a parts catalog. ■

Handy, Self-Polarizing Connector



☐ Next time you're in need of a two-post connector for a pair of speaker leads or a quick-disconnect plug for a transistor-equipment power supply, give this idea a try. Just pull a couple of dead 9-V transistor radio batteries out of your wastebasket and carefully remove their terminal strips. Put what's left back in the wastebasket again and take a good look at the handy, self-polarizing connector you've just concocted. Plug one into the other, solder up the appropriate leads, and give yourself a pat on the back for good old ingenuity. No reason to color-code for polarity, either—this one is self-polarizing, remember? —*Bob Stephens* ■

SUPER STABLE RECEIVER

Lets you eavesdrop on aircraft communications as well as on the 2-Meter ham band

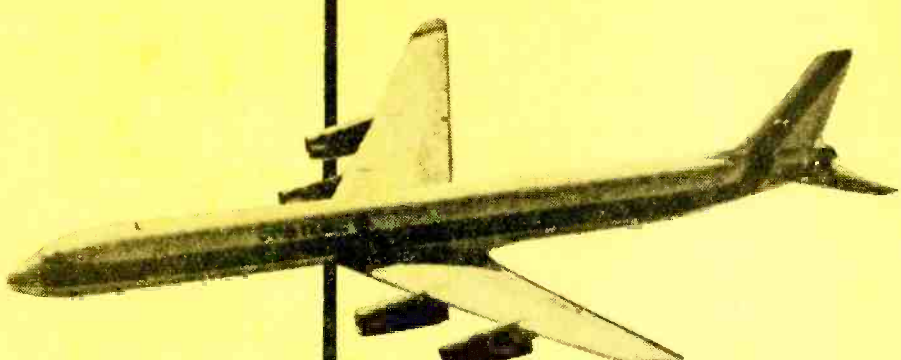
by Robert E. Kelland

SINCE AIR-TO-GROUND communications is in the vhf band, radio listeners are evidencing an increasing interest in this band.

Our project covers a receiver tunable over the normal 117 to 150 MHz aircraft band and also the 2-Meter amateur band. Though the basic receiver includes an AC power-supply for operation from nominal 117-V, 50-60-Hz power lines, it can be operated as a portable receiver from a standard 9-V transistor radio battery.

This receiver is comprised of three sections: a superregenerative detector, an audio amplifier, and an AC power supply. It is completely solid-state and quite stable. The detector employs a pnp-type GE-9, RF transistor that is readily available from most supply houses. To let the constructor experiment with different transistors we used a standard transistor socket so that different transistors can be plugged into the socket when experimenting to find other suitable transistors for the circuit.

Signals picked up by the antenna are coupled to the tuned circuit, comprised of L2-C1 through primary winding L1. They



SUPER STABLE RECEIVER

are then fed to Q1 where they are amplified and detected. Superregeneration, which accounts for the tremendous amplification of the circuit, is controlled by varying capacitor C5.

The audio signal, produced by the detection function of the circuit, is coupled to a separate, prefabricated audio amplifier through transformer T1.

The low-voltage power supply is regulated by means of a Zener diode (D2) to maintain 9 VDC. It's necessary to use a regulated power supply in order to prevent instability in the superregenerative portion of the receiver.

Construction. We built the receiver on a 5 x 7 x 2-in. aluminum chassis with a 5½ x 7 x 1/16-in. front panel. The power supply and audio amplifier nearly fill the space on the underside of the chassis. Most of the components in the basic superregenerative circuit, with the exception of the regenerative control C5 and L3, are mounted on the top of the chassis. L3 is self-supported by its leads which are connected to C5. C5, in turn, is fastened to the underside of the chassis through a small right-angled bracket. The socket for Q1 and components L1, L2, C2, C3, and R1 are mounted on a 1½ x 1-in. piece of perf board which is fastened to the top of the chassis by means of a small right-angled bracket. Both C1 and C5 have insulated mounting inserts to isolate these capacitors from the common chassis ground and still allow them rigid mounting to their respective bracket assemblies.

A capacitor, referred to in the schematic as "gimmic" C is made by soldering ½-in. lengths of insulated hookup wire to the collector and emitter pins of the transistor socket and then twisting the free ends together for a turn or two.

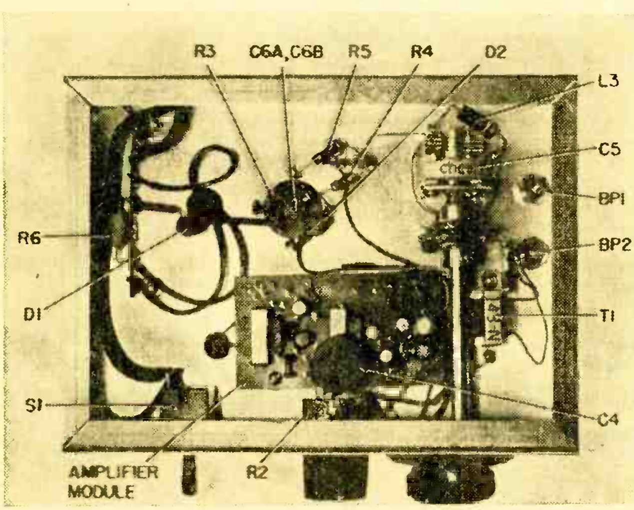
Insulated, flexible couplings were used to isolate the variable capacitors from their respective tuning knobs, to prevent any receiver instability that may be created by hand capacity when adjusting the receiver. Straight through, insulated bushings can be substituted for the flexible couplings.

The location of components making up the superregenerative detector portion of the circuit is critical. We suggest you follow the layout as seen in the photographs. The power supply and audio amplifier section isn't critical and therefore can be laid out in a plan that best suits your desires. All leads should be kept as short and direct as possible.

Coil Making. L1 is made by closely winding three turns of 20-gauge insulated hookup wire into a self-supporting coil ½-in. in diameter (see photo). L2 is made by winding 2½ turns of #12 AWG bare copper wire within a length of ½ in. Diameter of the windings should be ½ in. Adjustment of the spacing between turns may be necessary to set the desired frequency. Coil L2 is self-supporting and is mounted directly on capacitor C1.

L1 is self-supported by mounting it directly to the two input binding posts (BP1 and BP2), both of which should be insulated from the common chassis ground.

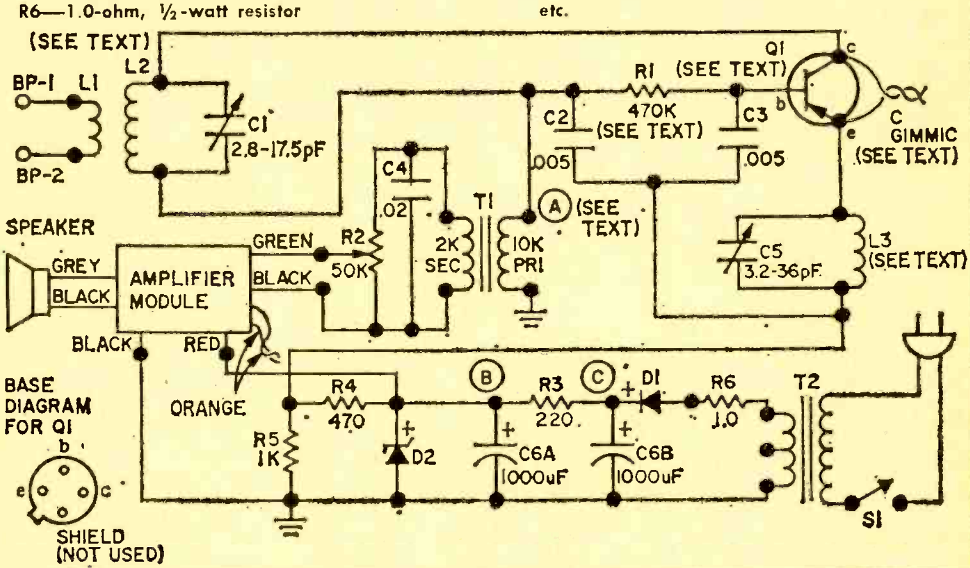
L3 is made by winding 18 turns of #30 AWG enameled copper wire around the insulated form of a very high resistance 1-watt carbon resistor. The ends of the coil are soldered directly to the resistor pigtail.



Note complete amplifier module mounted on underside of chassis. Location of this module isn't critical. However, be certain position of superregeneration components C5 and L3 is exactly as shown. Electrolytic is just left of center.

PARTS LIST FOR SUPER STABLE RECEIVER

B1—9-V transistor radio battery (Lafayette 32E48077 or equiv.) (optional—see text)
BP1, BP2—5-way, red binding post (Lafayette 99E61202 or equiv.)
C1—2.8 to 17.5-pF variable capacitor (Lafayette 40E28817 or equiv.)
C2, C3—0.005-uF, 75-V ceramic disc capacitor (Lafayette 33E69048 or equiv.)
C4—0.02-uF, 75-V ceramic disc capacitor (Lafayette 33E69063 or equiv.)
C5—3.2 to 36.0 pF variable capacitor (Lafayette 40E28825 or equiv.)
C6A, C6B—1000-1000 uF, 15-VDC dual electrolytic capacitor, Sprague TV6-2160 (Allied 43A9120 or equiv.)
D1—750-mA, 400-PIV silicon diode (Lafayette 19E50021 or equiv.)
D2—Zener diode, 9.1-V, 1-watt Motorola HEP-104 (Lafayette 19E54056 or equiv.)
L1—Coil, made from #20 insulated wire—see text
L2—Coil, made from #12 bare copper wire—see text
L3—Coil, made from #30 enameled copper wire—see text
Q1—Pnp RF type transistor, GE-9 or Motorola HEP-3
R1—470,000-ohm, ½-watt resistor
R2—50,000-ohm, linear taper potentiometer (Lafayette 33E12634 or equiv.)
R3—220-ohm, ½-watt resistor
R4—470-ohm, ½-watt resistor
R5—1000-ohm, ½-watt resistor
R6—1.0-ohm, ½-watt resistor
S1—Spst toggle switch (Lafayette 34E33026 or equiv.)
S2—Spdt toggle switch (Lafayette 34E33059 or equiv.) (optional—see text)
T1—Interstage audio transformer: primary 10,000 ohm; secondary 2000 ohm (Lafayette 99E61244 or equiv.)
T2—Filament transformer: primary 117-V, 50-60 Hz; secondary 12.6 V @ 2 amps. (Lafayette 33E81191 or equiv.)
1—Amplifier assembly, transistorized push-pull output @ 100 mW into 8-ohm speaker (Lafayette 99T90425 or equiv.)
1—AC line cord (Lafayette 12E39011 or equiv.)
1—5 x 7 x 2-in. aluminum chassis (Lafayette 12E81955 or equiv.)
1—3-in. diameter, 8-ohm voice coil speaker (Lafayette 99E60329 or equiv.)
1—Transistor socket (Lafayette 32E42211 or equiv.)
1—2-in. diameter, 8 to 1 ratio vernier dial (Lafayette 99R60303 or equiv.)
Misc.—Bolts, nuts, grommets, perforated metal, 5½ x 7 x 1/16-in. aluminum sheet for panel, perfboard, aluminum right angle for mounting brackets, tie strips, flexible couplings, ¼-in. bushings, hookup wire, solder, scraps of #12 gauge bare copper wire, #20 gauge solid insulated wire and #30 gauge enameled wire to make coils L1, L2, L3, knobs, press-on letters for marking panel, 300-ohm twin lead for antenna, etc.



L3 is then self-supporting when mounted directly to C5. Use a rubber grommet to protect the leads from L3-C5 as they pass through the chassis from bottom to top.

The audio volume control (R2) is centered on the front apron of the chassis. The prefab audio amplifier is mounted on the underside of the chassis so that leads between the amplifier and volume control are short in length. Raise the amplifier about ¼ in. above the metal of the chassis with spacers to prevent shorting out the circuit board.

The power switch (S1) is also mounted on the front apron of the chassis to balance the controls. All other components of the

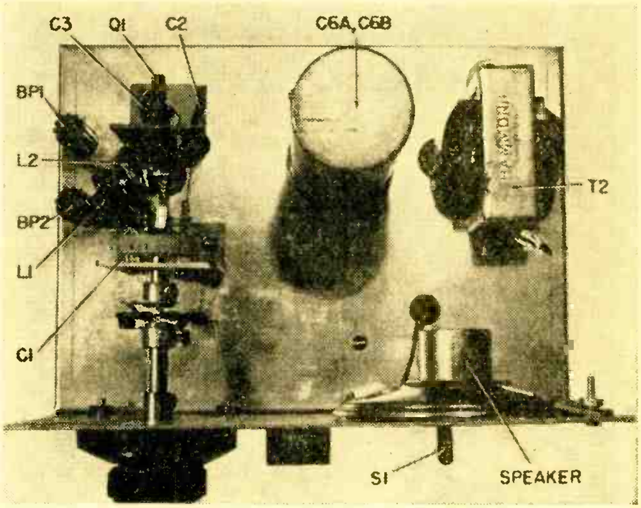
SUPER STABLE RECEIVER

power supply, with the exception of the power transformer T1 and filter capacitor C6A & C6B, which are mounted on the top of the chassis, are fastened to tie strips mounted on the underside of the chassis.

The speaker is mounted on the front panel. We made a simple grille by backing with perforated metal, two rows of ⅝-in. diameter holes drilled perpendicularly in the form of a red cross. You may have other ideas for a grille so don't necessarily stick to our pattern.

Be sure all electrolytic capacitors and diodes are properly polarized before soldering them into the circuit. Check the wiring for errors before turning on the power.

Checking and Aligning. Now that you are certain that the hookup is correct you are ready to turn *on* the power and align the receiver.

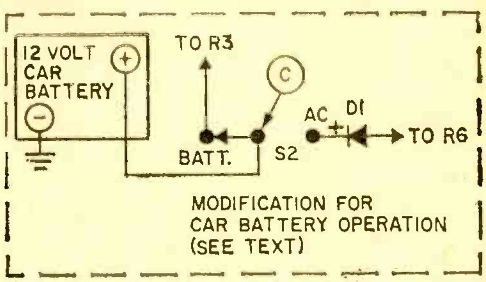


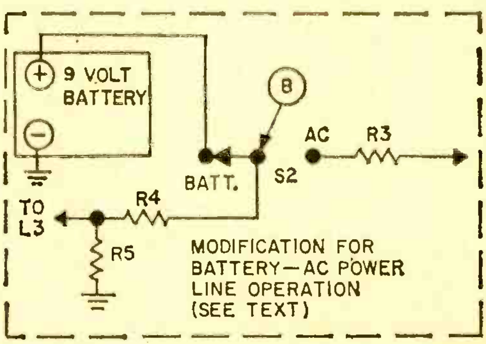
Top side view of chassis shows simple arrangement of components. Grouping at left are tuning units; T2 is at right.

When you first turn *on* the power you should hear some evidence of audio output, which may be in the form of noise. Note changes in the tone of this noise by adjusting the regeneration control (C5). There will be a soft rushing sound, *sans* low-frequency hum, at one setting of this control. When this point is reached, the receiver will be set at its most sensitive condition.

You now leave this control set at this point and tune the receiver over the band. You should be able to tune in transmitters operating in the band. Variations in transistors and other components as well as your actual construction work may affect the receiver to the extent that the regeneration control (C5) may have to be reset at least once over the full tuning range of the receiver. As you operate the receiver you will gain knowledge as to where the best settings are to cover specific portions of the tuning range.

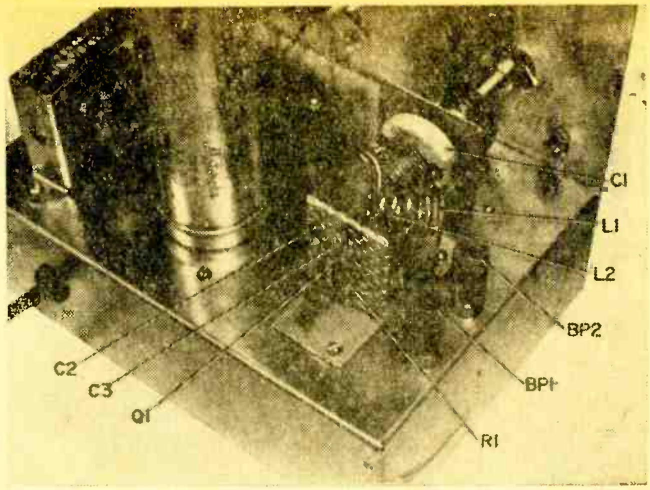
It's suggested that you make a notation of the dial setting for each station received, and also note the station's frequency. From this you can produce a calibration chart or curve covering the entire band. Remember, to a certain extent, the dial setting can be affected by the adjustment of the regeneration control, so it would be wise to note the setting of the regeneration control for each





Upper schematic details modification for operating receiver from your car battery. Spdt switch S2 will facilitate transfer from built-in power supply to car battery. Lower schematic shows similar modification to adapt receiver for portable battery operation. Standard 9-volt transistor radio battery should be used.

Heart of Super Stable receiver is, except for regeneration control, shown. Note positioning coils and circuit card.



dial calibration. Another cause for variation in the original calibrations could be a change in transistor Q1.

Base-bias resistor R1 may require a change in value to suit the particular transistor being used. The value of R1 should never be less than 100,000 ohms to prevent damage to the transistor. You may arrive at a correct value by the cut-and-try method of substituting different values and checking the performance of the receiver or you can arrive at the correct value by measuring the collector current flow. Open the lead of T1 at A on the schematic and insert a 0-5 mA milliammeter. The best value for R1 will produce a current flow of between 0.5 to 3.0 mA, depending on the characteristics of the transistor used.

Antenna Recommendations. At these frequencies antenna design is somewhat critical to ensure maximum signal strength being fed to the receiver.

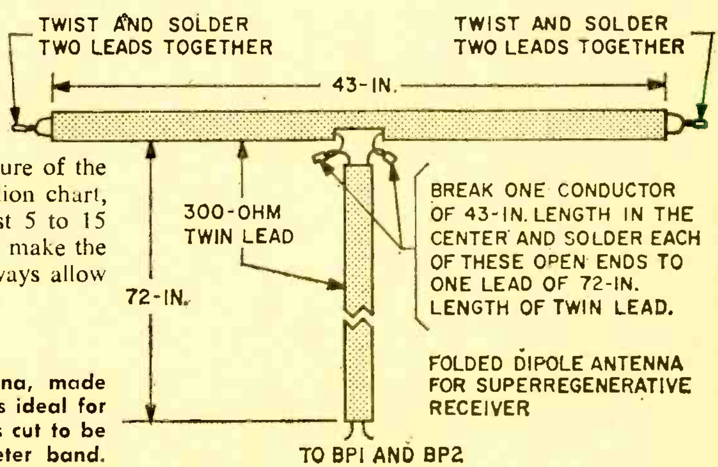
Obviously best results will be obtained by using a commercially-built antenna designed for this frequency band. A ¼- or ½-wave whip antenna will be satisfactory only for receiving strong signals.

You can make an antenna that will be quite satisfactory. Just follow the dimensions and construction details shown in the drawing for a folded dipole antenna. This antenna may be supported by pinning the ends to a wall, using small wire brads.

A closing hint: to be sure of the accuracy of your calibration chart, allow the receiver at least 5 to 15 minutes before starting to make the calibration chart, and always allow the receiver to warm up before using the chart once it's been made.

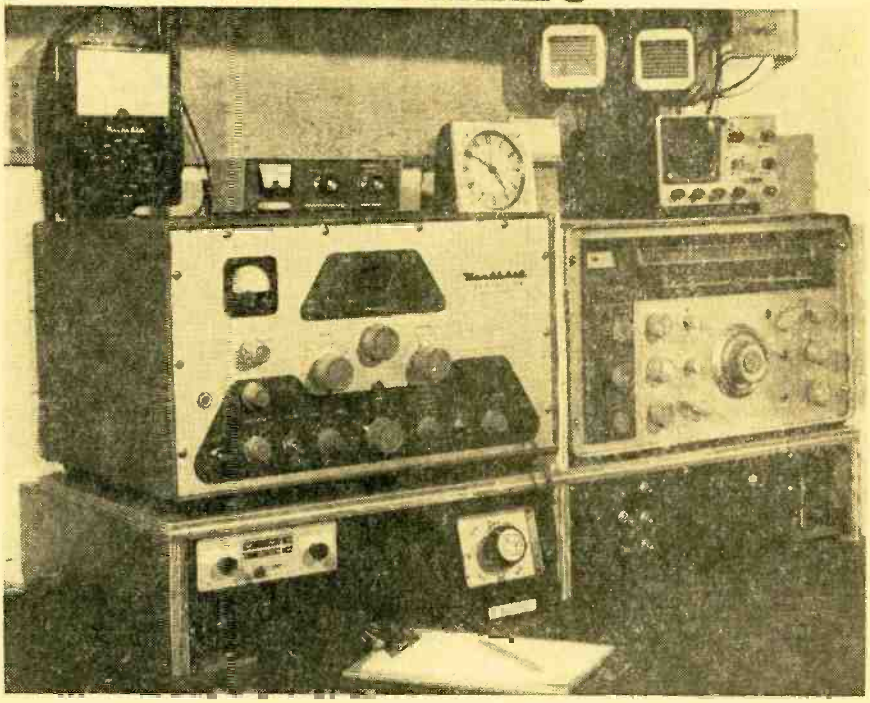
In the event you want to operate the receiver from a 9-V battery, all power supply components up to point B in the schematic are not required and battery + is connected at this point. If, by chance, you operate the receiver from your 12-V automotive battery, R3 will be required and auto battery + is connected at point C. The value of R3 may have to be increased to hold the voltage applied to the Zener diode (D2) to a safe level to prevent its destruction.

You may want to build the receiver for both battery and AC power line operation. By placing an spdt switch at point (B) when using a 9-V transistor radio battery or point (C) when using a car battery, the receiver can be switched to operate either on the AC line or from a battery. See schematic drawing for details. ■

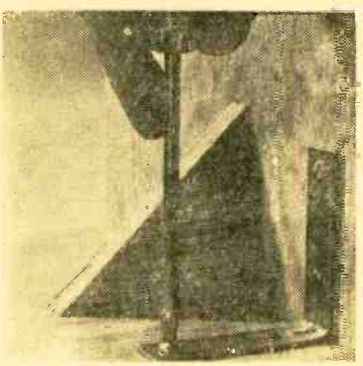


This folded dipole antenna, made from 300-ohm twinlead, is ideal for use anywhere indoors. It's cut to be used in the aircraft/2-Meter band.

Operation Face-Lift



Convenience is the keynote in this custom platform for your shack

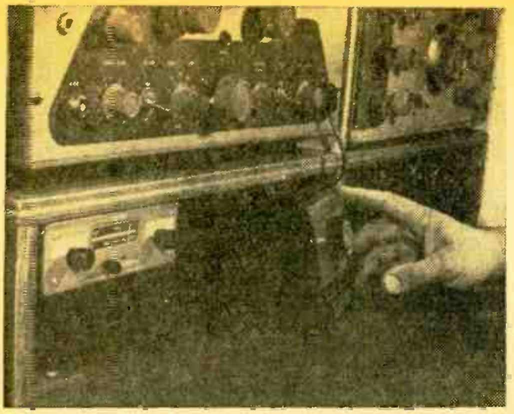


Gear can be weighty, so strive for rigidity when constructing your platform. Angle brackets and wooden braces will turn the trick —use both screws and glue on wooden braces for extra strength.

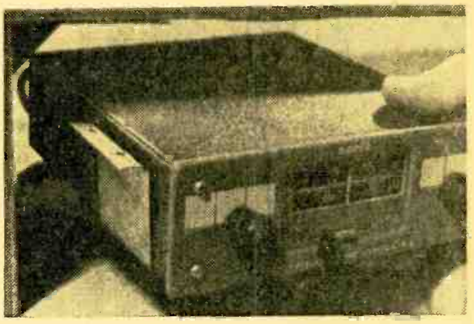
☐ DXers, SWLs, novice hams can give their hobby a lift by hoisting it up on an operating platform similar to the one pictured here. Construction is easy and economical, and the benefits and convenience certainly balance out the small amount of time required for construction. In fact, this simple accessory, tailored to your needs, can easily multiply the usefulness and enjoyment you receive from all your other equipment.

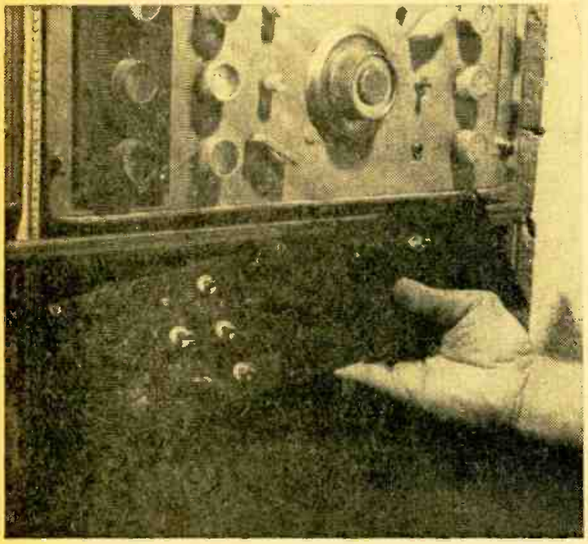
Need for this accessory is usually spawned by normal growth of the radio shack inventory. Just about the time the radio hobbyist acquires his third or fourth major piece of equipment, he begins scratching his head in bewilderment over where to put all the gear. By this time, the radio table is becoming overburdened and it's easy for the hobbyist to give in to inconvenient stacking of one piece of gear on top of another. The result is inconvenient at best, and sometimes just plain dangerous.

An operating platform, however, eliminates these



Far left, typical operating platform. It allows addition of considerable equipment to basic station, yet takes up no more table space and succeeds in keeping everything handy for use. Left, measure highest item you intend to place under platform top (it's a beam rotor control box in our photo), then make supports for platform top about ¼-in. higher than selected item. This way, everything should fit beneath shelf without problems.





Left, panel for switches controlling various items of equipment can be made from medium-gauge steel or aluminum, painted for pleasing appearance, then mounted beneath operating platform on angle brackets attached to underside of platform top. Above, small pieces of equipment, such as this aircraft receiver, can be attached to bottom side of platform top with mounting straps made of sheet metal. Use wood screws to hold bracket to underside of platform top.

by Marshall Lincoln, W7DQS

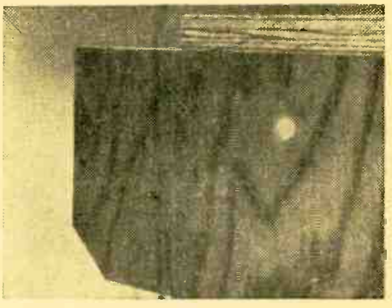
disadvantages. And it brings with it a number of convenient features which can't be obtained any other way. Purpose of such a platform is to lift the main pieces of radio gear a few inches above the table top they normally sit on and allow space beneath this gear for smaller equipment—antenna rotor controls, telegraph keys, control switches and inter-connecting wiring, file boxes, note books, pencils, log books, etc.

Besides keeping these items handy to reach, the platform makes it easier to rearrange equipment without producing a major upheaval of your entire station.

Planned To Please. Such a platform must be custom designed to fit the needs of the individual user, since no two persons have the same line-up of equipment. However, the one shown here illustrates the basic idea and will serve as a working model for your own design.

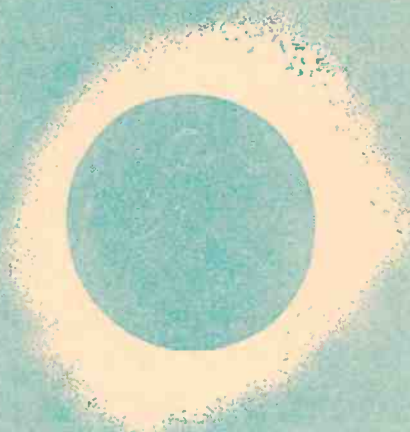
Generally, ¾-in. plywood is the best material to build the platform out of. It's strong enough, when properly braced, to hold just about any piece of radio gear you're likely

(Continued on page 108)



About 1-in. of bottom rear corner of vertical supports should be mitered off to allow space for line cords and other wiring to pass along table top between platform and wall. Supports should extend about 3 in. beyond top of platform at rear to prevent equipment from being pushed flush against wall.

Radio Astronomy By Mail



by Jorma Hyypia

Since SW radio is affected by solar X-rays, data from SW listeners 'round-the-world pinpoints astronomical happenings.

It was lucky that astronomer David Meisel's shoestring budget could not stand the strain of buying an earth-orbiting satellite observatory which modern astronomers consider essential to the study of solar X-rays. Otherwise he might never have discovered that solar research can be done by *mail*!

It all began when Meisel—then still a graduate student—watched the 1963 solar eclipse while stationed with a Cree Indian tribe in Canada. During the eclipse period, Meisel noticed that the signal strength of his shortwave communications receiver fluctuated oddly. Figuring out why this happened wasn't too tricky. Meisel's real ingenuity was displayed by his subsequent discovery that these signal fluctuations can be used to pinpoint the locations of solar "hot spots" that produce X-rays.

D-LAYER ABSORPTION As any radio ham knows, long distance shortwave radio reception is not as good during daylight hours as at night. The reason: during the day, X-rays emanating from the sun create the so-called "D-layer" of the lower ionosphere of the Earth. This ionized layer absorbs radio energy, thereby weakening radio signals transmitted through the D-layer. In fact, energy absorption takes place at least twice on a long-distance transmission because the signal must pass through the D-layer on the way to the reflecting F_2 layer of the upper ionosphere, and again on the way back to Earth.

At night, when solar X-rays no longer reach the dark side of the Earth's atmosphere, the D-layer vanishes and radio transmission improves. Likewise, during the "twilight" period of an eclipse, solar X-rays are blocked from those parts of the ionosphere that lie within the eclipse zone. Thus a short-wave radio signal passing through a moon-shadowed area of the ionosphere is briefly strengthened because the energy-absorbing power of the D-layer, in that area, is temporarily reduced.

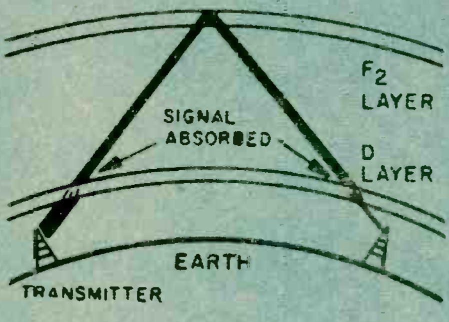
ABRUPT FLUCTUATIONS Meisel observed that the signal fluctuations in radio reception were remarkably *abrupt*. This could only mean that *localized* hot-spot sources of X-rays on the sun were being detected. The idea followed that radio signal fluctuations might be used to locate the exact positions of solar hot spots.

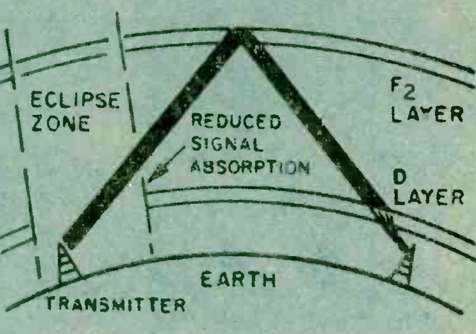
This could not be done using only one radio receiver because, as far as it could indicate, any given solar X-ray source in the process of being blocked off by the moon might lie *anywhere* behind the leading edge of the moon. The exact position would have to be determined by mathematical triangulation, using data obtained simultaneously by several widely separated monitoring stations.

The accompanying diagram will help make this clear. Note that the simultaneous positions of the moon represent viewing positions 1, 2 3 *in the D-layer of the Earth's ionosphere,* not

SW listener searches for a "hot-spot" that is producing X-rays during a recent solar eclipse. Key is an oddly fluctuating signal.

Left hand drawing details how solar X-rays create the D-layer during daytime hours. This layer absorbs radio energy. Right hand drawing shows that during a solar eclipse a reduction in ionization of D-layer reduces radio absorption and increases signal energy.





Radio Astronomy

at ground positions. However, radios on the ground, beamed through these ionospheric areas, can detect changes in radio signal transmissions as they are affected by changing X-ray concentrations.

As seen from ionospheric positions 1 and 3, the moon (in this hypothetical case) is just about to pass over an X-ray hot spot on the sun; blocking of the X-rays will cause a strengthening of radio signals reaching ground monitoring stations after passing through these two areas in the ionosphere. On the other hand, radio waves passing through ionospheric position 2 have already been strengthened because the moon, as seen from position 2, already covers the same X-ray source. Thus signal fluctuations observed by three or more ground stations can be used to determine the exact position of the hot spot on the sun. Observations made by other monitoring stations can, of course, be used as verification.

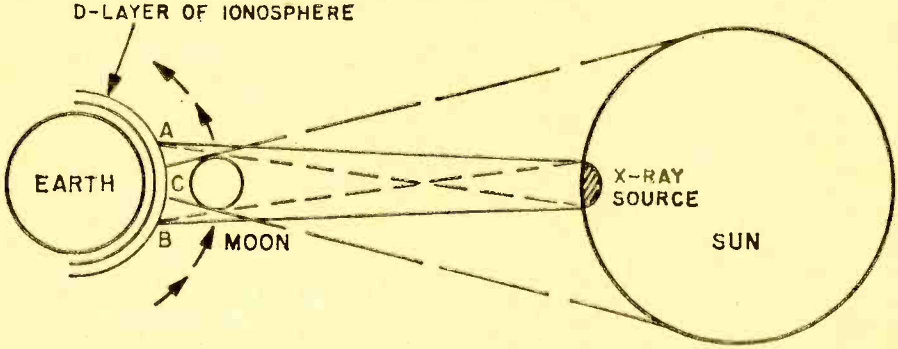
MAIL-ORDER MONITORS. To detect and locate *many* solar hot spots, Meisel realized, would call for the use of hundreds of ground monitoring stations. That seemed like a practical impossibility, until Meisel conceived the idea of enlisting the aid of shortwave radio listeners spread out all the way from Eastern Europe to the Cook Islands in the Pacific.

So Meisel dipped into his "shoestring" research fund to pay for postage stamps, envelopes, and a few hundred mimeographed questionnaires. He sent about 650 survey forms to shortwave listeners in 35 countries and in the U.S. Transcript describing the experiment and requesting aid were read over European radio stations as far east as Budapest. The unique experiment was to take place during the September 22, 1968, solar eclipse.

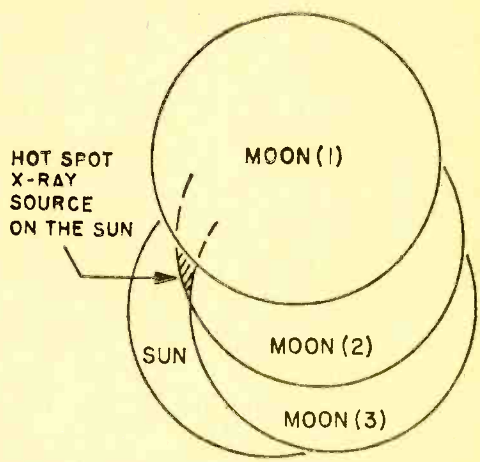
Each listener was to beam his radio into the eclipse zone and listen, for at least two hours, to a broadcast station at least 2000 kilometers away. He was to record all signal *strength* fluctuations on a chart, then send the data to Meisel, at the University of Virginia, for analysis.

The result? Meisel received about 350 replies, mainly from listeners having no previous technical experience, but also some from such experienced observers as radio station engineers, astronomers, teachers and students. Meisel now reports that preliminary analysis of the reports indicates the presence

(Continued on page 109)

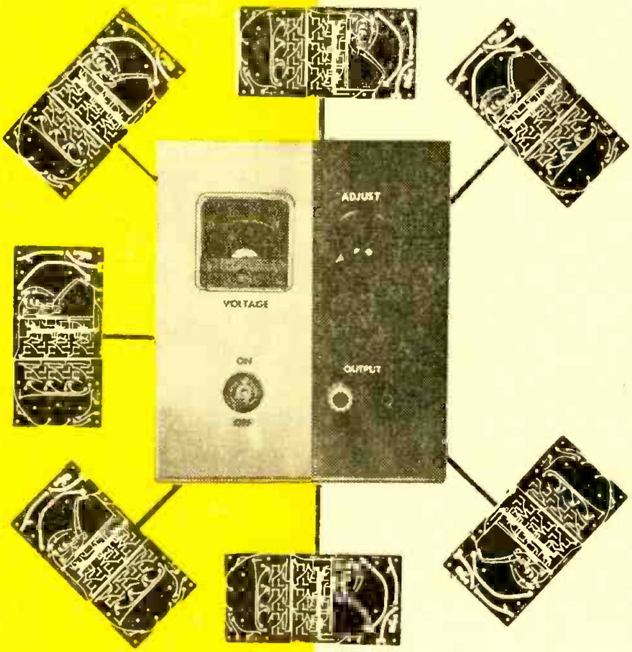


During an eclipse, solar X-rays that reach the earth's ionospheric D-layer are modulated by the moon. X-ray intensity decreases at A, minimum at C, and increases at B.



Here is how the path of the moon blocks out an X-ray source on the sun as seen from one spot on the surface of the earth. Each observer's location sees a different arrangement which causes different radio wave absorption.

UNIVERSAL REGULATED POWER SUPPLY



Reliable current- and voltage-regulated low-voltage supply powers experiments using solid-state devices

by Herb Cohen

Many solid-state projects require a reliable source of low voltage power. Therefore, why not equip your shop with one or more DC power supplies having both current and voltage regulation to provide the necessary reliable low voltage power needed for various projects?

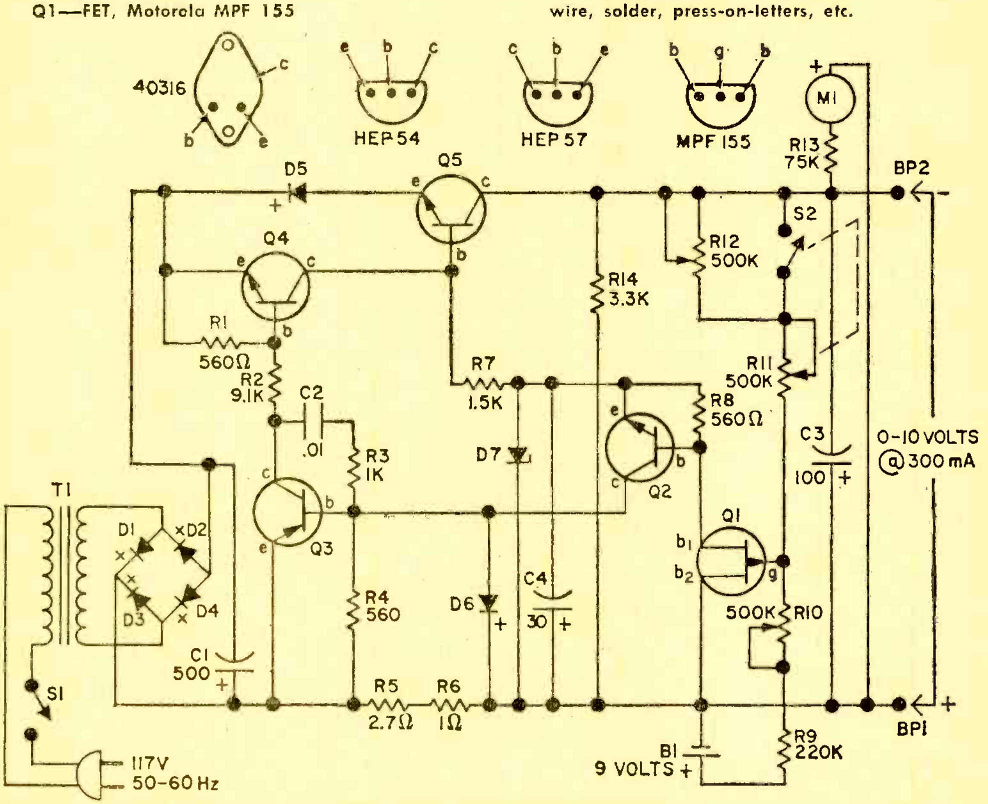
Best way to acquire this power source is build your own. As a starter, try the power supply detailed on the following pages. It's designed to have a 10-volt output at a maximum of 300 mA that is both voltage and current regulated.

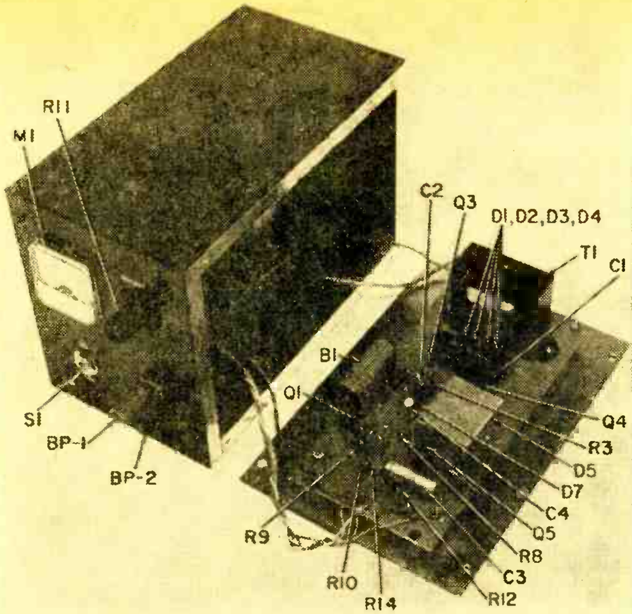
Voltage Limiting. Reference battery, B1, maintains a voltage flow through R9, R10 and R11 to the negative side of the power supply, which is at zero potential. Therefore, the gate of the FET (Q1) is positive and Q1 is turned *off*. This being the

UNIVERSAL REGULATED POWER SUPPLY

PARTS LIST

B1—9-V transistor radio battery (Lafayette 32E48077 or equiv.)
BP1—Red binding post, accepts banana plug or phone tip (Lafayette 99E61202 or equiv.)
BP2—Black binding post, accepts banana plug or phone tip (Lafayette 99E61210 or equiv.)
C1—500-uF, 25-VDC electrolytic capacitor (Lafayette 34E55243 or equiv.)
C2—0.01-uF, 100-VDC paper tubular capacitor (Lafayette 34E67057 or equiv.)
C3—100-uF, 25-VDC electrolytic capacitor (Lafayette 34E85682 or equiv.)
C4—30-uF, 16-VDC electrolytic capacitor (Lafayette 34E85505 or equiv.)
D1, D2, D3, D4, D5, D6—750-mA, 400-PIV diode (Lafayette 19E50021 or equiv.)
D7—5.6-V, 250-mW Zener diode, IR type 1N708 or Motorola HEP 603
M1—0-1-mA, 1 9/16-in. square meter (Lafayette 99E50528 or equiv.)
Q1—FET, Motorola MPF 155
Q2, Q4—Npn silicon transistor, Motorola HEP 54
Q3—Pnp Silicon transistor, Motorola HEP 57
Q5—Npn silicon transistor, RCA 40316
R1, R4, R8—560-ohm, ½-watt resistor
R2—9100-ohm, 5%, ½-watt resistor
R3—1000-ohm, ½-watt resistor
R5—2.7-ohm, ½-watt resistor
R6—1.0-ohm, ½-watt resistor
R7—1500-ohm, ½-watt resistor
R9—220,000-ohm, ½-watt resistor
R10, R12—500,000-ohm, subminiature, printed circuit type potentiometer (Lafayette 99-E614678 or equiv.)
R11—500,000-ohm, linear taper potentiometer with spst switch S2 (Lafayette 33T1277 or equiv.)
R13—75,000-ohm, 5%, ½-watt resistor
R14—3300-ohm, ½-watt resistor
S1—Spst toggle switch (Lafayette 34E33026 or equiv.)
S2—Spst switch (part of R11)
T1—Filament transformer: primary 117 V, 50-60 Hz; secondary 12.6 V @ 2 A (Lafayette 33E81191 or equiv.)
1—AC line cord (Lafayette 12E39011 or equiv.)
1—6 x 9 x 5-in. aluminum utility box with removable sides (Lafayette 12E83530 or equiv.)
1—Battery connector for 9-volt transistor radio battery (Lafayette 99E62879 or equiv.)
Mics.—Bolts, nuts, screws, insulated sleeving, push pins, perf board, grommets, hook-up wire, solder, press-on-letters, etc.





Here's what's inside our regulated supply. Note accessibility of components on circuit board. Because power transformer is relatively heavy, it needs extra support to prevent board from cracking.

case, no current flows through R8 and the base of Q2, so Q2 is also turned *off*. With Q2 *off*, no current flows and therefore Q3 is turned *off*. This effectively turns *off* Q4.

Transistor Q4 bypasses the base current of Q5, the series pass transistor that regulates the output voltage, and turns it *off*. With Q4 turned *off*, Q5 gets all of its base current and turns *on*, which causes the negative side of the power supply to rise off zero voltage. As this voltage rises, the gate of Q1 becomes less positive, and at a pre-set voltage, Q1 starts to conduct. The series pass transistor Q5 is now controlled and holds the voltage at the pre-set level.

The output voltage is controlled by programming series network R12, R11, R10—which serves as a sensitivity network. When R11 is turned *on* S2 is closed, shorting out R12, and R11 controls the output voltage. Its range is controlled by R10. When R11 is set at minimum resistance, S2 opens and R12 will control the voltage. (See paragraph on adjustments for correct setting of R12 and R10.)

When Q2 is turned *on*, it compares the voltage to that of D7, the Zener diode. The difference between the two voltages determines the amount of conduction of Q3. As the output voltage increases, the base voltage of Q3 increases, turning it *on* even more. This reduces the base current of Q4, which, in turn, reduces the conduction of Q5, thus reducing the output voltage. If the output voltage drops, Q3 begins to turn *off*, which turns *on* Q4 and Q5, increasing the output voltage. In essence, we have a feedback amplifier that tries to maintain constant output voltage irrespective of the load.

Current Limiting. In this supply, current limiting will start at 250 mA and output current won't exceed 300 mA with a full short across the output.

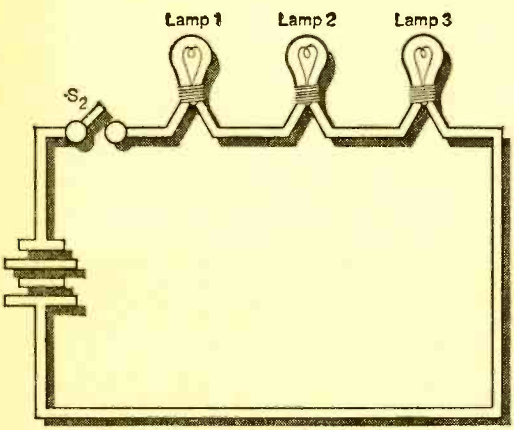
Current limiting is effected through R5, R6, and D6. A load placed across the output draws the current through R5 and R6. Normally the base of Q3 is −0.5 V with respect to its emitter, and D6 is reverse biased. When current through R5 and R6 reaches 250 mA, D6 is forward biased and conducts current into the base of Q3, turning it *on* hard. Q3, in turn, turns *on* Q4, which controls current through Q5, the series pass transistor. Q1 and Q2 no longer control the output, being overridden by the current sensing circuit R5, R6, and D6. When the excessive load is removed, D6 is reverse biased again the voltage regulators Q1 and Q2 take over again.

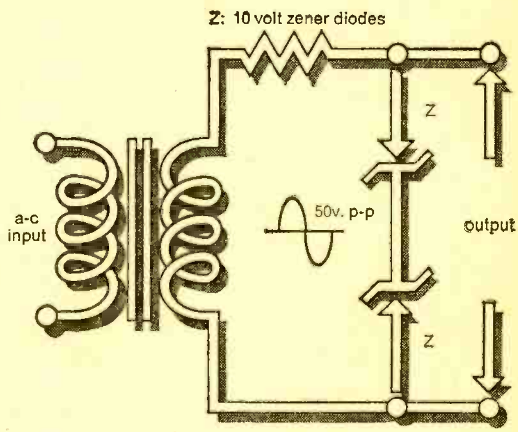
Building The Supply. A 6 x 5 x 5 x 9-in. (HWD) aluminum utility cabinet with removable sides houses the power supply. The voltmeter (M1), switch S2, potentiometer R11, and output binding posts BP1 and BP2 are mounted on one of the 5 x 6-in. ends of the cabinet as shown in the photos. All other components are mounted on a piece of perf board that is fastened to one of the removable 6 x 9-in. sides. It is raised from the metal side by ¼-in. bushings to prevent shorts in the wiring on the under side of the circuit perf board.

If possible, use two additional mounting

(Continued on page 56)

Can you solve these two basic problems in electronics?





This one is relatively simple:

When Switch S_2 is closed, which lamp bulbs light up?

Note: If you had completed only the first lesson of any of the RCA Institutes Home Study programs, you could have solved this problem.

ANSWERS: Problem 1—they all light up
Problem 2—20 Volts (p-p)

This one's a little more difficult:

What is the output voltage (p–p)?

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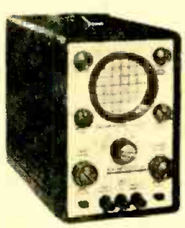

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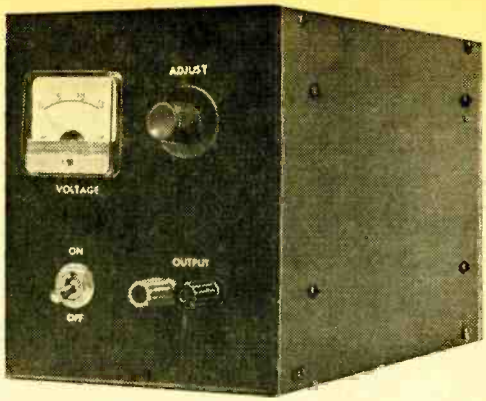


Output and control panel of this compact, utilitarian, low-voltage, regulated power supply usable either in experiments or as primary supply for operating equipment.

screws and bushings to add support to the perf board where the relatively heavy power transformer is mounted. (We lost a perf board because this additional support had not been included in the model.)

Push pins should be used for mounting and connecting components. They make it easier to replace defective components and tend to reduce heat damage from soldering. Spray paint the outside of the cabinet in a distinctive color and use press-on letters to mark the various facilities and controls on the front panel. You may want to add a carrying handle to the top to facilitate moving the power supply.

Be sure all diodes and electrical capacitors are properly polarized and all transistors are correctly connected before soldering them into the circuit.

Adjustments. R10 and R12 are set during construction and normally are not adjusted again. Therefore we used miniature potentiometers that mount directly to the circuit board. R9 is a standard-sized, panel-mounted potentiometer complete with switch that's mounted on the front panel since it is the means to adjust output voltage and should be readily accessible.

R10 is adjusted so that output is zero volts when R11 is at minimum resistance and 10 volts with R11 at maximum resistance.

When S2 is open (R11 at minimum resistance), R12 is adjusted so that output voltage is 9 volts. ■

This Call Girl Is Legit

Produced by firm in Wisconsin, Call Girl telephone stems from clever play on words. Girl she isn't, but call she can and does.

Her name is Call Girl and she stands about 3 ft. high, all gleaming. Just above her rounded breasts there lurks a dial: high on her right thigh is a coin-return slot. Her navel is discreetly concealed by a locked panel. Her left arm is missing, but her right arm has been replaced by a length of coiled flex. Instead of a hand she has a telephone headset. She doesn't even have a head—just a few slots like a pay phone. Put in a few dimes, and there'll be a satisfied ping issuing from her stomach.

In case you haven't guessed by now, *she* is the latest thing in U.S. telephone design.

An American firm is already marketing this kooky piece of telephone art in three colors: black, white, and psychedelic with chrome fittings. Call Girl can be installed over an ordinary standard issue subscriber telephone. Once set up, she's sure as shootin' to set every man Jack rushing off to make a phone call. ■

A Saint Valentine's Day gift suggestion
from the Editors of Science & Electronics

you'll love our

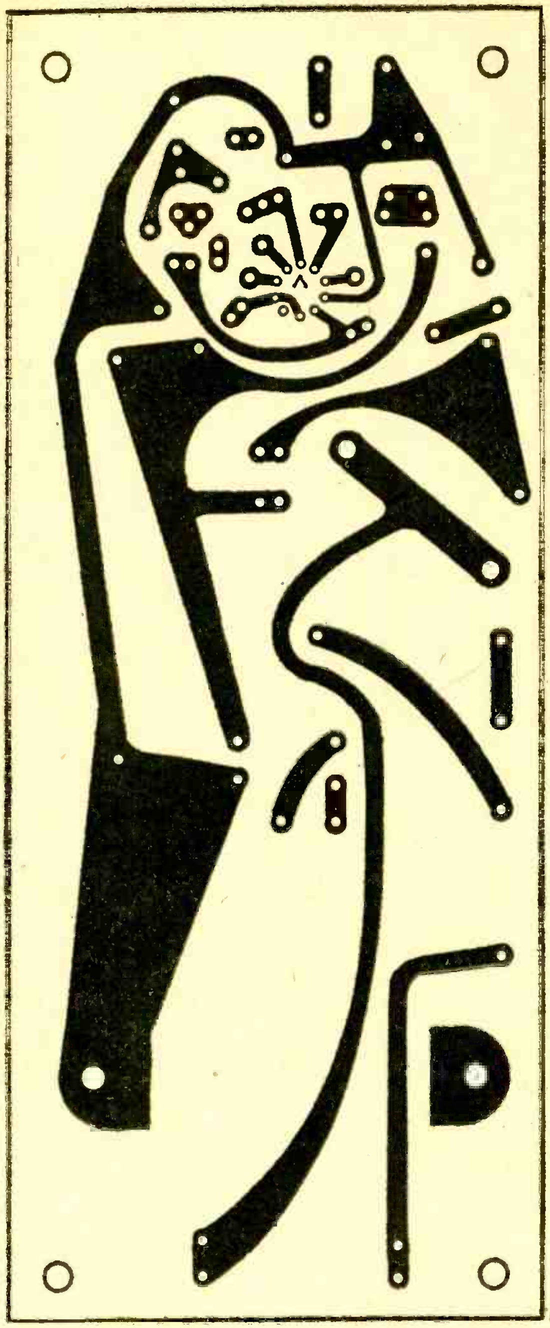
LOVER'S LAMP

. . . the sound-actuated controller that frees your fingers for other things

by Chris Jameson

☐ Nothing is more *gauche* than the character, who, after an evening of dancing, gentle conversation, and sweet music, leaves his date to turn down the lights to create a romantic setting. This may be okay for the movies, but most modern chicks will turn *off* with the lights. How much better to turn your chick *on* by murmuring soft nothings in her ear as the lights snap *off* or diminish

LOVER'S LAMP



Circuit board for Lover's Lamp appears here exact size—6¾ x 3¾ in. Small V within 10-pin circular configuration at busier end of board indicates pin 1 of integrated circuit IC1. See text for information re sizes of bits to use for holes.

in intensity as if by magic. (*That's* class!)

The magical light control is accomplished through our Lover's Lamp, a device that operates a room lamp by the soft snap of a finger or a gentle whistle. And it's strictly a one-shot device. Once the lamps go down or *off* they stay that way. There's not a chance in the world of their popping back *on* again just as you've got your date convinced you're the greatest gift to women.

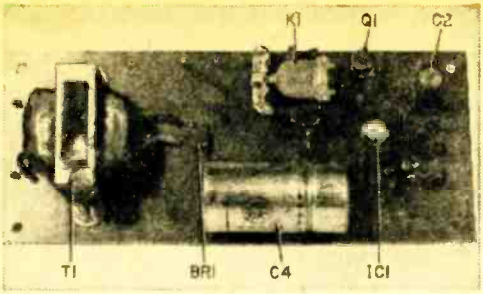
Of course, if you're not romantically inclined or if you score without need for electronic contrivances, our Lover's Lamp makes a great lighting control for such things as hot studio lights. You can set up your lighting arrangement with low wattage "cool" lamps, then turn the floods *on* anytime you want with just a whistle or finger snap. Or, you can use the device as a sound tripper for strobe lights by simply eliminating the control relay (as we'll show later).

How It Works. As shown in the schematic, our Lover's Lamp consists of a tuned amplifier, a Triac tripper, and a relay whose contacts do the actual switching of lamps.

Integrated circuit IC1 is an operational amplifier tuned to approximately 5 kHz by the notch filter network consisting of R6, R7, R8, C7, C8, and C9. A notch filter is a device that attenuates a given frequency, passing frequencies other than the one it's tuned to. In the operational amplifier shown, the attenuation characteristic of the filter is used to peak the amplifier response in the following manner.

The overall AC gain of an operational amplifier is determined by the ratio of the feedback impedance from the output (pin 5) to the inverting (—) input divided by the impedance from the inverting input to ground (R5 and C6). At about 5kHz, C6's impedance is less than 1/10 that of R5 so it can be ignored; as a result, the amplifier's gain becomes the Network Impedance/R5.

At the frequencies other than 5 kHz, the network impedance is predominantly that of R6 and R7, so the gain is approximately 100k/5k or 20. At 5 kHz the network impedance appears as approximately 500k, so the amplifier gain is roughly 500k/5k or 100



All circuitry, including AC power supply, is assembled on printed circuit board. Photo shows location of most major components.

(40 dB). (Actually, the gain will run even higher depending on the matching of the network components.) As we've shown, the operational amplifier's output is the inverse (opposite) of the filter when the filter is in the inverting input feedback loop; hence, the notch filter actually peaks the Opamp's response.

The Opamp's output signal is used to trigger Triac Q1. Note that even though K1's power source is DC, we still use a Triac. This is because the Triac will respond to the Opamp's AC output signal, whereas an SCR would require an additional handful of components.

Diode D1 suppresses the inductive kick-back voltage across K1's coil, while R9 simply provides additional holding current for the Triac. (R9 can be eliminated if a heavier-duty relay—i.e., one drawing more current—is substituted for the specified K1). The B+ power source is 24 VDC, and you must take care not to exceed this value to avoid damage to IC1. You can use a few volts less but not more.

Once our Lover's Lamp is tripped—by a finger snap, a whistle, or a click—it can be reset by turning *off* power switch S1 for approximately 5 seconds. This is the time needed for C11 to discharge.

Construction. All the electronics including the power supply is assembled on a 6¾ in. x 3¾ in. printed circuit board. The PC template shown provides all the connections for the unit shown in the photographs and schematic, right down to the K1 connections. If you study the board carefully you'll note that there is considerable board area around the K1-D1-R9 location which allows you to substitute a heavier relay if desired . . . simply add your own PC layout. However, don't under any circumstances change the PC layout for the IC amplifier or its related components.

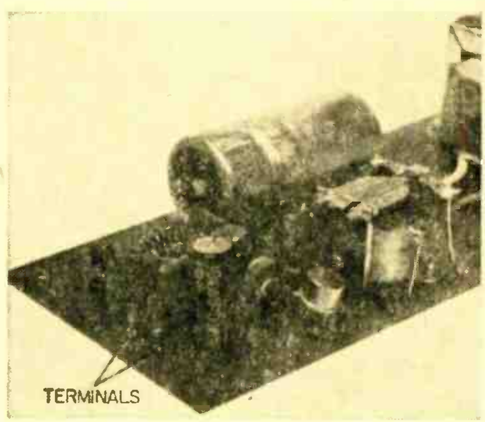
The component holes are drilled with a #57 bit, those for IC1's socket with a #54 bit. The holes for T1 and K1 and any other components depend on the particular item; #6 screw body holes should do for T1 and #4 screw body holes for K1. Connections between the cabinet components and the PC board are made via push-in terminals which will fit a hole made with a #54 bit.

The tab on IC1's case and socket corresponds to pin #1; make certain the socket tab is oriented opposite the #1 pin, which is indicated on the PC template by the "<" symbol. The symbol's tip points to the #1 pin.

BR1 is a packaged diode bridge rectifier. The leads from T1 connect to the two terminals indicated by the "~" symbol; the DC output is indicated by "+" and "−". When using the BR1 specified in the Parts List, proper output polarity is ensured if the bridge is mounted with the side having the symbols against the PC board. The end of BR1's leads are about twice as thick as the rest of the lead and this excess width must be cut away in order for the leads to fit the #57 holes. We suggest you trim the excess rather than enlarge the hole, since the flat leads might be somewhat difficult to solder into a round, oversize hole.

Triac Q1's triangular-arranged leads match the triangle holes in the PC board. Allow about ¼-in. between the base of Q1 and the PC board.

The PC layout will accommodate the component types specified in the Parts List if the resistors are end-mounted. However, if you don't use the miniature components specified, it is possible the component leads



Perf-board type push-in terminals provide tie-points for amplifier input, AC power input, and connections to relay K1's terminals.

LOVER'S LAMP

will require some bending to fit the PC holes. Again, we strongly advise against modifying the layout of the IC1 circuit foils, since instability may result if the foil area and positions are changed.

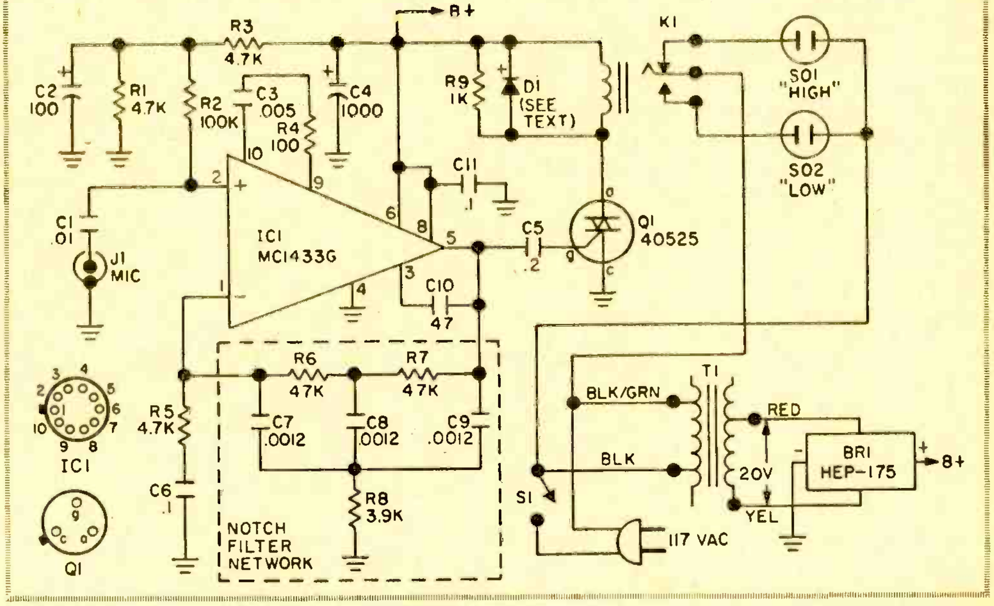
Circuit Modifications. You may safely substitute any 24 VDC relay for K1 as long as it doesn't require more than 35 mA. for operation.

To use the unit as a sound-activated strobe light tripper, eliminate relay K1 and connect a sync cord (for the strobe) across Q1. Polarity of connections to the strobe sync isn't important, since the Triac—unlike an SCR—will trigger the strobe regardless of polarity. When used for strobe sync, the Lover's Lamp automatically resets itself after each flash. Also, since the Opamp itself uses only about 2 mA, T1 and BR1 can be eliminated; any battery arrangement that provides 18-24 VDC can be used in their place as the power supply.

Final Assembly. The Lover's Lamp can be mounted in any convenient cabinet; the unit shown is mounted in the U-section of a 5- x 3- x 7-in. Minibox. Sockets SO1 and

PARTS LIST FOR LOVER'S LAMP

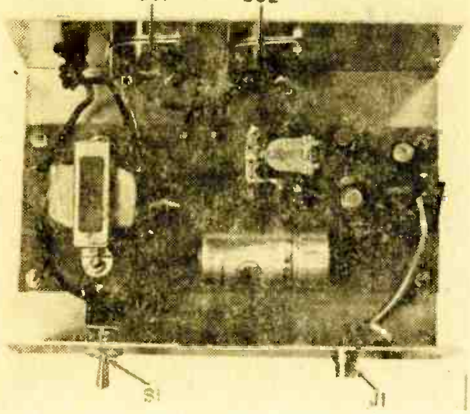
BR1—Bridge rectifier (Motorola HEP-175 or equiv.)
Capacitors—All 75 VDC unless otherwise indicated
C1—.01-uF subminiature (Lafayette 33 E 69055)
C2—100-uF, 15-V electrolytic
C3—.005-uF subminiature (Lafayette 33 E 69048)
C4—1000-uF, 25-V electrolytic
C5—.2-uF subminiature (Lafayette 33 E 69097)
C6, C11—.1-uF subminiature (Lafayette 33 E 69089)
C7, C8, C9—.0012-uF, 200-VDC (Sprague "Pacer"—Allied 43 A 0336)
C10—47 pF, 1000-V ceramic disc
D1—Silicon diode (100 PIV or higher)
IC1—Motorola MC1433G integrated circuit (Allied 50F26 MC1433G MOT, $9.75)
J1—RCA phono jack
K1—Spdt relay (Potter & Brumfield RS5D-2500 ohms or equiv.—see text)
Q1—40525 Triac (RCA—Allied 49F1 40525 RCA, $1.57)
Resistors—All ½-watt, 10% unless otherwise indicated
R1, R3, R5—4700 ohms
R2—100,000 ohms
R4—100 ohms
R6, R7—47,000 ohms, 5%
R8—3900 ohms
R9—1000 ohms
S1—Spst switch
SO1, SO2—AC chassis receptacle
T1—Power transformer: primary, 117-VAC; secondaries, 10-20 CT and 40 CT @ .035 A (Allied 54 A 4731 or equiv.)
Misc.—Microphone, cabinet, wire, terminals, etc.



SO2 are chassis-type AC receptacles; one provides for the high-intensity lamp, one for the low. In the model shown a microphone connects to J1 so that the mike can be positioned some distance from the control unit. However, the mike can be placed directly in the cabinet by eliminating J1 and cementing a mike element to the front panel.

Checkout. Connect a crystal or ceramic mike to J1 and turn S1 *on*. Snapping your finger within, say, 10 ft. of the mike should cause K1's armature (wiper contact) to pull down. The unit should be resistant to normal speech or music at distances greater than two feet from the mike. Depending on the characteristic of the components used in the filter network (how closely they're matched), the unit should respond to snaps or whistles from 15 to 30 ft.

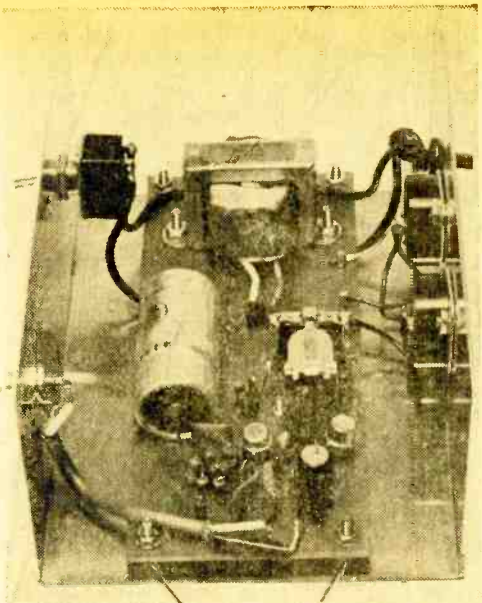
If the unit doesn't function, first check for proper B+ voltage, then check that the voltage to ground at the R1-R3 junction and at IC1 pin 5 is approximately one-half the B+ voltage. If the voltages check out make certain the filter network is properly installed by connecting a signal generator set to approximately 100 mV output to J1 and a scope or VTVM across the Opamp output.



Completed PC assembly fits easily in base of 3 x 5 x 7-in. aluminum cabinet. Use at least #18 wire to connect up SO1 and SO2.

Sweep the frequency band from approximately 500 Hz to 10 kHz; the output should peak sharply—about 40 dB—in the vicinity of 5 kHz. If the output doesn't peak, something is wrong with the filter network. If the output is correct, check Q1's connections, and make certain that D1 isn't installed with reversed polarity (K1 won't operate if D1 is reversed).

Using Lover's Lamp. Connect a 100-watt lamp to the *high* socket (SO1) and a low-wattage lamp, say 15 watts, to SO2. Activating the device with sound will cause the 100-watt lamp to extinguish and the low-wattage lamp to go *on* and stay *on*.



To prevent foil from shorting to chassis, place ¼-in. spacers between PC board and aluminum chassis box at each mounting screw.

The maximum lamp wattage is determined by the relay contacts. For the relay specified, 100 watts is maximum. Larger relays with heavy contacts can naturally handle much larger lamp loads.

If the device is used to control photoflood lamps, the specified K1 should be used to control a second relay with contacts rated at least 15 A. Reason: photoflood lamps of the #2 type pull approximately 4 A each.

There are plenty of other uses for Lover's Lamp, of course, in addition to the roles already outlined. Since the unit is basically a sound-actuated relay, you might try using it as a burglar alarm. Set up in an office, say, the device could be turned *on* after all the busy beavers have gone home to din-din; any noise created by intruders could be used to set off an alarm remote from the area under surveillance. Then, too, the unit could also be used to trigger a new telephone gadget that automatically calls the nearest police station and continually repeats a recorded message stating the address of the location and the fact that an unauthorized entry has occurred. ■

What did that bus say?

Just as some of the airlines provide taped music and conversational programs to make flights more pleasant, some educators are now experimenting with "cultural enrichment" on a school bus.

At this time the idea is unique with the Board of Education of Gunnison, Colorado, and the children who enjoy a "talking" school bus. But soon the idea will spread because of so much success in Gunnison.

Many Gunnison kids live on ranches spread far and wide from the center of town. Some spend as much as one-and-a-half hours on a one way trip to and from school as some of the children live as far as 30 miles from the school or more. Thus the idea of occupying that length of time from home to school with something instructive was the idea of Aton Christoff, one of the directors at the school in Gunnison. He and his colleagues at the Central School designed the project to help students pass time faster, and more valuably.

Their first dream was closed circuit TV in a school bus, but the $250,000 tab was a bit too steep. Mr. Christoff arranged a grant for $43,685 to buy a transit-type bus with audio tape equipment installed. There were funds left over also, and this was used to buy more tapes.

Jack Shepard (below, left) and Roland Ruffe are men responsible for recording material for bus programs. Right, each headset in bus is equipped with individual volume control.

Kids out Gunnison, Colo. way still spend many an hour traveling twixt home and school. Thing is, a talking school bus has turned their daily trips into educational experiences that most everyone enjoys.

How It Works. The students can don earphones that hang at each child's seat and tune in any of five taped programs especially chosen for them. The bus driver operates the master switch, and in this case it is Steve Price who is studying for his Master's degree in Education.

Each morning before the bus leaves the garage new pre-selected tapes are inserted in each channel, and for the afternoon return trip the tapes were changed again.

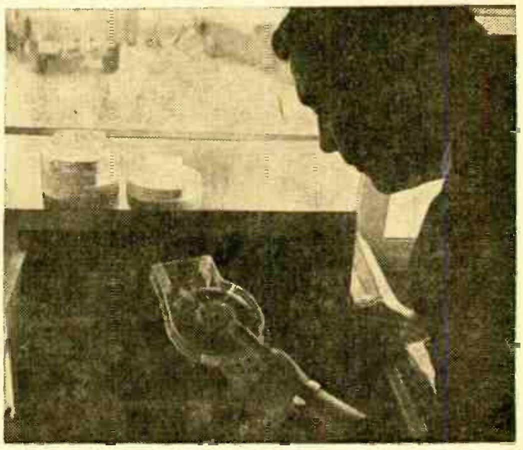
What the Kids Say. "I like the tapes a lot," said one of the Gunnison kids as he rode along, "because the other guys don't shoot paper wads at me." Another girl commented, "and the music kind of soothes me on the way home. I just kind of dream, and think about school tomorrow, and how nice it will be."

So it seems that the children benefit from the program. It also stimulates conversation on a subject that is later discussed in class. And as a result more library books have been issued it seems, because of an interest in a variety of subjects by the children, who were stimulated to read more on the subjects programed in the bus.

Mr. James R. Raine, who is also a project director, said he is trying to get funds for

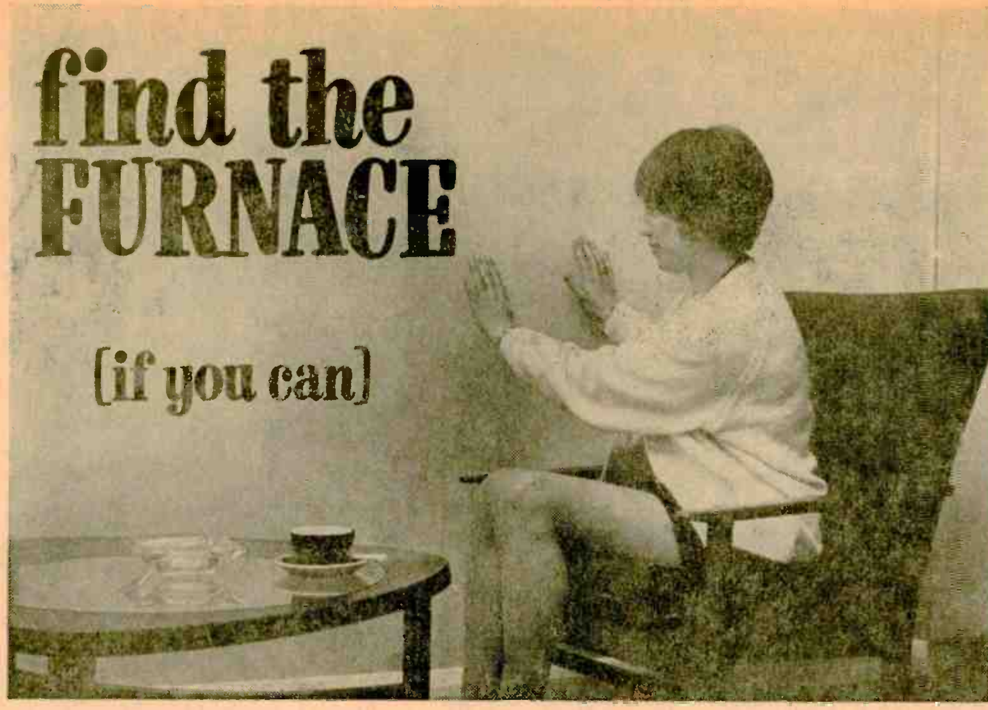
(Continued on page 109)

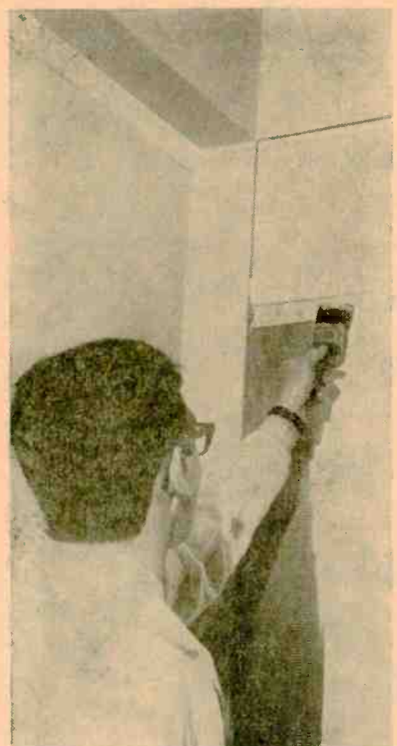
Each youngster selects his own program (far left), so there's no attempt to force children to listen to anything they don't want to. However, many of things heard on tapes are dealt with later in classroom. Driver (left) knows what's going on, since he's furnished with complete program of week's fare on tape. Cartridges (right) are changed daily for afternoon trip back home.



find the FURNACE

(if you can)





Technician applies decorative paint over wall that has been fitted with paint-it-on central heating system.

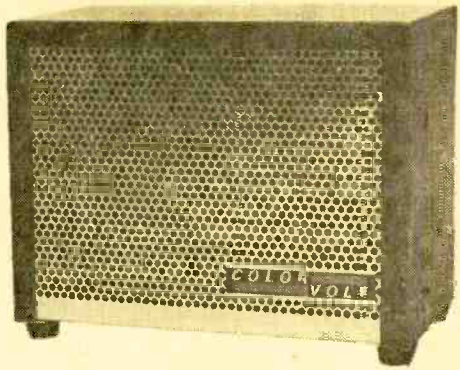
England may have some disabling weather, but it also has some able minds trying to cope with it. Their latest brainchild: a central heating system you *paint* on the wall.

Secret behind the system is the paint itself, which has a conductive form of carbon ground into it. In the words of one of the system's developers, "We were looking for a new paint binding agent and then we found this blend would conduct electricity. (Now) . . . it looks as if it's going to revolutionize the heating industry."

Test setup at Paint Research Station in Teddington, England. Current fed through conductive paint is converted to heat, radiated into room.

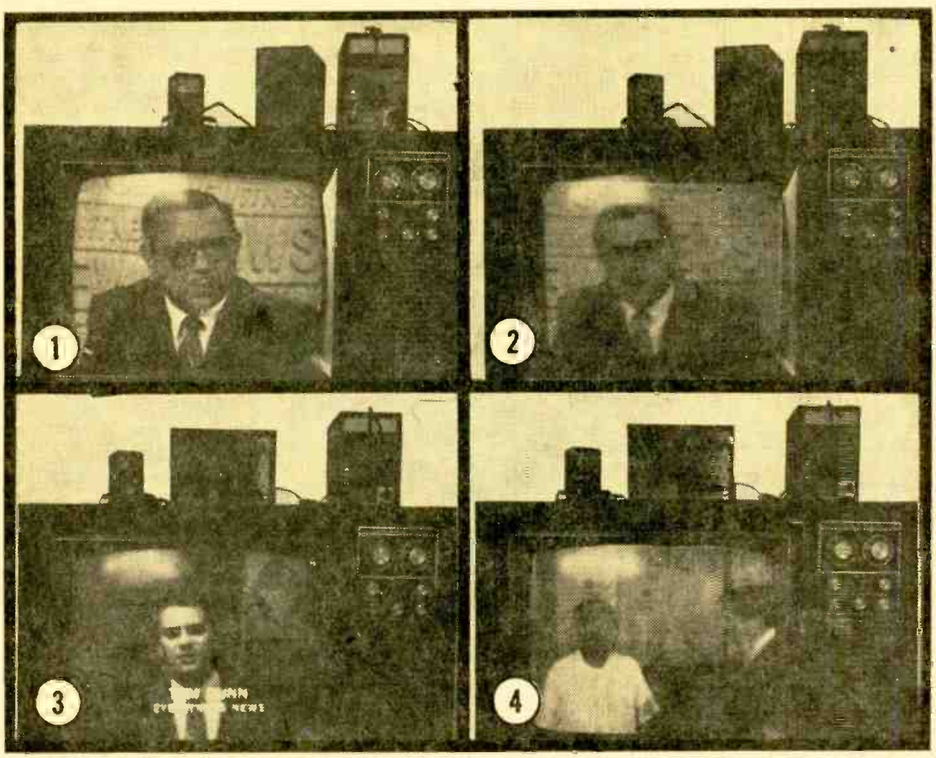
Science and Electronics LAB CHECK

SOLA ELECTRIC COLORVOLT
Automatic Line-Voltage Regulator
For Color TV Receivers



☐ For really top-notch color-TV reception, the circuits in a color set should be voltage-regulated. Reason is that just a small line surge or voltage change—which generally goes unnoticed on a B&W set—is sufficient to cause color changes and perhaps even affect picture brilliance. Regulators aren't built into TVs for a very simple reason: they would cause a sharp rise in the price of the television receiver.

The next best thing, if you're plagued with a "soft" power line, is a Sola ColorVolt.



Photos above show color-TV set under four different sets of operating conditions. In photo 1, set displays normal picture with 117-V power line. In photo 2, line voltage has been deliberately cut to 95V; picture has shrunk, gone out of focus, and shifted color. In photo 3, line voltage is again 95V, but ColorVolt is now in circuit, so set receives normal 117V. Acid test of ColorVolt's prowess was conducted when large air conditioner on same side of power line was switched on; ColorVolt almost totally absorbed heavy line surge, maintaining reasonably normal picture with but slight shrinkage at extreme bottom of screen (photo 4).

LAB CHECK

Basically, it's a device that regulates the voltage fed into the TV. You might also call it a miniature version of the regulators TV broadcast stations use to regulate their power supplies to color-transmission equipment. Connected between the power line and the TV, it holds output voltage reasonably steady even though input voltage swings between 95 and 130 volts.

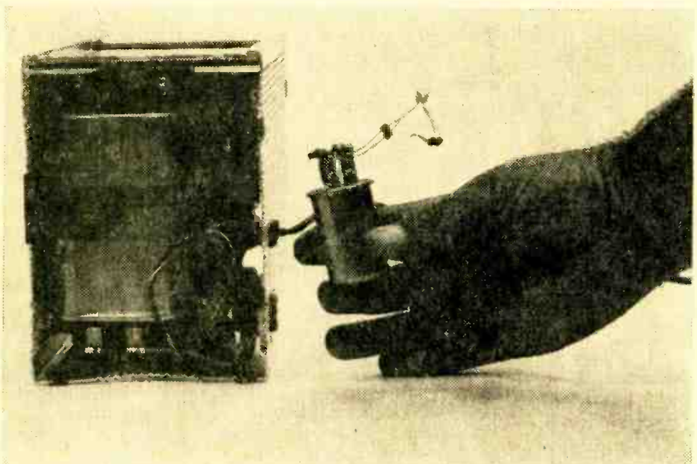
Easy On and Off. The ColorVolt is automatically switched *on* by the TV and is therefore left permanently connected. The TV plugs into a socket on the ColorVolt and the ColorVolt in turn is plugged into the power line. Since the ColorVolt is effectively in series with one leg of the power line, a relay connected in this leg turns the ColorVolt *on* and *off*. When the TV is turned *on*, the current through the relay connects the regulator; conversely, when the TV is turned *off*, the relay automatically drops the regulator off the line.

The photographs illustrate the effect of the ColorVolt. (Room light reflections are on the screen because we wanted to show the test setup consisting of a voltmeter, variable AC supply, and the ColorVolt.) Photo 1 shows the normal picture with 117-V normal line voltage. Photo 2 is the result of a 95-V power line. Note that the picture has shrunk and is out of focus. You might also notice that the brightness has decreased. Because the photo is in black-and-white you cannot see the purple flesh tone caused by the 95-V power line. Photo 3 is again with the 95-V power line, but this time it's regulated by the ColorVolt, which is delivering 117 V. Note that the picture fills the screen and is back in focus.

Photo 4 was taken the instant a 19,000 BTU air conditioner on the same side of the power line was started. Normally, the picture gets a severe color shift and shrink due to the surge current. Note that the ColorVolt held the picture despite the resulting dip in the line voltage, with only a slight (though noticeable) shrink apparent at the bottom of the CRT.

Volts and Loads. The ColorVolt's output is by no means rock steady. Over a 90 to 130 volt input range the regulator held the output voltage between 115 and 120 volts. Even so, this is sufficient for good color presentation.

The ColorVolt's automatic relay is supposed to work with a power line load in excess of 150 watts; if not, you can remove the relay. Unfortunately, the relay in our model gave intermittent operation up to a 200-watt load. And as for removing the relay, no instructions are given with the ColorVolt (other than "see a serviceman"—who will also have trouble), though it is easy for any intelligent soul to figure out.



Though no instructions are furnished, relay within ColorVolt can be removed if unit is to be operated with loads under approximately 150 W. Effect is to cause regulator to operate on continuous-duty cycle. Alternatively, simple spst switch can be installed.

The ColorVolt is rated at 3.1 A. Heavier loads won't cause damage, but they will interfere with the regulating action.

Summing Up. The Sola ColorVolt, priced at $39.95, does exactly what it claims to do. And its use is generally a lot cheaper than rewiring for a "hard" power line.

For additional information write to Sola Electric, Dept. D, 1717 Busse Rd., Elk Grove Village, Ill. 60007. ■

Fitted with laser simulator on top of gun barrel, British-made Chieftain tank rumbles into battle on training exercise. Tank's engine, radio, and gun go dead when hit with electronic shells; smoke automatically pours from tank when hit would have left it totally disabled.

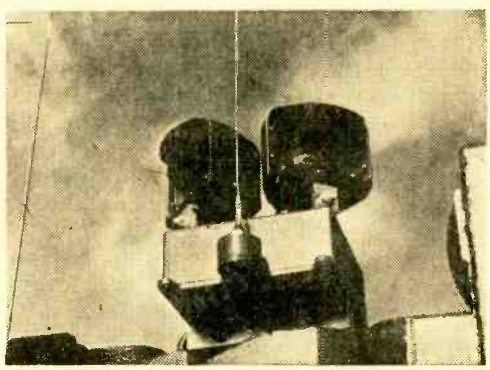
INFRARED MOCKFARE

A large Chieftain tank moves in on its target: another tank. It fires several times. The target tank comes to a halt and dense smoke pours ever upwards. The tank has "destroyed" its target. Thing is, the target tank and the crew inside it are unharmed. Reason is that the Chieftain was using a new British gunnery simulator which fires electronic shells instead of real ones.

Because of the danger and the high cost of live shells (roughly $180.00 each), mock tank battles with real ammunition were no privates' picnic. Therefore, the simulator was developed by a British firm to give tank crews practical experience in full-scale armored warfare under realistic conditions. The simulator consists of a 12-in., low-powered infrared projector fitted on the tank's gun barrel. The device emits infrared rays which are registered by special detectors on the target tanks.

With the simulator, tank crews are able to engage and destroy each other in war exercises without firing live shells. When a tank has received a direct hit from an infrared gun, its engine, radio, and its own gun become unserviceable. A smoke generator sends up smoke to indicate when a tank is completely disabled and no longer in battle. Also part of the mock warfare setup is a control box which registers the number of shots fired. When the alloted ammunition is used up, the tank's infrared gun goes deader than a dozen dormouses. ■

Infrared projector is mounted on top of tank's gun barrel in matter of minutes. It, not gun, will be source of deadly barrage.



Two detectors mounted on sister tanks register whether target has been hit or missed. Each hit is immediately relayed to attacker.

HAM TRAFFIC DE W7DQS

by MARSHALL LINCOLN

The Thinking Ham's Frequencies

What's your favorite band? Do you spend most of your time on 40? Or maybe on 15? Or possibly on 2 meters?

If you're a thinking ham, your answer would be "It all depends on what I want to do."

For, with most hams today set up for operating on more than one band, the actual choice of which one to use should depend on what they want to accomplish. There's no single band that serves for all purposes all of the time.

Anyone who tries to use a band for something that just won't work well is hurting both himself and his fellow hams. He's hurting himself by deliberately being inefficient. And he's hurting his fellow hams by walking over their toes with brute force.

Let's look at some examples to see how this works.

The whole thing is primarily a matter of different frequencies being usable for communication over different distances. An added complication is the fact that these effective distances change—at different times of the year, and from year to year.

Blame It On Sunshine. Basically, the changes are brought about by the Sun. As Ol' Sol beams down those bright rays of light and heat, he creates changes in the ionosphere—that invisible blanket of radio-reflecting particles about a hundred miles or so over our heads.

During summer in the northern hemisphere, the sun shines for longer than in the winter, so its effects on the ionosphere are stronger. In the winter, when the sun moves south it has less effect on the ionosphere over our part of the world, and so has a different effect on radio communications.

Another factor is the sunspot cycle. Sunspots are violent storms on the surface of the sun. They increase the radiation which bombards our ionosphere, so they also have a strong effect on which radio signals are reflected part way around the earth. These sunspots generally fluctuate in an 11-year cycle. That is, the times of maximum sunspot activity occur about 11 years apart. Between these sunspot peaks, the spots taper off slowly, then build up slowly for the next peak 11 lears later.

So, what does all this do to our ham bands? Basically, it works like this: the higher of our HF bands, say 10, 15 and 20 meters, work best for long distances during daytime, in the summer, and during sunspot maximum periods. At the same time, the 40 and 80 meter bands are best for local or medium distance communication.

However, in the winter time, and at times of sunspot minimums, the 40 and 80 meter bands begin to take on long distance characteristics, especially at night, while the 10, 15 and 20 meter bands become very weak, and sometimes go completely dead, except for contacts of a few miles!

These changes don't occur suddenly, but rather they take place slowly, over a period of several months. So, anyone who understands what's happening can switch bands as necessary to carry on with his favorite operating activity.

The DXer, for example, will be really happy on 10, 15 and 20 during a period of high sunspot activity. When the sunspots decline, however, as they are beginning to do now, he will have to switch to 40 or maybe even 80 to maintain his worldwide contacts.

The traffic man, who usually finds 80 (or 75) exactly to his liking for a state-wide net, may have to move his net to earlier in the evening or even into the afternoon, or else switch to 160, because he will find his favorite band being cluttered during the mid and late evening by stations on the other side of the world!

All this is necessary, if we're to make intelligent use of our frequencies. We can't battle the foreign interference on a net, so we must switch bands or operating times to avoid it. And we can't bulldoze a DX contest signal around the world if the band is dead to distant operating. You just can't fight it; you must switch!

There's an element of courtesy involved too, by understanding why some stations you never heard before are beginning to cause you interference. These fellows aren't doing it deliberately, usually. They're just victims of circumstances, just as you are. The ionosphere is beginning to play tricks with their signals to create different "paths" than existed last month or last year.

By understanding how come this is happening, and putting this understanding to work for you, you will become a more effective radio operator—and a happier one as a result.

For Speedier Messages. Anyone who has ever received a traffic message on the air and then had to deliver it by telephone knows it's much easier if the telephone number of the addressee is included in the address portion of the message. Many times, though, the station which originates the message doesn't know this number, so he naturally doesn't include it in the message when he sends it out in the first place.

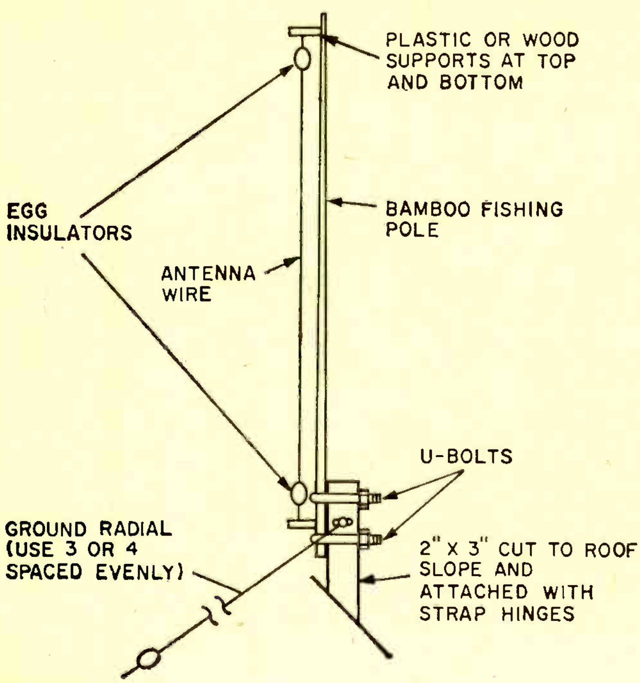
Thanks to the Direct Distance Dialing system that Ma Bell is now providing in most areas, there's a quick and simple way to get this number—and it doesn't cost a cent!

All you have to do is dial the information operator in the city to which you are sending the radio message. Give her the name of the person to whom the message will be sent, and ask for that party's phone number. (Don't confuse the girl by explaining why you want the number, though; that could upset her whole day by trying to understand what you're talking about.)

Include the number she gave you in the address portion of your radio message when you take it to the traffic net. That way, the number will be there for the receiving ham in that city, making it possible for him to quickly call the party on the phone and deliver the message.

These information calls are not charged against your phone bill, since Ma Bell wants to encourage everyone to use Direct Distance Dialing instead of going through the long distance operators. (Personally, I think some of Ma's long distance operators need the practice, but that's another story).

You can find the procedure for making an information call in the front of your phone book, if it's possible to make such calls from your area. *(Continued overleaf)*



Simple, low-cost way to put up single-band ham antenna in sketch submitted to Ham Traffic by Jim Ingham, WN5VFW, of Fort Worth, Tex., who received it from Bob Gooding, W3OII, of Beltsville, Md. It uses a bamboo fishing pole as a support for a piece of wire which forms radiator of ground-plane vertical; ground radials are similar sections of wire stretched downward from mounting point to fixed anchors. Cut vertical element and ground radials to quarter wavelength on your favorite frequency on 10, 15, or 20 meters. Feed with 52-ohm coax: connect shield from coax to radials, center conductor to bottom of vertical element.

HAM TRAFFIC

Tin Badges of Conceit. That's what some so-called public official once called the special license plates issued by many states to special groups, including ham radio operators.

Practically every state has them now, but it's well to continually review why they exist.

Although some special interest groups really do use special plates as status symbols in some states, the original intent of ham radio call letter license plates was to make it possible to quickly identify a *trained radio operator* in cases of emergency.

All too often, many hams have used them just to show off their hobby, with no real serious effort to maintain their ability to use ham radio if called upon in an emergency.

Consequently, every so often some long-winded politician gets on a soap box and screams that these special plates should be abolished, or that the price for them should be raised sky high.

I maintain that these plates serve a useful function and should be retained, at the lowest possible price, but along with that, I believe *we should continue to show that we deserve to have them.* If we become complacent in our obligations, then we deserve to have them taken away.

It's interesting to note, as reported in the Lockheed Employees Radio Club Bulletin (Burbank, Calif.), that Alaska has reduced the cost of ham call letter places to $1 a year in recognition of the fine job hams did during the 1964 earthquake and the 1967 Fairbanks flood! Now that's what I call putting your money where your mouth is! My hat's off to the good folks of Alaska—and to the deserving hams involved.

Don't Knock It 'Till You've Tried It. The guys who sneer at CW and say it's old-fashioned and useless in this space age could take a lesson from crewmen of the USS *Pueblo* who were prisoners of the North Koreans.

After their release, it was revealed that some of those fellows communicated between their prison cells by using Morse Code. A tap was a "dit" and a scrape was a "dah." Primitive, to be sure, but it was all they had, so they used it.

Before their capture, they had at their finger tips some of the most modern gear in existence. When this was taken from them, though, they weren't rendered completely helpless. They put to use a part of their training as radio operators—the still useful and practical ability to communicate with dots and dashes.

Anyone who scoffs and says we hams don't need Morse Code because we don't expect to be thrown into a communist prison should stop and think—these guys didn't expect it either! You never know when the unexpected will happen and a little Morse ability will come in handy. And ours is the only "hobby" that requires it!

Watch That Meter. Most every modern transceiver is equipped with a front panel relative power meter. It functions differently from the older plate current meter that used to be so common on ham rigs, and often a misunderstanding exists on just how to make use of it.

W5VCE wrote a brief description of *do's* and *don'ts* regarding this meter, which has been reprinted in the Amateur Radio News Service Bulletin and in the Penn Wireless Association X-Mitter.

Here's what he has to say:

"Can this meter be used to adjust the transmitter controls for maximum output? Yes!

"Is a higher reading on this meter an indication of a properly tuned antenna? Absolutely not!

"Odd as it may sound, the relative output meter will read less and less as the antenna is tuned or pruned to optimum," he says. How come?

"These meters are usually simply uncalibrated RF voltmeters which read the RF voltage at the transmitter antenna connector," he explains. "The antenna always presents its lowest impedance, that is, non-reactive. Consequently, the relative power meter or RF voltmeter will be measuring the RF voltage across the minimum impedance when the antenna is correctly tuned.

"So, as you move up and down the band either side of the frequency for which the antenna is resonant, you will find the relative output minimum at the point where you are actually radiating best. Don't be fooled by high readings on the relative power meter. It may be used for tuning the transmitter for maximum output and as a relative indication of whether the transmitter and antenna are still like they were yesterday on a given frequency." ■

Science and Electronics LAB CHECK

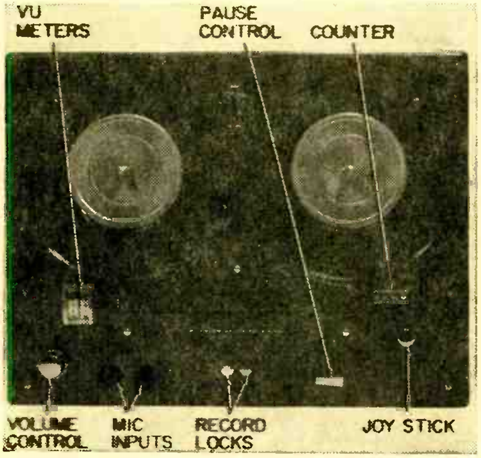
TANDBERG MODEL 1641X
Cross-Field Bias
4-Track Stereo Tape Deck

☐ Tandberg recorders have always enjoyed a justified reputation for quality . . . which happened to go hand in hand with cost and weight. A Tandberg recorder could easily cost as much as all the other components of a hi-fi system; tied to a string, it made an excellent boat anchor. But now, using the latest in solid-state techniques and cross-field bias, the new model 1641X delivers the expected Tandberg performance at considerably reduced weight, and a competitive cost of $249.50.

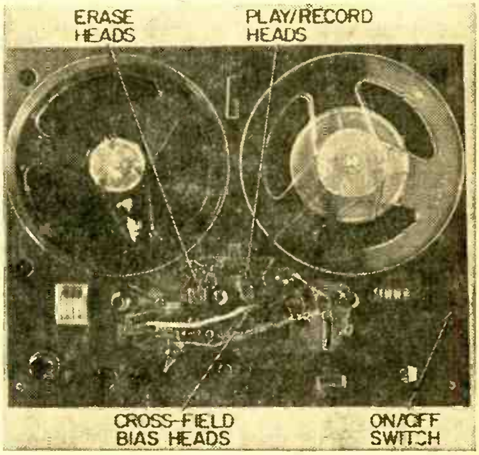
The 1641X is a 4-track stereo recorder with inputs for low-impedance microphone, magnetic pickup, and line (tuner, etc.). Three speeds (7½, 3¾, and 1⅞ ips) are provided, with automatic equalization by the speed selector. Independent volume controls and VU meters are featured, along with independent record locks for each channel. Mechanical operation is controlled by a single, four-position joystick that provides for play, fast forward, fast reverse, and unlocked reels (for easy threading). A reset counter and locking pause control are also part of the picture.

While the list of features reads about the same as for any other similarly priced tape deck, performance is something else, starting off with the cross-field bias.

Why Bias? A tape's magnetizing curve is non-linear; in simple terms, this means that you would normally get a distorted playback of whatever you tried to record. To overcome the distortion, an ultrasonic bias signal is ordinarily mixed with the input signal in the record head; the bias signal "stretches" the linear portion of the tape magnetization, allowing a much higher input signal. Simultaneously, output level and signal-to-noise ratio increase sharply, while distortion goes way, way down. Unfortunately, the bias level needed for good low-speed operation often requires extreme frequency



Top of Tandberg deck is conventional in appearance. Hub at right is for takeup reel.



Tape path is straightforward, but bias heads are mounted across from play/record heads.

equalization. Result is that it's difficult to interchange recorded tapes between recorders of different manufacture, and distortion of high frequencies is often excessive.

Cross-field bias is a fairly new way of applying the bias signal. It generally results in better equalization and lower distortion, particularly at the slower tape speeds. Instead of being applied as a mix in the record head, the bias signal is fed to a separate head which presses on the *back* of the tape, directly opposite the record head. The magnetizing field from the bias head crosses through the tape to the oxide coating, "stretching" the tape's magnetization to obtain lowest recording distortion when the input field is applied from the record head.

Cross-Field Performance. Though the 1641X is specified for use with low-noise tape, such tape is both relatively expensive and not generally available. Therefore, our tests were conducted with "standard" tape as would be used by the average tape fan—the equivalent of Scotch type 111 or Audiotape 1251. (Tests with low-noise tape showed the 1641X to be essentially right on the claimed specifications.)

At 3¼ ips the 1641X will play back a standard NAB equalized test tape within −0, +3.5 dB 100 to 7500 Hz . . . the test tape limits. At 7½ ips the NAB playback checked out within the test tape limits of 50 to 15,000 Hz as −0.5, +5 dB (very good for a "home" machine).

The overall recorder response from microphone input to its line-level output was within 3 dB from 40 to 20,000 Hz at 7½ ips and within 4 dB from 40 to 12,000 Hz at 3¾ ips. Response at 1⅞ ips was −4 dB, +2 dB from 40 to 8000 Hz.

Combined wow and flutter at all speeds was well within professional standards, measuring 0.05% at 7½ ips, 0.08% at 3¾ ips, and 0.15% at 1⅞ ips. With standard tape the noise measured −53 dB (very good) below maximum recording level and −59 dB with low noise tape (almost dead quiet).

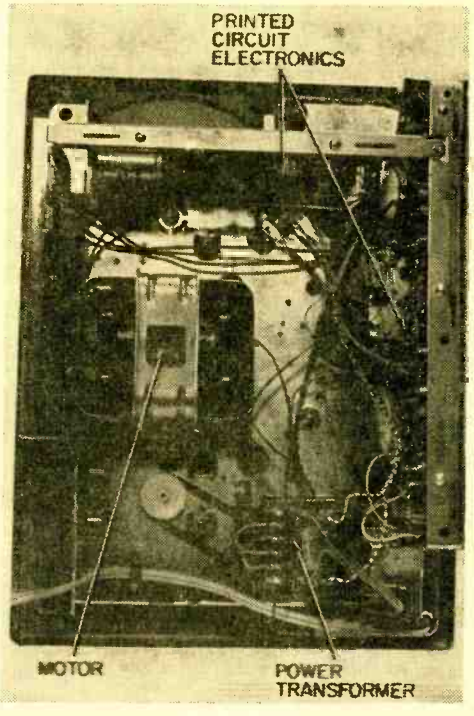
No Magic Eyes. Unlike earlier Tandberg recorders, the 1641X has no "magic eye" record level indicators. In their place, the 1641X has VU meters. But unlike conventional recorder VUs which are frequency-equalized to show a flat input level even after the record equalization, the 1641X's meters are unequalized. This means that they will tend to show the exact input level to the record head.

By way of explanation, let's assume you have a typical recorder with an equalized VU meter and that you're trying to record a high-pitched sound—chimes, say. If you set the record gain so the meter indicates zero level (maximum recording level), the actual signal delivered to the head can be up to 10 dB or even more. This is because of the record equalization (which is de-emphasized in playback to improve signal-to-noise ratio). The result would be tape overload and severe distortion.

Thing is, with the 1641X's meters, which are not equalized, you would be aware of the excessive recording level, and you would reduce the record gain so as not to drive the tape into distortion.

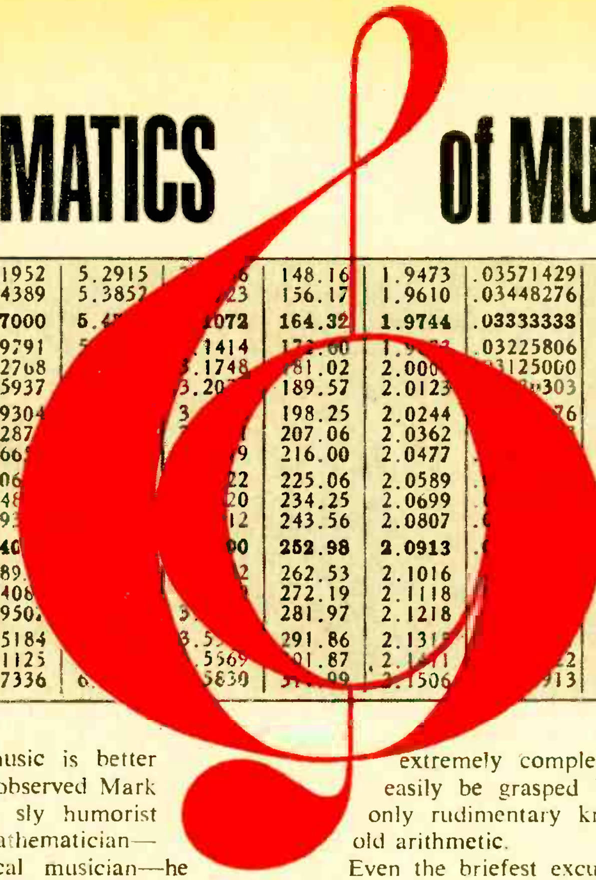
Summing Up. Typical of the more expensive Tandberg models, the 1641X is a beautiful piece of machinery. And, though reasonably priced, it delivers a performance level generally expected of professional type studio recorders.

For additional information, write Tandberg of America, Inc., 8 Third Ave., Pelham. N.Y. 10803. ■



Thanks to use of printed circuits, underside of Tandberg is clean and uncluttered.

the MATHEMATICS of MUSIC



by Jorma Hyvnia

28	784	21952	5.2915	[illegible]	148.16	1.9473	.03571429	87.9645	615.7522
29	841	24389	5.3852	[illegible]	156.17	1.9610	.03448276	91.1061	660.5198
30	**900**	**27000**	[illegible]	[illegible]	**164.32**	**1.9744**	**.03333333**	**94.2477**	**706.8583**
31	961	29791	[illegible]	[illegible]	[illegible]	[illegible]	.03225806	97.3893	754.7676
32	1024	32768	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.5309	804.2477
33	1089	35937	[illegible]	[illegible]	189.57	2.0123	[illegible]	103.6725	855.2986
34	1156	39304	[illegible]	[illegible]	198.25	2.0244	[illegible]	106.8141	907.9203
35	1225	[illegible]	[illegible]	[illegible]	207.06	2.0362	[illegible]	109.9557	962.1127
36	1296	[illegible]	[illegible]	[illegible]	216.00	2.0477	[illegible]	113.0972	1017.8760
37	1369	[illegible]	[illegible]	[illegible]	225.06	2.0589	[illegible]	116.2388	1075.2101
38	1444	[illegible]	[illegible]	[illegible]	234.25	2.0699	[illegible]	119.3804	1134.1149
39	1521	[illegible]	[illegible]	[illegible]	243.56	2.0807	[illegible]	122.5220	1194.5906
40	**1600**	[illegible]	[illegible]	[illegible]	**252.98**	**2.0913**	[illegible]	**125.6636**	**1256.6371**
41	1681	[illegible]	[illegible]	[illegible]	262.53	2.1016	[illegible]	128.8052	1320.2543
42	1764	[illegible]	[illegible]	[illegible]	272.19	2.1118	[illegible]	131.9468	1385.4424
43	1849	[illegible]	[illegible]	[illegible]	281.97	2.1218	[illegible]	135.0884	1452.2012
44	1936	85184	[illegible]	[illegible]	291.86	[illegible]	[illegible]	138.2300	1520.5308
45	2025	91125	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	141.3716	1590.4313
46	2116	97336	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	144.5131	1661.9025

"Wagner's music is better than it sounds," observed Mark Twain. Had the sly humorist been a musical mathematician—or a mathematical musician—he might have made this more general observation: "Most music sounds better than it really is."

The fact is that almost all of the music we hear today, whether Wagnerian opera or high-decibel Rock 'n Roll, is less than perfect. This has nothing to do with room acoustics, poor hi-fi equipment, or mediocre musicianship. For even under the best of conditions, most music is of necessity somewhat less than ideal.

It may come as a minor shock to many a music lover to learn that his favorite concert pianist, who appears to be making sublime music with his Steinway, is actually playing his thirds and sixths somewhat sharp, and his fifths slightly flat! He can't avoid it. That's the way his piano is tuned. Then why not call in the piano tuner and have things set right? Because this would force the pianist to use an instrument having over 500 keys instead of the usual 88!

To appreciate the scientific basis and the unavoidable *arbitrariness* of music, let's delve a bit into the underlying mathematics. Though musical mathematics can become extremely complex, the basics can easily be grasped by anyone having only rudimentary knowledge of plain old arithmetic.

Even the briefest excursion into musical mathematics can be fascinating. On the one hand, it's most satisfying to discover that there's a certain mathematical neatness about harmonic chords. On the other hand, you may be surprised to learn that dissonance, properly utilized in the playing of even *The Star-Spangled Banner*, can make music more enjoyable than it would be if the music were virginally "pure." And it may be more than a little disconcerting to discover that A above middle C, the traditional tuning note, has not always been what it is today!

Diatonic Scale. Though there is a distinct mathematical basis to all music, we must realize that there is no such thing as a single "natural" scale system. The scale system used in the Western world seems natural enough to us; the scales used by other cultures to produce music strange to our ears seem equally natural to those alien cultures. All have sound mathematical bases.

Our *diatonic* scale is the result of considerable experimentation throughout the musical ages. The term diatonic pertains to or designates a standard major or minor scale of eight notes to the octave. For example, a major diatonic scale would be represented by eight consecutive white keys on a piano. Add to these eight notes the five intermediate (black keys) semitones, and you have a *chromatic* scale.

Are these 13 notes per octave sufficient to produce top-quality music? The answer depends on how you define top quality. If you mean adequately pleasing harmony that can be created by physically manageable instruments, then the answer is yes. If you are thinking about complete tonal purity, the answer is no. You can't have both at the same time *if* you include the use of percussion and valve instruments. The reason will become clear later.

True Scale. In order to understand why we are forced to use a somewhat inexact compromise scale, it's necessary to begin with consideration of a *true* scale. As a convenient example, let's take the key of C major scale beginning with middle C on the piano:

C, D, E, F, G, A, B, C^1

As it happens, A above middle C was long ago selected as the basic pitch for instrumental tuning. In terms of the vibrational frequency of the fundamental tone of A, this note has been many things throughout musical history. The pitch of a musical note was first determined by Père Mersenne (1648), a French ecclesiast and mathematician. During his time, the lowest church pitch of A was 373.7 Hz while the chamber pitch was 402.9 Hz. In 1751 Handel used an A of 422.5 Hz.

In 1834, a group of physicists meeting at Stuttgart, Germany, settled on a standard of 440 Hz, but 25 years later an orchestral A of 435 was legalized in France. This lack of uniformity created problems. For example, instruments made in one country wouldn't be in tune with those manufactured in some other country. A singer trained in one country might be forced to sing at an unaccustomed pitch when performing with a foreign orchestra.

In 1939 the problem was at long last resolved. An international conference held in London set the standard pitch of A above middle C at 440 Hz.

The term *pitch* can be misunderstood. The pitch of a played or sung note is related to, but not synonymous with, the vibrational frequency of the fundamental tone. Pitch is a subjective characteristic of sound that depends not only on the vibrational frequency of the note, but also on the loudness of the sound. Moreover, the pitch of a musical sound pertains to a complex sound consisting of the fundamental frequency (e.g., 440 Hz for A) plus many related frequencies called *overtones*. To avoid confusion, we'll henceforth talk only in terms of fundamental frequencies and avoid the use of the term pitch.

To grasp the difficulties that a *true* scale would impose on musicians, consider what happens when a musician decides to switch from one key to another—for example, from the key of C to the key of D. In terms of vibrational frequencies, the following changes would have to be made:

	Frequencies (Hz)	
Note	**Key of C**	**Key of D**
C	264	–
D	297	297
E	330	334
F	352	371
G	396	396
A	440	445
B	495	495
C^1	528	557
D^1	–	594

Note that the four underlined notes in the key-of-D scale have frequencies that differ from the frequencies of the corresponding notes in the key-of-C scale. In order to switch from the key of C to the key of D, a musician would have to use an instrument which had several new notes added. But that isn't all. Still more new notes would be required when switching to each of the other keys. To complicate matters more, additional notes would be required for the various minor scales. Consequently, at least 72 notes would be needed for each octave of an instrument's total range. Since the piano has seven octaves, more than 500 keys would be needed. This would clearly be impractical.

Percussion instruments such as the piano, and valve instruments such as woodwinds, would be most seriously affected. Stringed instruments such as the violin, and the human voice, could theoretically at least provide all of the tonal nuances demanded by the true scale.

Frequency Calculations. It's a simple matter to calculate the tonal frequencies for any diatonic scale. For example, the key of D scale, above, was developed from the tonic D (a tonic is the first or lowest note in any scale) by multiplying this basic frequency (D=297 Hz) by the appropriate ratios for musical thirds. fourths, fifths, etc. These values are given in Fig. 1.

For example, the frequency ratio of a musical fifth (the interval between the first and fifth notes of the scale) is 3 to 2. In the key of D scale. note A represents a fifth. Thus, by setting up the proportion 3:2= X:297, and solving for X, we obtain 445 Hz as the frequency of A in the key of D scale. Other values are determined in exactly the same way. The octave D^1 of course has just twice the frequency of the tonic D.

Musical Intervals. There are two kinds of musical intervals. First, those between various notes of a scale and the tonic note (the low "do"). These intervals are identified as thirds, fourths. fifths. etc. Secondly, there are tone intervals represented by adjacent notes in a scale.

In Fig. 1, note that there is one octave interval with a 2 to 1 frequency ratio, two major sixths (5:3), one minor sixth (8:5), three fifths (3:2), four fourths (4:3), three major thirds (5:4), and two minor thirds (6:5). The differences between the major and minor categories are somewhat arbitrary, but important to understanding music's math. For example, if the frequency of E is divided by the frequency of C, (a "third") the simplest ratio that results is 5:4. The same applies to the F-A third and the G-B third.

On the other hand, the G-E and C^1-A thirds yield a numerically smaller—hence "minor"—ratio of 6:5. The size relationship is clearer if the fractions are changed to decimal forms: 5/4=1.25 while 6/5=1.20. The same explanation holds for the difference between the major and minor sixths.

But haven't we overlooked something? What of the seeming D-F third? Is it major or minor? Neither. because the frequency ratio of 352 to 297 cannot be further simplified. Further, this tone interval isn't musically significant according to the law of Pythagoras, which demands that the tonal relations must be reducible to simple whole-number ratios.

Figure 2 shows how these various intervals are calculated. In line three, the frequency of each note is divided by the frequency of

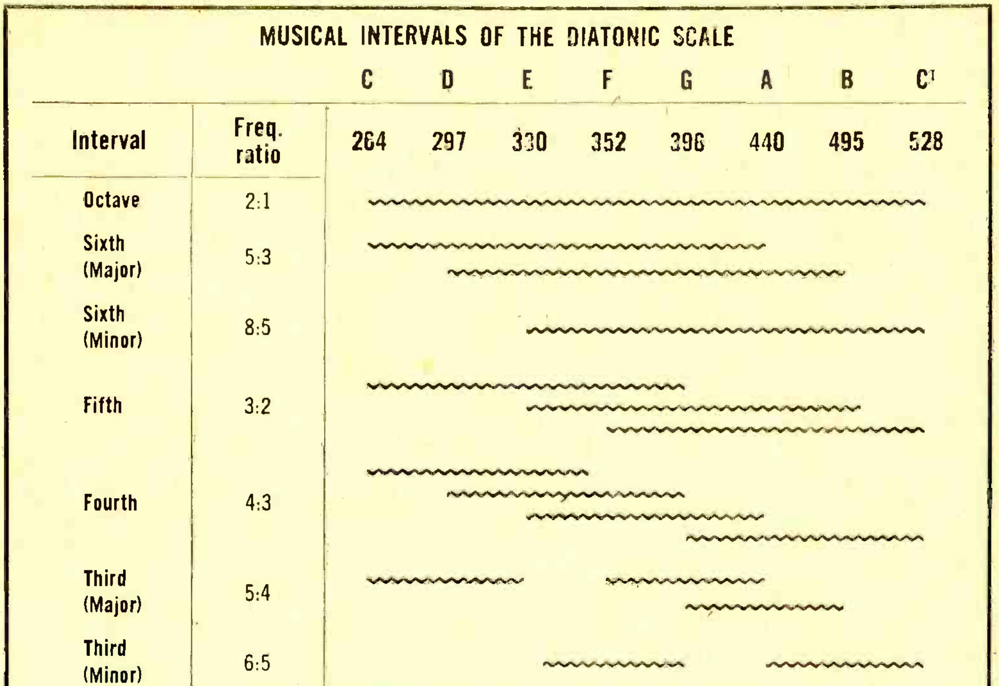


Fig. 1. Musical intervals and their frequency ratios for diatonic scale. Since interval ratios are constant, they can be used to find frequencies for scale in another key.

the tonic (264). The next line shows the simplified ratios, just as they appeared in Fig. 1.

Some music mathematicians, disliking fractions, eliminate the fractions by multiplying with a common factor, in this case 24. This yields the relative frequencies shown in line five. What do they mean? Simply this: in the time that the tonic C vibrates 24 times, D vibrates 27 times, E vibrates 30 times, etc.

By dividing the relative frequencies of adjacent notes, the adjacent tone interval ratios shown in the last three lines are obtained. Note that there are three 9:8 *major* intervals (four if the scale is extended by one note), two 10:9 *minor* intervals, and two 16:15 *semitone* intervals. In this case the terms major and minor are used simply to indicate the relative numerical sizes of the ratios—i.e., 9:8 represents a bigger number than 10:9.

Figure 3 illustrates the tone intervals in major and minor *scales*. The minor scale has three flatted notes with frequencies somewhat lower than those of the corresponding notes in the major scale. The last two lines reveal that the same intervals occur in both major and minor scales but in different order. Both scales fully satisfy the law of Pythagoras by adhering to simple numerical ratios between adjacent notes.

Mathematical hint: when handling numbers having decimal fractions, first multiply both denominator and numerator by a common factor (usually 10) to clear the decimal, then reduce to the simplest fraction. For example, to calculate the G-A flat interval:

$$\frac{442.4}{396} = \frac{4224}{3960} = \frac{16}{15}$$

Tempered Scales. In order to avoid using an inordinately large number of notes per octave, thus necessitating very complicated musical instruments, musicians throughout the centuries have attempted to devise compromise scales called tempered scales. The most important of these have been the Pythagorean, the mean tone temperament, and the now generally accepted equal temperament scale established about 150 years ago.

In the equal temperament scale, each octave is divided into twelve equal divisions called tempered semitones. Two semitones are equivalent to one full tone.

FREQUENCY RATIOS OF THE TRUE SCALE (KEY OF C MAJOR)

Note	C	D	E	F	G	A	B	C′	D′
Frequency (Hz)	264	297	330	352	396	440	495	528	594
Ratio to tonic note C	$\frac{264}{264}$	$\frac{297}{264}$	$\frac{330}{264}$	$\frac{352}{264}$	$\frac{396}{264}$	$\frac{440}{264}$	$\frac{495}{264}$	$\frac{528}{264}$	$\frac{594}{264}$
Simplified ratio	$\frac{1}{1}$	$\frac{9}{8}$	$\frac{5}{4}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{15}{8}$	$\frac{2}{1}$	$\frac{9}{4}$
Relative frequency (Ratio x 24 to clear fractions)	24	27	30	32	36	40	45	48	54
Major tone intervals	$\frac{9}{8}$ (C–D)			$\frac{9}{8}$ (F–G)		$\frac{9}{8}$ (A–B)		$\frac{9}{8}$ (C′–D′)	
Major tone intervals		$\frac{10}{9}$ (D–E)			$\frac{10}{9}$ (G–A)				
Semitone intervals			$\frac{16}{15}$ (E–F)				$\frac{16}{15}$ (B–C′)		

Fig. 2. Frequency ratios between notes in diatonic scale. In line five, simplified ratios in line four have been cleared of fractions in order to show relative frequencies.

MAJOR AND MINOR TRUE SCALES (KEY OF C)

Notes (major)	C	D	E	F	G	A	B	C'
Notes (minor)	C	D	E♭	F	G	A♭	B♭	C'
Frequency (major)	264	297	330	352	396	440	495	528
Frequency (minor)	264	297	316.8	352	396	422.4	475.4	528

	C–D	D–E	E–F	F–G	G–A	A–B	B–C'
Intervals (major)	$\frac{9}{8}$	$\frac{10}{9}$	$\frac{16}{15}$	$\frac{9}{8}$	$\frac{10}{9}$	$\frac{9}{8}$	$\frac{16}{15}$
Intervals (minor)	$\frac{9}{8}$	$\frac{16}{15}$	$\frac{10}{9}$	$\frac{9}{8}$	$\frac{16}{15}$	$\frac{9}{8}$	$\frac{10}{9}$

Fig. 3. Frequencies and tone intervals for major and minor scales in key of C. Interesting here is that very same intervals occur in both scales, though in different order.

One important consequence of this type of tempering is that flats and sharps lose their original significance as different tones. For example, G♯ and A♭ are now identical. In effect, five new notes (the black keys on a piano) were added to the original diatonic scale (white keys). This arrangement is diagrammed in Fig. 4.

It's obvious that when these thirteen notes

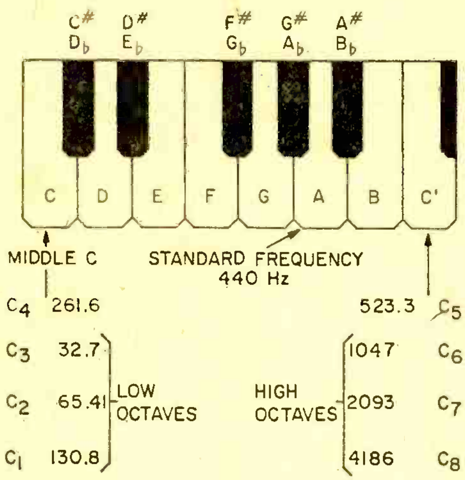


Fig. 4. Equal temperament scale now in common use allows no difference between sharps and flats (D♯ and E♭ are thus identical).

of an octave are asked to do the job of 72 notes in a true scale system, there must be some sacrifice of tonal quality. An instrument tuned to the equal temperament scale has only one correct interval—the octave. All other intervals are to some degree in error; thirds and sixths are a little sharp, while fifths are flat.

Note that middle C now has a frequency of 261.7 Hz instead of the 264 we have so far talked about in relation to the true scale. This adjustment is necessary in order to make the frequency of the standard A work out to 440 Hz.

Figure 5 compares the frequencies of the true scale with those of the equal temperament scale. Note that A is the only note having the same frequency in both scales. The frequency of C^1 is of course just twice that of its lower octave, C. When the five half tones are added to this diatonic scale, the frequency range between C and C^1 must be divided into twelve equal parts. Mathematically, each twelfth part is the 12th root of 2 because the frequency of C must be multiplied by 2 to obtain C^1.

Thus: $n = \sqrt[12]{2} = 1.05946$

Figure 6 shows how the frequency ratios work out for each note. These ratios are ob-

SCALE FREQUENCIES (A = 440 Hz)

Note	True scale (Hz)	Equal temperament scale (Hz)
C	264	261.7
D	297	293.7
E	330	329.7
F	352	349.2
G	396	392
A	440	440
B	495	493.9
C^1	528	523.3

Fig. 5. Frequencies of true scale compared with those of equal temperament scale. Only note having same frequency in both is A.

tained by multiplying each successive ratio by the common factor of 1.05946 to obtain the next ratio. For example, to derive the ratio for F, multiply the previously calculated ratio for E (1.2598) by 1.05946. The derived ratios can then be used to calculate actual note frequencies. For example, by multiplying 261.7 (tonic C) by 1.6818 (ratio for A), the frequency of 439.985 is obtained for A—very close to the standard 440 Hz.

It's important to remember that when intervals are to be added, their ratios must be multiplied. For example, to add the C-F fourth to the C-G fifth, one would multiply 1.3347 x 1.4982 to obtain 1.9996 which is almost 2, the expected octave ratio. To avoid such complicated mathematics, other more empirical systems of indicating frequency intervals are sometimes used. The *cent* system (Fig. 6) is a numerical scale in which the tonic is 0, the tonic octave is 1200, and each semitone interval is equivalent to 100 cents.

Unlike the decimal frequency ratios, these values can be added. For example, the C-F fourth is represented by 500 cents and the C-G fifth by 700 cents. The sum of these two numbers is 1200 indicating that a fourth plus a fifth is equal to an octave. Another somewhat similar numerical system makes use of units called *savarts*.

FREQUENCY RATIOS OF THE EQUAL TEMPERAMENT SCALE

Note	Frequency ratio	Cents from tonic
C	1.0000	0
C♯ (D♭)	1.05946	100
D	1.1224	200
D♯ (E♭)	1.1891	300
E	1.2598	400
F	1.3347	500
F♯ (G♭)	1.4141	600
G	1.4982	700
G♯ (A♭)	1.5873	800
A	1.6817	900
A♯ (B♭)	1.7817	1000
B	1.8876	1100
C¹	2.0000	1200

Fig. 6. Frequency ratios of equal temperament scale. Since scale comprises twelve equal parts, common factor is 1.05946.

Incidentally, you now have enough information to easily calculate the frequency of any note, in any octave of the equal temperament scale. The frequencies of all the Cs on a piano are given in Fig. 4. To obtain the frequency of any other note, use the frequency ratios in Fig. 6.

Let's assume you want to know the frequency of E_3 which is the E in the octave below middle C. First find the frequency of E_4 (E above middle C) by multiplying 261.6 by the E-ratio 1.2598. The answer is 329.56. To drop down one octave, simply divide by 2 to get 164.78 Hz as the frequency of C_3. Halving this number would give the frequency of E_2 in the next lower octave. Obviously, to find the value of E in a higher octave, you simply multiply instead of divide by two.

Harmonic Triads. There are certain naturally agreeable ("harmonious") note combinations which chords can be derived from by the addition of a fourth note. (This note, incidentally, must be an octave of one of the three notes comprising the triad.) To show how triads can be discovered by mathematical analysis, it's preferable to work with the *true* scale because the mathematical relationships are simpler and more exact.

Derivation of the harmonic triads in the key of C major is shown in Fig. 7. First set up the diatonic scale and extend it by one note (D^1) and set down the vibrational frequency for each note. Now simplify these frequency relationships by dividing all frequencies by eleven to obtain the relative frequencies shown in line three (C=24, D=27, etc.). It will now be discovered that certain numbers can be divided by 6 to yield still smaller whole numbers; these are C, E, and G which have frequency ratios of 4:5:6. Dividing by 8 and then by 9 will yield two more 4:5:6 triads—FAC^1 and GBD^1.

Incidentally, note what happens if the same calculations are made using the corresponding frequencies in the equal temperament scale (C=261.7, E=329.7, G=392). In this case the CEG ratio would work out to approximately 4. 1:5. 1:6.1, which is close to what is obtained with the true scale. Even so, it doesn't provide the small whole number relationships that are characteristic of highest consonance or harmony.

Figure 8 shows a similar derivation of the three triads in the scale key of C minor.

MAJOR HARMONIC TRIADS (KEY OF C)										
Note	**C**	**D**	**E**	**F**	**G**	**A**	**B**	**C^1**	**D^1**	
Frequency (Hz)	264	297	330	352	396	440	495	528	594	
Freq. ÷ 11	24	27	30	32	36	40	45	48	54	
÷ 6	4		5		6	(CEG)				
÷ 8	6			4		5		6	(FAC^1)	
÷ 9		3			4		5		6	(GBD^1)

Fig. 7. Derivation of *major* harmonic triads for diatonic scale in key of C major. Dividing frequencies by 6, 8, and 9 reveals three triads, each having frequency ratios of 4:5:6.

The mathematical procedure has been modified slightly in order to handle the decimal values more easily. The frequencies are first all multiplied by ten to eliminate the decimal fractions, after which basic simplification is achieved by dividing by 22. When the simplified relative frequencies are then divided by 12, 16, and 18, three sets of minor triads having frequency ratios of 10:12:15 are discovered. Note that though the frequency ratios are different from those obtained with major triads, the same notes still make up the triads.

Incidentally, there's nothing mysterious about the primary divisors used in each case (11 for major triads, 22 for minor triads). Perusal of the frequencies indicated that these divisors were merely convenient for reducing the sizes of the numbers. You could in fact skip this step and divide the major frequencies directly by 66, 88, and 99 and arrive at the same conclusions.

Figure 9 helps show just what the triad ratios mean. Consider the CEG major triad. In the time period that the note C vibrates through four cycles, E will go through 5 cycles, and G will vibrate six times. In the case of the CEG triad, this happens in one 66th of a second. The same vibrational relationships hold for the FAC^1 and GBD^1 triads except that the time periods are shorter.

For the record, the CEG triad is known as the *tonic triad*, GBD^1 is the *dominant triad*, and FAC^1 is the *sub-dominant triad.*

A number of different chords can be developed from the major and minor triads by a procedure called inversion. For example, the chord CEG is called the common chord. A first inversion is obtained by using the octave of C to form the chord EGC^1. A second inversion is obtained by using E that is an octave higher to obtain the chord GC^1E^1. Similar inversions can be made with the minor triads.

(Continued on page 104)

MINOR HARMONIC TRIADS (KEY OF C)										
Note	**C**	**D**	**E♭**	**F**	**G**	**A♭**	**B♭**	**C^1**	**D^1**	
Frequency (Hz)	264	297	316.8	352	396	422.4	475.4	528	594	
X 10	2640	2970	3168	3520	3960	4224	4754	5280	5940	
÷ 22	120	135	144	160	180	192	216	240	270	
÷ 12	10		12		15	(CEG)				
÷ 16				10		12		15	(FAC^1)	
÷ 18					10		12		15	(GBD^1)

Fig. 8. Derivation of *minor* harmonic triads for diatonic scale in key of C minor. Even though frequency ratios differ from those in Fig. 7, triads are comprised of same notes.

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* was founded in Providence, R. I. by Charles De Witt White as an extension of his earlier publishing activities. Interestingly enough, these, in turn, were a continuation of the business established by his father: the publication of city directories, street guides, and municipal tax guides.

In the early days of broadcasting, compiling a list of operating stations and their frequencies was no simple task. Reason was that prior to the Dill-White Radio Act of 1927, any feed merchant, auto dealer, barber, or undertaker who wanted to advertise his wares or services had only to select a frequency and go on the air. A great many experimenters and businessmen did just that.

Nevertheless, Mr. White's directory publishing experience had convinced him that he could successfully assemble a radio log. In 1924 he justified this conviction with *The Rhode Island Radio Call Book*, following this shortly after with *White's Triple List of Radio Broadcasting Stations*.

In 1927 the two publications were merged and nation-wide distribution established. In ensuing years related publications, such as *Sponsored Radio Programs*, *Radio Announcer's Guide*, *Short-Wave Schedule Guide*, and a special Canadian edition of the *Log* (which had had its title shortened to the one it bears today), were also issued.

The *Log* itself eventually reached a combined circulation of well over a million copies. It also came up with some rather unusual bedfellows. In 1929-31 it was distributed as the *Enna Jettick Radio Log* (to promote the sale of shoes); in 1938-9 as the *General Electric Radio Log* to promote General Electric's "sensational 1939 receivers with pushbutton tuning."

The Fall-Winter number of the 1927 *Log* listed 701 U.S. stations. Most powerful were WEAF (now WRCA), New York, with 50,000 watts; KDKA, Pittsburgh; WGY, Schenectady; and WJZ (now WABC), New York, each with 30,000 watts; WGN-WLIB, Chicago, with 15,000 watts; and Boston's WBZ, also with 15,000. Five stations listed (one a Junior High School in Norfolk, Va.) operated on a mighty 5 watts; more than 100 stations had outputs of less than 100 watts.

The current *Log* cross-indexes over 4244 U.S. standard-broadcast (AM) stations, over 2247 U.S. frequency-modulation (FM) and over 810 television stations, has a complete compilation of Canadian broadcasters, and, in addition, has a comprehensive world-wide roster of shortwave stations.

With the success of his *Log*, Charles De Witt White (a direct descendant of Peregrine White, the first child born on the *Mayflower's* historic crossing and bearer of the name of another illustrious ancestor, De Witt Clinton) disposed of his city directory and street guide interests. In time, he transferred his editorial operations to Bronxville, N. Y., a suburb of New York City, where he could remain in close touch with the broadcasting industry. On April 6, 1957, having only recently completed revising and updating material for the 34th consecutive year of his *Log*, Mr. White died in his sleep. He was 76 years old.

Charles De Witt White's daughter and heir, Mrs. W. R. Washburn, sold all rights in and to the *Log* to Science & Mechanics Publishing Co., and entrusted us with continuing her father's work. This we were proud to do back in 1958 in RADIO-TV EXPERIMENTER—which later became the current SCIENCE AND ELECTRONICS.

Beginning with our first bimonthly issue in 1964, *White's Radio Log* was divided into three parts (it had grown to 60 pages in size and was much too large to incorporate in any one issue). From 1964 until the present, we published the *Log* in three parts, updating each part right up to press time.

Now, in 1969, the size of the *Log* again necessitates a change. Therefore, *White's Radio Log* will be published in six parts during 1969. In each issue we will include a major listing for either AM Broadcasting Stations, FM Broadcasting Stations or Television Stations; plus the expanded World-Wide Shortwave Section (brand new for each issue); plus the all-new Emergency Radio Listing for major U.S. cities (a different major city will appear in every issue).

In this issue of SCIENCE AND ELECTRONICS, *White's Radio Log* contains *U.S. AM Stations by Frequency*, *World-Wide Shortwave Stations*, and *Emergency Radio Listings for Florida*.

As always, as we go to press on each issue of *White's Radio Log*, station additions, changes, and deletions are made by the U.S. and Canadian governments. The same holds true for the world-wide shortwave broadcasters. Therefore, the Editor cordially invites all readers to inform him of any changes that must be made to keep the *Log* up to date. (In some instances our readers discover and notify us of changes *before* the FCC or DOT officially inform us.) Keep your cards and letters coming—they are most sincerely appreciated, and it's the one way you can help us make a better *Log*.

WHITE'S RADIO LOG CONTENTS FOR 1969-1970

WHITE'S

RADIO LOG

U.S. AM Stations by Frequency

U. S. stations listed alphabetically by states within groups. Abbreviations: kHz. frequency in kilocycles; W.P., power in watts; d, operates daytime only; n, operates nighttime only. Wave length is given in meters. Listing indicates stations on the air up to October 14, 1968.

kHz Wave Length W.P.

540—555.5

KVIP Redding, Calif. 1000
WGTO Cypress Gardens, Fla. 50000d
WDAK Columbus, Ga. 5000
KWMT Ft. Dodge, Iowa 5000d
KNOE Monroe, La. 5000
WDMV Pocomoke City, Md. 500d
WLIX Islip, N.Y. 250d
WETC Wendell-Zebluon, N.C. 5000d
WARO Canonsburg, Pa. 250d
WYNN Florence, S.C. 250d
WDXN Clarksville, Tenn. 1000d
WRIC Richlands, Va. 1000d
WYLO Jackson, Wisc. 250d

550—545.1

KENI Anchorage, Alaska 5000
KOY Phoenix, Ariz. 5000
KAFY Bakersfield, Calif. 1000
KRAI Craig, Colo. 5000
WAFR Orange Park, Fla. 1000d
WGGA Gainesville, Ga. 5000
KMVI Wailuku, Hawaii 500d
KFRM Salina, Kans. 5000d
WCBI Columbus, Miss. 1000
KSD St. Louis, Mo. 5000
KBOW Butte, Mont. 1000
WGR Buffalo, N.Y. 5000
WDBM Statesville, N.C. 500d
KFYR Bismarck, N.Dak. 5000
WKRC Cincinnati, Ohio 5000
KOAC Corvallis, Oreg. 5000
WHLM Bloomsburg, Pa. 1000
WPAB Ponce, P.R. 5000
WXTR Pawtucket, R.I. 1000
KCRS Midland, Tex. 5000
KTSA San Antonio, Tex. 5000
WDEV Waterbury, Vt. 5000
WSVA Harrisonburg, Va. 5000
KARI Blaine, Wash. 5000
WSAU Wausau, Wis. 5000

560—535.4

WOOF Dothan, Ala. 5000d
KYUM Yuma, Ariz. 1000
KSFO San Fran., Calif. 5000
KLZ Denver, Colo. 5000
WQAM Miami, Fla. 5000
WIND Chicago, Ill. 5000
WMIK Middlesboro, Ky. 500d
WCSH Portland, Maine 5000
WFRB Frostburg, Md. 1000d
WHYN Springfield, Mass. 5000
WQTE Monroe, Mich. 500d
WEBC Duluth, Minn. 5000
KWTO Springfield, Mo. 5000
KMON Great Falls, Mont. 5000
WCKL Catskill, N.Y.
WGAI Elizabeth City, N.C. 1000
WFIL Philadelphia, Pa. 5000
WIS Columbia, S.C. 5000
WHBQ Memphis, Tenn. 5000
KLVI Beaumont, Tex. 5000
KPQ Wenatchee, Wash. 5000
WJLS Beckley, W.Va. 5000

570—526.0

WAAX Gadsden, Ala. 5000
KCNO Alturas, Cal. 5000d
WFSU Pinellas Park, Fla. 500d
WACL Waycross, Ga. 5000
KYKX Paducah, Ky. 1000
WGMS Bethesda, Md. 5000
WVMI Biloxi, Miss. 1000d
KGRT Las Cruces, N.Mex. 5000d
WMCA New York, N.Y. 5000
WSYR Syracuse, N.Y. 5000
WWNC Asheville, N.C. 5000
WLLE Raleigh, N.C. 500d
WKBN Youngstown, Ohio 5000
WNAX Yankton, S.Dak. 5000
WFAA Dallas, Tex. 5000
WBAP Ft. Worth, Tex. 5000
KLUB Salt Lake City, Utah 5000
KVI Seattle, Wash. 5000
WMAM Marinette, Wis. 250

580—516.9

WABT Tuskegee, Ala. 500d
KIKX Tucson, Ariz. 5000
KMJ Fresno, Calif. 5000
KUBC Montrose, Colo. 5000
WDBO Orlando, Fla. 5000
WGAC Augusta, Ga. 5000
KFXD Nampa, Idaho 5000
WILL Urbana, Ill. 5000d
KSAC Manhattan, Kans. 5000
WIBW Topeka, Kans. 5000
KALB Alexandria, La. 5000
WTAG Worcester, Mass. 5000
WELO Tupelo, Miss. 1000
KANA Anaconda, Mont. 1000d
WAGR Lumberton, N.C. 500d
KWIN Ashland, Oreg. 1000
WHP Harrisburg, Pa. 5000
WKAQ San Juan, P.R. 5000
KOBH Hot Springs, S.Dak. 500d
WRKH Rockwood, Tenn. 1000d
KDAV Lubbock, Tex. 500d
WLES Lawrenceville, Va. 500d
WCHS Charleston, W.Va. 5000
WKTY LaCrosse, Wis. 5000

590—508.2

KHAR Anchorage, Alaska 5000
WLAG Carrollton, Ala. 1000d
KBHS Hot Springs, Ark. 5000d
KFXM San Bernardino, Cal. 1000
KTHO S. Lake Tahoe, Cal. 1000d
KCSJ Pueblo, Colo. 1000
WDLP Panama City, Fla. 1000
WPLO Atlanta, Ga. 5000
KGMB Honolulu, Hawaii 5000
KID Idaho Falls, Idaho 5000
WRTH Wood River, Ill. 1000
WVLK Lexington, Ky. 5000
WEEI Boston, Mass. 5000
WJMS Ironwood, Mich. 5000
WKZO Kalamazoo, Mich. 5000
KGLE Glendive, Mont. 500d
WOW Omaha, Nebr. 5000
WROW Albany, N.Y. 5000
WCAB Rutherfordton, N. C. 500d
WGTM Wilson, N.C. 5000
KUGN Eugene, Oreg. 5000
WARM Scranton, Pa. 5000
WMBS Uniontown, Pa. 1000
KTBC Austin, Tex. 5000
KSUB Cedar City, Utah 1000
WLVA Lynchburg, Va. 1000
KHQ Spokane, Wash. 5000

600—499.7

WIRB Enterprise, Ala. 1000d
KCLS Flagstaff, Ariz. 5000
KVCV Redding, Calif. 1000
KOGO San Diego, Calif. 5000
KEWE Ft. Collins, Colo.
WICC Bridgeport, Conn. 5000
WPDQ Jacksonville, Fla. 5000
WMT Cedar Rapids, Iowa 5000
WWOM New Orleans, La. 1000d
WFST Caribou, Maine 5000d
WCAO Baltimore, Md. 5000
WLST Escanaba, Mich. 1000d
WTAC Flint, Mich. 1000
KGEZ Kalispell, Mont. 1000
WCVP Murphy, N.C. 1000d
WSJS Winston-Salem, N.C. 5000
KSJB Jamestown, N.D. 5000
WSOM Salem, Ohio 500d
WFRM Coudersport, Pa. 1000d
WAEL Mayaguez, P.R. 1000
WREC Memphis, Tenn. 5000
KROD El Paso, Tex. 5000
KERB Kermit, Tex. 1000d
KTBB Tyler, Tex. 1000
WVAR Richwood, W.Va. 1000d

610—491.5

WSGN Birmingham, Ala. 5000
KAVL Lancaster, Calif. 1000
KFRC San Francisco, Calif. 5000
WTOR Torrington, Conn. 1000
WIOD Miami, Fla. 5000
WMEL Pensacola, Fla. 500d
WCEH Hawkinsville, Ga. 500d
KNAH Agana, Guam 1000
WRUS Russellville, Ky. 500d
KDAL Duluth, Minn. 5000
WDAF Kansas City, Mo. 5000
KOJM Havre, Mont. 1000
KCSR Chadron, Nebr. 1000d
WGIR Manchester, N.H. 5000
KGGM Albuquerque, N.Mex. 5000
WAYS Charlotte, N.C. 5000
WTVN Columbus, Ohio 5000
WIP Philadelphia, Pa. 5000
KILT Houston, Tex. 5000
KVNU Logan, Utah 5000
WSLS Roanoke, Va. 5000
WHPL Winchester, Va. 500
KEPR Kennewick-Richmond-Pasco, Wash. 5000

620—483.6

KTAR Phoenix, Ariz. 5000
KNGS Hanford, Calif. 1000
KWSD Mt. Shasta, Calif. 1000d
KSTR Grand Junction, Colo. 5000d
WSUN St. Petersburg, Fla. 5000
WTRP LaGrange, Ga. 1000d
KWAL Wallace, Idaho 1000
KMNS Sioux City, Iowa 1000
WTMT Louisville, Ky. 500d
WLBZ Bangor, Maine 5000
WJDX Jackson, Miss. 5000
WVNJ Newark, N.J. 5000
WHEN Syracuse, N.Y. 5000
WDNC Durham, N.C. 5000
KGW Portland, Oreg. 5000
WHJB Greensburg, Pa. 1000
WCAY Cayce, S.C. 500d
WATE Knoxville, Tenn. 5000
KWFT Wichita Falls, Tex. 5000
WVMT Burlington, Vt. 5000
WWNR Beckley, W.Va. 1000
WTMJ Milwaukee, Wis. 5000

630—475.9

WAVU Albertville, Ala. 1000d
WJDB Thomasville, Ala. 1000d
KJNO Juneau, Alaska 1000
KVMA Magnolia, Ark. 1000d
KIDD Monterey, Calif. 1000
KHOW Denver, Colo. 5000
WMAL Washington, D.C. 5000
WSAV Savannah, Ga. 5000
WNEG Toccoa, Ga. 500d
KIDO Boise, Idaho 5000
WLAP Lexington, Ky. 5000
KTIB Thibodaux, La. 500d
KDWB So. St. Paul, Minn. 5000
KXOK St. Louis, Mo. 5000
KGVW Belgrade, Mont. 1000d
KOH Reno, Nev. 5000
KLEA Lovington, N.Mex. 500d
WIRC Hickory, N.C. 1000d
WMFD Wilmington, N.C. 1000
KWRO Coquille, Oreg. 5000d
WEJL Scranton, Pa. 500d
WPRO Providence, R.I. 5000
KMAC San Antonio, Tex. 5000
KSXX Salt Lake City, Utah 1000d
KGDN Edmonds, Wash. 5000d
KZUN Opportunity, Wash. 500d

640—468.5

KFI Los Angeles, Calif. 50000
WOI Ames, Iowa 5000d
WHLO Akron, O. 1000d
WNAD Norman, Okla. 1000d

650—461.3

KYAK Anchorage, Alaska 25000
KORL Honolulu, Hawaii 10000
WQBS San Juan, P.R. 1000
WSM Nashville, Tenn. 50000
KIKK Pasadena, Texas 250d

660—454.3

KFAR Fairbanks, Alaska 10000
KOZN Omaha, Neb. 1000d
WNBC New York, N.Y. 50000
WESC Greenville, S.C. 10000d
KSKY Dallas, Tex 10000d

670—447.5

KBOI Boise, Idaho 50000
WMAQ Chicago, Ill. 50000

680—440.9

KNBR San Francisco, Cal. 50000
WWBA St. Petersburg, Fla. 1000d
WRNG N. Atlanta, Ga. 5000d
WCTT Corbin, Ky. 1000
WCBM Baltimore, Md. 10000
WRKO Boston, Mass. 50000
WDBC Escanaba, Mich. 10000
KFEQ St. Joseph, Mo. 5000
WINR Binghamton, N.Y. 1000
WNYR Rochester, N.Y. 250d
WPTF Raleigh, N.C. 50000
WISR Butler, Pa. 250d
WAPA San Juan, P.Rico. 10000
WMPS Memphis, Tenn. 10000
KBAT San Antonio, Tex. 50000
KOMW Omak, Wash. 1000d
WCAW Charleston, W.Va. 10000

690—434.5

WVOK Birmingham, Ala. 50000d
KEOS Flagstaff, Ariz. 1000
KEVT Tucson, Ariz. 250d
KBBA Benton, Ark. 250d
KAPI Pueblo, Colo. 250d
WADS Ansonia, Conn. 500d
WAPE Jacksonville, Fla. 50000
KKUA Honolulu, Hawaii 10000
KBLI Blackfoot, Idaho 1000d
KGGF Coffeyville, Kans. 10000
WTIX New Orleans, La. 10000
KTCR Minneapolis, Minn. 500d
KSIL St. Louis, Mo. 1000d
KEYR Terrytown, Nebr. 1000d
KRCO Prineville, Oreg. 1000d
WXUR Media, Pa. 500d
KUSD Vermillion, S.Dak. 1000d
KHEY El Paso, Tex. 10000
KPET Lamesa, Tex. 250
KZEY Tyler, Tex. 5000d
WCYB Bristol, Va. 10000d
WNNT Warsaw, Va. 250d
WELD Fisher, W. Va. 500d
WAGO Oshkosh, Wis. 2500

700—428.3

WLW Cincinnati, Ohio 50000

710—422.3

WKRG Mobile, Ala. 1000
KMPC Los Angeles, Calif. 50000
KBTR Denver, Colo. 5000
WGBS Miami, Fla. 50000
WUFF Eastman, Ga. 1000d
WROM Rome, Ga. 1000d
KEEL Shreveport, La. 50000
WHB Kansas City, Mo. 10000
WOR New York, N.Y. 50000
DZRH Manila, P.I. 10000
WKJB Mayaguez, P.Rico 1000
WTPR Paris, Tenn. 250d
KGNC Amarillo, Tex. 10000
KURV Edinburg, Tex. 250
KIRO Seattle, Wash. 50000
WDSM Superior, Wis. 5000

720—416.4

KUAI Eleele, Hawaii 5000
WGN Chicago, Ill. 50000

730—410.7

WJMW Athens, Ga. 1000d
KSUD W. Memphis, Ark. 250d
WLOR Thomasville, Ga. 5000d
KLOE Goodland, Kans. 1000d
WFMW Madisonville, Ky. 500d
WMTC Vancleve, Ky. 1000d
KTRY Bastrop, La. 250d
WARB Covington, La. 250d
WJTO Bath, Maine 1000d
WACE Chicopee, Mass. 5000d
WVIC E. Lansing, Mich. 500d
KWRE Warrenton, Mo. 1000d
KWOA Worthington, Minn. 1000d
KURL Billings, Mont. 500d
KVOD Albuquerque, N. Mex. 1000d
WDOS Oneonta, N.Y. 1000d
WFMC Goldsboro, N.C. 1000d
WOHS Shelby, N.C. 1000d
WMGS Bowling Green, Ohio 1000d
KBOY Medford, Oreg. 1000d
WNAK Nanticoke, Pa. 1000d
WPIT Pittsburgh, Pa. 5000d
WPAL Charleston, S.C. 1000d
WLIL Lenoir, Tenn. 1000d
KKDA Grand Prairie, Tex. 500d
KSVN Ogden, Utah 1000d
WPIK Alexandria, Va. 5000d
WMNA Gretna, Va. 1000d
KULE Ephrata, Wash. 1000d
WXMT Merrill, Wis. 1000d

740—405.2

WBAM Montgomery, Ala. 50000d
KMEO Phoenix, Ariz. 1000d
KBIG Avalon, Cal. 10000d
KCBS San Francisco, Calif. 50000
KSSS Colorado Springs, Colo. 1000
KVFC Cortez, Colo. 1000
WSBR Boca Raton, Fla. 1000
WKMK Blountstown, Fla. 1000d
WKIS Orlando, Fla. 5000
KYME Boise, Idaho 500d
WVLN Olney, Ill. 1000d
KBOE Oskaloosa, Iowa 250d
WNOP Newport, Ky. 1000d
WCAS Cambridge, Mass 250d
KBAD Carlsbad, N.M.

kHz Wave Length W.P.

WGSM Huntington, N.Y. 5000d
WMBL Morehead City, N.C. 1000d
WPAQ Mount Airy, N.C. 10000d
KRMG Tulsa, Okla. 50000
WVCH Chester, Pa. 1000d
WIAC San Juan, P.Rico 10000
WBAW Barnwell, S.C. 1000d
WIRJ Humboldt, Tenn. 250d
WJIG Tullahoma, Tenn. 250d
KTRH Houston, Tex. 50000
KCMC Texarkana, Tex. 1000
WBCI Williamsburg, Va. 500d
WBOO Baraboo, Wis. 250d

750—399.8

KFQD Anchorage, Alaska 10000
WSB Atlanta, Ga. 50000
WBMD Baltimore, Md. 1000d
KMMS Grand Island, Neb. 10000d
WHEB Portsmouth, N.H. 1000d
KSEO Durant, Okla. 250d
KXL Portland, Oreg. 50000d
WPDX Clarksburg, W.Va. 1000d

760—394.5

KFMB San Diego, Cal. 5000
KGU Honolulu, Hawaii 10000
WJR Detroit, Mich. 50000
WCPS Tarboro, N.C. 1000d
WORA Mayaguez, P.R. 5000

770—389.4

KUOM Minneapolis, Minn. 5000d
WCAL Northfield, Minn. 5000d
WEW St. Louis, Mo. 1000d
KOB Albuquerque, N.Mex. 50000
WABC New York, N.Y. 50000
KXA Seattle, Wash. 1000d

780—384.4

WBBM Chicago, Ill. 50000
WJAG Norfolk, Neb. 1000d
KCRL Reno, Nev.
WCKB Dunn, N.C. 1000d
WBBO Forest City, N.C. 1000d
KSPI Stillwater, Okla. 250d
WAVA Arlington, Va. 1000d

790—379.5

WTUG Tuscaloosa, Ala. 1000d
KCAM Glennallen, Alaska 5000
KCEE Tucson, Ariz. 5000
KOSY Texarkana, Ark. 1000
KABC Los Angeles, Calif. 5000
WLBE Leesburg, Fla. 5000
WFUN Miami, Fla. 5000
WPFA Pensacola, Fla. 1000d
WQXI Atlanta, Ga. 5000
WYNR Brunswick, Ga. 500d
WGRA Cairo, Ga. 1000d
KKON Kealakekua, Hawaii
KEST Boise, Idaho 1000d
KBRV Soda Springs, Ida. 5000d
WRMS Beardstown, Ill. 500d
KXXX Colby, Kans. 5000d
WAKY Louisville, Ky. 5000
WRUM Rumford, Me. 1000d
WSGW Saginaw, Mich. 5000
KGHL Billings, Mont. 5000
WWNY Watertown, N.Y. 1000
WLSV Wellsville, N.Y. 1000d
WTNC Thomasville, N.C. 1000d
KFGO Fargo, N.D. 5000
KWIL Albany, Oreg. 1000
WAEB Allentown, Pa. 1000
WPIC Sharon, Pa. 1000d
WEAN Providence, R.I. 5000
WWBD Bamberg-Denmark, S.C. 1000d
WETB Johnson City, Tenn. 1000d
WMC Memphis, Tenn. 5000
KTHT Houston, Tex. 5000
KFYO Lubbock, Tex. 5000
KUTA Blanding, Utah 1000d
WSIG Mount Jackson, Va. 1000d
WTAR Norfolk, Va. 5000
KGMI Bellingham, Wash. 5000
KJRB Spokane, Wash 5000
WEAQ Eau Claire, Wis. 5000

800—374.8

WHOS Decatur, Ala. 1000d
WMGY Montgomery, Ala. 1000d
KINY Juneau, Alaska 5000
KAGH Crossett, Ark. 250d
KVOM Morrilton, Ark. 250d
KUZZ Bakersfield, Calif. 250d
KBRN Brighton, Colo. 500d
WLAD Danbury, Conn. 1000d
WRKV Rockville, Conn. 1000d
WSUZ Palatka, Fla. 1000d
WJAT Swainsboro, Ga. 1000d
WKZI Casey, Ill. 250d
KXIC Iowa City, Iowa 1000d
WCCM Lawrence, Mass. 1000d
WVAL Sauk Rapids, Minn. 250d
KREI Farmington, Mo. 1000d
WTMR Camden, N.J. 5000d
KJEM Okla. City, Okla. 250d
KPDQ Portland, Ore. 1000d
WCHA Chambersburg, Pa. 5000d
WDSC Dillon, S.C. 1000d

WEAB Greer, S.C. 250d
WDEH Sweetwater, Tenn. 1000d
KDDD Dumas, Tex. 250d
KBUH Brigham City, Utah 250d
WSVS Crewe, Va. 5000d
WKEE Huntington, W.Va. 5000d
WDUX Waupaca, Wis. 5000d

810—370.2

KGO San Francisco, Calif. 50000
KWSR Rifle, Colo. 1000d
WATI Indianapolis, Ind. 250d
WEKG Jackson, Ky.
WYRE Annapolis, Md. 250d
WJPW Rockford, Mich. 500d
WSJC Magee, Miss. 50000
KCMO Kansas City, Mo. 50000
KAFE Santa Fe, N.M.
WGY Schenectady, N.Y. 50000
WKBC N.Wilkesboro, N.C. 1000d
WCEC Rocky Mount, N.C. 1000d
WEDO McKeesport, Pa. 1000d
WKVM San Juan, P.R. 50000
WQIZ St. George, S.C. 5000d
KBHB Sturgis, S.D. 5000d
WMTS Murfreesboro, Tenn. 5000d
KWDR Del Rio, Tex. 1000d
WDMP Dodgeville, Wis. 1000d
WELF Tomahawk, Wis. 500d

820—365.6

WAIT Chicago, Ill. 5000d
WIKY Evansville, Ind. 250d
WOSU Columbus, Ohio 5000d
WFAA Dallas, Tex. 50000
WBAP Ft. Worth, Tex. 50000

830—361.2

KIKI Honolulu, Hawaii 10000
WCCO Minneapolis-St. Paul, Minn. 50000
KBOA Kennett, Mo. 1000d
WNYC New York, N.Y. 1000d

840—356.9

WMOB Mobile, Ala. 1000d
WRYM New Britain, Conn. 1000d
WHAS Louisville, Ky. 50000
WVPO Stroudsburg, Pa. 250d

850—352.7

WYDE Birmingham, Ala. 10000
KICY Nome, Alaska 5000
KGKO Benton, Ark. 1000d
KOA Denver, Colo. 50000
WRUF Gainesville, Fla. 5000
WEAT W. Palm Beach, Fla. 1000
KHLO Hilo, Hawaii 1000
WCLR Crystal Lake, Ill. 500d
WHDH Boston, Mass. 50000
WKBZ Muskegon, Mich. 1000
KFUO Clayton, Mo. 5000d
WKIX Raleigh, N.C. 10000
WJW Cleveland, Ohio 10000
WJAC Johnstown, Pa. 10000
WEEU Reading, Pa. 1000
WABA Aguadilla, P.R. 500
WIVK Knoxville, Tenn. 50000d
WRAP Norfolk, Va. 5000
KTAC Tacoma, Wash. 10000

860—348.6

WHRT Hartselle, Ala. 250d
WAMI Opp, Ala. 1000d
KIFN Phoenix, Ariz. 1000d
KOSE Osceola, Ark. 1000d
KWRF Warren, Ark. 250d
KTRB Modesto, Calif. 10000
WAZE Clearwater, Fla. 500d
WKKO Cocoa, Fla. 1000
WERD Atlanta, Ga. 1000d
WDMG Douglas, Ga. 5000d
WMRI Marion, Ind. 250d
KWPC Muscatine, Iowa 250d
KOAM Pittsburg, Kan. 10000
WSON Henderson, Ky. 500d
WAYE Baltimore, Md. 1000d
WSBS Gt. Barrington, Mass. 250d
KNUJ New Ulm, Minn. 1000d
WMAG Forest, Miss. 500d
KARS Belen, N. Mex. 250d
WFMO Fairmont, N.C. 1000d
WSTH Taylorsville, N. C. 250d
KSHA Medford, Oreg. 1000d
WAMO Pittsburgh, Pa. 1000d
WTEL Philadelphia, Pa. 10000d
WLBG Laurens, S.C. 1000d
KFST Ft. Stockton, Tex. 250d
KPAN Hereford, Tex. 250d
KSFA Nacogdoches, Tex. 1000d
KONO San Antonio, Tex. 5000
KWHO Salt Lake City, Utah 1000d
WEVA Emporia, Va. 1000d
WOAY Oak Hill, W.Va. 10000d
WNOV Milwaukee, Wis. 250d

870—344.6

KIEV Glendale, Calif. 500d
KAIM Honolulu, Hawaii 5000

WWL New Orleans, La. 50000
WKAR E. Lansing, Mich. 10000d
WCHU Ithaca, N.Y. 5000d
WGTL Kannapolis, N.C. 1000d
WHOA San Juan, P.R. 5000
KJIM Ft. Worth, Tex. 250d
WFLO Farmville, Va. 1000d

880—340.7

KRVN Lexington, Neb. 50000
WCBS New York, N.Y. 50000
WRRZ Clinton, N.C. 1000d
WRFD Worthington, Ohio 5000d

890—336.9

WLS Chicago, Ill. 50000
WHNC Henderson, N.C. 1000d
KBYE Okla. City, Okla. 1000d

900—333.1

WATV Birmingham, Ala. 1000d
WGOK Mobile, Ala. 1000d
WOZK Ozark, Ala. 1000d
KPRB Fairbanks, Alaska 10000
KHOZ Harrison, Ark. 1000d
KBIF Fresno, Calif. 1000d
KGRB West Covina, Cal. 250d
WJWL Georgetown, Del. 1000d
WSWN Belle Glade, Fla. 1000d
WMOP Ocala, Fla. 1000d
WCGA Calhoun, Ga. 1000d
WCRY Macon, Ga. 250d
WEAS Savannah, Ga. 5000d
KTEE Idaho Falls, Ida. 1000d
KEYN Wichita, Kan. 250d
WFIA Louisville, Ky. 1000d
WLSI Pikeville, Ky. 5000d
KREH Oakdale, La. 250d
WCME Brunswick, Maine 1000d
WLMD Laurel, Md. 1000d
WATC Gaylord, Mich. 1000d
KTIS Minneapolis, Minn. 1000d
WDDT Greenville, Miss. 1000d
KFAL Fulton, Mo. 1000d
KJSK Columbus, Nebr. 1000d
WOTW Nashua, N.H. 1000d
WBRV Boonville, N.Y. 1000d
WKAJ Saratoga Springs, N.Y. 250d
WKJK Granite Falls, N.C. 500d
WAYN Rockingham, N.C. 1000d
WIAM Williamston, N.C. 1000d
KFNW Fargo, N.Dak. 1000d
WNYN Canton, Ohio 500d
WFRO Fremont, Ohio 500d
WCPA Clearfield, Pa. 1000d
WFLN Philadelphia, Pa. 1000d
WKXV Knoxville, Tenn. 1000d
WCOR Lebanon, Tenn. 500d
KALT Atlanta, Tex. 1000d
KMCO Conroe, Tex. 500d
KFLD Floydada, Tex. 250d
KCLW Hamilton, Tex. 250d
WODY Bassett, Va. 500d
WAFC Staunton, Va. 1000d
KUEN Wenatchee, Wash. 1000d
WATK Antigo, Wis. 250d

910—329.5

WDVC Dadeville, Ala. 500d
KPHO Phoenix, Ariz. 5000
KLCN Blytheville, Ark. 5000d
KAMD Camden, Ark. 5000
KDEO El Cajon, Calif. 1000
KNEW Oakland, Calif. 5000
KOXR Oxnard, Cal. 5000
KPOF Denver, Colo. 5000
WRCH New Britain, Conn. 5000
WPLA Plant City, Fla. 1000d
WGAF Valdosta, Ga. 5000
KBGN Caldwell, Ida. 1000d
WAKO Lawrenceville, Ill. 500d
WSUI Iowa City, Iowa 5000
KLSI Salina, Kan. 500d
WLCS Baton Rouge, La. 1000
WABI Bangor, Maine 5000
WFDF Flint, Mich. 5000
WCOC Meridian, Miss. 5000
KOYN Billings, Mont. 1000d
KBIM Roswell, N. M. 5000
WRKL New City, N.Y. 1000d
WLAS Jacksonville, N.C. 5000d
KCJB Minot, N. D. 5000
WBRJ Marietta, O. 5000d
WPFB Middletown, Ohio 1000
KGLC Miami, Okla. 1000
KURY Brookings, Oreg. 1000d
WAVL Apollo, Pa. 1000d
WGBI Scranton, Pa. 1000
WSBA York, Pa. 5000
WPRP Ponce, P.R. 5000
WNCG North Charleston, S.C. 500d
WORD Spartanburg, S.C. 5000
WJCW Johnson City, Tenn. 5000
WEPG S. Pittsburgh, Tenn. 500d
KNAF Fredericksburg, Tex. 1000d
KRIO McAllen, Tex. 5000
KRRV Sherman, Tex. 1000
KALL Salt Lake City, Utah 5000
WNHV White River Jct., Vt. 1000d

WRNL Richmond, Va. 5000
WTOY Roanoke, Va. 1000d
KORD Pasco, Wash. 1000d
KIXI Seattle, Wash. 1000
KISN Vancouver, Wash. 5000
WHSM Hayward, Wis. 5000d
WDOR Sturgeon Bay, Wis. 1000d

920—325.9

WCTA Andalusia, Ala. 5000
WWWR Russellville, Ala. 1000d
KSRM Soldotna, Alaska 5000
KARK Little Rock, Ark. 5000
KLOC Ceres, Calif. 500d
KDES Palm Springs, Cal. 5000
KVEC San Luis Obispo, Cal. 1000
KLMR Lamar, Colo. 5000
WMEG Eau Gallie, Fla. 1000
WGST Atlanta, Ga. 5000
WVOH Hazelhurst, Ga. 500d
WGNU Granite City, Ill. 500d
WMOK Metropolis, Ill. 1000d
WBAA W. Lafayette, Ind. 5000
WTCW Whitesburg, Ky. 5000d
WBOX Bogalusa, La. 1000d
KTOC Jonesboro, La. 1000d
WPTX Lexington Park, Md. 5000
WMPL Hancock, Mich. 1000d
KDHL Faribault, Minn. 5000
KWAD Wadena, Minn. 1000
KWYS W. Yellowstone, Mont. 1000
KORK Las Vegas, Nev. 5000
KOLO Reno, Nev. 5000d
KQEO Albuquerque, N.Mex. 1000
WTTM Trenton, N.J. 1000
WKRT Cortland, N.Y. 1000
WGHQ Kingston, N.Y. 5000d
WIRD Lake Placid, N.Y. 5000d
WBBB Burlington-Graham, N.C. 5000d
WPTL Canton, N.C. 500d
WMNI Columbus, Ohio 1000
KGAL Lebanon, Oreg. 1000
WKVA Lewistown, Pa. 1000
WJAR Providence, R.I. 5000
WTND Orangeburg, S.C. 1000d
KEZU Rapid City, S.Dak. 1000d
WLIV Livingston, Tenn. 1000d
KELP El Paso, Tex. 1000
KBZB Odessa, Tex. 1000d
KTLW Texas City, Tex. 1000d
KVEL Vernal, Utah 5000d
KITN Olympia, Wash. 1000d
KXLY Spokane, Wash. 5000
WMMN Fairmont, W.Va. 5000
WOKY Milwaukee, Wis. 10000

930—322.4

WJBY Gadsen, Ala. 1000d
KTKN Ketchikan, Alaska 5000
KAPR Douglas, Ariz. 1000d
KAFF Flagstaff, Ariz. 5000d
KHJ Los Angeles, Calif. 5000
KEWA Paradise, Calif. 500d
KIUP Durango, Colo. 5000
WTHD Milford, Del. 500d
WHAN Haines City, Fla. 500d
WJAX Jacksonville, Fla. 5000
WKXY Sarasota, Fla. 1000
WMGR Bainbridge, Ga. 5000
KSEI Pocatello, Idaho 5000
WTAD Quincy, Ill. 5000
WHON Centerville, Ind. 500d
WKCT Bowling Green, Ky. 1000
WFMD Frederick, Md. 5000
WREB Holyoke, Mass. 500d
WBCK Battle Creek, Mich. 5000
KKIN Aitkin, Minn. 1000d
WSLI Jackson, Miss. 5000
KWOC Poplar Bluff, Mo. 5000
KYSS Missoula, Mont. 5000d
KOGA Ogallala, Nebr. 500d
KCCC Carlsbad, N. M. 1000d
WSOC Charlotte, N.C. 5000
WITN Washington, N.C. 5000
WWNH Rochester, N.H. 5000
WPAT Paterson, N.J. 5000
WBEN Buffalo, N.Y. 5000
WIZR Johnstown, N.Y. 1000d
WEOL Elyria, Ohio 1000
WKY Oklahoma City, Okla. 5000
KAGI Grants Pass, Oreg. 5000
KSWB Seaside, Ore. 1000d
WCNR Bloomsburg, Pa. 1000d
WEKQ Cabo Rojo, P.R.
KSDN Aberdeen, S.D. 1000
WSEV Sevierville, Tenn. 5000d
KDET Center, Tex. 1000d
KITE Terrell Hills, Tex. 5000
WLLL Lynchburg, Va. 5000d
KBFW Bellingham, Wash. 5000d
KQOT Yakima, Wash. 1000d
WSAZ Huntington, W.Va. 5000
KROE Sheridan, Wyo. 1000d
WLBL Auburndale, Wis. 5000d

940—319.0

KHOS Tucson, Ariz. 1000
KFRE Fresno, Calif. 50000
WINE Brookfield, Conn. 1000d
WLQH Chiefland, Fla. 500d

WHITE'S

RADIO LOG

kHz	Wave Length	W.P.
WINZ	Miami, Fla.	50000
WMAZ	Macon, Ga.	50000
KAHU	Waipahu, Hawaii	10000
WMIX	Mt. Vernon, Ill.	5000d
KIOA	Des Moines, Iowa	10000
WCND	Shelbyville, Ky.	250d
WYLD	New Orleans, La.	10000
WIDG	St. Ignace, Mich.	5000d
WJOR	South Haven, Mich.	1000d
WCPC	Houston, Miss.	50000d
KSWM	Aurora, Mo.	500d
KVSH	Valentine, Nebr.	5000d
WFNC	Fayetteville, N.C.	50000
WCIT	Lima, Ohio	250d
WNAL	Nelsonville, Ohio	250d
KGRL	Bend, Oreg.	1000d
KWRC	Woodburn, Ore.	1000d
WESA	Charleroi, Pa.	250d
WGRP	Greenville, Pa.	1000d
WIPR	San Juan, P.R.	10000
KIXZ	Amarillo, Tex.	5000
KTON	Belton, Tex.	1000d
KATQ	Texarkana, Tex.	1000d
WNRG	Grundy, Va.	5000d
WFAW	Ft. Atkinson, Wis.	500d
WCSW	Shell Lake, Wis.	1000d

950—315.6

WRMA	Montgomery, Ala.	1000d
KXJK	Forrest City, Ark.	5000d
KFSA	Ft. Smith, Ark.	1000
KAHI	Auburn, Calif.	5000d
KIMN	Denver, Colo.	5000
WLOF	Orlando, Fla.	5000
WGTA	Summerville, Ga.	5000d
WGOV	Valdosta, Ga.	5000
KATN	Boise, Ida.	5000d
KLER	Orofino, Ida.	1000
WGRT	Chicago, Ill.	1000d
WXLW	Indianapolis, Ind.	5000d
KOEL	Oelwein, Ia.	5000
KJRG	Newton, Kans.	500d
WYWY	Barbourville, Ky.	1000d
WAGM	Presque Isle, Maine	5000
WRYT	Boston, Mass.	5000d
WWJ	Detroit, Mich.	5000
KRSI	St. Louis Park, Minn.	1000
WBKH	Hattiesburg, Miss.	5000d
KLIK	Jefferson City, Mo.	5000
KNFT	Bayard, N. M.	
WHVW	Hyde Park, N.Y.	500d
WBBF	Rochester, N.Y.	1000
WIBX	Utica, N.Y.	5000
WPET	Greensboro, N.C.	500d
KYES	Roseburg, Oreg.	1000d
WNCC	Barnesboro, Pa.	500d
WPEN	Philadelphia, Pa.	5000
WBER	Moncks Corner, S. C.	500d
WSPA	Spartanburg, S.C.	5000
KWAT	Watertown, S.Dak.	1000
WAGG	Franklin, Tenn.	1000d
KDSX	Denison-Sherman, Tex.	500
KPRC	Houston, Tex.	5000
KSEL	Lubbock, Tex.	5000
WXGI	Richmond, Va.	5000d
KJR	Seattle, Wash.	5000
WERL	Eagle River, Wis.	1000d
WKAZ	Charleston, W.Va.	5000
WKTS	Sheboygan, Wis.	500d
KMER	Kemmerer, Wyo.	5000d

960—312.3

WBRC	Birmingham, Ala.	5000
WMOZ	Mobile, Ala.	1000d
KOOL	Phoenix, Ariz.	5000
KAVR	Apple Valley, Calif.	5000d
KNEZ	Lompoc, Calif.	500
KABL	Oakland, Calif.	5000
WELI	New Haven, Conn.	5000
WGRO	Lake City, Fla.	500d
WJCM	Sebring, Fla.	1000d
WJAZ	Albany, Ga.	5000d
WRFC	Athens, Ga.	5000
KSRA	Salmon, Idaho	1000d
WDLM	E. Moline, Ill.	1000d
WSBT	South Bend, Ind.	5000
KMA	Shenandoah, Iowa	5000
WPRT	Prestonsburg, Ky.	5000d
KROF	Abbeville, La.	1000d
WBOC	Salisbury, Md.	5000
WFGL	Fitchburg, Mass.	1000
WHAK	Rogers City, Mich.	5000d
KLTF	Little Falls, Minn.	500d
WABG	Greenwood, Miss.	1000
KFVS	Cape Girardeau, Mo.	5000
KFLN	Baker, Mont.	5000d
KNEB	Scottsbluff, Nebr.	1000
KWYK	Farmington, N.Mex.	1000d
WEAV	Plattsburg, N.Y.	5000
WAAK	Dallas, N.C.	1000d
WFTC	Kinston, N.C.	5000

kHz	Wave Length	W.P.
WWST	Wooster, Ohio	1000d
KGWA	Enid, Okla.	1000
WHYL	Carlisle, Pa.	5000d
WKZA	Kane, Pa.	1000d
WATS	Sayre, Pa.	1000d
WBEU	Beaufort, S.C.	1000d
WBMC	McMinnville, Tenn.	500d
KIMP	Mt. Pleasant, Tex.	1000d
KGKL	San Angelo, Tex.	5000
KOVO	Provo, Utah	5000
WDBJ	Roanoke, Va.	5000
KALE	Richland, Wash.	1000
WTCH	Shawano, Wis.	1000

970—309.1

WERH	Hamilton, Ala.	5000d
WTBF	Troy, Ala.	5000
KVWM	Show Low, Ariz.	5000d
KNEA	Jonesboro, Ark.	1000d
KBIS	Bakersfield, Calif.	1000
KCHV	Coachella, Calif.	5000
KBEE	Modesto, Calif.	1000
KFEL	Pueblo, Colo.	1000d
WBOM	Jacksonville, Fla.	1000d
WFLA	Tampa, Fla.	5000
WIIN	Atlanta, Ga.	5000d
WVOP	Vidalia, Ga.	5000d
KPUA	Hilo, Hawaii	5000
KAYT	Rupert, Idaho	1000d
WMAY	Springfield, Ill.	1000
WAVE	Louisville, Ky.	5000
KSYL	Alexandria, La.	1000
WCSH	Portland, Maine	5000
WAMD	Aberdeen, Md.	500
WESO	Southbridge, Mass.	1000d
WCKO	Ishpeming, Mich.	5000d
WKHM	Jackson, Mich.	1000
KQAQ	Austin, Minn.	5000
WRKN	Brandon, Miss.	
KOOK	Billings, Mont.	5000
KJLT	No. Platte, Nebr.	5000d
KVEG	Las Vegas, Nev.	500d
WJRZ	Hackensack, N.J.	5000
KDCE	Espanola, N. M.	1000d
WEBR	Buffalo, N.Y.	5000
WCHN	Norwich, N.Y.	500d
WRCS	Ahoskie, N.C.	1000d
WWIT	Canton, N.C.	1000d
WDAY	Fargo, N.Dak.	5000
WRED	Ashtabula, Ohio	5000
WATH	Athens, Ohio	1000d
KAKC	Tulsa, Okla.	1000
KOIN	Portland, Oreg.	5000
WWSW	Pittsburgh, Pa.	5000
WJMX	Florence S.C.	5000
KTAP	Austin, Tex.	1000d
KBSN	Crane, Tex.	1000d
KNOK	Ft. Worth, Tex.	1000d
WSTX	Christiansted, V.I.	5000
WYPR	Danville, Va.	1000d
WANV	Waynesboro, Va.	5000
KREM	Spokane, Wash.	5000
WWYO	Pineville, W.Va.	1000d
WHA	Madison, Wis.	5000d

980—305.9

WKLF	Clanton, Ala.	1000d
WXLL	Big Delta, Alaska	100
KCAB	Dardanelle, Ark.	1000d
KINS	Eureka, Calif.	5000
KEAP	Fresno, Calif.	500d
KFWB	Los Angeles, Calif.	5000
KCTY	Salinas, Calif.	1000d
KGLN	Glennwood Springs, Colo.	1000d
WSUB	Groton, Conn.	1000d
WRC	Washington, D.C.	5000
WDVH	Gainesville, Fla.	5000d
WTOT	Marianna, Fla.	1000d
WBOP	Pensacola, Fla.	1000d
WLOD	Pompano Beach, Fla.	1000d
WKLY	Hartwell, Ga.	1000d
WPGA	Perry, Ga.	1000d
WRIP	Rossville, Ga.	500d
KUPI	Idaho Falls, Idaho	1000d
KSGM	Chester, Ill.	1000
WITY	Danville, Ill.	1000
KCIJ	Shreveport, La.	250d
WCAP	Lowell, Mass.	1000d
WAOP	Otsego, Mich.	1000d
WPBC	Richfield, Minn.	5000
WAPF	McComb, Miss.	5000d
WKOR	Starksville, Miss.	1000d
KMBZ	Kansas City, Mo.	5000
KLYQ	Hamilton, Mont.	1000d
KVLV	Fallon, Nev.	5000d
KICA	Clovis, N. Mex.	1000
KMIN	Grants, N. Mex.	1000d
WTRY	Troy, N.Y.	5000
WKLM	Wilmington, N.C.	5000d
WAAA	Win.-Salem, N.C.	1000d
WONE	Dayton, Ohio	5000
WILK	Wilkes-Barre, Pa.	5000
WAZS	Summerville, S.C.	1000d
WYCL	York, S. C.	1000d
KDSJ	Deadwood, S.Dak.	1000
WSIX	Nashville, Tenn.	5000
KFRD	Rosenberg-Richmond, Tex.	1000d
KSVC	Richfield, Utah	5000d
WFHG	Bristol, Va.	5000

kHz	Wave Length	W.P.
WMEK	Chase City, Va.	500d
KUTI	Yakima, Wash.	5000d
WHAW	Weston, W Va.	1000d
WCUB	Manitowoc, Wis.	1000d
WNBI	Park Falls, Wis.	1000d
WPRE	Prairie du Chien, Wis.	1000d

990—302.8

WEIS	Centre, Ala.	250d
WWWF	Fayette, Ala.	1000d
WTCB	Flomaton, Ala.	500d
KTKT	Tucson, Ariz.	10000
KKIS	Pittsburg, Calif.	5000
KGUD	Santa Barbara, Calif.	1000d
KLIR	Denver, Colo.	1000d
WNTY	Southington, Conn.	500d
WFAB	Miami, Fla.	5000
WHOO	Orlando, Fla.	50000
WDWD	Dawson, Ga.	1000d
WGML	Hinesville, Ga.	250d
KTRG	Honolulu, Hawaii	5000
WCAZ	Carthage, Ill.	1000d
WITZ	Jasper, Ind.	1000d
WERK	Muncie, Ind.	250d
KAYL	Storm Lake, Iowa	250d
KRSL	Russell, Kans.	250d
WJMR	New Orleans, La.	250d
KRIH	Rayville, La.	250d
WCRM	Clare, Mich.	250d
WABO	Waynesboro, Miss.	250d
KRMO	Monett, Mo.	250d
KSVP	Artesia, N.Mex.	1000
WEEB	Southern Pines, N.C.	5000d
WBTE	Windsor, N.C.	
WJEH	Gallipolis, Ohio	1000d
WTIG	Massillon, Ohio	250d
KRKT	Albany, Oreg.	250d
WIBG	Philadelphia, Pa.	50000
WVSC	Somerset, Pa.	5000d
WPRA	Mayaguez, P.R.	1000
WLKW	Providence, R.I.	50000d
WAKN	Aiken, S.C.	1000d
WNOX	Knoxville, Tenn.	10000
KWAM	Memphis, Tenn.	10000d
KTRM	Beaumont, Tex.	1000
KAML	Kenedy-Karnes City, Tex.	250d
KNIN	Wichita Falls, Tex.	10000
KDYL	Tooele, Utah	1000d
WNRV	Narrows-Pearisburg, Va.	5000d
WANT	Richmond, Va.	1000d
WWDA	Wisconsin Dells, Wis.	

1000—299.8

WVOV	Huntsville, Ala.	10000d
WFMI	Montgomery, Ala.	5000d
KMLO	Vista, Cal.	1000d
WKMK	Blountstown, Fla.	1000d
WJST	Jupiter, Fla.	1000d
WCFL	Chicago, Ill.	50000
WREN	Jenkins, Ky.	
WLMS	Leominster, Mass.	1000d
WXTN	Lexington, Miss.	5000d
WIQT	Horseheads, N.Y.	1000d
WKBQ	Garner, N.C.	250d
WSPF	Hickory, N.C.	5000d
KTOK	Okla. City, Okla.	5000
WIOO	Carlisle, Pa.	1000
WKYB	Hemingway, S.C.	
WGOG	Wahalla, S. C.	1000d
KXRB	Sioux Falls, S.D.	
KSTA	Coleman, Tex.	250d
KGRI	Henderson, Tex.	250d
WKDE	Altavista, Va.	1000d
WHWB	Rutland, Vt.	1000d
WBNB	Charlotte Amalie, Virgin Islands	1000
KOMO	Seattle, Wash.	50000

1010—296.9

KCAC	Phoenix, Ariz.	500d
KVNC	Winslow, Ariz.	1000
KLRA	Little Rock, Ark.	10000
KCHJ	Delano, Calif.	5000
KCMJ	Palm Sprgs., Calif.	1000
KSAY	San Fran., Calif.	10000d
WCNU	Crestview, Fla.	1000d
WBIX	Jacksonville Beach, Fla.	10000d
WINQ	Tampa, Fla.	50000d
WGUN	Atlanta-Decatur, Ga.	50000d
WCSI	Columbus, Ind.	500d
KSMN	Mason City, Iowa	1000d
KIND	Independence, Kans.	250d
WMJL	Marion, Ky.	250d
KDLA	DeRidder, La.	1000d
WSID	Baltimore, Md.	1000d
WITL	Lansing, Mich.	5000d
WJSW	Maplewood, Minn.	250d
WMOX	Meridian, Miss.	10000
KCHI	Chillicothe, Mo.	250d
KXEN	Festus-St. Louis, Mo.	50000d
WCNL	Newport, N.H.	250d
WINS	New York, N.Y.	50000
WABZ	Albermarle, N.C.	1000d
WFGW	Black Mountain, N.C.	50000d

kHz	Wave Length	W.P.
WELS	Kinston, N.C.	1000d
WIOI	New Boston, Ohio	1000d
WUDO	Lewisburg, Pa.	250d
WHIN	Gallatin, Tenn.	1000d
WORM	Savannah, Tenn.	250d
KDJW	Amarillo, Tex.	5000
KODA	Houston, Tex.	5000d
KAWA	Waco-Marlin, Tex.	10000d
WELK	Charlottesville, Va.	1000d
WMEV	Marion, Va.	1000d
WPMH	Portsmouth, Va.	5000d
WCST	Berkeley Sprgs., W.Va.	250d
WSPT	Stevens Pt., Wis.	1000d

1020—293.9

KGBS	Los Angeles, Calif.	50000d
WCIL	Carbondale, Ill.	1000d
WPEO	Peoria, Ill.	10000d
KSWS	Roswell, N. M.	50000
KDKA	Pittsburgh, Pa.	50000

1030—291.1

WBZ	Boston, Mass.	50000
KCTA	Corpus Christi, Tex.	50000d
KTWO	Casper, Wyo.	10000

1040—288.3

KHVH	Honolulu, Hawaii	5000
WHO	Des Moines, Iowa	50000
KIXL	Dallas, Tex.	1000d

1050—285.5

WRFS	Alexander City, Ala.	1000d
WCRI	Scottsboro, Ala.	250d
KMYO	Little Rock, Ark.	1000d
KTOT	Big Bear Lake, Cal.	250d
KOFY	San Mateo, Calif.	1000d
KWSO	Wasco, Calif.	1000d
WJSB	Crestview, Fla.	1000d
WIVY	Jacksonville, Fla.	1000d
WHBO	Tampa, Fla.	250d
WRMF	Titusville, Fla.	500d
WAUG	Augusta, Ga.	5000d
WMNZ	Montezuma, Ga.	250d
WDZ	Decatur, Ill.	1000d
WTCA	Plymouth, Ind.	250d
KUPK	Garden City, Kan.	5000d
WNES	Central City, Ky.	500d
KLPL	Lake Providence, La.	250d
KREB	Shreveport, La.	250d
KVPI	Villa Platte, La.	250d
WMSG	Oakland, Md.	500d
WQMR	Silver Sprg., Md.	1000d
WPAG	Ann Arbor, Mich.	5000d
KLOH	Pipestone, Minn.	1000d
WACR	Columbus, Miss.	1000d
KMIS	Portageville, Mo.	1000d
KSIS	Sedalia, Mo.	1000d
WBNC	Conway, N.H.	1000d
WSCV	Peterborough, N.H.	1000d
WSEN	Baldwinsville, N.Y.	250d
WYBG	Massena, N.Y.	1000d
WHN	New York, N.Y.	50000
WFSC	Franklin, N.C.	1000d
WLON	Lincolnton, N.C.	1000d
WWGP	Sanford, N.C.	1000d
WZIP	Cincinnati, Ohio	1000d
KCCO	Lawton, Okla.	250d
KFMJ	Tulsa, Okla.	1000d
KORE	Eugene, Ore.	1000d
WBUT	Butler, Pa.	250d
WSKE	Everett, Pa.	250d
WLYC	Williamsport, Pa.	1000d
WCGB	Pastillo, P. R.	1000d
WSMT	Sparta, Tenn.	1000d
KLEN	Killeen, Tex.	250d
KPXE	Liberty, Tex.	250d
KCAS	Slaton, Tex.	250d
WGAT	Gate City, Va.	1000d
WBRG	Lynchburg, Va.	1000d
WCMS	Norfolk, Va.	5000d
KBLE	Seattle, Wash.	5000d
WCEF	Parkersburg, W. Va.	5000d
WOKL	Eau Claire, Wis.	1000d
WKAU	Kaukauna, Wis.	1000d
WLIP	Kenosha, Wis.	250d
KWIV	Douglas, Wyo.	250d

1060—282.8

KUPD	Tempe, Ariz.	500
KPAY	Chico, Calif.	10000
KLMO	Longmont, Colo.	10000d
WMCL	McLeansboro, Ill.	250d
WRHL	Rochelle, Ill.	250d
WJKY	Jamestown, Ky.	1000d
WNOE	New Orleans, La.	50000
WGTR	Natick, Mass.	1000d
WHFB	Benton Harbor-St. Joseph, Mich.	5000d
KFIL	Preston, Miss.	1000d
KNLV	Ord, Neb.	1000d
WMAP	Monroe, N.C.	1000d
WBYB	St. Pauls, N.C.	250d
WCOK	Sparta, N.C.	250d
WOIO	Canton, O.	5000d
KYW	Philadelphia, Pa.	50000
WRJS	San German, P. R.	250
WALD	Walterboro, S. C.	1000d
KGFX	Pierre, S. D.	10000d
WPHC	Waverly, Tenn.	1000d

kHz	Wave Length	W.P.
KHRB	Lockhart, Tex.	250d
KRSP	Salt Lake City, Utah	10000d

1070—280.2

WAPI	Birmingham, Ala.	50000
KNX	Los Angeles, Calif.	50000
WIBC	Indianapolis, Ind.	50000
KILR	Estherville, Iowa	250d
KFDI	Wichita, Kans.	10000
KHMO	Hannibal, Mo.	5000
WKDR	Plattsburgh, N. Y.	
WNCT	Greenville, N.C.	10000
WHPE	High Point, N.C.	1000d
WKOK	Sunbury, Penn.	10000
WMIA	Arecibo, P.R.	500
WHYZ	Greenville, S.C.	50000d
WFLI	Lookout Mtn., Tenn.	50000
WDIA	Memphis, Tenn.	50000
KOPY	Alice, Tex.	1000
KNNN	Friona, Tex.	250d
KENR	Houston, Tex.	5000d
WINA	Charlottesville, Va.	5000
WCIR	Beckley, W.Va.	10000d
WKOW	Madison, Wis.	10000

1080—277.6

WKAC	Athens, Ala.	1000d
KSCO	Santa Cruz, Calif.	10000
WTIC	Hartford, Conn.	50000
WVCG	Coral Gables, Fla.	10000
WFIV	Kissimmee, Fla.	5000d
WJOE	Port St. Joe, Fla.	1000d
WBIE	Marietta, Ga.	10000d
WPOK	Pontiac, Ill.	1000d
WNWI	Valparaiso, Ind.	5000d
KOAK	Red Oak, Iowa	500d
WKLO	Louisville, Ky.	10000
WOAP	Owosso, Mich.	1000d
KYMN	Northfield, Minn.	1000d
KYMO	East Prairie, Mo.	250d
WUFO	Amherst, N.Y.	1000d
WEWO	Laurinburg, N.C.	5000d
WKGX	Lenoir, N.C.	
WWDR	Murfreesboro, N.C.	1000d
KNDK	Langdon, N.D.	1000d
WMVR	Sidney, O.	250d
KWJJ	Portland, Oreg.	50000
WEEP	Pittsburgh, Pa.	50000d
WLEY	Cayey, P.R.	250
KRLD	Dallas, Tex.	50000
WKBY	Chatham, Va.	1000d

1090—275.1

KAAY	Little Rock, Ark.	50000
KNCR	Fortuna, Cal.	10000d
WQIK	Jacksonville, Fla.	50000d
WWSD	Monticello, Fla.	1000d
WBAF	Barnesville, Ga.	
WCRA	Effingham, Ill.	1000d
WGLC	Mendota, Ill.	250d
KHAI	Honolulu, Hawaii	5000
WFWR	Fort Wayne, Ind.	1000d
KVDB	Sioux City, Iowa	
KNWS	Waterloo, Iowa	1000d
WSLG	Donaldsonville, La.	500d
WBAL	Baltimore, Md.	50000
WILD	Boston, Mass.	1000d
WMUS	Muskegon, Mich.	1000d
WTAK	Garden City, Mich.	250d
KEXS	Excelsior Springs, Mo.	250d
WKTE	King, N. C.	1000d
KTGO	Tioga, N.D.	250d
WMWM	Wilmington, O.	1000d
WKSP	Kingstree, S.C.	500d
WBZB	Selma, N.C.	1000d
WENR	Englewood, Tenn.	1000d
WJKM	Hartsville, Tenn.	250d
WGOC	Kingsport, Tenn.	
KANN	Ogden, Utah	1000d
KING	Seattle, Wash.	50000
WISS	Berlin, Wis.	500d

1100—272.6

KFAX	San Francisco, Calif.	50000d
KREX	Grand Junction, Colo.	50000
WLBB	Carrollton, Ga.	1000d
WHLI	Hempstead, N.Y.	10000d
WKYC	Cleveland, O.	50000
WGPA	Bethlehem, Pa.	250d

1110—270.1

WBCA	Bay Minette, Ala.	10000d
WBIB	Centreville, Ala.	1000d
KRLA	Pasadena, Cal.	50000
KPOP	Roseville, Cal.	500
WALT	Tampa, Fla.	50000d
WEBS	Calhoun, Ga.	250d
KIPA	Hilo, Hawaii	1000
WMBI	Chicago, Ill.	5000d
WKOZ	Cadiz, Ky.	1000d
WFCG	Franklinton, La.	1000d
WUNN	Mason, Mich.	
WJML	Petoskey, Mich.	
WKRA	Holly Springs, Miss.	1000d
KFAB	Omaha, Nebr.	50000
WSFW	Seneca Falls, N.Y.	1000
WTBQ	Warwick, N.Y.	
WBT	Charlotte, N.C.	50000

kHz	Wave Length	W.P.
WELX	Xenia, Ohio	250d
KEOR	Atoka, Okla.	5000d
KBND	Bend, Oreg.	5000
WJSM	Martinsburg, Pa.	1000d
WNAR	Norristown, Penn.	50000d
WVJP	Caguas, P.R.	250
WHIM	Providence, R.I.	1000d
KDRY	Alamo Heights, Tex.	1000d

1120—267.7

WUST	Bethesda, Md.	250d
KMOX	St. Louis, Mo.	50000
WWOL	Buffalo, N.Y.	1000d
KPNW	Eugene, Ore.	50000
KCNW	Springfield, Ore.	
KCLE	Cleburne, Tex.	250d

1130—265.3

KRDU	Dinuba, Calif.	1000
KSDO	San Diego, Cal.	50000
WPUL	Bartow, Fla.	
WMGA	Moultrie, Ga.	10000
KLEI	Kailua, Hawaii	10000
KLEY	Wellington, Kan.	250d
KWKH	Shreveport, La.	50000
WCAR	Detroit, Mich.	50000
WDGY	Minneapolis, Minn.	50000
KBLR	Bolivar, Mo.	250d
WNEW	New York, N.Y.	50000
WPYB	Benson, N.C.	1000d
WASP	Brownsville, Pa.	1000d
KBGH	Memphis, Tex.	1000d
WDTM	Selmer, Tenn.	250d
WISN	Milwaukee, Wis.	50000

1140—263.0

KRAK	Sacramento, Calif.	50000
KNAB	Burlington, Colo.	1000d
WQBA	Miami, Fla.	10000
KGEM	Boise, Idaho	10000
WSIV	Pekin, Ill.	5000d
WAWK	Kendallville, Ind.	250d
KNEI	Waukon, Iowa	1000d
KBIL	Liberty, Mo.	500d
KPWB	Piedmont, Mo.	1000d
KLUC	Las Vegas, Nev.	10000d
WCLW	Mansfield, Ohio	250d
KLPR	Oklahoma City, Okla.	1000d
WBZ	New Castle, Pa.	5000d
WITA	San Juan, P.R.	10000
KSOO	Sioux Falls, S.Dak.	10000
KORC	Mineral Wells, Tex.	250d
WRVA	Richmond, Va.	50000

1150—260.7

WGEA	Geneva, Ala.	1000d
WJRD	Tuscaloosa, Ala.	5000
KCKY	Coolidge, Ariz.	1000
KXLR	No. Little Rock, Ark.	5000
KRKD	Los Angeles, Calif.	5000
KPLS	Santa Rosa, Calif.	5000
KGMC	Englewood, Colo.	1000d
WCNX	Middletown, Conn.	1000d
WDEL	Wilmington, Del.	5000
WNDB	Daytona Bch., Fla.	1000
WTMP	Tampa, Fla.	5000d
WFPM	Fort Valley, Ga.	1000d
WJEM	Valdosta, Ca.	1000d
WCGH	Marion, Ill.	5000d
WYFE	Rockford, Ill.	500d
KYND	Burlington, Ia.	500d
KWKY	Des Moines, Iowa	1000
WIFF	Auburn, Ind.	250d
KSAL	Salina, Kans.	5000
WMST	Mt. Sterling, Ky.	500d
WLOC	Munfordville, Ky.	1000d
WJBO	Baton Rouge, La.	5000
WCHM	Skowhegan, Maine	5000d
WHMC	Gaithersburg, Md.	1000
WCOP	Boston, Mass.	5000
WCEN	Mt. Pleasant, Mich.	1000
KASM	Albany, Minn.	1000d
KRMS	Osage Beach, Mo.	1000d
KSEN	Shelby, Mont.	5000
KDEF	Albuquerque, N. M.	5000
WRUN	Utica, N.Y.	5000
WBAG	Burlington, N.C.	1000d
WGBR	Goldsboro, N.C.	5000
WCUE	Cuyahoga Falls, Ohio	1000d
WIMA	Lima, Ohio	1000
KNED	McAlester, Okla.	1000
KAGO	Klamath Falls, Oreg.	5000
KKEY	Portland, Ore.	5000d
WHUN	Huntington, Pa.	1000d
WYNS	Lehighton, Pa.	1000d
WKPA	New Kensington, Pa.	1000d
WDIX	Orangeburg, S.C.	5000
WTYC	Rock Hill, S.C.	1000d
WSNW	Seneca, S.C.	1000d
KIMM	Rapid City, S.Dak.	5000d
WGOW	Chattanooga, Tenn.	5000
WCRK	Morristown, Tenn.	1000
WTAW	College Station, Tex.	1000d
KCCT	Corpus Christi, Tex.	1000d
KIZZ	El Paso, Tex.	1000d
KVIL	Highland Park, Tex.	1000d
KJBC	Midland, Tex.	1000d
KPNG	Port Neches, Tex.	500d
KOLJ	Quanah, Tex.	500d

kHz	Wave Length	W.P.
KBER	San Antonio, Tex.	1000d
KPUL	Pullman, Wash.	1000d
KAYO	Seattle, Wash.	5000
WABH	Deerfield, Va.	1000d
WELC	Welch, W.Va.	1000d
WAXX	Chippewa Falls, Wis.	5000d

1160—258.5

WJJD	Chicago, Ill.	50000d
KSL	Salt Lake City, Utah	50000

1170—256.3

WCOV	Montgomery, Ala.	10000
KJND	North Pole, Alaska	10000
KCBQ	San Diego, Calif	50000
KLOK	San Jose, Cal.	50000
KUAD	Windsor, Colo.	1000d
KOHO	Honolulu, Hawaii	5000
WLBH	Mattoon, Ill.	250d
KSTT	Davenport, Iowa	1000
WVLC	Orleans, Mass.	
WWLE	Cornwall, N.Y.	1000d
KVOO	Tulsa, Okla.	50000
WLEO	Ponce, P.R.	250
KPUG	Bellingham, Wash.	5000
WWVA	Wheeling, W.Va.	50000
WLKE	Waupun, Wis.	1000d

1180—254.1

WLDS	Jacksonville, Ill.	1000d
KOFI	Kalispell, Mont.	50000
WHAM	Rochester, N.Y.	50000

1190—252.0

WAYD	Ozark, Ala.	1000d
KRDS	Tolleson, Ariz.	250
KMCW	Augusta, Ark.	250d
KEZY	Anaheim, Calif	5000
KNBA	Vallejo, Cal.	1000d
WAVS	Ft. Lauderdale, Fla.	
WGKA	Atlanta, Ga.	1000d
WOWO	Ft. Wayne, Ind.	50000
WANN	Annapolis, Md.	10000d
WKOX	Fram'gham, Mass.	1000d
KHAD	DeSoto, Mo.	1000d
KPAR	Albuquerque, N. M.	1000d
WLIB	New York, N.Y.	10000
WSML	Graham, N.C.	500d
WIXE	Monroe, N.C.	500d
KEX	Portland, Oreg.	50000
WRAI	Rio Piedras, P.R.	500
WBMJ	San Juan, P.R.	10000
KLIF	Dallas, Tex.	50000
WAMB	Donelson, Tenn.	250d

1200—249.9

WOAI	San Antonio, Tex.	50000

1210—247.8

KZOO	Honolulu, Hawaii	1000
WILY	Centralia, Ill.	1000d
WKNX	Saginaw, Mich.	10000d
WADE	Wadesboro, N.C.	1000d
WAVI	Dayton, Ohio	250d
KGYN	Cuymon, Okla.	10000
WCAU	Philadelphia, Pa.	50000
WHOY	Salinas, P.R.	1000d

1220—245.8

WAQY	Birmingham, Ala.	1000d
WABF	Fairhope, Ala.	1000d
KVSA	McGehee, Ark.	1000d
KLIP	Fowler, Calif.	250d
KIBE	Palo Alto, Cal.	5000d
KKAR	Pomona, Calif.	250d
KFSC	Denver, Colo.	1000d
WCDQ	Hamden, Conn.	1000d
WOCJ	Arlington, Fla.	1000d
WACY	Kissimmee, Fla.	
WLTO	Miami, Fla.	250d
WSAF	Sarasota, Fla.	1000d
WCLB	Camilla, Ga.	1000d
WPLK	Rockmart, Ga.	500d
WSFT	Thomaston, Ga.	250d
WLPO	LaSalle, Ill.	1000d
WKRS	Waukegan, Ill.	1000d
WSLM	Salem, Ind.	5000d
KJAN	Atlantic, Iowa	250d
KOUR	Independence, Iowa	250d
KOFO	Ottawa, Kans.	250d
WFKN	Franklin, Ky.	250d
KBCL	Shreveport, La.	250d
WLBI	Denham Springs, La.	250d
WSME	Sanford, Maine	1000d
WBCH	Hastings, Mich.	250d
WAVN	Stillwater, Minn.	5000d
WMDC	Hazlehurst, Miss.	250d
KZYM	Cape Girardeau, Mo.	250d
KBHM	Branson, Mo.	1000d
KLPW	Union, Mo.	1000d
WLBK	Keene, N.H.	1000d
WGNY	Newburgh, N.Y.	5000d
WSOQ	N. Syracuse, N.Y.	1000d
WKMT	Kings Mtn., N.C.	1000d
WREV	Reidsville, N.C.	1000d
WENC	Whiteville, N.C.	5000d
KEYD	Oakes, N.Dak.	1000d
WGAR	Cleveland, Ohio	50000
WERT	Van Wert, Ohio	250d
KBLY	Gold Beach, Oreg.	1000d

kHz	Wave Length	W.P.
KAPT	Salem, Ore.	1000d
WJUN	Mexico, Pa.	1000d
WRIB	Providence, R.I.	1000d
WFWL	Camden, Tenn.	250d
WCPH	Etowah, Tenn.	1000d
KZEE	Weatherford, Tex.	250d
KVLL	Woodville, Tex.	250d
WLSD	Big Stone Gap, Va.	1000d
WFAX	Falls Church, Va.	5000d
KASY	Auburn, Wash.	250d

1230—243.8

WAUD	Auburn, Ala.	1000
WJBB	Haleyville, Ala.	1000
WBHP	Huntsville, Ala.	1000
WNUZ	Talledega, Ala.	1000
WTBC	Tuscaloosa, Ala.	1000
KIFW	Sitka, Alaska	250
KSUN	Bisbee, Ariz	250
KAAA	Kingman, Ariz.	1000
KRIZ	Phoenix, Ariz.	250
KATO	Safford, Ariz.	250
KINO	Winslow, Ariz.	1000
KCON	Conway, Ark	250
KFPW	Ft. Smith, Ark.	1000
KBTM	Jonesboro, Ark.	1000
KCON	Conway, Ark.	1000
KGEE	Bakersfield, Calif.	1000
KWTC	Barstow, Calif.	1000
KIBS	Bishop, Calif.	1000
KXO	El Centro, Calif.	250
KDAC	Ft. Bragg, Calif.	250
KGFJ	Los Angeles, Calif.	1000
KPRL	Paso Robles, Calif.	1000
KRDG	Redding, Calif.	250
KWG	Stockton, Calif	1000
KEXO	Grand Junction, Colo.	1000
KBRR	Leadville, Colo.	1000
KDZA	Pueblo, Colo.	1000d
KGEK	Sterling, Colo.	1000d
WINF	Manchester, Conn.	1000
WGGG	Gainesville, Fla.	1000
WONN	Lakeland, Fla	1000
WMAF	Madison, Fla.	1000
WSBB	New Smyrna Bch., Florida	1000
WNVY	Pensacola, Fla.	1000
WCNH	Quincy, Fla.	1000d
WJNO	W. Palm Beach, Fla.	250
WBIA	Augusta, Ga.	1000d
WBLJ	Dalton, Ga.	1000
WXLI	Dublin, Ga.	1000
WFOM	Marietta, Ga.	1000
WSOK	Savannah, Ga.	1000
WAYX	Waycross, Ga.	1000
KBAR	Burley, Idaho	1000
KORT	Grangeville, Ida.	1000
KRXK	Rexburg, Idaho	1000
WJBC	Bloomington, Ill.	1000
WQUA	Moline, Ill.	1000
WHCO	Sparta, Ill.	250
WJOB	Hammond, Ind.	1000
WSAL	Logansport, Ind.	1000
WTCJ	Tell City, Ind.	1000
WBOW	Terre Haute, Ind.	1000
KFJB	Marshalltown, Iowa	1000
WHIR	Danville, Ky.	1000d
WHOP	Hopkinsville, Ky.	1000
WANO	Pineville, Ky.	1000d
KLIC	Monroe, La.	1000d
WBOK	New Orleans, La.	1000d
KSLO	Opelousas, La.	1000
WBME	Belfast, Me.	250
WQDY	Calais, Maine	1000d
WSJR	Madawaska, Me.	1000
WITH	Baltimore, Md.	1000d
WCUM	Cumberland, Md.	1000
WMNB	No. Adams, Mass.	1000d
WESX	Salem, Mass.	1000
WNEB	Worcester, Mass.	1000
WJEF	Grand Rapids, Mich.	1000
WIKB	Iron River, Mich.	1000d
WMPC	Lapeer, Mich.	1000
WSOO	Slt. Ste. Marie, Mich.	1000
WSTR	Sturgis, Mich.	1000
WKLK	Cloquet, Minn.	1000
KGHS	Internat'l Falls, Minn.	250
KYSM	Mankato, Minn.	1000
KMRS	Morris, Minn.	250
KTRF	Thief Riv. Falls, Minn.	1000
KWNO	Winona, Minn.	1000d
WCMA	Corinth, Miss.	1000
WHSY	Hattiesburg, Miss.	1000
WSSO	Starkville, Miss.	1000
WAZF	Yazoo City, Miss.	1000
KODE	Joplin, Mo.	1000
KLWT	Lebanon, Mo.	1000
KWIX	Moberly, Mo.	1000d
KBMN	Bozeman, Mont.	1000d
KHDN	Hardin, Mont.	1000
KXLO	Lewistown, Mont.	1000
KLCB	Libby, Mont.	1000
KTNC	Falls City, Nebr.	100
KHAS	Hastings, Neb.	1000
KELY	Ely, Nev.	250
KLAV	Las Vegas, Nev.	250
KCBN	Reno, Nev.	1000
WMOU	Berlin, N.H.	1000
WTSV	Claremont, N.H.	1000
WCMC	Wildwood, N.J.	1000
KALG	Alamagordo, N. M.	1000

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Only NRI offers you this pioneering method of "3 Dimensional" home-study training in Electronics, TV-Radio . . . a remarkable teaching idea unlike anything you have ever encountered. Founded more than half a century ago — in the days of wireless — NRI pioneered the "learn-by-doing" method of home-study. Today, NRI is the oldest, largest home-study Electronics school. The NRI staff of more than 150 dedicated people has made course material entertaining and easy to grasp. NRI has simplified, organized and dramatized subject matter so that any ambitious man — regardless of his education — can effectively learn the Electronics course of his choice.

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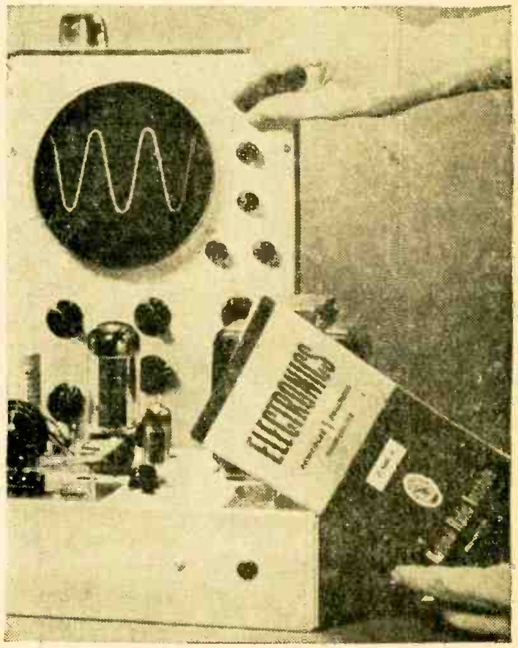

WHITE'S RADIO LOG

kHz	Wave Length	W.P.
KDOT	Deming, N.M.	250d
KYVA	Gallup, N. Mex.	1000
KFUN	Las Vegas, N.M.	1000
KRSY	Roswell, N. Mex.	1000
WNIA	Cheektowaga, N.Y.	500
WENY	Elmira, N.Y.	1000
WIGS	Gouverneur, N. Y.	1000
WHUC	Hudson, N. Y.	1000
WLFH	Little Falls, N. Y.	1000
WFAS	White Plains, N. Y.	1000
WSKY	Asheville, N.C.	1000
WFAI	Fayetteville, N.C.	1000
WMFR	High Point, N.C.	1000
WISP	Kinston, N.C.	1000
WNNC	Newton, N. C.	1000
WCBT	Roanoke Rap., N. C.	1000
KDIX	Dickinson, N.D.	1000
WUBE	Cincinnati, O.	1000
WCOL	Columbus, Ohio	1000
WIRO	Ironton, O.	1000
WCWA	Toledo, O.	1000
KADA	Ada, Okla.	1000
WBBZ	Ponca City, Okla.	250
KVAS	Astoria, Ore.	1000
KRNS	Burns, Ore.	1000
KOOS	Coos Bay, Ore.	1000
KRDR	Gresham, Oreg.	1000
KYJC	Medford, Oreg.	1000
KQIK	Lakeview, Ore.	1000
KTDO	Toledo, Ore.	1000
WBVP	Beaver Falls, Pa.	1000
WEEX	Easton, Pa.	1000
WKBO	Harrisburg, Pa.	1000
WCRO	Johnstown, Pa.	1000
WBPZ	Lock Haven, Pa.	1000
WTIV	Titusville, Pa.	1000
WNIK	Arecibo, P.R.	1000
WERI	Westerly, R.I.	1000
WAIM	Anderson, S.C.	1000
WNOK	Columbia, S C.	1000
WOLS	Florence, S.C.	1000
KISD	Sioux Falls, S.Dak.	1000
WAKI	McMinnville, Tenn.	1000
KSIX	Corpus Christi, Tex.	1000
KDLK	Del Rio, Tex.	250
KNUZ	Houston, Tex.	1000
KERV	Kerrville, Tex.	1000
KLVT	Levelland, Tex.	1000
KEEE	Nacogdoches, Tex.	1000
KOZA	Odessa, Tex.	1000
KGRO	Pampa, Tex.	250
KSEY	Seymour, Tex.	1000
KSST	Sulphur Sprgs., Tex.	1000
KWTX	Waco, Tex.	1000
KMOR	Murray, Utah	1000
KOAL	Price, Utah	1000
WJOY	Burlington, Vt.	1000
WBBI	Abingdon, Va.	1000
WODI	Brookneal, Va.	1000
WCFV	Clifton Forge, Va.	1000
WFVA	Fredericksburg, Va.	1000
WNOR	Norfolk, Va.	1000
KOZI	Chelan, Wash.	1000
KWYZ	Everett, Wash.	1000
KSPO	Spokane, Wash.	1000
KREW	Sunnyside, Wash.	1000
WLOG	Logan, W.Va.	1000
WTAP	Parkersburg, W.Va.	1000
WHBY	Appleton, Wis.	1000
WCLO	Janesville, Wis.	1000
WXCO	Wausau, Wis.	1000
KVOC	Casper, Wyo.	1000

1240—241.8

WEBJ	Brewton, Ala.	250
WPRN	Butler, Ala.	1000
WULA	Eufaula, Ala.	1000
WOWL	Florence, Ala.	1000
WARF	Jasper, Ala.	1000
KVRD	Cottonwood, Ariz.	250
KZOW	So. of Globe, Ariz.	1000
KCYN	Williams, Ariz.	1000
KVRC	Arkadelphia, Ark.	1000
KTLO	Mountain Home, Ark.	1000
KWAK	Stuttgart, Ark.	1000
KPLY	Crescent City, Calif.	250
KOAD	Lemoore, Cal.	250
KMBY	Monterey, Calif.	1000
KPPC	Pasadena, Calif.	100
KLOA	Ridgecrest, Calif.	250
KROY	Sacramento, Calif.	1000
KRNO	San Bernardino, Calif.	1000
KSON	San Diego, Calif.	250
KSMA	Santa Maria, Calif.	250
KSUE	Susanville, Calif.	1000
KRDO	Colo. Springs, Colo.	1000d
KDGO	Durango, Colo.	1000
KSLV	Monte Vista, Colo.	1000
KCRT	Trinidad, Colo.	250
WWCO	Waterbury, Conn.	1000
WBGC	Chipley, Fla.	1000
WLCO	Eustis, Fla.	1000
WINK	Ft. Myers, Fla.	1000
WMMB	Melbourne, Fla.	1000
WFOY	St. Augustine, Fla.	1000
WBHB	Fitzgerald, Ga.	1000
WDUN	Gainesville, Ga.	1000
WLAG	LaGrange, Ga.	1000
WBML	Macon, Ga.	1000
WWNS	Statesboro, Ga.	1000
WPAX	Thomasville, Ga.	1000
WTWA	Thomson, Ga.	250
KVNI	Coeur d'Alene, Idaho	1000
KFLI	Mountain Home, Idaho	250
KMCL	McCall, Ida.	500
KWIK	Pocatello, Ida.	1000
WCRW	Chicago, Ill.	1000d
WEDC	Chicago, Ill.	250
WSBC	Chicago, Ill.	1000
WEBQ	Harrisburg, Ill.	1000
WTAX	Springfield, Ill.	1000
WSDR	Sterling, Ill.	500
WHBU	Anderson, Ind.	1000
KDEC	Decorah, Iowa	1000
KWLC	Decorah, Iowa	1000
KBIZ	Ottumwa, Iowa	1000
KICD	Spencer, Iowa	1000
KIUL	Garden City, Kans.	1000
KAKE	Wichita, Kans.	250
WINN	Louisville, Ky.	1000
WFTM	Maysville, Ky.	1000
WPKE	Pikeville, Ky.	1000
WSFC	Somerset, Ky.	1000
KASO	Minden, La.	1000
KANE	New Iberia, La.	1000
WCOU	Lewiston, Maine	1000
WMKR	Millinocket, Me.	1000
WCEM	Cambridge, Md.	1000
WJEJ	Hagerstown, Md.	1000
WHAI	Greenfield, Mass.	1000
WOCB	W. Yarmouth, Mass.	1000
WATT	Cadillac, Mich.	1000
WCBY	Cheboygan, Mich.	1000
WJPD	Ishpeming, Mich.	1000
WJIM	Lansing, Mich.	1000
WMFG	Hibbing, Minn.	1000
KPRM	Park Rapids, Minn.	1000
WJON	St. Cloud, Minn.	1000
WMPA	Aberdeen, Miss.	1000
WGRM	Greenwood, Miss.	250
WGCM	Gulfport, Miss.	1000
WMIS	Natchez, Miss.	1000
KFMO	Flat River, Mo.	1000
KWOS	Jefferson City, Mo.	1000
KNEM	Nevada, Mo.	250
KBMY	Billings, Mont.	1000
KLTZ	Glasgow, Mont.	1000
KBLL	Helena, Mont.	1000
KFOR	Lincoln, Nebr.	1000
KODY	North Platte, Nebr.	1000
KELK	Elko, Nev.	1000
WFTN	Franklin, N.H.	250
WSNJ	Bridgeton, N. J.	1000
KAVE	Carlsbad, N.Mex.	1000
KCLV	Clovis, N.Mex.	1000
WGBB	Freeport, N.Y.	1000
WGVA	Geneva, N.Y.	1000
WJTN	Jamestown, N.Y.	500
WVOS	Liberty, N. Y.	1000
WNBZ	Saranac Lake, N.Y.	1000
WSNY	Schenectady, N.Y.	1000
WATN	Watertown, N. Y.	1000
WPNF	Brevard, N.C.	1000
WIST	Charlotte, N.C.	1000
WJNC	Jacksonville, N.C.	1000
WRNC	Raleigh, N.C.	1000
WWWC	Wilkesboro, N.C.	
KDLR	Devils Lake, N.Dak.	250
WBBW	Youngstown, Ohio	1000
WHIZ	Zanesville, Ohio	1000
KVSO	Ardmore, Okla.	1000
KBEK	Elk City, Okla.	250
KBEL	Idabel, Okla.	1000
KOKL	Okmulgee, Okla.	1000
KFLY	Corvallis, Oreg.	1000
KTIX	Pendleton, Oreg.	1000
KPRB	Redmond, Ore.	1000
KQEN	Roseburg, Ore.	1000
WRTA	Altoona, Pa.	1000
WHUM	Reading, Pa.	1000
WSEW	Selinsgrove, Pa.	250
WBAX	Wilkes-Barre, Pa.	1000
WALO	Humacao, P.R.	1000
WWON	Woonsocket, R.I.	1000
WKDK	Newberry, S.C.	1000
WDXY	Sumter, S. C.	1000
KCCR	Pierre, S. D.	1000
WBEJ	Elizabethton, Tenn.	1000
WEKR	Fayetteville, Tenn.	1000
WBIR	Knoxville, Tenn.	1000
WKDA	Nashville, Tenn.	1000
WENK	Union City, Tenn.	1000
KVLF	Alpine, Tex.	1000
KEAN	Brownwood, Tex.	1000
KORA	Bryan, Tex.	1000
KOCA	Kilgore, Tex.	1000
KSOX	Raymondville, Tex.	250
KXOX	Sweetwater, Tex.	1000
WSKI	Montpelier, Vt.	1000
WSSV	Petersburg, Va.	1000
WROV	Roanoke, Va.	1000
WTON	Staunton, Va.	1000
KXLE	Ellensburg, Wash.	1000
KGY	Olympia, Wash.	1000
WKOY	Bluefield, W.Va.	1000
WTIP	Charleston, W.Va.	1000
WDNE	Elkins, W.Va.	1000
WOMT	Manitowoc, Wis.	1000
WIBU	Poynette, Wis.	1000
WOBT	Rhinelander, Wis.	1000
WJMC	Rice Lake, Wis.	1000
KFBC	Cheyenne, Wyo.	1000
KEVA	Evanston, Wyo.	1000
KASL	Newcastle, Wyo.	1000
KRAL	Rawlins, Wyo.	1000
KTHE	Thermopolis, Wyo.	1000

1250—239.9

WZOB	Ft. Payne, Ala.	1000d
WETU	Wetumpka, Ala.	5000d
KSWW	Wickenburg, Ariz.	500d
KHIL	Willcox, Ariz.	5000d
KFAY	Fayetteville, Ark.	1000d
KALO	Little Rock, Ark.	1000
KHOT	Madera, Calif.	500d
KTMS	Santa Barbara, Calif.	1000
KDHI	Twenty-Nine Palms, California	1000d
KMSL	Ukiah, Cal.	
WNER	Live Oak, Fla.	1000d
WDAE	Tampa, Fla.	5000
WLYB	Albany, Ga.	1000d
WYTH	Madison, Ga.	1000d
WIZZ	Streator, Ill.	500d
WGL	Ft. Wayne, Ind.	1000
WRAY	Princeton, Ind.	1000d
KCFI	Cedar Falls, Iowa	500d
KFKU	Lawrence, Kans.	5000
WREN	Topeka, Kans.	5000
WNVL	Nicholasville, Ky.	500d
WLCK	Scottsville, Ky.	500d
WGUY	Bangor, Maine	5000d
WARE	Ware, Mass.	1000
WXOX	Bay City, Mich.	1000d
KBRF	Fergus Falls, Minn.	1000
KCUE	Red Wing, Minn.	1000d
WHNY	McComb, Miss.	5000
KBTC	Houston, Mo.	1000d
WKBR	Manchester, N.H.	5000
WMTR	Morristown, N.J.	5000d
WIPS	Ticonderoga, N.Y.	1000d
WFAG	Farmville, N.C.	500d
WKDX	Hamlet, N. C.	1000d
WBRM	Marion, N.C.	1000d
WCHO	Washington Court House, Ohio	500d
WLEM	Emporium, Pa.	1000d
WPEL	Montrose, Pa.	1000d
WTAE	Pittsburgh, Pa.	5000
WNOW	York, Pa.	5000d
WTMA	Charleston, S.C.	5000
WCKM	Winnsboro, S.C.	500d
WKBL	Covington, Tenn.	1000d
WKYZ	Madisonville, Tenn.	500d
WNTT	Tazewell, Tenn.	500d
KPRE	Paris, Tex.	500d
KPAC	Port Arthur, Tex.	5000
KUKA	San Antonio, Tex.	1000d
KIKZ	Seminole, Tex.	1000d
KVEL	Vernal, Utah	5000d
WDVA	Danville, Va.	5000
WYSR	Franklin, Va.	1000d
WEER	Warrenton, Va.	1000d
KWSU	Pullman, Wash.	5000
KTW	Seattle, Wash.	5000
WEMP	Milwaukee, Wis.	5000

1260—238.0

WCRT	Birmingham, Ala.	5000d
KPIN	Casa Grande, Ariz.	1000d
KCCB	Corning, Ark.	1000d
KBHC	Nashville, Ark.	500d
KGIL	San Fernando, Calif.	5000
KYA	San Francisco, Calif.	5000
KSNO	Aspen, Colo.	5000d
WCRT	Birmingham, Ala.	5000d
WMMM	Westport, Conn.	1000d
WNRK	Newark, Del.	500d
WWDC	Washington, D.C.	5000
WFTW	Fort Walton Beach, Florida	1000d
WWOK	Miami, Fla.	5000
WWPF	Palatka, Fla.	1000
WUFE	Baxley, Ga.	5000d
WBBK	Blakely, Ga.	1000d
WTJH	East Point, Ga.	5000d
KTEE	Idaho Falls, Ida.	5000d
KWEI	Weiser, Ida.	1000d
WIBV	Belleville, Ill.	5000
WFBM	Indianapolis, Ind.	5000
KFGQ	Boone, Iowa	1000d
KWHK	Hutchinson, Kans.	1000
WAIL	Baton Rouge, La.	1000d
WEZE	Boston, Mass.	5000
WALM	Albion, Mich.	1000
WJBL	Holland, Mich.	5000
KROX	Crookston, Minn.	1000
KDUZ	Hutchinson, Minn.	1000d
WGVM	Greenville, Miss.	5000d
WNSL	Laurel, Miss.	5000d
WCSA	Ripley, Miss.	500d
KGBX	Springfield, Mo.	5000
KIMB	Kimball, Nebr.	1000d
WBUD	Trenton, N.J.	5000
KVSF	Santa Fe, N.Mex.	1000
WBNR	Beacon, N.Y.	1000d
WNDR	Syracuse, N.Y.	5000
WGWR	Asheboro, N.C.	5000
WCDJ	Edenton, N.C.	1000d
WIXY	Cleveland, O.	5000
WNXT	Portsmouth, Ohio	5000
KWSH	Wewoka-Seminole, Oklahoma	1000
KMCM	McMinnville, Oreg.	1000
WWYN	Erie, Pa.	5000
WPHB	Philipsburg, Pa.	5000d
WISO	Ponce, P.R.	1000
WMUU	Greenville, S.C.	5000d
WJOT	Lake City, S.C.	1000d
KWYR	Winner, S.Dak.	5000d
WNOO	Chattanooga, Tenn.	1000d
WMCH	Church Hill, Tenn.	1000d
WDKN	Dickson, Tenn.	1000d
WCLC	Jamestown, Tenn.	1000d
KSPL	Diboll, Tex.	1000d
KPSO	Falfurrias, Tex.	500d
KWFR	San Angelo, Tex.	1000d
KTUE	Tulia, Tex.	1000d
KTAE	Taylor, Tex.	1000d
WCHV	Charlottesville, Va.	5000
WJJJ	Christiansburg, Va.	1000d
KWIQ	Moses Lake, Wash.	1000d
WVVW	Grafton, W.Va.	500d
WWIS	Black River Falls, Wis.	1000d
WEKZ	Monroe, Wis.	1000d
WOCO	Oconto, Wis.	1000d
KPOW	Powell, Wyo.	5000

1270—236.1

WGSV	Guntersville, Ala.	1000d
WZAM	Prichard, Ala.	1000d
KBYR	Anchorage, Alaska	1000
KDJI	Holbrook, Ariz.	5000d
KADL	Pine Bluff, Ark.	5000d
KBLC	Lakeport, Calif.	
KGOL	Palm Desert, Cal.	1000d
KCOK	Tulare, Calif.	5000
WNOG	Naples, Fla.	500d
WORJ	Orlando, Fla.	5000d
WTNT	Tallahassee, Fla.	5000
WKRW	Cartersville, Ga.	500d
WHYD	Columbus, Ga.	5000d
WJJC	Commerce, Ga.	1000d
KNDI	Honolulu, Hawaii	5000
KTFI	Twin Falls, Idaho	5000
WEIC	Charleston, Ill.	1000d
WHBF	Rock Island, Ill.	5000
WCMR	Elkhart, Ind.	5000
WWCA	Gary, Ind.	1000
WORX	Madison, Ind.	1000d
KSCB	Liberal, Kans.	1000
WAIN	Columbia, Ky.	1000d
WFUL	Fulton, Ky.	1000d
KVCL	Winnfield, La.	1000d
WUOK	Cumberland, Md.	5000
WSPR	Springfield, Mass.	5000
WXYZ	Detroit, Mich.	5000
KWEB	Rochester, Minn.	5000
WVOM	Iuka, Miss.	1000d
WLSM	Louisville, Miss.	5000d
KUSN	St. Joseph, Mo.	1000d
KFBD	Waynesville, Mo.	500d
KBUB	Sparks, Nev.	5000d
WTSN	Dover, N.H.	5000
WDVL	Vineland, N.J.	500d
KINN	Alamogordo, N.M.	1000d
WHLD	Niagara Falls, N.Y.	5000d
WDLA	Walton, N.Y.	1000d
WCGC	Belmont, N. C.	1000
WMPM	Smithfield, N.C.	5000d
KBOM	Mandan, N.Dak.	1000
WILE	Cambridge, Ohio	1000d
KWPR	Claremore, Okla.	500d
KAJO	Grants Pass, Oreg.	5000d
WLBR	Lebanon, Pa.	5000
WBHC	Hampton, S.C.	1000d
KNWC	Sioux Falls, S.Dak.	1000
WLIK	Newport, Tenn.	5000
KIOX	Bay City, Tex.	1000
KHEM	Big Spring, Tex.	1000d
KEPS	Eagle Pass, Tex.	1000d
KFJZ	Fort Worth, Tex.	5000
WTID	Newport News, Va.	1000d
WHEO	Stuart, Va.	1000d
KCVL	Colville, Wash.	1000d
KBAM	Longview, Wash.	5000d
WRJC	Mauston, Wis.	500d
WWJC	Superior, Wis.	5000d
KIML	Gillette, Wyo.	5000

1280—234.2

WPID	Piedmont, Ala.	1000d
WNPT	Tuscaloosa, Ala.	5000
KHEP	Phoenix, Ariz.	1000d
KNBY	Newport, Ark.	1000d
KOAG	Arroyo Grande, Cal.	1000
KNCR	Fortuna, Cal.	5000d
KFOX	Long Beach, Calif.	1000
KJOY	Stockton, Calif.	1000
KTLK	Denver, Colo.	5000
WSUX	Seaford, Del.	1000d
WDSP	DeFuniak Springs, Florida	5000d
WIPC	Lake Wales, Fla.	1000d
WYND	Sarasota, Fla.	500d

kHz	Wave Length	W.P.
WIBB	Macon, Ga.	5000d
WMRO	Aurora, Ill.	1000d
WGBF	Evansville, Ind.	5000
KCOB	Newton, Iowa	1000d
KSOK	Arkansas City, Kans.	1000
WCPM	Cumberland, Ky.	1000d
WIXI	Lancaster, Ky.	1000d
WDSU	New Orleans, La.	5000
KWCL	Oakgrove, La.	1000d
WABK	Gardiner, Me.	5000
WEIM	Fitchburg, Mass.	5000
WFYC	Alma, Mich.	5000d
WWTC	Minneapolis, Minn.	5000
KVOX	Moorhead, Minn.	1000
WSCO	Taylorsville, Miss.	500d
KDKD	Clinton, Mo.	1000d
KYRO	Petosi, Mo.	500
KCNI	Broken Bow, Nebr.	1000d
KTOO	Henderson, Nev.	5000d
KRZE	Farmington, N.Mex.	5000d
WADO	New York, N.Y.	5000
WROC	Rochester, N.Y.	5000
WSAT	Salisbury, N.C.	1000
WYAL	Scotland Neck, N.C.	5000d
WONW	Defiance, Ohio	1000
WLMJ	Jackson, Ohio	1000d
KLCO	Poteau, Okla.	1000d
KERG	Eugene, Oreg.	5000
WBRX	Berwick, P.	1000d
WHVR	Hanover, Pa.	5000
WKST	New Castle, Pa.	1000
WCMN	Arecibo, P.R.	5000
WANS	Anderson, S.C.	5000
WJAY	Mullins, S.C.	5000d
WMCP	Columbia, Tenn.	1000d
WDNT	Dayton, Tenn.	1000d
KNIT	Abilene, Tex.	500d
KWHI	Brenham, Tex.	1000d
KLUE	Longview, Tex.	1000d
KRAN	Morton, Tex.	500d
KVWG	Pearsall, Tex.	500d
KNAK	Salt Lake City, Utah	5000
WYVE	Wytheville, Va.	1000d
KMAS	Shelton, Wash.	1000d
KUDY	Spokane, Wash.	5000d
KIT	Yakima, Wash.	5000
WNAM	Neenah, Wis.	5000

1290—232.4

WHOD	Jackson, Ala.	1000d
WSHF	Sheffield, Ala.	1000d
WMLS	Sylacauga, Ala.	1000d
KCUB	Tucson, Ariz.	1000
KDMS	El Dorado, Ark.	5000d
KUOA	Siloam Sprgs., Ark.	5000d
KHSL	Chico, Calif.	5000
KAZA	Gilroy, Calif.	5000d
KMEN	San Bernardino, California	5000
KACL	Santa Barbara, Cal.	500d
WCCC	Hartford, Conn.	500d
WTUX	Wilmington, Del.	1000d
WTMC	Ocala, Fla.	5000
WSCM	Panama City Beach, Florida	500d
WIRK	W. Palm Bch., Fla.	5000
WDEC	Americus, Ga.	1000d
WCHK	Canton, Ga.	1000d
WTOC	Savannah, Ga.	5000
KSNN	Pocatello, Idaho	1000d
WIRL	Peoria, Ill.	5000
WREY	New Albany, Ind.	500d
KWNS	Pratt, Kansas	5000
WCBL	Benton, Ky.	5000d
KJEF	Jennings, La.	1000d
WHGR	Houghton Lake, Mich.	5000
WNIL	Niles, Mich.	500d
WOIB	Saline, Mich.	500d
KBMO	Benson, Minn.	500d
WBLE	Batesville, Miss.	1000d
WTYL	Tylertown, Miss.	1000d
KALM	Thayer, Mo.	1000d
KGVO	Missoula, Mont.	5000
KOIL	Omaha, Nebr.	5000
WKNE	Keene, N.H.	5000
KSRC	Socorro, N.M.	1000d
WGLI	Babylon, N. Y.	5000
WNBF	Binghamton, N.Y.	5000
WHKY	Hickory, N.C.	5000
WBBS	Jacksonville, N.C.	1000d
WEYE	Sanford, N.C.	1000d
WOMP	Bellaire, Ohio	1000d
WHIO	Dayton, Ohio	5000
KUMA	Pendleton, Oreg.	5000
KLIQ	Portland, Oreg.	5000d
WFBG	Altoona, Pa.	5000
WICE	Providence, R.I.	5000
WFIG	Sumter, S.C.	1000
WATO	Oak Ridge, Tenn.	5000
KWGH	Big Lake, Tex.	1000d
KIVY	Crockett, Tex.	1000d
KRGV	Weslaco, Tex.	5000
KTRN	Wichita Falls, Tex.	5000
WPVA	Colonial Hgts., Va.	5000d
WAGE	Leesburg, Va.	1000d
WKWS	Rocky Mount, Va.	1000d
WVOW	Logan, W.Va.	5000
KAPY	Port Angeles, Wash.	1000d
WMIL	Milwaukee, Wis.	1000d
WCOW	Sparta, Wis.	5000d
KOWB	Laramie, Wyo.	5000

1300—230.6

WBSA	Boaz, Ala.	1000d
WTLS	Tallassee, Ala.	1000d
WEZQ	Winfield, Ala.	1000d
KHAC	Window Rock, Ariz.	1000d
KWCB	Searcy, Ark.	1000d
KROP	Brawley, Calif.	1000
KYNO	Fresno, Calif.	5000
KMFB	Mendocino, Cal.	1000d
KWKW	Pasadena, Calif.	5000
KVOR	Colorado Springs, Colo.	5000
WAVZ	New Haven, Conn.	1000
WRKT	Cocoa Beach, Fla.	5000
WFFG	Marathon, Fla.	500
WSFR	Sanford, Fla.	
WSOL	Tampa, Fla.	5000d
WMTM	Moultrie, Ga.	5000d
WNEA	Newman, Ga.	500
WIMO	Winder, Ga.	1000d
KOZE	Lewiston, Idaho	5000
WTAQ	La Grange, Ill.	5000
WFRX	W. Frankfort, Ill.	1000d
WHLT	Huntington, Ind.	500d
WAAC	Terre Haute, Ind.	500d
KGLO	Mason City, Iowa	5000
WBLG	Lexington, Ky.	1000
WIBR	Baton Rouge, La.	1000
WFBR	Baltimore, Md.	5000
WJDA	Quincy, Mass.	1000d
WOOD	Grand Rapids, Mich.	5000
WKPM	Princeton, Minn.	1000d
WRBC	Jackson, Miss.	5000
KMMO	Marshall, Mo.	1000d
KBRL	McCook, Nebr.	5000d
KRWL	Carson City, Nev.	5000
WPNH	Plymouth, N.H.	1000d
WAAT	Trenton, N.J.	5000d
WOSC	Fulton, N.Y.	1000d
WMMJ	Lancaster, N.Y.	1000d
WEEE	Rensselaer, N.Y.	5000d
WKQW	Spring Valley, N.Y.	5000
WGOL	Goldsboro, N.C.	1000d
WLNC	Laurinburg, N.C.	500d
WSYD	Mt. Airy, N.C.	5000
WERE	Cleveland, Ohio	5000
WMVO	Mt. Vernon, Ohio	500d
KCNW	Tulsa, Okla.	5000
KDOV	Medford, Oreg.	5000d
KACI	The Dalles, Oreg.	1000d
WWCH	Clarion, Pa.	500d
WTIL	Mayaguez, P.R.	1000
WLOW	Aiken, S.C.	500d
WCKI	Greer, S.C.	1000d
WKSC	Kershaw, S.C.	500d
KOLY	Mobridge, S.D.	5000d
WMTN	Morristown, Tenn.	5000d
WMAK	Nashville, Tenn.	5000
KVET	Austin, Tex.	5000
KKUB	Brownfield, Tex.	1000d
KLAR	Laredo, Tex.	1000
KKAS	Silsbee, Tex.	500d
KSTU	Logan, Utah	1000
WKCY	Harrisonburg, Va.	5000d
KOL	Seattle, Wash.	5000
WCLG	Morgantown, W.Va.	1000d
WKLC	St. Albans, W.Va.	1000d
WLOT	Marinette, Wis.	

1310—228.9

WHEP	Foley, Ala.	1000d
WJAM	Marion, Ala.	5000d
KBUZ	Mesa, Ariz.	5000
KBOK	Malvern, Ark.	1000d
KIOT	Barstow, Calif	5000d
KPOD	Crescent City, Calif.	1000d
KDIA	Oakland, Cal.	5000
KTKR	Taft, Calif.	1000d
KFKA	Greeley, Colo.	5000d
WICH	Norwich, Conn.	5000
WOOO	Deland, Fla.	5000d
WGKR	Perry, Fla.	1000d
WAUC	Wauchula, Fla.	500d
WOMN	Decatur, Ga.	500d
WOKA	Douglas, Ga.	1000d
WBRO	Waynesboro, Ga.	1000d
WBMK	West Point, Ga.	1000d
KNUI	Kahalui, Hawaii	1000
KLIX	Twin Falls, Idaho	5000
WIFE	Indianapolis, Ind.	5000
KDLS	Perry, Iowa	500d
KOKX	Keokuk, Ia.	1000
KFLA	Scott City, Kans.	500d
WTTL	Madisonville, Ky.	1000
WDOC	Prestonsburg, Ky.	5000d
KIKS	Sulphur, La.	500d
KUZN	W. Monroe, La.	1000d
WLOB	Portland, Me.	5000
WORC	Worcester, Mass.	5000
WKNR	Dearborn, Mich.	5000
WCCW	Traverse City, Mich.	5000d
KRBI	St. Peter, Minn.	1000d
WXXX	Hattiesburg, Miss.	1000d
KFSB	Joplin, Mo.	5000
KGKF	Great Falls, Mont.	5000
KGMT	Fairbury, Nebr.	500d
WJLK	Asbury Park, N.J.	1000
WCAM	Camden, N.J.	1000d
WPRJ	Parsippany-Troy Hills, N.J.	
WVIP	Mt. Kisco, N.Y.	5000d
WTLB	Utica, N.Y.	1000
WISE	Asheville, N.C.	5000
WKTC	Charlotte, N.C.	1000d
WTIK	Durham, N.C.	5000
KNOX	Grand Forks, N.Dak.	5000
WFAH	Alliance, Ohio	1000d
KNPT	Newport, Oreg.	5000
WBFD	Bedford, Pa.	5000d
WGSA	Ephrata, Pa.	5000d
WNAE	Warren, Pa.	5000
WDKD	Kingstree, S.C.	5000d
WDOD	Chattanooga, Tenn.	5000
WDXI	Jackson, Tenn.	5000
WBNT	Oneida, Tenn.	1000d
KZIP	Amarillo, Tex.	1000d
WRR	Dallas, Tex.	5000
KOYL	Odessa, Tex.	1000d
KBUC	San Antonio, Tex.	5000
WEEL	Fairfax, Va.	5000
WGH	Newport News, Va.	5000
KARY	Prosser, Wash.	1000d
WIBA	Madison, Wis.	5000

1320—227.1

WAGF	Dothan, Ala.	1000
WENN	Birmingham, Ala.	5000d
KBLU	Yuma, Ariz.	500d
KWHN	Fort Smith, Ark.	5000
KRLW	Walnut Ridge, Ark.	1000d
KHSJ	Hemet, Calif.	500d
KLAN	Lemoore, Calif.	1000d
KUDE	Oceanside, Calif.	500
KCRA	Sacramento, Calif.	5000
KAVI	Rocky Ford, Colo.	1000d
WATR	Waterbury, Conn.	5000
WGMA	Hollywood, Fla.	5000
WVOJ	Jacksonville, Fla.	5000
WAMR	Venice, Fla.	500d
WHIE	Griffin, Ga.	5000d
WKAN	Kankakee, Ill.	1000
KNIA	Knoxville, Iowa	500d
KMAQ	Maquoketa, Iowa	500d
KLWN	Lawrence, Kans.	500d
WBRT	Bardstown, Ky.	1000d
WCLU	Covington, Ky.	500d
WNGO	Mayfield, Ky.	1000d
KHAL	Homer, La.	1000d
WICO	Salisbury, Md.	1000d
WARA	Attleboro, Mass.	1000
WILS	Lansing, Mich.	5000
WDMJ	Marquette, Mich.	1000
WRJW	Picayune, Miss.	5000d
WVLY	Water Valley, Miss.	500d
KXLW	Clayton, Mo.	5000d
KOLT	Scottsbluff, Nebr.	5000
KRDD	Roswell, N.M.	1000d
WHHO	Hornell, N.Y.	5000d
WAGY	Forest City, N.C.	1000d
WCOG	Greensboro, N.C.	5000
WKRK	Murphy, N.C.	5000d
WEEW	Washington, N.C.	500d
KHRT	Minot, N.D.	1000d
WHOK	Lancaster, Ohio	1000d
KWOE	Clinton, Okla.	1000d
KATR	Eugene, Ore.	1000d
WKAP	Allentown, Pa.	5000
WGET	Gettysburg, Pa.	1000
WJAS	Pittsburgh, Pa.	5000
WSCR	Scranton, Pa.	1000
WUNO	Rio Piedras, P.R.	5000
WOIC	Columbia, S. C.	5000
KELO	Sioux Falls, S.Dak.	5000
WKIN	Kingsport, Tenn.	5000d
WMSR	Manchester, Tenn.	5000d
KVMC	Colo. City, Tex.	1000d
KXYZ	Houston, Tex.	5000
KCPX	Salt Lake City, Utah	5000
WCVR	Randolph, Vt.	1000d
WLGM	Lynchburg, Va.	1000d
WEET	Richmond, Va.	1000d
KXRO	Aberdeen, Wash.	5000d
KHIT	Walla Walla, Wash.	1000d
WAKX	Superior, Wis.	1000d
WFHR	Wisconsin Rapids, Wis.	5000

1330—225.4

WROS	Scottsboro, Ala.	1000d
KHYT	Tucson, Ariz.	500d
KVEE	Conway, Ark.	500d
KLOM	Lompoc, Cal.	1000d
KFAC	Los Angeles, Calif.	5000
KLBS	Los Banos, Calif.	500d
KCLM	Redding, Cal.	5000d
WARN	Ft. Pierce, Fla.	1000
WWAB	Lakeland, Fla.	1000d
WEBY	Milton, Fla.	5000d
WMEN	Tallahassee, Fla.	5000d
WMLT	Dublin, Ga.	5000
WEAW	Evanston, Ill.	5000d
WRAM	Monmouth, Ill.	1000d
WRRR	Rockford, Ill.	1000d
WJPS	Evansville, Ind.	5000
WTRE	Greensburg, Ind.	1000d
KWWL	Waterloo, Iowa	5000
KFH	Wichita, Kans.	5000
WYGO	Corbin, Ky.	5000d
WMOR	Morehead, Ky.	1000d
KVOL	Lafayette, La.	5000
WASA	Havre de Grace, Md.	5000d
WCRB	Waltham, Mass.	5000
WTRX	Flint, Mich.	5000
WLOL	Minneapolis, Minn.	5000
WFTO	Fulton, Miss.	1000d
WJPR	Greenville, Miss.	1000
WOAL	Meridian, Miss.	5000d
KUKU	Willow Springs, Mo.	1000d
KGAK	Gallup, N.Mex.	5000
WEVD	New York, N.Y.	5000
WPOW	New York, N.Y.	5000
WEBO	Owego, N.Y.	1000d
WHAZ	Troy, N.Y.	1000
WKVO	Havelock, N.C.	1000d
WHOT	Campbell, Ohio	1000
WFIN	Findlay, Ohio	1000d
WKOV	Wellston, Ohio	500d
WELW	Willoughby, O.	500d
KPOJ	Portland, Oreg.	5000
WBLF	Bellefonte, Pa.	500d
WRIE	Erie, Pa.	5000
WLAT	Conway, S. C.	5000
WFBC	Greenville, S.C.	5000
WAEW	Crossville, Tenn.	1000d
WTRO	Dyersburg, Tenn.	500d
KMIL	Cameron, Tex.	500d
KSWA	Graham, Tex.	500d
KINE	Kingsville, Tex.	1000d
KVKM	Monahans, Tex.	5000
KZAK	Tyler, Tex.	1000d
WBTM	Danville, Va.	5000
WRAA	Luray, Va.	1000d
WOLD	Marion, Va.	1000d
WESR	Tasley, Va.	5000d
KCFA	Spokane, Wash.	5000d
WETZ	New Martinsville, W.Va.	1000d
WHBL	Sheboygan, Wis.	5000
KOVE	Lander, Wyo.	5000

1340—223.7

WKUL	Cullman, Ala.	1000
WJOI	Florence, Ala.	1000
WAMA	Selma, Ala.	250
WFEB	Sylacauga, Ala.	1000
KIKO	Miami, Ariz.	1000
KFBR	Nogales, Ariz.	250
KPGE	Page, Ariz.	1000
KENT	Prescott, Ariz.	1000
KBTA	Batesville, Ark.	1000
KZNG	Hot Springs, Ark.	1000
KBRS	Springdale, Ark.	1000
KATA	Arcata, Cal.	1000d
KWXY	Cathedral City, Cal.	500 1000
KMAK	Fresno, Calif	1000
KDOL	Mojave, Cal	500
KSFE	Needles, Calif.	250
KAOR	Oroville, Cal.	1000
KATY	San Luis Obispo, California	1000
KIST	Santa Barbara, Calif.	1000
KOMY	Watsonville, Calif.	1000
KDEN	Denver, Colo.	1000
KQIL	Grand Junction, Colo	250
KVRH	Salida, Colo.	1000
WNHC	New Haven, Conn.	1000
WOOK	Washington, D. C.	1000
WTAN	Clearwater, Fla.	250
WROD	Daytona Bch., Fla.	1000
WDSR	Lake City, Fla.	1000
WTYS	Marianna, Fla.	1000
WQXT	Palm Beach, Fla.	500
WSEB	Sebring, Fla.	1000
WFSH	Valparaiso, Fla.	1000
WIGO	Atlanta, Ga.	1000
WGAU	Athens, Ga.	1000
WBBQ	Augusta, Ga.	1000
WGAA	Cedartown, Ga.	1000
WOKS	Columbus, Ga.	1000
WBBT	Lyons, Ga.	1000
WTIF	Tifton, Ga.	1000
KAIN	Nampa, Idaho	1000
KPST	Preston, Idaho	250
KSKI	Sun Valley, Idaho	1000
WSOY	Decatur, Ill.	1000
WJPF	Herrin, Ill	1000
WJOL	Joliet, Ill.	1000
WBIW	Bedford, Ind.	1000
WTRC	Elkhart, Ind.	1000
WLBC	Muncie, Ind.	1000
KROS	Clinton, Iowa	1000
KCKN	Kansas City, Kans.	1000
KSEK	Pittsburg, Kans.	1000
WCMI	Ashland, Ky.	1000
WNBS	Murray, Ky.	1000
WEKY	Richmond, Ky.	1000
KVOB	Bastron, La.	1000
KRMD	Shreveport, La.	1000
WFAU	Augusta, Maine	1000
WDME	Dover-Foxcroft, Me.	250
WHOU	Houlton, Maine	1000
WGAW	Gardner, Mass.	1000
WNBH	New Bedford, Mass.	1000
WBRK	Pittsfield, Mass.	1000
WLEW	Bad Axe, Mich.	1000
WLAV	Grand Rap., Mich.	1000
WCSR	Hillsdale, Mich.	1000
WMTE	Manistee, Mich.	1000
WAGN	Menominee, Mich.	1000
WMBN	Petoskey, Mich.	1000
WEXL	Royal Oak, Mich.	1000
KVBR	Brainerd, Minn.	1000
KDLM	Detroit Lakes, Minn.	1000
WEVE	Eveleth, Minn.	1000

WHITE'S

RADIO LOG

kHz	Wave Length	W.P.
KROC	Rochester, Minn.	1000
KWLM	Willmar, Minn.	1000
WJMB	Brookhaven, Miss.	1000
WKOZ	Kosciusko, Miss.	1000d
WAML	Laurel, Miss.	1000
KXEO	Mexico, Mo.	1000
KLID	Poplar Bluff, Mo.	1000
KSGM	St. Genevieve, Mo.	1000
KSMO	Salem, Mo.	1000
KICK	Springfield, Mo.	1000
KCAP	Helena, Mont.	1000
KPRK	Livingston, Mont.	1000
KATL	Miles City, Mont.	1000
KYLT	Missoula, Mont.	250
KHUB	Fremont, Nebr.	500
KGFW	Kearney, Nebr.	1000
KSID	Sidney, Nebr.	1000
KRAM	Las Vegas, Nev.	1000
KBET	Reno, Nev.	1000
WDCR	Hanover, N.H.	1000
WMID	Atlantic City, N.J.	1000
KHAP	Aztec, N.M.	1000
KRRR	Ruidoso, N. Mex.	1000
KKIT	Taos, N.Mex.	250
KSIL	Silver City, N.Mex.	1000
WMBO	Auburn, N.Y.	1000
WENT	Gloversville, N.Y.	1000
WKSN	Jamestown, N.Y.	250
WUSJ	Lockport, N.Y.	250
WMSA	Massena, N.Y.	1000
WALL	Middletown, N.Y.	1000
WIRY	Plattsburgh, N.Y.	1000
WJRI	Lenoir, N.C.	1000
WTSB	Lumberton, N.C.	1000
WOXF	Oxford, N.C.	1000
WOOW	Greenville, N.C.	1000
WGNI	Wilmington, N.C.	1000
WAIR	Winston-Salem, N.C.	1000
KGPC	Grafton, N.Dak.	1000
WNCO	Ashland, O.	1000
WOUB	Athens, Ohio	250
WIZE	Springfield, Ohio	1000
WSTV	Steubenville, Ohio	1000
KIHN	Hugo, Okla.	250
KOCY	Okla. City, Okla.	1000
KTOW	Sand Springs, Okla.	500
KLOO	Corvallis, Ore.	1000
KWVR	Enterprise, Oreg.	250
KIHR	Hood River, Ore.	1000
KBBR	N. Bend, Ore.	1000
WCVI	Connellsville, Pa.	1000
WSAJ	Grove City, Pa.	100
WKRZ	Oil City, Pa.	1000
WHAT	Philadelphia, Pa.	1000
WRAW	Reading, Pa.	1000
WTRN	Tyrone, Pa.	1000
WBRE	Wilkes-Barre, Pa.	1000
WWPA	Williamsport, Pa.	1000
WUNA	Aquadilla, P.R.	250
WOKE	Charleston, S.C.	1000
WRHI	Rock Hill, S.C.	1000
WSSC	Sumter, S.C.	1000
KIJV	Huron, S. D.	1000
KRSD	Rapid City, S.Dak.	1000
WBAC	Cleveland, Tenn.	1000
WKRM	Columbia, Tenn.	1000
WGRV	Greeneville, Tenn.	1000
WKGN	Knoxville, Tenn.	1000
WLOK	Memphis, Tenn.	1000
WCDT	Winchester, Tenn.	1000
KWKC	Abilene, Tex.	1000
KTSL	Burnett, Tex.	250
KAND	Corsicana, Tex.	1000
KSET	El Paso, Tex.	250
KLBK	Lubbock, Tex.	1000
KRBA	Lufkin, Tex.	1000
KPDN	Pampa, Tex.	1000
KOLE	Port Arthur, Tex.	250
KTEO	San Angelo, Tex.	250
KVIC	Victoria, Tex.	250
WTWN	St. Johnsbury, Vt.	1000
WSTA	Charlotte Amalie, V.I.	250
WKEY	Covington, Va.	1000
WHAP	Hopewell, Va.	1000
WJMA	Orange, Va.	1000
KAGT	Anacortes, Wash.	250
KSMK	Kennewick, Wash.	1000
KAPA	Raymond, Wash.	1000
KMEL	Wenatchee, Wash.	250
WHAR	Clarksburg, W.Va.	1000
WEPM	Martinsburg, W. Va.	1000
WMON	Montgomery, W.Va.	1000
WOVE	Welch, W.Va.	1000
WLDY	Ladysmith, Wis.	1000
WRIT	Milwaukee, Wis.	1000
KSGT	Jackson, Wyo.	1000
KYCN	Wheatland, Wyo.	250
KWOR	Worland, Wyo.	1000

1350—222.1

kHz	Wave Length	W.P.
WELB	Elba, Ala.	1000d
WGAD	Gadsden, Ala.	5000d
KLYD	Bakersfield, Calif.	1000d
KCKC	San Bernardino, Cal.	5000
KSRO	Santa Rosa, Calif.	5000
KKAM	Pueblo, Colo.	5000
WNLK	Norwalk, Conn.	1000
WINY	Putnam, Conn.	1000d
WEZY	Cocoa, Fla.	1000
WDCF	Dade City, Fla.	1000d
WCAI	Ft. Myers, Fla.	1000d
WBSG	Blackshear, Ga.	500d
WRWH	Cleveland, Ga.	1000d
WAVC	Warner Robins, Ga.	5000d
KTOH	Lihue, Hawaii	5000
KRLC	Lewiston, Ida.-Clarkston, Wash.	5000d
WXCL	Peoria, Ill.	1000
WJBD	Salem, Ill.	500d
WIOU	Kokomo, Ind.	5000
KRNT	Des Moines, Iowa	5000
KMAN	Manhattan, Kans.	500d
WLOU	Louisville, Ky.	5000d
WSMB	New Orleans, La.	5000
WHMI	Howell, Mich.	500
KTMF	New Prague, Minn.	
KDIO	Ortonville, Minn.	1000d
WCMP	Pine City, Minn.	1000d
WKCU	Corinth, Miss.	1000
WKOZ	Kosciusko, Miss.	5000d
KCHR	Charleston, Mo.	1000d
KBRX	O'Neill, Nebr.	1000d
WLNH	Laconia, N.H.	5000d
WHWH	Princeton, N.J.	5000
KABQ	Albuquerque, N.M.	5000
WCBA	Corning, N.Y.	1000d
WRNY	Rome, N.Y.	500d
WBMS	Black Mountain, N. C.	500d
WHIP	Mooresville, N.C.	1000d
WLLY	Wilson, N.C.	1000d
KBMR	Bismarck, N. D.	500d
WSLR	Akron, O.	5000
WCSM	Celina, Ohio	500d
WCHI	Chillicothe, Ohio	1000d
KRHD	Duncan, Okla.	250
KTLQ	Tahlequah, Okla.	1000d
KRVC	Ashland, Oreg.	1000d
WNOW	York, Pa.	1000d
WWBR	Windber, Pa.	1000d
WDAR	Darlington, S.C.	1000d
WGSW	Greenwood, S.C.	1000d
WRKM	Carthage, Tenn.	1000d
KCAR	Clarksville, Tex.	500d
KTXJ	Jasper, Tex.	1000d
KCOR	San Antonio, Tex.	5000
WBLT	Bedford, Va.	1000d
WFLS	Fredericksburg, Va.	1000d
WNVA	Norton, Va.	5000d
WCVU	Portsmouth, Va.	5000
WPDR	Portage, Wis.	1000d

1360—220.4

kHz	Wave Length	W.P.
WWWB	Jasper, Ala.	1000d
WLIQ	Mobile, Ala.	5000d
WMFC	Monroeville, Ala.	1000d
WELR	Roanoke, Ala.	1000d
KRUX	Glendale, Ariz.	5000
KLYR	Clarksville, Ark.	500d
KFFA	Helena, Ark.	1000
KFIV	Modesto, Cal.	5000
KRCK	Ridgecrest, Calif.	1000d
KGB	San Diego, Calif.	5000
WDRC	Hartford, Conn.	5000
WOBS	Jacksonville, Fla.	5000
WKAT	Miami Beach, Fla.	5000
WINT	Winter Haven, Fla.	1000d
WAZA	Bainbridge, Ga.	1000d
WLAW	Lawrenceville, Ga.	1000d
WMAC	Metter, Ga.	500d
WIYN	Rome, Ga.	500d
WLBK	DeKalb, Ill.	1000d
WVMC	Mt. Carmel, Ill.	500d
WGFA	Watseka, Ill.	1000d
KHAK	Cedar Rapids, Iowa	1000d
KXGI	Ft. Madison, Iowa	1000d
KSCJ	Sioux City, Iowa	5000
KBTO	El Dorado, Kans.	500d
WFLW	Monticello, Ky.	1000d
KDXI	Mansfield, La.	1000d
KNIR	New Iberia, La.	1000d
KTLD	Tallulah, La.	500d
WEBB	Baltimore, Md.	5000d
WLYN	Lynn, Mass.	1000d
WKYO	Caro, Mich.	500d
WKMI	Kalamazoo, Mich.	5000
WFFF	Columbia, Miss.	1000d
KLRS	Mountain Grove, Mo.	1000d
KICX	McCook, Nebr.	1000d
WNNJ	Newton, N.J.	1000d
WWBZ	Vineland, N.J.	1000
WKOP	Binghamton, N.Y.	5000
WMNS	Olean, N.Y.	1000d
WCHL	Chapel Hill, N.C.	1000
KEYZ	Williston, N.D.	5000
WSAI	Cincinnati, Ohio	5000
WWOW	Conneaut, Ohio	500d
KUIK	Hillsboro, Oreg.	1000d
WIXZ	McKeesport, Pa.	5000d
WPPA	Pottsville, Pa.	5000
WELP	Easley, S.C.	1000d
WLCM	Lancaster, S.C.	1000d
WBLC	Lenoir City, Tenn.	1000
WNAH	Nashville, Tenn.	1000d
KRAY	Amarillo, Tex.	500d
KACT	Andrews, Tex.	1000d
KWBA	Baytown, Tex.	1000
KRYS	Corpus Christi, Tex.	1000
KXOL	Ft. Worth, Tex.	5000
WBOB	Galax, Va.	1000d
WHBG	Harrisonburg, Va.	5000d
KFDR	Grand Coulee, Wash.	1000d
KMO	Tacoma, Wash.	5000
WHJC	Matawan, W.Va.	1000d
WMOV	Ravenswood, W.Va.	1000d
WBAY	Green Bay, Wis.	5000
WISV	Viroqua, Wis.	1000
WMNE	Menomonie, Wis.	1000d
KVRS	Rock Springs, Wyo.	1000

1370—218.8

kHz	Wave Length	W.P.
WBYE	Calera, Ala.	1000d
KAWW	Heber Springs, Ark.	1000d
KTPA	Prescott, Ark.	500d
KREL	Corona, Cal.	5000
KPCO	Quincy, Cal.	500d
KEEN	San Jose, Calif.	5000
KGEN	Tulare, Calif.	1000d
WKMK	Blountstown, Fla.	500d
WWKE	Ocala, Fla.	5000d
WCOA	Pensacola, Fla.	5000
WAXE	Vero Beach, Fla.	1000d
WLOP	Jesup, Ga.	5000
WFDR	Manchester, Ga.	1000d
WLOV	Washington, Ga.	1000d
WPRC	Lincoln, Ill.	1000d
WTTS	Bloomington, Ind.	5000
WLTH	Gary, Ind.	1000d
KDTH	Dubuque, Iowa	5000
KGNO	Dodge City, Kans.	5000
KALN	Iola, Kans.	500d
WABD	Ft. Campbell, Ky.	500d
WGOH	Grayson, Ky.	5000d
WTKY	Tompkinsville, Ky.	1000d
KAPB	Marksville, La.	1000d
WDEA	Ellsworth, Me.	5000
WMHI	Braddocks Hts., Md.	500d
WKIK	Leonardtown, Md.	1000d
WWAM	Cadillac, Mich.	
WGHN	Grand Haven, Mich.	500
KSUM	Fairmont, Minn.	1000
WMKT	S. St. Paul, Minn.	500d
WMGO	Canton, Miss.	1000d
KWRT	Boonville, Mo.	1000d
KCRV	Caruthersville, Mo.	1000d
KXLF	Butte, Mont.	5000
KAWL	York, Nebr.	500d
WFEA	Manchester, N.H.	5000
WELV	Ellenville, N.Y.	500d
WALK	Patchogue, N.Y.	500d
WSAY	Rochester, N.Y.	5000
WLTC	Gastonia, N.C.	5000d
WTAB	Tabor City, N.C.	5000d
KFJM	Grand Forks, N.D.	1000d
WSPD	Toledo, Ohio	5000
KVYL	Holdenville, Okla.	500d
KAST	Astoria, Oreg.	1000
KFIR	Sweet Home, Ore.	1000d
WOTR	Corry, Pa.	1000
WPAZ	Pottstown, Pa.	1000d
WKMC	Roaring Spring, Pa.	1000d
WIVV	Vieques, P.R.	1000
WKFD	Wickford, R.I.	500d
WDEF	Chattanooga, Tenn.	5000
WDXE	Lawrenceburg, Tenn.	1000d
WRGS	Rogersville, Tenn.	1000d
KOKE	Austin, Tex.	1000d
KFRO	Longview, Tex.	1000
KPOS	Post, Tex.	1000d
KSOP	Salt Lake City, Utah	1000d
WBTN	Bennington, Vt.	1000d
WHEE	Martinsville, Va.	5000d
WJWS	South Hill, Va.	5000d
KPOR	Quincy, Wash.	1000d
WEIF	Moundsville, W. Va.	1000d
WCCN	Neillsville, Wis.	5000d
KVWO	Cheyenne, Wyo.	1000d

1380—217.3

kHz	Wave Length	W.P.
WRAB	Arab, Ala.	1000d
WGYV	Greenville, Ala.	1000d
WVSA	Vernon, Ala.	1000d
KDXE	N. Little Rock, Ark.	1000d
KBVM	Lancaster, Calif.	1000d
KGMS	Sacramento, Calif.	1000
KTOM	Salinas, Cal.	5000
KFLJ	Walsenburg, Colo.	1000d
WOWW	Naugatuck, Conn.	5000
WAMS	Wilmington, Del.	5000
WLIZ	Lake Worth, Fla.	1000d
WDAT	Ormond Bch. Fla.	1000d
WLCY	St. Petersburg, Fla.	5000
WAOK	Atlanta, Ga.	5000
WSIZ	Ocilla, Ga.	5000d
KPOI	Honolulu, Hawaii	5000
WBEL	So. Beloit, Ill.	5000
WWCM	Brazil, Ind.	500d
WKJG	Ft. Wayne, Ind.	5000
KCIM	Carroll, Iowa	1000
KCII	Washington, Iowa	500d
KUDL	Fairway, Kan.	5000
WMTA	Central City, Ky.	500d
WWKY	Winchester, Ky.	1000d
WYNK	Baton Rouge, La.	500d
WKTJ	Farmington, Me.	1000d
WPHM	Port Huron, Mich.	1000
WPLB	Greenville, Mich.	1000
KLIZ	Brainerd, Minn.	5000
KAGE	Winona, Minn.	1000
WDLT	Indianola, Miss.	500d
KWK	St. Louis, Mo.	5000
KUVR	Holdredge, Neb.	500d
WBBX	Portsmouth, N.H.	1000
WAWZ	Zarephath, N.J.	5000
WFSR	Bath, N.Y.	500d
WBNX	New York, N.Y.	5000
WKKE	Asheville, N.C.	5000
WTOB	Winston-Salem, N.C.	5000
WPKO	Waverly, Ohio	1000d
KSWO	Lawton, Okla.	1000
KMUS	Muskogee, Okla.	1000
KBCH	Ocean Lake, Oreg.	1000d
KSRV	Ontario, Oreg.	5000
WACB	Kittanning, Pa.	1000d
WMLP	Milton, Pa.	1000d
WAYZ	Waynesboro, Pa.	1000d
WNRI	Woonsocket, R.I.	1000d
WAGS	Bishopville, S.C.	1000d
WGUS	N. Augusta, S.C.	1000d
KOTA	Rapid City, S.Dak.	5000
KFCB	Redfield, S.Dak.	500d
WYSH	Clinton, Tenn.	1000d
WIZO	Franklin, Tenn.	
WTNN	Millington, Tenn.	500d
KJET	Beaumont, Tex.	1000d
KBWD	Brownwood, Tex.	1000
KCRM	Crane, Tex.	1000d
KTSM	El Paso, Tex.	5000
KMUL	Muleshoe, Tex.	1000d
KBOP	Pleasanton, Tex.	1000d
WSYB	Rutland, Vt.	5000
WTVR	Richmond, Va.	5000
KRKO	Everett, Wash.	5000
KPEG	Spokane, Wash.	5000d
WMTD	Hinton, W.Va.	1000d

1390—215.7

kHz	Wave Length	W.P.
WHMA	Anniston, Ala.	5000
KDQN	DeQueen, Ark.	500d
KAMO	Rogers, Ark.	1000d
KGER	Long Beach, Calif.	5000
KCEY	Turlock, Calif.	5000
KFML	Denver, Colo	5000d
WAVP	Avon Park, Fla.	1000d
WUWU	Gainsville, Fla.	5000d
WISK	Americus, Ga.	5000d
WNUS	Chicago, Ill.	5000
WFIW	Fairfield, Ill.	1000
WJCD	Seymour, Ind.	1000d
KCLN	Clinton, Iowa	1000d
KCBC	Des Moines, Iowa	1000
KNCK	Concordia, Kans.	500d
WANY	Albany, Ky.	1000d
WKIC	Hazard, Ky.	5000d
KFRA	Franklin, La.	500d
WEGP	Presque Isle, Me.	5000d
KJPW	Waynesville, Mo.	1000d
WCAT	Orange, Mass.	1000d
WPLM	Plymouth, Mass.	5000
WCER	Charlotte, Mich.	5000d
KAOH	Duluth, Minn.	500
KRFO	Owatonna, Minn.	500d
WROA	Gulfport, Miss.	1000d
WQIC	Meridian, Miss.	5000d
KJPW	Waynesville, Mo.	1000d
KENN	Farmington, N.Mex.	5000
KHOB	Hobbs, N.Mex.	5000d
WEOK	Poughkeepsie, N.Y.	5000
WRIV	Riverhead, N.Y.	1000d
WFBL	Syracuse, N.Y.	5000
WEED	Rocky Mount, N.C.	5000
WADA	Shelby, N.C.	1000
WJRM	Troy, N.C.	1000d
KLPM	Minot, N.Dak.	5000
WTOO	Bellefontaine, Ohio	500
WMPO	Middleport-Pomeroy, O.	5000d
WFMJ	Youngstown, Ohio	5000
KCRC	Enid, Okla.	1000
KSLM	Salem, Oreg.	5000
WLAN	Lancaster, Pa.	5000
WRSC	State College, Pa.	1000d
WISA	Isabella, P.R.	1000
WHPB	Belton, S.C.	1000d
WCSC	Charleston, S.C.	5000
KJAM	Madison, S.D.	500d
WYXI	Athens, Tenn.	500d
WTJS	Jackson, Tenn.	5000
WMCT	Mountain City, Tenn.	500d
KULP	El Campo, Tex.	500d
KBEC	Waxahachie, Tex.	500d
KBLW	Logan, Utah	1000
WEAM	Arlington, Va.	5000
WWOD	Lynchburg, Va.	5000
WKLP	Keyser, W.Va.	1000d
KBBO	Yakima, Wash.	1000

1400—214.2

kHz	Wave Length	W.P.
WMSL	Decatur, Ala.	1000
WXAL	Demopolis, Ala.	1000
WFPA	Ft. Payne, Ala.	1000
WJLO	Homewood, Ala.	1000
WJHO	Opelika, Ala.	1000

kHz	Wave Length	W.P.
KSEW	Sitka, Alaska	1000
KCLF	Clifton, Ariz.	250
KXIV	Phoenix, Ariz.	1000
KTUC	Tucson, Ariz.	250
KVDY	Yuma, Ariz.	250
KELD	El Dorado, Ark.	1000
KCLA	Pine Bluff, Ark.	1000
KWYN	Wynne, Ark.	1000
KPAT	Berkeley, Calif.	1000
KREO	Indio, Cal.	1000
KQMS	Redding, Cal.	1000
KSLY	San Luis Obispo, Cal.	250
KQIQ	Santa Paula, Cal.	1000
KTRT	Truckee, Cal.	1000
KUKI	Ukiah, Calif.	1000
KONG	Visalia, Calif.	1000
KRLN	Canon City, Colo.	250
KDTA	Delta, Colo.	1000
KFTM	Ft. Morgan, Colo.	250
KBZZ	La Junta, Colo.	1000
WSTC	Stamford, Conn.	1000
WILI	Willimantic, Conn.	1000
WFTL	Ft. Lauderdale, Fla.	1000
WIRA	Ft. Pierce, Fla.	1000
WNUE	Ft. Walton Beach, Fla.	1000
WRHC	Jacksonville, Fla.	1000
WPRY	Perry, Fla.	1000
WTRR	Sanford, Fla.	1000
WPAS	Zephyrhills, Fla.	1000
WULF	Alma, Ga.	1000
WSGC	Elberton, Ga.	1000
WNEX	Macon, Ga.	1000
WCOH	Newnan, Ga.	1000
WSGA	Savannah, Ga.	1000
KART	Jerome, Ida.	1000
KRPL	Moscow, Ida.	1000
KIGO	St. Anthony, Ida.	
KSPT	Sandpoint, Idaho	1000
WDWS	Champaign, Ill.	1000
WGIL	Galesburg, Ill.	1000
WROZ	Evansville, Ind.	1000
WBAT	Marion, Ind.	1000
KCOG	Centerville, Ia.	500
KVFD	Fort Dodge, Iowa	1000
KVOE	Emporia, Kans.	1000
KAYS	Hays, Kans.	1000
WCYN	Cynthiana, Ky.	250
WIEL	Elizabethtown, Ky.	1000
WFTG	London, Ky.	250
WFPR	Hammond, La.	1000
KAOK	Lake Charles, La.	1000
WRDO	Augusta, Maine	1000
WIDE	Biddeford, Maine	1000
WMCS	Machias, Me.	1000
WWIN	Baltimore, Md.	1000
WALE	Fall River, Mass.	1000
WLLH	Lowell, Mass.	1000
WHMP	Northampton, Mass.	1000
WKFR	Battle Creek, Mich.	1000
WJLB	Detroit, Mich.	1000
WHDF	Houghton, Mich.	250
WGON	Munising, Mich.	1000
WSAM	Saginaw, Mich.	1000
WSJM	St. Joseph, Mich.	1000
WTCM	Traverse City, Mich.	1000
KEYL	Long Prairie, Minn.	1000
KMHL	Marshall, Minn.	1000
WMIN	Mpls.-St. Paul, Minn.	1000
WHLB	Virginia, Minn.	1000
WBIP	Booneville, Miss.	1000
WNAG	Grenada, Miss.	1000
WFOR	Hattiesburg, Miss.	1000
WJQS	Jackson, Miss.	1000d
WMBC	Macon, Miss.	1000
KFRU	Columbia, Mo.	1000
KJCF	Festus, Mo.	1000
KSIM	Sikeston, Mo.	1000
KTTS	Springfield, Mo.	1000
KDRG	Deer Lodge, Mont.	250
KXGN	Glendive, Mont.	250
KARR	Great Falls, Mont.	1000
KBRB	Ainsworth, Neb.	1000
KCOW	Alliance, Nebr.	1000
KLIN	Lincoln, Neb.	1000
KBMI	Henderson, Nev.	250
KWNA	Winnemucca, Nev.	1000
WBRL	Berlin, N.H.	250
WTSL	Hanover, N.H.	1000
WLTN	Littleton, N.H.	250
KTRC	Santa Fe, N.M.	1000
KCHS	Truth or Consequences, New Mexico	250
KTNM	Tucumcari, N.M.	1000
WOND	Pleasantville, N.J.	1000
WABY	Albany, N.Y.	1000
WYSL	Buffalo, N.Y.	1000
WSLB	Ogdensburg, N.Y.	1000
WBMA	Beaufort, N.C.	250
WGBG	Greensboro, N.C.	1000
WSHB	Raeford, N.C.	1000
WSIC	Statesville, N.C.	1000
WLSE	Wallace, N. C.	1000
WHCC	Waynesville, N.C.	1000
WSMY	Weldon, N.C.	1000
KEYJ	Jamestown, N.Dak.	1000
WMAN	Mansfield, Ohio	1000
WPAY	Portsmouth, Ohio	1000
KWON	Bartlesville, Okla.	1000
KTMC	McAlester, Okla.	250
KNDR	Norman, Okla.	250
KPTN	Central Point, Ore.	250
KNND	Cottage Grove, Oreg.	1000
KJDY	John Day, Ore.	1000
WEST	Easton, Pa.	1000
WJET	Erie, Pa.	1000
WFEC	Harrisburg, Pa.	1000
WWSF	Loretto, Pa.	250
WKBI	St. Marys, Pa.	1000
WICK	Scranton, Pa.	1000
WRAK	Williamsport, Pa.	1000
WVOZ	Carolina, P. R.	500
WCOS	Columbia, S.C.	1000
WGTN	Georgetown, S.C.	1000
WHCQ	Spartanburg, S.C.	1000
KBJM	Lemmon, S.D.	1000
WJZM	Clarksville, Tenn.	1000
WHUB	Cookeville, Tenn.	1000
WLSB	Copperhill, Tenn.	1000
WKPT	Kingsport, Tenn.	1000
WGAP	Maryville, Tenn.	1000
WHAL	Shelbyville, Tenn.	1000
KRUN	Ballinger, Tex.	1000
KBYG	Big Spring, Tex.	1000
KUNO	Corpus Christi, Tex.	1000
KILE	nr. Galveston, Tex.	250
KGVL	Greenville, Tex.	1000
KEBE	Jacksonville, Tex.	1000
KIUN	Pecos, Tex.	1000
KEYE	Perryton, Tex.	1000
KVOP	Plainview, Tex.	1000
KDWT	Stamford, Tex.	1000
KTEM	Temple, Tex.	1000
KTFS	Texarkana, Tex.	1000
KVOU	Uvalde, Tex.	250
KIXX	Provo, Utah	250
WDOT	Burlington, Vt.	1000
WELK	Charlottesville, Va.	1000
WHHV	Hillsville, Va.	1000
WHIH	Portsmouth, Va.	1000
WHLF	So. Boston, Va.	1000
WINC	Winchester, Va.	1000
KEDO	Longview, Wash.	1000
KRSC	Othello, Wash.	250
KTNT	Tacoma, Wash.	1000
WBOY	Clarksburg, W.Va.	1000
WRON	Ronceverte, W.Va.	1000
WVRC	Spencer, W.Va.	1000
WKWK	Wheeling, W.Va.	1000
WBTH	Williamson, W.Va.	1000
WATW	Ashland, Wis.	1000
WBIZ	Eau Claire, Wis.	1000
WDUZ	Green Bay, Wis.	1000
WRJN	Racine, Wis.	1000
WRDB	Reedsburg, Wis.	1000
WRIG	Wausau, Wis.	1000
KATI	Casper, Wyo.	1000
KODI	Cody, Wyo.	1000

1410—212.6

kHz	Wave Length	W.P.
WUNI	Mobile, Ala.	5000
WPXC	Prattville, Ala.	5000
WRCK	Tuscumbia, Ala.	500d
KTCS	Fort Smith, Ark.	1000d
KERN	Bakersfield, Calif.	1000
KRML	Carmel, Calif.	500d
KKOK	Lompoc, Calif.	500d
KMYC	Marysville, Calif.	5000
KCAL	Redlands, Cal.	5000
KCOL	Ft. Collins, Colo.	1000
WPOP	Hartford, Conn.	5000
WDOV	Dover, Del.	5000
WMYR	Fort Myers, Fla.	5000
WZST	Leesburg, Fla.	1000d
WONS	Tallahassee, Fla.	5000d
WGRI	Griffin, Ga.	1000d
WSNE	Cummings, Ga.	1000d
WDAX	McRae, Ga.	1000d
WLAQ	Rome, Ga.	1000
WRMN	Elgin, Ill.	1000d
WTIM	Taylorville, Ill.	1000d
WAZY	Lafayette, Ind.	1000d
KGRN	Grinnell, Iowa	500d
KLEM	LeMars, Iowa	1000d
KCLO	Leavenworth, Kans.	5000d
KWBB	Wichita, Kans.	5000
WLBJ	Bowling Green, Ky.	5000
WHLN	Harlan, Ky.	5000d
KDBS	Alexandria, La.	1000d
WHAG	Halfway, Md.	1000d
WOKW	Brockton, Mass.	1000d
WGRD	Grand Rap., Mich.	1000d
KLFD	Litchfield, Minn.	500d
KRWB	Roseau, Minn.	1000
WDSK	Cleveland, Miss.	1000d
WBKN	Newton, Miss.	500d
KNOP	North Platte, Neb.	1000
WHTG	Eatontown, N.J.	500d
WDOE	Dunkirk, N.Y.	1000
WELM	Elmira, N.Y.	1000
WBZA	Glens Falls, N. Y.	1000d
WOTT	Watertown, N.Y.	5000d
WEGO	Concord, N.C.	1000d
WSRC	Durham, N.C.	1000d
WVCB	Shallotte, N.C.	500d
WING	Dayton, Ohio	5000
KPAM	Portland, Oreg.	5000d
WLSH	Lansford, Pa.	5000d
KQV	Pittsburgh, Pa.	5000
WPCC	Clinton, S.C.	1000d
WYMB	Manning, S.C.	1000d
WCMT	Martin, Tenn.	1000d
KBUD	Athens, Tex.	1000d
KBAN	Bowie, Tex.	500d
KVLB	Cleveland, Tex.	500
KXIT	Dalhart, Tex.	500d
KDOX	Marshall, Tex.	500d
KRIG	Odessa, Tex.	1000
KBAL	San Saba, Tex.	500d
KNAL	Victoria, Tex.	500
WIKI	Chester, Va.	5000d
WRIS	Roanoke, Va.	5000d
WRDS	S. Charleston, W.Va.	1000d
WKBH	LaCrosse, Wis.	5000
KWYO	Sheridan, Wyo.	1000

1420—211.1

kHz	Wave Length	W.P.
WACT	Tuscaloosa, Ala.	5000d
KHFH	Sierra Vista, Ariz.	1000
KXOW	Hot Sprinks, Ark.	
KPOC	Pocahontas, Ark.	1000d
KJST	Joshua Tree, Cal.	1000d
KSTN	Stockton, Calif.	5000
WLIS	Old Saybrook, Conn.	500d
WBRD	Bradenton, Fla.	1000
WDBF	Delray Beach, Fla.	5000d
WETH	St. Augustine, Fla.	1000d
WAVO	Avondale Estates, Ga.	1000d
WRBL	Columbus, Ga.	5000
WPEH	Louisville, Ga.	1000d
WLET	Toccoa, Ga.	5000d
KCCN	Honolulu, Hawaii	5000
WINI	Murphysboro, Ill.	500d
WIMS	Michigan City, Ind.	5000d
WOC	Davenport, Iowa	5000
KJCK	Junction City, Kans.	1000d
KULY	Ulysses, Kan.	1000
WTCR	Ashland, Ky.	5000d
WHBN	Harrodsburg, Ky.	1000d
WVJS	Owensboro, Ky.	5000
KPEL	Lafayette, La.	1000
WBSM	New Bedford, Mass.	5000
WBEC	Pittsfield, Mass.	1000
WAMM	Flint, Mich.	500d
WKPR	Kalamazoo, Mich.	1000d
KTOE	Mankato, Minn.	5000
WSUH	Oxford, Miss.	1000d
WQBC	Vicksburg, Miss.	1000
WIGG	Wiggins, Miss.	1000d
KBTN	Neosho, Mo.	500d
KOOO	Omaha, Nebr.	1000d
KSYX	Santa Rosa, N.Mex.	1000d
WALY	Herkimer, N.Y.	1000d
WACK	Newark, N.Y.	500d
WLNA	Peekskill, N.Y.	1000d
WMYN	Mayodan, N.C.	500d
WGAS	S. Gastonia, N.C.	500d
WVOT	Wilson, N.C.	1000
WHK	Cleveland, Ohio	5000
KYNG	Coos Bay, Oreg.	1000d
WCOJ	Coatesville, Pa.	5000
WCED	DuBois, Pa.	5000
WEUC	Ponce, P.R.	1000
WCRE	Cheraw, S.C.	1000d
KABR	Aberdeen, S. D.	1000d
WEMB	Erwin, Tenn.	5000d
WKSR	Pulaski, Tenn.	1000
KFYN	Bonham, Tex.	250d
KLFB	Lubbock, Tex.	500d
KTRE	Lufkin, Tex.	1000
KGNB	New Braunfels, Tex.	1000d
KPEP	San Angelo, Tex.	1000d
WWSR	St. Albans, Vt.	1000d
WDDY	Gloucester, Va.	1000d
WKCW	Warrenton, Va.	5000d
KITI	Chehalis-Centralia, Wash.	1000d
KREN	Renton, Wash.	500d
KUJ	Walla Walla, Wash.	5000
WPLY	Plymouth, Wis.	500d

1430—209.7

kHz	Wave Length	W.P.
WRMG	Red Bay, Ala.	
WFHK	Pell City, Ala.	1000d
KHBM	Monticello, Ark.	1000d
KAMP	El Centro, Calif.	1000d
KARM	Fresno, Calif.	5000
KALI	San Gabriel, Cal.	5000
KJAY	Sacramento, Calif.	500d
KEGL	Santa Clara, Cal.	1000
KOSI	Aurora, Colo.	5000
WIII	Homestead, Fla.	500d
WLAK	Lakeland, Fla.	5000
WPCF	Panama City, Fla.	5000
WGFS	Covington, Ga.	1000d
WRCD	Dalton, Ga.	1000d
WWGS	Tifton, Ga.	5000
WEEF	Highland Park, Ill.	1000d
WCMY	Ottawa, Ill.	500d
WIRE	Indianapolis, Ind.	5000
KASI	Ames, Iowa	1000d
KMRC	Morgan City, La.	500d
WNAV	Annapolis, Md.	5000
WTTT	Amherst, Mass.	5000d
WHIL	Medford, Mass.	5000d
WION	Ionia, Mich.	5000d
WBRB	Mt. Clemens, Mich.	500d
WLAU	Laurel, Miss.	5000d
KSOA	Ava, Mo.	500d
KAOL	Carrollton, Mo.	500d
WIL	St. Louis, Mo.	5000
KRGI	Grand Island, Nebr.	5000
KKAT	Roswell, N.M.	5000
WENE	Endicott, N.Y.	5000
WMNC	Morganton, N.C.	5000d
WDJS	Mt. Olive, N.C.	1000d
WRXO	Roxboro, N.C.	1000d
KTYN	Minot, N.D.	
WFOB	Fostoria, Ohio	1000
WCLT	Newark, Ohio	500d
KALV	Alva, Okla.	500
KELI	Tulsa, Okla.	5000
KGAY	Salem, Oreg.	5000d
WVAM	Altoona, Pa.	5000
WNEL	Caguas, P. R.	5000
WBLR	Batesburg, S.C.	5000d
WATP	Marion, S.C.	1000d
WBUG	Ridgeland, S.C.	1000d
KBRK	Brookings, S. Dak.	1000d
WJBE	Knoxville, Tenn.	1000d
WENO	Madison, Tenn.	5000
WHER	Memphis, Tenn.	1000d
KSTB	Breckenridge, Tex.	1000d
KEES	Gladewater, Tex.	1000d
KCOH	Houston, Tex.	1000d
KLO	Ogden, Utah	5000
KDXU	St. George, Utah	1000
WIVE	Ashland, Va.	1000d
WKEX	Blacksburg, Va.	1000d
WDIC	Clincho, Va.	1000d
KBRC	Mt. Vernon, Wash.	5000
WEIR	Weirton, W.Va.	1000
WBEV	Beaver Dam, Wis.	1000d
WRDN	Durand, Wis.	1000d

1440—208.2

kHz	Wave Length	W.P.
WHHY	Montgomery, Ala.	5000
KDOT	Scottsdale, Ariz.	5000d
KHOG	Fayetteville, Ark.	1000d
KOKY	Little Rock, Ark.	5000d
KVON	Napa, Cal.	5000
KPRO	Riverside, Calif.	1000
KUHL	Santa Maria, Cal.	1000
WBIS	Bristol, Conn.	500d
WAYK	Lehigh Acres, Fla.	5000
WABR	Winter Park, Fla.	5000
WWCC	Bremen, Ga.	1000d
WGIG	Brunswick, Ga.	5000
WVMG	Cochran, Ga.	
WRAJ	Anna, Ill.	500d
WIOK	Normal, Ill.	1000
WPRS	Paris, Ill.	1000d
WGEM	Quincy, Ill.	5000
WROK	Rockford, Ill.	5000
WPGW	Portland, Ind.	500d
KCHE	Cherokee, Iowa	500d
KEWI	Topeka, Kans.	5000
WCDS	Glasgow, Ky.	1000d
WPDE	Paris, Ky.	1000d
WEZJ	Williamsburg, Ky.	1000d
KMLB	Monroe, La.	5000
WJAB	Westbrook, Me.	5000d
WAAB	Worcester, Mass.	5000
WBCM	Bay City, Mich.	1000
WDOW	Dowagiac, Mich.	1000d
WCHB	Inkster, Mich.	1000
KQRS	Golden Valley, Minn.	5000
KEYL	Long Prairie Minn.	1000
WHHT	Lucedale, Miss.	5000d
WSEL	Pontotoc, Miss.	1000d
WMVB	Millville, N.J.	1000d
WBAB	Babylon, N.Y.	1000d
WJJL	Niagara Falls, N.Y.	1000d
WSGO	Oswego, N.Y.	1000d
WBLA	Elizabethtown, N.C.	1000d
WBUY	Lexington, N.C.	5000
KILO	Grand Forks, N.D.	1000
WHHH	Warren, Ohio	5000
KMED	Medford, Oreg.	5000
KODL	The Dalles, Oreg.	1000
WCDL	Carbondale, Pa.	5000d
WNPV	Lansdale, Pa.	500d
WGCB	Red Lion, Pa.	1000d
WQOK	Greenville, S.C.	5000
WZYX	Cowan, Tenn.	1000d
WHDM	McKenzie, Tenn.	500d
KPUR	Amarillo, Tex.	5000
KEYS	Corpus Christi, Tex.	1000
KDNT	Denton, Tex.	5000
KGVL	Greenville, Tex.	1000
KETX	Livingston, Tex.	5000d
WKLV	Blackstone, Va.	5000d
WHRN	Herndon, Va.	1000d
KDNC	Spokane, Wash.	5000d
WHIS	Bluefield, W.Va.	5000
WAJR	Morgantown, W.Va.	5000
WNFL	Green Bay, Wis.	5000

1450—206.8

kHz	Wave Length	W.P.
WDNG	Anniston, Ala.	1000
WYAM	Bessemer, Ala.	1000
WDIG	Dothan, Ala.	1000
WFIX	Huntsville, Ala.	1000
WLAY	Muscle Shoals City, Alabama	1000
KLAM	Cordova, Alaska	250
KAWT	Douglas, Ariz.	250
KNOT	Prescott, Ariz.	1000
KVSL	Show Low, Ariz.	1000
KOPO	Tucson, Ariz.	250
KENA	Mena, Ark.	1000
KJWH	Camden, Ark.	1000
KYOR	Blythe, Cal.	1000d
KAVA	Burney, Cal.	1000
KOWN	Escondido, Calif.	250
KPAL	Palm Springs, Cal.	1000
KTIP	Porterville, Calif.	1000
KSOL	San Francisco, Cal.	1000

WHITE'S RADIO LOG

kHz	Wave Length	W.P.
KVML	Sonora, Calif.	1000
KVEN	Ventura, Calif.	1000
KOBO	Yuba City, Cal.	250
KGIW	Alamosa, Colo.	1000
KYOU	Greeley, Colo.	1000
WNAB	Bridgeport, Conn.	1000
WILM	Wilmington, Del.	1000
WOL	Washington, D. C.	1000
WWJB	Brooksville, Fla.	250
WMFJ	Daytona Beach, Fla.	1000
WOCN	Miami, Fla.	250
WBSR	Pensacola, Fla.	1000d
WSPB	Sarasota, Fla.	1000
WSTU	Stuart, Fla.	250
WTAL	Tallahassee, Fla.	1000
WGPC	Albany, Ga.	1000
WBHF	Cartersville, Ga.	1000
WCON	Cornelia, Ga.	250
WKEU	Griffin, Ga.	1000
WMVG	Milledgeville, Ga.	1000
WBYG	Savannah, Ga.	1000
WVLD	Valdosta, Ga.	1000
KVSI	Montpelier, Ida.	1000
KEEP	Twin Falls, Idaho	1000
WVON	Cicero, Ill.	1000
WKEI	Kewanee, Ill.	500
WCVS	Springfield, Ill.	1000
WLYV	Ft. Wayne, Ind.	1000
WXVW	Jeffersonville, Ind.	1000
WASK	Lafayette, Ind.	1000
WAOV	Vincennes, Ind.	1000
KLWW	Cedar Rapids, Ia.	250
KYET	Payette, Ida.	250
KWBW	Hutchinson, Kans.	1000
WTCO	Campbellsville, Ky.	1000
WWXL	Manchester, Ky.	1000
WPAD	Paducah, Ky.	1000
WLKS	W. Liberty, Ky.	1000
KSIG	Crowley, La.	1000
KNDC	Natchitoches, La.	1000
WNPS	New Orleans, La.	250
WLKN	Lincoln, Me.	1000
WRKD	Rockland, Maine	250
WKTQ	South Paris, Maine	1000
WTBO	Cumberland, Md.	1000
WTHU	Thurmont, Md.	100
WMAS	Springfield, Mass.	1000
WATZ	Alpena Township, Michigan	1000
WHTC	Holland, Mich.	1000
WMIQ	Iron Mtn., Mich.	250
WIBM	Jackson, Mich.	1000
WKLA	Ludington, Mich.	1000
WNBY	Newberry, Mich.	1000
WHLS	Port Huron, Mich.	1000
KATE	Albert Lea, Minn.	250
KBUN	Bemidji, Minn.	1000
KBMW	Wahpeton, N.D., Breckinridge, Minn.	1000
WELY	Ely, Minn.	1000
KFAM	St. Cloud, Minn.	1000
WROX	Clarksdale, Miss.	1000
WCJU	Columbia, Miss.	250
WJXN	Jackson, Miss.	1000
WOKK	Meridian, Miss.	1000
WNAT	Natchez, Miss.	1000
WROB	West Point, Miss.	1000
KFTW	Fredericktown, Mo.	1000
WMBH	Joplin, Mo.	1000
KIRX	Kirksville, Mo.	1000
KOKO	Warrensburg, Mo.	1000
KWPM	West Plains, Mo.	1000
KXXL	Bozeman, Mont.	1000
KUDI	Great Falls, Mont.	1000
KGMY	Missoula, Mont.	250
KRBN	Red Lodge, Mont.	1000
KVCK	Wolf Point, Mont.	1000
KWBE	Beatrice, Neb.	1000
KONE	Reno, Nev.	250
WKXL	Concord, N.H.	1000
WFPG	Atlantic City, N.J.	1000
WCTC	New Brunswick, N. J.	1000
KRZY	Albuquerque, N.M.	1000
KLMX	Clayton, N.Mex.	1000
KOBE	Las Cruces, N.Mex.	250
KENM	Portales, N.Mex.	1000
WCLI	Corning, N.Y.	1000
WWSC	Glen Falls, N.Y.	1000
WHDL	Olean, N.Y.	1000
WKIP	Poughkeepsie, N. Y.	1000
WKAL	Rome, N.Y.	1000
WATA	Boone, N. C.	1000
WGAS	Gastonia, N.C.	250
WIZS	Henderson, N.C.	1000
WHKP	Hendersonville, N.C.	1000
WHIT	New Bern, N.C.	1000
WFBS	Spring Lake, N.C.	1000
KGCA	Rugby, N. D.	1000
WJER	Dover-New Philadelphia, Ohio	1000
WMOH	Hamilton, Ohio	1000
WLEC	Sandusky, Ohio	1000
KWHW	Altus, Okla.	1000
KGFF	Shawnee, Okla.	1000
KSIW	Woodward, Okla.	1000
KEEO	Eugene, Ore.	1000
KFLW	Klamath Falls, Ore.	1000
KLBM	La Grande, Oreg.	1000
WWGO	Erie, Pa.	1000
KBPS	Portland, Ore.	250
WFRA	Franklin, Pa.	1000
WDAD	Indiana, Pa.	1000
WPAM	Pottsville, Pa.	1000
WMPT	S. Williamsport, Pa.	1000
WMAJ	State College, Pa.	1000
WJPA	Washington, Pa.	1000
WCPR	Coamo, P.R.	1000
WSVP	West Warwick, R.I.	1000d
WQSN	Charleston, S.C.	1000
WCRS	Greenwood, S.C.	1000
WMYB	Myrtle Beach, S.C.	1000
WHSC	Hartsville, S.C.	1000
KBFS	Belle Fourche, S. Dak.	1000
KYNT	Yankton, S. D.	1000
WLAR	Athens, Tenn.	1000
WMOC	Chattanooga, Tenn.	1000
WDSG	Dyersburg, Tenn.	1000
WSMG	Greeneville, Tenn.	250
WLAF	LaFollette, Tenn.	1000
WGNS	Murfreesboro, Tenn.	1000
KAYC	Beaumont, Tex.	1000d
KBEN	Carrizo Sprgs., Tex.	250
KCTI	Gonzales, Tex.	250
KMBL	Junction, Tex.	1000
KCYL	Lampasas, Tex.	1000
KMHT	Marshall, Tex.	1000
KNET	Palestine, Tex.	1000
KSNY	Snyder, Tex.	1000
KURA	Moab, Utah	1000
KEYY	Provo, Utah	1000
WSNO	Barre, Vt.	1000
WTSA	Brattleboro, Vt.	1000
WFTR	Front Royal, Va.	1000
WENZ	Highland Springs, Va.	1000
WREL	Lexington, Va.	1000
WMVA	Martinsville, Va.	1000
WLPM	Suffolk, Va.	1000
KBKW	Aberdeen, Wash.	1000
KCLX	Colfax, Wash.	1000
KONP	Port Angeles, Wash.	250
KAYE	Puyallup, Wash.	1000
WPAR	Parkersburg, W. Va.	1000
KFIZ	Fond du Lac, Wis.	1000
WDLG	Marshfield, Wis.	1000
WRCO	Richland Center, Wis.	1000d
KBBS	Buffalo, Wyo.	250
KVOW	Riverton, Wyo.	1000

1460—205.4

kHz	Wave Length	W.P.
WFMH	Cullman, Ala.	5000d
WPNX	Phenix City, Ala.	5000
KZOT	Marianna, Ark.	500
KCCL	Paris, Ark.	500d
KTYM	Inglewood, Calif.	5000
KOON	Salinas, Calif.	5000
KVRE	Santa Rosa, Calif.	1000d
KYSN	Colo. Sprgs., Colo.	1000
WBAR	Bartow, Fla.	1000d
WZEP	DeFuniak Springs, Florida	1000d
WMBR	Jacksonville, Fla.	5000
WDYZ	Buford, Ga.	5000d
WPNX	Columbus, Ga.	5000d
WROY	Carmi, Ill.	1000d
WIXN	Dixon, Ill.	1000d
WRTL	Rantoul, Ill.	250d
WKAM	Goshen, Ind.	1000
WOCH	North Vernon, Ind.	1000d
KSO	Des Moines, Iowa	5000
KCRB	Chanute, Kans.	1000d
WRVK	Mt. Vernon, Ky.	500d
WXOK	Baton Rouge, La.	5000
KBSF	Springhill, La.	1000d
WEMD	Easton, Md.	1000
WBET	Brockton, Mass.	5000
WBRN	Big Rapids, Mich.	1000d
WPON	Pontiac, Mich.	1000
KDWA	Hastings, Minn.	1000d
KDMA	Montevideo, Minn.	1000
WELZ	Belzoni, Miss.	1000d
WCIS	Moss Point, Miss.	1000d
KIRL	St. Charles, Mo.	5000d
KRNY	Kearney, Nebr.	5000d
KENO	Las Vegas, Nev.	5000
WJJZ	Mt. Holly, N.J.	5000d
WOKO	Albany, N.Y.	5000
WVOX	New Rochelle, N.Y.	500d
WHEC	Rochester, N.Y.	5000
WAKS	Fuquay-Varina, N.C.	1000d
WRKB	Kannapolis, N.C.	500d
WMMH	Marshall, N.C.	500d
WBNS	Columbus, Ohio	5000
WPVL	Painesville, O.	1000d
KROW	Dallas, Oreg.	5000d
KELR	El Reno, Okla.	500d
WMBA	Ambridge, Pa.	500d
WCMB	Harrisburg, Pa.	5000
WFBA	San Sebastian, P.R.	500
WDOG	Allendale, S.C.	1000d
WBCU	Union, S.C.	1000
WJAK	Jackson, Tenn.	1000d
WEEN	Lafayette, Tenn.	1000d
KBRZ	Freeport, Tex.	500d
KRME	Hondo, Tex.	500d
KLLL	Lubbock, Tex.	1000d
WACO	Waco, Tex.	1000
WPRW	Manassas, Va.	5000
WRAD	Radford, Va.	5000
KYAC	Kirkland, Wash.	5000d
KIMA	Yakima, Wash.	5000
WBUC	Buckhannon, W.Va.	5000d
WRAC	Racine, Wis.	500d
WTMB	Wisconsin Rapids, Wis.	1000d

1470—204.0

kHz	Wave Length	W.P.
WBLO	Evergreen, Ala.	1000d
KDEW	DeWitt, Ark.	500d
KOLI	Coalinga, Calif.	500d
KUTY	Palmdale, Cal.	5000d
KXOA	Sacramento, Calif.	5000
KKEP	Estes Park, Colo.	500d
WMMW	Meriden, Conn.	1000d
WRBD	Pompano Beach, Fla.	5000
WCWR	Tarpon Springs, Fla.	5000d
WBIT	Adel, Ga.	1000d
WDOL	Athens, Ga.	1000d
WCLA	Claxton, Ga.	1000
WRGA	Rome, Ga.	5000
WMPP	Chicago Heights, Ill.	1000d
WMBD	Peoria, Ill.	5000
WHUT	Anderson, Ind.	1000d
KTRI	Sioux City, Iowa	5000
KWVY	Waverly, Iowa	1000d
KARE	Atchison, Kans.	1000
KLIB	Liberal, Kans.	1000d
WSAC	Fort Knox, Ky.	1000d
KTDL	Farmersville, La.	1000d
KPLC	Lake Charles, La.	5000
WLAM	Lewiston, Maine	5000
WJDY	Salisbury, Md.	5000d
WTTR	Westminster, Md.	1000d
WSRO	Marlborough, Mass.	1000d
WNBP	Newburyport, Mass.	500d
WKMF	Flint, Mich.	5000
WYYY	Kalamazoo, Mich.	500d
KANO	Anoka, Minn.	1000d
WCHJ	Brookhaven, Miss.	1000d
WNAU	New Albany, Miss.	500
KGHM	Brookfield, Mo.	500d
KTCB	Malden, Mo.	1000d
WTKO	Ithaca, N.Y.	1000d
WPDM	Potsdam, N.Y.	1000d
WPGF	Burgaw, N.C.	1000d
WBIG	Greensboro, N.C.	5000
WPNC	Plymouth, N.C.	1000d
WTOE	Spruce Pine, N.C.	1000d
WOHO	Toledo, Ohio	1000
KVLH	Pauls Valley, Okla.	250d
KVIN	Vinita, Okla.	500d
KDUN	Reedsport, Ore.	5000d
WSAN	Allentown, Pa.	5000
WFAR	Farrell, Pa.	1000
WWML	Portage, Pa.	500d
WQXL	Columbia, S.C.	5000d
WINH	Georgetown, S.C.	1000d
WEAG	Alcoa, Tenn.	1000d
WVOL	Berry Hill, Tenn.	5000
KRBC	Abilene, Tex.	5000
KDHN	Dimmitt, Tex.	500d
KWRD	Henderson, Tex.	500d
KCNY	San Marcos, Tex.	250d
WTZE	Tazewell, Va.	1000d
KELA	Centralia-Chehalis, Wash.	5000d
KSEM	Moses Lake, Wash.	5000
KAPS	Mount Vernon, Wash.	500d
WWHY	Huntington, W.Va.	5000d
WBZE	Wheeling, W.Va.	500d
WBKV	West Bend, Wis.	1000d

1480—202.6

kHz	Wave Length	W.P.
WARI	Abbeville, Ala.	1000d
WLPH	Irondale, Ala.	5000d
WBTS	Bridgeport, Ala.	1000d
WABB	Mobile, Ala.	5000
KHAT	Phoenix, Ariz.	500
KGLU	Safford, Ariz.	1000
KTHS	Berryville, Ark	1000
KWUN	Concord, Calif.	500d
KRED	Eureka, Cal.	
KYOS	Merced, Calif.	5000
KWIZ	Santa Ana, Calif.	5000
KSEE	Santa Maria, Calif.	1000
KCMS	Manitou Springs, Colo.	500
KPOB	Pueblo, Colo.	1000d
WKND	Windsor, Conn.	500d
WAPG	Arcadia, Fla.	1000d
WGNE	Panama City Beach, Fla.	500d
WVCF	Windermere, Fla.	1000d
WYZE	Atlanta, Ga.	5000d
WRDW	Augusta, Ga.	5000
KOFE	St. Maries, Ida.	1000d
WGSB	Geneva, Ill.	1000
WJBM	Jerseyville, Ill.	500d
WTHI	Terre Haute, Ind.	5000
WRSW	Warsaw, Ind.	1000
KLEE	Ottumwa, Iowa	500d
KBEA	Mission, Kan.	1000
KLEO	Wichita, Kans.	5000
WKOA	Hopkinsville, Ky.	1000d
WNKY	Neon, Ky.	1000d
WTLO	Somerset, Ky.	1000d
KCKW	Jena, La.	500d
KANV	Jonesville, La.	500d
KJOE	Shreveport, La.	1000d
WSAR	Fall River, Mass.	5000
WAFT	Grand Rapids, Mich.	5000d
WIOS	Tawas City-E. Tawas, Mich.	1000d
WSDS	Ypsilanti, Mich.	500d
KAUS	Austin, Minn.	1000
KEHG	Fosston, Minn.	5000d
WECP	Carthage, Miss.	500d
KGCX	Sidney, Mont.	5000
KLMS	Lincoln, Nebr.	1000
KWEW	Hobbs, N. Mex.	5000
WLEA	Hornell, N.Y.	1000d
WHOM	New York, N.Y.	5000
WADR	Remsen, N.Y.	5000d
WWKO	Fair Bluff, N. C.	1000d
WAME	Charlotte, N.C.	5000
WYRN	Louisburg, N.C.	500d
WMSJ	Sylva, N.C.	5000d
WYDK	Yadkinville, N.C.	1000d
WHBC	Canton, Ohio	5000
WCIN	Cincinnati, Ohio	5000
WTRA	Latrobe, Pa.	500d
WDAS	Philadelphia, Pa.	5000
WISL	Shamokin, Pa.	1000
WSHP	Shippensburg, Pa.	500d
WMDD	Fajardo, P.R.	5000
KSDR	Waterton, S.D.	1000d
WJFC	Jefferson City, Tenn.	500d
WMQM	Memphis, Tenn.	5000d
WJLE	Smithville, Tenn.	1000d
KBOX	Dallas, Tex.	5000
KLVL	Pasadena, Tex.	1000
KAPE	San Antonio, Tex.	500d
KONI	Spanish Fork, Utah	1000d
WCFR	Springfield, Vt.	5000d
WBBL	Richmond, Va.	5000
WLEE	Richmond, Va.	5000
WBLU	Salem, Va.	5000d
KOOD	Lakewood Center, Wash.	1000d
KVAN	Vancouver, Wash.	1000d
WISM	Madison, Wis.	5000
KRAE	Cheyenne, Wyo.	1000d

1490—201.2

kHz	Wave Length	W.P.
WANA	Anniston, Ala.	250
WAJF	Decatur, Ala.	1000
WRLD	Lanett, Ala.	1000
WHBB	Selma, Ala.	1000
KCUZ	Clifton, Ariz.	
KYCA	Prescott, Ariz.	1000
KAIR	Tucson, Ariz.	250
KXAR	Hope, Ark.	1000
KDRS	Paragould, Ark.	1000
KOTN	Pine Bluff, Ark.	1000
KARV	Russellville, Ark.	1000
KWAC	Bakersfield, Calif.	1000
KPAS	Banning, Calif.	250
KICO	Calexico, Calif.	250
KRKC	King City, Calif.	1000
KTOB	Petaluma, Calif.	1000
KBLF	Red Bluff, Calif.	1000
KDB	Santa Barbara, Calif.	1000
KOWL	So. Lake Tahoe, Cal.	250
KSYC	Yreka, Calif.	1000
KBOL	Boulder, Colo.	1000
KGUC	Gunnison, Colo.	250
KCMS	Manitou Springs, Colo.	500
WGCH	Greenwich, Conn.	1000
WTRL	Bradenton, Fla.	250
WJBS	De Land, Fla.	1000
WCOF	Immokalee, Fla.	250
WMBM	Miami Beach, Fla.	250
WSRA	Milton, Fla.	1000
WPXE	Starke, Fla.	1000
WTTB	Vero Beach, Fla.	1000
WSIR	Winter Haven, Fla.	500
WMOG	Brunswick, Ga.	1000
WMJM	Cordele, Ga.	1000
WMRE	Monroe, Ga.	1000
WSFB	Quitman, Ga.	250
WSNT	Sandersville, Ga.	500
WSYL	Sylvania, Ga.	250
KCID	Caldwell, Idaho	1000
WKRO	Cairo, Ill.	250
WDAN	Danville, Ill.	1000
WAMV	East St. Louis, Ill.	1000
WOPA	Oak Park, Ill.	1000
WZOE	Princeton, Ill.	1000
WKBV	Richmond, Ind.	1000
WNDU	South Bend, Ind.	1000
KBUR	Burlington, Iowa	1000
WDBQ	Dubuque, Iowa	1000
KBAB	Indianola, Ia.	500
KRIB	Mason City, Ia.	1000
KKAN	Phillipsburg, Kans.	250
KTOP	Topeka, Kan.	1000
WFKY	Frankfort, Ky.	1000
WKAY	Glasgow, Ky.	1000
WOMI	Owensboro, Ky.	1000
WSIP	Paintsville, Ky.	1000
WIKC	Bogalusa, La.	1000
KEUN	Eunice, La.	1000
KJIN	Houma, La.	1000
KRUS	Ruston, La.	1000
WPOR	Portland, Maine	1000

kHz	Wave Length	W.P.
WTVL	Waterville, Maine	1000
WARK	Hagerstown, Md.	1000
WHAV	Haverhill, Mass.	1000
WMRC	Milford, Mass.	1000
WTXL	W. Springfield, Mass.	1000
WABJ	Adrian, Mich.	1000
WMDN	Midland, Mich.	1000
WLRC	Whitehall, Mich.	1000
KXRA	Alexandria, Minn.	250
KOZY	Grand Rapids, Minn.	1000
KLGR	Redwd. Falls, Minn.	1000
WLOX	Biloxi, Miss.	1000
WCLD	Cleveland, Miss.	1000
WHOC	Philadelphia, Miss.	1000d
WTUP	Tupelo, Miss.	1000
WVIM	Vicksburg, Miss.	250
KDMO	Carthage, Mo.	1000
KTTR	Rolla, Mo.	1000
KDRO	Sedalia, Mo.	1000d
KDBM	Dillon, Mont.	1000
KBON	Omaha, Nebr.	1000
WEMJ	Laconia, N.H.	1000
WLDB	Atlantic City, N. J.	1000
KRSN	Los Alamos, N.Mex.	1000
KRTN	Raton, N.Mex.	1000
WCSS	Amsterdam, N.Y.	1000
WBTA	Batavia, N.Y.	500
WKNY	Kingston, N.Y.	1000
WICY	Malone, N.Y.	1000
WDLC	Port Jervis, N. Y.	1000
WOLF	Syracuse, N. Y.	1000
WSSB	Durham, N. C.	1000
WFLB	Fayetteville, N.C.	1000
WLOE	Leaksville, N.C.	1000
WRNB	New Bern, N.C.	1000
WRMT	Rocky Mount, N. C.	1000
WSTP	Salisbury, N. C.	1000
WSVM	Valdese, N.C.	1000
WHSL	Wilmington, N. C.	1000
KNDC	Hettinger, N.D.	1000
KOVC	Valley City, N. Dak.	1000
WBEX	Chillicothe, Ohio	1000
WJMO	Cleveland Hghts., O.	1000
WOHI	East Liverpool, Ohio	500
WMOA	Marietta, Ohio	1000
WMRN	Marion, Ohio	1000
KWRW	Guthrie, Okla.	100
KBIX	Muskogee, Okla.	1000
KBKR	Baker, Oreg.	1000
KRNR	Roseburg, Oreg.	1000
KBZY	Salem, Oreg.	1000
WESB	Bradford, Pa.	1000
WAZL	Hazleton, Pa.	1000
WARD	Johnstown, Pa.	1000
WGAL	Lancaster, Pa.	1000
WBCB	Levittown, Pa.	1000
WMRF	Lewiston, Pa.	1000
WMGW	Meadville, Pa.	1000
WNBT	Wellsboro, Pa.	1000
WSIB	Beaufort, S.C.	500
WGCD	Chester, S.C.	1000
WMRB	Greenville, S.C.	1000
KORN	Mitchell, S.Dak.	1000
WOPI	Bristol, Tenn.	1000
WDXB	Chattanooga, Tenn.	1000
WROL	Knoxville, Tenn.	1000
WJJM	Lewisburg, Tenn.	1000
WDXL	Lexington, Tenn.	1000
KNOW	Austin, Tex.	1000
KIBL	Beeville, Tex.	250
KBST	Big Spring, Tex.	1000
KHUZ	Borger, Tex.	250
KNEL	Brady, Tex.	1000
KWMC	Del Reo, Tex.	250
KSAM	Huntsville, Tex.	1000
KVOZ	Laredo, Tex.	250
KZZN	Littlefield, Tex.	1000
KPLT	Paris, Tex.	1000
KDOK	Tyler, Tex.	1000
KVWC	Vernon, Tex.	250
KVOG	Ogden, Utah	1000
WKVT	Brattleboro, Vt.	1000
WFAD	Middlebury, Vt.	1000
WIKE	Newport, Vt.	1000
WCVA	Culpeper, Va.	1000
WVEC	Hampton, Va.	1000
WAYB	Waynesboro, Va.	1000
KBRO	Bremerton, Wash.	1000
KVAC	Forks, Wash.	500
KLOG	Kelso, Wash.	1000
KENE	Toppenish, Wash.	1000
KTEL	Walla Walla, Wash.	1000
WXIT	Charleston, W.Va.	1000
WTCS	Fairmont, W.Va.	1000
WLOH	Princeton, W. Va.	1000
WSGB	Sutton, W.Va.	1000
WGEZ	Beloit, Wis.	1000
WLCX	LaCrosse, Wis.	1000
WIGM	Medford, Wis.	1000
WOSH	Oshkosh, Wis.	1000
KLME	Laramie, Wyo.	500
KRTR	Thermopolis, Wyo.	250
KGOS	Torrington, Wyo.	1000

1500—199.9

kHz	Wave Length	W.P.
WQTY	Montgomery, Ala.	
WVSM	Rainsville, Ala.	1000d
KGMR	Jacksonville, Ark.	1000d
KBBQ	Burbank, Cal.	10000
KXRX	San Jose, Cal.	10000
WFIF	Milford, Conn.	5000d
WTOP	Washington, D.C.	50000
WKIZ	Key West, Fla.	250
WGUL	New Port Richey, Fla.	250d
WSEM	Donaldsonville, Ga.	1000d
WDEN	Macon, Ga.	
WTHN	Thomaston, Ga.	1000d
KUMU	Honolulu, Hawaii	5000
WGEN	Genesco, Ill.	250d
WPMB	Vandalia, Ill.	250
WZBN	Zion, Ill.	250d
WBRI	Indianapolis, Ind.	5000d
WAKE	Valparaiso, Ind.	1000d
KWRG	New Roads, La.	1000d
WVOC	Battle Creek, Mich.	1000d
WJBK	Detroit, Mich.	50000
KSTP	St. Paul, Minn.	50000
WBFN	Quitman, Miss.	1000d
KDFN	Doniphan, Mo.	1000d
WKER	Pompton Lakes, N.J.	1000d
WGMF	Watkins Glen, N.Y.	250d
WLWL	Rockingham, N.C.	
WKBX	Winston-Salem, N.C.	10000d
WGIC	Xenia, O.	500d
KOSG	Pawhuska, Okla.	5000d
WMNT	Manati, P.R.	250
WEAC	Gaffney, S. C.	1000d
WDEB	Jamestown, Tenn.	1000d
WTNE	Trenton, Tenn.	250d
KWFA	Merkle, Tex.	250d
KXTO	Sherman, Tex.	1000d
KANI	Wharton, Tex.	500

1510—199.1

kHz	Wave Length	W.P.
KALF	Mesa, Ariz.	10000d
KSOM	Ontario, Cal.	10000
KIRV	Fresno, Cal.	500d
KTIM	San Rafael, Calif.	1000d
KDKO	Littleton, Colo.	1000
WNLC	New London, Conn.	10000
WWBC	Cocoa, Fla.	250d
WINU	Highland, Ill.	250d
WJRC	Joliet, Ill.	500d
WKAI	Macomb, Ill.	1000d
KIFG	Iowa Falls, Iowa	1000d
KANS	Larned, Kan.	1000d
KPBC	Port Sulphur, La.	1000d
WMEX	Boston, Mass.	50000
WJCO	Jackson, Mich.	5000d
KBJS	Sallisaw, Mich.	
WLKM	Three Rivers, Mich.	500
WKPO	Prentiss, Miss.	1000
KCCV	Independence, Mo.	1000d
KEMM	Marshfield, Mo.	
KTTT	Columbus, Nebr.	500d
WRAN	Dover, N.J.	10000
WJIC	Salem, N.J.	250d
WPUT	Brewster, N. Y.	1000d
WEAL	Greensboro, N.C.	1000d
WYRU	Red Springs, N.C.	
WLGN	Logan, Ohio	5000d
WLKR	Norwalk, Ohio	500d
WAHT	Annville-Cleona, Pa.	5000d
WPSL	Monroeville, Penn.	250d
WVAP	Burnettown, S.C.	500d
WSJW	Woodruff, S.C.	
WLAC	Nashville, Tenn.	50000
KCTX	Childress, Tex.	250d
KABH	Midland, Tex.	500d
KMOO	Mineola, Tex.	250d
KCAW	Port Arthur, Tex.	
KROB	Robstown, Tex.	500d
KSTV	Stephenville, Tex.	250d
KURB	Mountainlake Terrace, Wash.	250d
KGA	Spokane, Wash.	50000
WAUK	Waukesha, Wis.	10000d

1520—197.4

kHz	Wave Length	W.P.
WAOA	Opelika, Ala.	5000d
KACY	Port Hueneme, Cal.	50000
WTLN	Apopka, Fla.	5000d
WGNP	Indian Rocks Beach, Fla.	1000d
WIXX	Oakland Park, Fla.	1000d
WXPQ	Eatonton, Ga.	1000d
WNMT	Garden City, Ga.	1000d
WHOW	Clinton, Ill.	5000d
WLUV	Loves Park, Ill.	500d
WSVL	Shelbyville, Ind.	1000
KSIB	Creston, Iowa	1000d
WHIC	Hardinsburg, Ky.	250d
WRSL	Stanford, Ky.	500d
KXKW	Lafayette, La.	10000
WVOB	Bel Air, Md.	250d
WTRI	Brunswick, Md.	500d
WKJR	Muskegon Hts., Mich.	1000d
WYNZ	Ypsilanti, Mich.	250d
KOLM	Rochester, Minn.	10000d
WQMA	Marks, Miss.	250d
KMPL	Sikeston, Mo.	5000
WSLT	Ocean City-Somers Pt., N. J.	1000d
WKBW	Buffalo, N.Y.	50000
WTHE	Mineola, N.Y.	1000d
WDSL	Mocksville, N.C.	5000d
KMAV	Mayville, N. D.	250d
WBNO	Bryan, Ohio	500d
WINW	Canton, O.	1000d
WKNT	Kent, O.	1000d
WTTO	Toledo, O.	1000
KOMA	Okla. City, Okla.	50000
KYXI	Oregon City, Ore.	50000
WCHE	West Chester, Pa.	250d
WRAI	San Juan, P. R.	10000
WTGR	Myrtle Beach, S.C.	250d
WKMG	Newberry, S. C.	1000d
KXRB	Sioux Falls, S.D.	
WSLV	Ardmore, Tenn.	1000d
WBHT	Brownsville, Tenn.	250d
WCSV	Crossville, Tenn.	250d
WIDD	Elizabethton, Tenn.	1000d

1530—196.1

kHz	Wave Length	W.P.
WAAO	Andalusia, Ala.	1000d
WLCB	Moulton, Ala.	1000d
WCTR	Chestertown, Mo.	1530
KCAT	Pine Bluff, Ark	250d
KTMN	Trumann, Ark.	250d
KFBK	Sacramento, Calif.	50000
KRYT	Colorado Springs, Colo.	1000d
WDJZ	Bridgeport, Conn.	10000d
WENG	Englewood, Fla.	1000
WTTI	Dalton, Ga.	10000d
KDSN	Denison, Iowa	500d
KYMN	Northfield, Minn.	1000d
KNBI	Norton, Kan.	1000d
KWLA	Many, La.	1000d
WPNO	Auburn, Me.	
WCTR	Chestertown, Md.	250d
WJRL	Calhoun City, Miss.	
WRPM	Poplarville, Miss.	10000d
WTHM	Lapeer, Mich.	5000d
WERX	Wyoming, Mich.	500d
KSMM	Shakopee, Minn.	500d
KPCR	Bowling Green, Mo.	250d
KMAM	Butler, Mo.	500d
KLOL	Lincoln, Neb.	5000d
WELA	Elizabeth, N.J.	
WOBR	Wanchese, N.C.	
WCKY	Cincinnati, Ohio	50000
KWLG	Wagoner, Okla.	250d
WHYP	North East, Pa.	1000d
WMBT	Shenandoah, Pa.	250d
WUPR	Utuado, P.R.	1000d
WASC	Spartanburg, S.C.	1000d
KGTN	Georgetown, Tex.	1000d
KGBT	Harlingen, Tex.	50000
KCLR	Ralls, Tex.	5000d
WFIC	Collinsville, Va.	
WQUA	Quantico, Va.	250d

1540—195.0

kHz	Wave Length	W.P.
WCOX	Camden, Ala.	1000d
WANL	Lineville, Ala.	
KZRK	Ozark, Ark.	500d
KASA	Phoenix, Ariz.	10000d
KMPG	Hollister, Cal.	500
KPOL	Los Angeles, Calif.	50000
WJGA	Jackson, Ga.	
WOGA	Sylvester, Ga.	1000d
WSMI	Litchfield, Ill.	1000d
WBNL	Boonville, Ind.	250d
WADM	Decatur, Ind	250d
WLOI	LaPorte, Ind.	250d
WCBK	Martinsville, Ind.	250d
KXEL	Waterloo, Iowa	50000
KNEX	McPherson, Kans.	250d
KLKC	Parsons, Kans.	250d
KCTO	Columbia, La.	1000d
WGLA	Gretna, La.	500d
WDON	Wheaton, Md.	1000d
WLEF	Greenwood, Miss.	1000d
KBXM	Kennett, Mo.	1000d
WKXR	Exeter, N.H.	1000d
WPTR	Albany, N.Y.	50000
WPAW	E. Syracuse, N.Y.	1000d
WKYK	Burnsville, N.C.	1000d
WRPL	Charlotte, N.C.	1000d
WIFM	Elkin, N.C.	1000d
WBCO	Bucyrus, Ohio	500d
WABQ	Cleveland, Ohio	1000d
WNIO	Niles, Ohio	500d
WBTC	Uhrichsville, O.	250d
KZEL	Eugene, Ore.	1000d
WRCP	Philadelphia, Pa.	50000d
WPTS	Pittston, Pa.	1000d
WFME	Punxsutawney, Pa.	5000d
WAOK	Newport, R.I.	1000d
WKKR	Pickens, S.C.	1000d
WMLR	Hohenwald, Tenn.	
WBFJ	Woodbury, Tenn.	500d
KBUY	Ft. Worth, Tex.	50000d
KGBC	Galveston, Tex.	1000
KEDA	San Antonio, Tex.	
WRGM	Richmond, Va.	10000d
KFKF	Bellevue, Wash.	1000
WTKM	Hartford, Wis.	500d

1550—193.5

kHz	Wave Length	W.P.
WAAY	Huntsville, Ala.	5000d
WMOO	Mobile, Ala.	50000d
KUAT	Tucson, Ariz.	50000d
KXEX	Fresno, Calif.	500d
KKHI	San Fran., Calif.	10000
KQXI	Arvada, Colo.	1000d
WEXT	W. Hartford, Conn.	1000d
WRIZ	Coral Gables, Fla.	10000d
WOGO	New Smyrna Beach, Fla.	250
WYOU	Tampa, Fla.	10000d
WTHB	Augusta, Ga.	5000d
WYNX	Smyrna, Ga.	10000
WJIL	Jacksonville, Ill.	1000d
WCSJ	Morris, Ill.	250d
WPDF	Corydon, Ind.	250d
WCVL	Crawfordsville, Ind.	250
WCTW	New Castle, Ind.	250
WKQV	Sullivan, Ind.	250d
KIWA	Sheldon, Iowa	500d
KEDD	Dodge City, Kans.	1000d
KNIC	Winfield, Kan.	250d
WIRV	Irvine, Ky.	1000d
WMSK	Morganfield, Ky.	250d
WLUX	Baton Rouge, La.	5000d
KOKA	Shreveport, La.	10000
WSER	Elkton, Md.	1000d
WNTN	Newton, Mass.	10000d
WSHN	Fremont, Mich.	1000d
WOKJ	Jackson, Miss.	50000
WSAO	Senatobia, Miss.	5000d
KGMO	Cape Girardeau, Mo.	5000d
KKJO	St. Joseph, Mo.	5000
KICS	Hastings, Neb.	500d
KOBY	Reno, Nev.	10000d
WCGR	Canandaigua, N.Y.	250d
WBAZ	Kingston, N.Y.	500d
WBVM	Utica, N.Y.	1000
WPXY	Greenville, N.C.	1000d
WYNA	Raleigh, N.C.	1000d
WTYN	Tryon, N.C.	1000d
WFCM	Winston-Salem, N.C.	1000d
KQWB	Fargo, N.D.	5000d
WDLR	Delaware, Ohio	500d
KMAD	Madill, Okla.	250d
KREK	Sapulpa, Okla.	500d
WLOA	Braddock, Pa.	1000d
WTTC	Towanda, Pa.	500d
WKFE	Yauco, P.R.	250
WBSC	Bennetsville, S.C.	10000
KCAN	Canyon, Tex.	1000d
KWBC	Navasota, Tex.	250d
WKYE	Bristol, Tenn.	1000d
WPTN	Cookeville, Tenn.	250d
WTPI	Cookville, Tenn.	250d
KCOM	Comanche, Tex.	250d
KRGO	Salt Lake City, Utah	10000d
WKBA	Vinton, Va.	10000d
WVAB	Virginia Bch., Va.	5000d
WXVA	Charles Town, W.Va.	5000d
KOQT	Bellingham, Wash.	1000d
KGAR	Vancouver, Wash.	1000d
WMIR	Lake Geneva, Wis.	1000d
WMAO	Madison, Wis.	5000d
WEVR	River Falls, Wis.	

1560—192.3

kHz	Wave Length	W.P.
WAGC	Centre, Ala.	1000d
KDDA	Dumas, Ark.	
KBIB	Monette, Ark.	250d
KPMC	Bakersfield, Calif.	10000
KIQS	Willows, Calif.	250d
WTAI	Eau Gallie, Fla.	5000d
WYSE	Inverness, Fla.	1000
WCIK	Gordon, Ga.	5000d
WBYS	Canton, Ill.	250d
WVAK	Paoli, Ind	250d
WRIN	Rensselaer, Ind.	1000d
KRCB	Council Bluffs, Iowa	1000d
KABI	Abilene, Kan.	250d
WKDO	Liberty, Ky.	250d
WAFI	Middlesboro, Ky.	
WDXR	Paducah, Ky.	10000
WBGS	Sidell, La.	1000d
WSMD	La Plata, Md.	1000d
WTPS	Portage, Mich.	1000d
WMIC	Sandusky, Mich.	1000d
KBEW	Blue Earth, Minn.	1000
KQYX	Joplin, Mo	250d
KLTI	Macon, Mo.	250d
KTUI	Sullivan, Mo.	1000d
WQXR	New York, N.Y.	50000
WBKC	Chardon, O.	
WTNS	Coshocton, Ohio	1000d
WCNW	Fairfield, O.	5000d
WTDO	Toledo, Ohio	5000d
KWCO	Chickasha, Okla.	1000
WRSJ	Bayamon, P.R.	5000
WCCP	Clemson, S.C.	
WAGL	Lancaster, S.C.	10000d
WWGM	Nashville, Tenn.	10000d
WBOL	Bolivar, Tenn.	250d
KCAD	Abilene, Tex.	500d
KEGG	Daingerfield, Tex.	1000d
KHBR	Hillsboro, Tex.	250d
KGUL	Port Lavaca, Tex.	500d
KGHO	Hoquiam, Wash.	1000d
KDFL	Sumner, Wash.	250d
WFSP	Kingwood, W. Va.	1000d
WGLB	Port Washington, Wis.	250d

1570—191.1

kHz	Wave Length	W.P.
WCRL	Oneonta, Ala.	1000d
WTQX	Selma, Ala.	5000d
KBRI	Brinkley, Ark.	250d
KBJT	Fordyce, Ark.	250d
KCVR	Lodi, Cal.	5000d

WHITE'S

RADIO LOG

kHz	Wave Length	W.P.
KACE	Riverside, Cal.	5000d
KRSA	Salinas, Cal.	250d
KLOV	Loveland, Colo.	250d
WTWB	Auburndale, Fla.	5000d
WFBF	Fernandina Bch., Fla.	1000d
WOKC	Okeechobee, Fla.	1000d
WMES	Ashburn, Ga.	1000d
WGHC	Clayton, Ga.	1000d
WSSA	College Park, Ga.	1000d
WGSR	Millen, Ga.	250d
WOKZ	Alton, Ill.	1000d
WBEE	Harvey, Ill.	1000d
WTAY	Robinson, Ill.	250d
WIFF	Auburn, Ind.	500d
WILO	Frankfort, Ind.	250d
WHEL	New Albany, Ind.	1000d
KMCD	Fairfield, Iowa	250d
KJFJ	Webster City, Iowa	250d
KNDY	Marysville, Kans.	250d
WKKS	Vanceburg, Ky.	250d
WABL	Amite, La.	500d
KLLA	Leesville, La.	1000d
KMAR	Winnsboro, La.	1000d
WTOW	Towson, Md.	5000d
WPEP	Taunton, Mass.	1000d
WMLO	Beverly, Mass.	500d
WDEW	Westfield, Mass.	1000d
WMRP	Flint, Mich.	1000d
WFUR	Grand Rapids, Michigan	1000d
KUXL	Golden Valley, Minn.	1000d
WONA	Winona, Miss.	1000d
KLEX	Lexington, Mo.	250d
WKOL	Amsterdam, N.Y.	1000d
WFLR	Dundee, N.Y.	1000d
WBUZ	Fredonia, N.Y.	250d
WHRF	Riverhead, N. Y.	1000d
WTLK	Taylorsville, N.C.	500d
WNCA	Siler City, N.C.	1000d
WPTW	Piqua, Ohio	250d
WONL	Warren, Ohio	1000d
KTAT	Frederick, Okla.	250d
KOLS	Pryor, Okla.	1000d
KOHU	Hermiston, Oreg.	1000d
WPGM	Danville, Penn.	1000d
WRUX	Doylestown, Pa.	5000d
WQTW	Latrobe, Pa.	1000d
WFGN	Gaffney, S.C.	250d
WJES	Johnston, S.C.	250d
WLSC	Loris, S.C.	1000d
KURA	Vermillion, S.D.	500d
WHLP	Centerville, Tenn.	1000d
WCLE	Cleveland, Tenn.	1000d
WTRB	Ripley, Tenn.	1000d
KZOL	Farwen, Tex.	250d
KVLG	La Grange, Tex.	250d
KTER	Terrell, Tex.	250d
WSWV	Pennington Gap, Va.	1000d
WYTI	Rocky Mount, Va.	1000d
WAPL	Appleton, Wis.	1000d

1580—189.2

kHz	Wave Length	W.P.
WEYY	Talladega, Ala.	1000d
KTUF	Tempe, Ariz.	50000d
KPCA	Marked Tree, Ark.	250d
KFDF	Van Buren, Ark.	1000d
KMRE	Anderson, Cal.	1000d
KWIP	Merced, Cal.	1000d
KDAY	Santa Monica, Cal.	50000
KPIK	Colorado Sprgs., Colo.	5000d
WSBP	Chattachoochee, Fla.	1000d
WSRF	Fort Lauderdale, Fla.	10000
WVGT	Mount Dora, Fla.	5000d
WCCF	Punta Gorda, Fla.	1000d
WCLS	Columbus, Ga.	1000
WNRJ	Gainsville, Ga.	10000d
WKIG	Glenville, Ga.	1000d
WKKD	Aurora, Ill.	250d
WDQN	DuQuoin, Ill.	250d
WBBA	Pittsfield, Ill.	250d
WCCR	Urbana, Ill.	250d
WCNB	Connersville, Ind.	250d
WJVA	South Bend, Ind.	1000d
WAMW	Washington, Ind.	250d
KCHA	Charles City, Iowa	500d
KWNT	Davenport, Iowa	500d
KDSN	Denison, Iowa	500d
WAXU	Georgetown, Ky.	10000d
WMTL	Leitchfield, Ky.	250d
WPKY	Princeton, Ky.	250d
KLUV	Haynesville, La.	1000d
KLOU	Lake Charles, La.	1000
WPGC	Bradbury Hts., Md.	10000d
WTOW	Towson, Md.	5000d
WRBJ	St. Johns, Mich.	1000d
KDOM	Windom, Minn.	250d
WAMY	Amory, Miss.	5000d
WLBS	Centreville, Miss.	250d
WORV	Hattiesburg, Miss.	
WESY	Leland, Miss.	1000d
WPMP	Pascagoula-Moss Point, Mississippi	1000d
KTGR	Columbia, Mo.	250d
KESM	El Dorado Springs, Mo.	500d
KNIM	Maryville, Mo.	250d
KAMI	Cozad, Neb.	1000d
WMIH	Hammonton, N.J.	1000d
WCRV	Washington, N.J.	1000d
KZIA	Albuquerque, N. M.	1000d
WPAC	Patchogue, N.Y.	10000d
WZKY	Albemarle, N.C.	250d
WVKO	Columbus, Ohio	1000d
KLOR	Blackwell, Okla.	1000d
WCOY	Columbia, Pa.	500d
WEND	Ebensburg, Pa.	1000d
WANB	Waynesburg, Pa.	250d
WORG	Orangeburg, S.C.	1000d
WBBR	Travelers Rest, S. C.	1000d
WSKT	Colonial Village, Tenn.	250d
WHHM	Henderson, Tenn.	250d
WLIJ	Shelbyville, Tenn.	1000d
WSKT	Knoxville, Tenn.	5000d
KKAL	Denver City, Tex.	250d
KGAF	Gainesville, Tex.	250d
KIRT	Mission, Tex.	1000d
KTLU	Rusk, Tex.	500d
KWED	Seguin, Tex.	1000d
KBYP	Shamrock, Tex.	250d
WILA	Danville, Va.	1000d
WPUV	Pulaski, Va.	5000d
WTTN	Watertown, Wis.	1000d

1590—188.7

kHz	Wave Length	W.P.
WATM	Atmore, Ala.	5000d
WVNA	Tuscumbia, Ala.	5000
KVSL	Show Low, Ariz.	
KPBA	Pine Bluff, Ark.	1000d
KSPR	Springdale, Ark.	500d
KLIV	San Jose, Cal.	5000
KUDU	Ventura, Cal.	5000
KCIN	Victorville, Calif.	500d
WTBY	Waterbury, Conn.	5000
WOWY	Clewiston, Fla.	
WILZ	St. Petersburg Beach, Florida	1000d
WELE	S. Daytona Bch., Fla.	1000d
WALG	Albany, Ga.	5000
WLFA	Lafayette, Ga.	5000d
WTGA	Thomaston, Ga.	500d
WNMP	Evanston, Ill.	1000d
WAIK	Galesburg, Ill.	5000d
WGEE	Indianapolis, Ind.	5000d
WPCO	Mt. Vernon, Ind.	500d
KWBG	Boone, Iowa	1000
KVGB	Great Bend, Kans.	5000
WLBN	Lebanon, Ky.	1000d
KEVL	White Castle, La.	1000d
WISZ	Glen Burnie, Md.	500
WETT	Ocean City, Md.	1000
WTVB	Coldwater, Mich.	5000
WSMA	Marine City, Mich.	1000d
KRAD	E. Grand Forks, Minn.	1000d
WWUN	Jackson, Miss.	5000
KDEX	Dexter, Mo.	1000d
KPBS	Kansas City, Mo.	1000d
KCLU	Rolla, Mo.	1000d
KTCH	Wayne, Neb.	500d
WSMN	Nashua, N.H.	5000
WERA	Plainfield, N.J.	500d
WAUB	Auburn, N.Y.	500d
WEHH	Elmira Heights-Horseheads, N.Y.	500d
WGGO	Salamanca, N.Y.	5000d
WBHN	Bryson City, N. C.	500d
WCSL	Cherryville, N.C.	1000d
WVOE	Chadbourn, N.C.	1000d
WNOS	High Point, N.C.	1000d
WAKR	Akron, Ohio	5000
WSRW	Hillsboro, Ohio	500d
KHEN	Henryetta, Okla.	500d
KZYX	Weatherford, Okla.	1000d
KTIL	Tillamook, Ore.	5000
WZUM	Carnegie, Pa.	1000d
WCBG	Chambersburg, Pa.	5000
WEEZ	Chester, Pa.	1000
WMIM	Mt. Carmel, Pa.	500d
WXRF	Guayama, P.R.	1000
WARV	Warwick-E. Greenwich, R.I.	1000d
WABV	Abbeville, S.C.	1000d
WACA	Camden, S.C.	1000d
WPIP	Collierville, Tenn.	500d
WJSO	Jonesboro, Tenn.	5000d
WOBL	Springfield, Tenn.	1000d
KGAS	Carthage, Tex.	1000d
KERC	Eastland, Tex.	500d
KINT	El Paso, Tex.	1000d
KYOK	Houston, Tex.	5000
KCBD	Lubbock, Tex.	1000
KBUS	Mexia, Tex.	500d
KTOD	Sinton, Tex.	1000
WGOE	Richmond, Va.	5000d
KSND	Seattle, Wash.	5000
WIXK	New Richmond, Wis.	5000d
WSWW	Platteville, Wis.	5000
WQTC	Two Rivers, Wis.	1000d
WAWA	West Allis, Wis.	1000d
KCGO	Cheyenne, Wyo.	10000

1600—187.5

kHz	Wave Length	W.P.
WEUP	Huntsville, Ala.	5000d
WAPX	Montgomery, Ala.	1000
KVIO	Cottonwood, Ariz.	1000d
KXEW	Tucson, Ariz.	1000
KGST	Fresno, Cal.	5000d
KWOW	Pomona, Cal.	5000
KZON	Santa Maria, Cal.	500d
KUBA	Yuba City, Calif.	5000
KLAK	Lakewood, Colo.	5000
WKEN	Dover, Del.	500d
WKTX	Atlantic Beach, Fla.	1000d
WKWF	Key West, Fla.	500
WXVI	Riviera Beach, Fla.	1000
WPRV	Wauchula, Fla.	500d
WOKB	Winter Garden, Fla.	5000d
WACX	Austell, Ga.	1000d
WNGA	Nashville, Ga.	1000d
WRBN	Warner Robins, Ga.	1000d
WCGO	Chicago Hgts., Ill.	1000d
WMCW	Harvard, Ill.	500d
WBTO	Linton, Ind.	500d
WARU	Peru, Ind.	1000d
KLGA	Algona, Iowa	5000d
KCRG	Cedar Rapids, Iowa	5000
KMDO	Ft. Scott, Kans.	500d
WSTL	Eminence, Ky.	500d
WLLS	Hartford, Ky.	
KFNV	Ferriday, La.	1000d
KLEB	Golden Meadow, La.	1000d
KNCB	Vivian, La.	5000d
WINX	Rockville, Md.	1000
WUNR	Brookline, Mass.	5000
WTYM	East Longmeadow, Mass.	5000d
WAAM	Ann Arbor, Mich.	5000
WTRU	Muskegon, Mich.	5000
WKDL	Clarksdale, Miss.	1000d
WFFF	Columbia, Miss.	500d
KATZ	St. Louis, Mo.	5000
KTTN	Trenton, Mo.	500d
KNCY	Nebraska City, Nebr.	500d
KRFS	Superior, Nebr.	500d
WWRL	New York, N. Y.	5000
WMCR	Oneida, N.Y.	1000d
WLNG	Sag Harbor, N.Y.	500d
WXKW	Troy, N.Y.	500d
WGIV	Charlotte, N.C.	1000
WIDU	Fayetteville, N.C.	1000d
WHVL	Hendersonville, N.C.	1000d
WFRC	Reidsville, N.C.	1000
WKSK	W. Jefferson, N.C.	1000d
KDAK	Carrington, N.Dak.	500d
WAQI	Ashtabula, Ohio	1000d
WBLY	Springfield, Ohio	1000d
WTTF	Tiffin, Ohio	500d
KUSH	Cushing, Okla.	1000d
KASH	Eugene, Oreg.	5000
KOHI	St. Helens, Ore.	1000d
WHOL	Allentown, Pa.	500d
WEPN	Elizabethtown, Pa.	500d
WFIS	Fountain Inn, S.C.	1000d
WFNL	No. Augusta, S.C.	500d
WHBT	Harriman, Tenn.	5000d
WKBJ	Milan, Tenn.	1000d
KBBB	Borger, Tex.	5000d
KBOR	Brownsville, Tex.	1000
KCFH	Cuero, Tex.	500d
KWEL	Midland, Tex.	1000d
KYAL	McKinney, Tex.	5000d
KOGT	Orange, Tex.	1000
KBBC	Centerville, Utah	1000d
WCPK	Chesapeake, Va.	1000d
WHLL	Wheeling, W.Va.	5000d
WCWC	Ripon, Wis.	5000

White's World-Wide Shortwave Stations

Prepared by Don Jensen

☐ Suddenly, it seems, the Philippines has become one of the world's "hottest" DX countries. Until recently, to most SWLs, the Philippines meant the Voice of America relays or the missionary outlets of the Far East Broadcasting Company. *period!*

But things have changed. Now, fully a half dozen broadcasters have powerful transmitters—50 kw. or more—operating from this republic of 7,000 islands.

FEBC, granddaddy of the Manila-based religious stations, has been joined by two other missionary broadcasters. One, SEARV, the South East Asian Radio Voice, is a Protestant station serving the Christian Councils of South East Asia with a 50 kw. transmitter at Bulacan. The second, and newer, Radio Veritas, 100 kw., was built and is operated by the Roman Catholic Church for Asian listeners unable to get good reception from Vatican Radio.

Even more recently, the first three of a battery of ten 250-kilowatt Voice of America transmitters have been installed at Tinang. Along with the less powerful stations at Poro, they relay the VOA's programs to the Far East.

The opening of the Tinang complex during the summer freed several 20-year-old VOA transmitters. A commercial station, the Philippine Broadcasting Service is now using a couple of the units at the Poro site, relaying VOA programs until 0830 GMT, then switching to its own features.

The VOA plant at Malolos, just north of Manila, apparently has been peddled to the Philippine government. Activated on new frequencies, at least one of the new stations has been heard in the U.S. recently. This operation identifies as "The Voice of the Philippines" and is "owned and operated by the Republic of the Philippines."

So set your Big Ben for an early hour and start tuning! How many of these Philippine goodies can you snare?

1. VOA-Tinang/Poro—You can expect to hear a few English programs and IDs but most programs in Asian lingos. Try 9,665, 11,965 or 15,105 kHz any time between 1000 and 1700 GMT.

2. Far East Broadcasting Company—This religious outlet uses many—would you believe 40—different dialects and languages for its Oriental audiences, but you can hear English from 1245 to 1400 GMT on about 15,440 kHz. If not, there's always 9,504 and 11,920 kHz.

3. South East Asia Radio Voice—Not as easy as you might think for their antennas are aimed the other way. Winter catches possible on 15,420 kHz from 1100 to 1300 GMT.

4. Radio Veritas—Another one you'll really have to try for. A New Yorker recently heard Veritas on 15,170 kHz around 1230 GMT. Also listen on 11,830 between 1000 and 1300 GMT.

5. Philippine Broadcasting Service—Lately PBS has been putting "socko" signals into the Midwest between 1000 and 1100 GMT on 6,170 kHz. Its commercial program format is pretty good listening too. Both English and Tagalog, the Philippine language, are used.

6. Voice of the Philippines—QRM is a real headache on VOP's frequencies—9,580 and 11,950 kHz. Look for breaks in the interference, like before 1100 and between 1300 and 1330 GMT. Full morning sked is 0900 to 1400 GMT.

For the hard-nosed, calloused-eared crowd, here are a couple of "ultras!"

7. Mindanao Broadcasting Network—This 500 watter, located in Davao City (others say its "Voice of the City" ID means Manila), signs off early—0800 GMT. It's listed for 7,280 kHz, but we can tell you it skips around a bit, varying to 7,265.

8. Voice of the State University—DUH9, on 7,160, but varying to 7,150 kHz, will drive you nuts. A measly thousand watts is all this University of the Philippines station runs. It's located at Quezon City, just outside Manila, and is scheduled from 0900 to 1300 GMT, Monday-Saturday, mostly in English.

9. National Civil Defense Administration—This government agency station uses two channels, each one tougher than the other, 3,305 and 5,970 kHz. Schedule is 0800 to 1100 GMT.

Scoring—Give yourself 5 points for each VOA and FEBC frequency you hear. Numbers 3 through 5 rate 25 points each.

Total less than 25? Keep trying. Score 50 points? Bully for you. One hundred puts you up with the pros. Log any one of the last three and you, Bunky, take home all the marbles!

1970 DX Census. Ever wonder how many of us there are around? So does the Association of North American Radio Clubs, the continent-

This Issue's Shortwave Contributors

Ernest Behr (Ontario); Steve Kamp (Texas); Bill Berghammer (New York); Dan Ferguson (Florida); R. S. Heggs (Br. Columbia); David Williams (Oregon); Bob Hagerman (Michigan); Gerry Dexter (Wisconsin); Stanley Cabral (California); Richard Murphy (Texas); Richard Fortson (Texas); Gladys Sienkiewicz (New York); Sam Rowell (Washington); Carter Scholz (New Jersey); Del Hirst (Texas); Newark News Radio Club (215 Market St., Newark, N.J.); North American SW Assn. (Box 989, Altoona, Pa.); Japanese SW Club (Sendai, Japan).

Introducing White's Radio Log New Shortwave Columnist

Don Jensen tuned his first station, Ecuador's HCJB, at the tender age of 11. That was 22 years ago. Since then he has heard and verified shortwave stations in nearly 200 countries. SWLs have read his articles and column on shortwave broadcasting in **Elementary Electronics, Science and Electronics'** sister magazine, and in other electronics publications.

Though an ex-ham (KN4ISC) and ex-CBer (18W6098), his first love is DXing. Like most serious listeners, Jensen belongs to DX clubs here and abroad, holding executive positions in several. He has edited SWBC columns in a few radio club bulletins. He founded the Association of North American Radio Clubs, an organization linking all the major listeners clubs in the continent.

He knows DXing and DXers. A former radio and TV staffer, he also knows the broadcaster's point of view. He's visited stations in Europe, South America and the Caribbean and seen how they operate. A newspaper reporter, Jensen relates DX happenings to contemporary world events. He tells it like it is.

The Editor hopes you'll read the shortwave section in White's Radio Log regularly for the inside story of what's happening in the DXing world today. He believes that Don Jensen's shortwave news and views will become a steady diet for our growing DX-SWL crowd.

WHITE'S RADIO LOG—SW

wide organization linking the various SWL hobby clubs. To find out the answer, ANARC is conducting a DXer census.

If you want to be tallied too, jot down the following information: Name, address, age, occupation, education level and the type of DXing you prefer, long wave, medium wave, shortwave broadcast, amateur listening or what have you. If you belong to any radio hobby clubs, note which ones. Do you have an amateur or CB license? What type of receiver, auxiliary equipment and antenna do you use? Do you build, repair or maintain any of the equipment you own? What electronics magazines do you read and what types of articles do you prefer?

Send your data to ANARC CENSUS, 152 Third Street, Leominster, Mass., 01453. When results are tallied, we'll let you know.

90-Meter Band—3200 to 3400 kHz

kHz	Call	Name	Location	
3305	VL8BD	R. Western District	Daru, Papua Territory	1115
3315	—	ORTF	Ft. de France, Martinique	0100
3316	—	R. Sierra Leone	Freetown, Sierra Leone	0600
3322	VL9BA	R. Bougainville	Kieta, Bougainville	1130
3325	YVRA	R. Monegas	Maturin, Venezuela	0230
3346	—	R. Zambia	Lusaka, Zambia	0410
3380	TGCH	R. Chortis	Jocotan, Guatemala	0245
3390	HCOTI	R. Zaracuy	Sto. Domingo Cds., Ecuador	0700
3910	—	Far East Network	Tokyo, Japan	1230
3995	—	SIBS	Honiara, Solomon Is.	1100

60-Meter Band—4750 to 5060 kHz

kHz	Call	Name	Location	
4765	—	R-TV Congolaise	Brazzaville, Congo Rep.	0530
4770	ELWA	—	Monrovia, Liberia	0600
4795	—	R. Comercial	Sa da Bandeira, Angola	0600
4841	HCCRI	R. Casa de la Cultura	Quito, Ecuador	0330
4865	—	Brunei Broadcasting Svc.	Berakas, Brunei	1300
4907	—	Radio Cambodia	Phnom Penh, Cambodia	1230
4910	HIN	Radio HIN	Sto. Domingo, Dom. Rep.	2300
4912	—	R. Tarawa	Betio, Tarawa, Gilbert and Solomon Is.	0800
4932	—	Nigerian Bc. Corp.	Benin City, Nigeria	0600
4950	—	R. Senegal	Dakar, Senegal	0600
4972	—	R. Yaoundi	Yaoundi, Cameroon	0500
4975	OCX4H	R. del Pacifico	Lima, Peru	0230
4976	—	R. Uganda	Kampala, Uganda	1830
4995	ZYX9	R. Brasil Central	Goiania, Brazil	0830
5015	—	—	Vladivostok, USSR	1200
5040	—	R. Valparaiso	Port de Paix, Haiti	0100

49-Meter Band—5950 to 6200 kHz

kHz	Call	Name	Location	
5987	—	Radio Republik Indonesia	Menado, Indonesia	1100
6005	—	RIAS	Berlin, Germany	0300
6010	—	BBC Relay	Limassol, Cyprus	0200
6015	PRA8	R. Clube de Pernambuco	Recife, Brazil	0815
6030	CFVP	Voice of the Prairies	Calgary, Canada	1230
6065	—	R. Singapura	Singapore	1145
6095	HJIW	La Voz del Centro	Espinal, Colombia	0330
6115	OBZ40	R. Union	Lima, Peru	1130
6140	—	L.V. del la Revolution	Bujumbura, Burundi	0430
6145	—	V. of Biafra	Orlu, Biafra	0530
6170	—	Philippine Bc. Svc.	Manila, Philippines	1045
6192	—	R-TV Tunisienne	Tunis, Tunisia	0400

41-Meter Band—7100 to 7300 kHz

kHz	Call	Name	Location	
7140	—	Radio Republik Indonesia	Ambon, Indonesia	1230
7155	—	ORTF	Paris, France	0530
7170	—	R. Noumea	Noumea, New Caledonia	1045
7173	—	VTVN	Saigon, S. Vietnam	1145
7200	—	V. of Righteousness	Taipei, Taiwan	1100
7205	—	R. Australia	Melbourne, Australia	1200
7225	—	Deutsche Welle Relay	Kigali, Rwanda	0330
7235	—	BBC Relay	Johore Baru, Malaysia	1200
7265	—	Sudwestfunk	Rohrdorf, Germany	0600
7300	—	R. Tirana	Tirana, Albania	0200

31-Meter Band—9500 to 9775 kHz

kHz	Call	Name	Location	
9505	OAX4V	R. America	Lima, Peru	0530
9515	XEWW	L.V. de la America Latina	Mexico City, Mexico	0440
	—	R. Ankara	Ankara, Turkey	1800
9520	—	R. Denmark	Copenhagen, Denmark	0200
	VLT9	ABC	Port Moresby, New Guinea	0700
9540	—	R. Lubumbashi	Lubumbashi, Rep. of Congo	0500
9550	—	R. Tanzania	Dar es Salaam, Tanzania	1300
9553	YSS	R. Nac. de El Salvador	San Salvador, El Salvador	0340
9570	CE956	R. Portales	Santiago, Chile	0330
9575	—	RAI	Rome, Italy	0500
	—	All India Radio	Bombay, India	1300
9576	ZYN29	R. Cultura de Bahia	Salvador, Brazil	2330
	—	L.V. del Comercio	Santa Ana, El Salvador	1740
9580	—	V. of the Philippines	Manila, Philippines	1100
9581	YNTP	R. Mar	Puerto Cabezas, Nicaragua	1330
9600	—	R. Tashkent	Tashkent, USSR	1315
9605	—	Trans World Radio	Bonaire, Neth. Antilles	0000
9615	—	R. Pyongyang	Pyongyang, N. Korea	1350
	TIRICA	L.V. de la Victor	San Jose, Costa Rica	0200
9655	OAX9C	R. Nor Peruana	Chachapoyas, Peru	0315
9683	LRA32	RAE	Buenos Aires, Argentina	0300
9700	—	R. Sofia	Sofia, Bulgaria	2200
9705	—	R. RSA	Johannesburg, South Africa	0100
9710	HCJB	L.V. de los Andes	Quito, Ecuador	0600
9730	—	R. Berlin International	Berlin, E. Germany	0130
9760	—	R. Nac. de Espana	Madrid, Spain	0230
	JOZ7	Nihon Sw. Bc. Co.	Tokyo, Japan	0050

25-Meter Band—11700 to 11975 kHz

kHz	Call	Name	Location	
11706	TGQB	R. Nacional de Quetzaltenango	Quetzaltenango, Guatemala	0200
11720	PRL	R. Nacional	Brasilia, Brazil	0000
11730	—	R. Nederland	Bonaire, Netherlands Antilles	0600
11735	ZYW28	R. Clube de Goiania	Goiania, Brazil	0045
	—	R. Norway	Oslo, Norway	0100
	—	R. TV Marocaine	Tangier, Morocco	0700
11765	—	R. Pyongyang	Pyongyang, North Korea	1400

Science and Electronics Propagation Forecast for February/March 1970

Prepared by C. M. Stanbury II

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	25, 31	41, 49	60e, 90e	31e, 41w	(49), 60, 90
0300-0600	41, 69	31 (poor)	19w	49, 60, (90)	49, 60, 90
0600-0900	25, 49w	16, 19	19	25,31,(41),(49)	31, 49
0900-1200	19, 25	13, 16, 19	19, 25	19 (poor)	(19), 25, 31
1200-1500	16, 19	13, 16, 19	19, 25	19 (poor)	(19), 25, 31
1500-1800	16, 19	(25), 31, (41), 49	31w, 60e	19, 25	31
1800-2100	16, 19	25, 31	25e, 31e, 60w	16, 19	49, 60, (90)
2100-2400	16, 19	31, 41, 49	60, 90	16, 19, 31w	49, 60, (90)

kHz	*Call*	*Name*	*Location*	
11770	—	R. Nigeria	Lagos, Nigeria	1900
11780	—	R.A.E.	Buenos Aires, Argentina	0530
11790	—	R. Afghanistan	Kabul, Afghanistan	1730
11800	—	R. Nacional de Espana	Sta. Cruz de Tenerife, Canary Is.	2120
	—	R.A.I.	Rome, Italy	2100
	—	R. Ceylon	Colombo, Ceylon	1100
11810	—	R. Australia	Melbourne, Australia	1000
11815	—	R. Warsaw	Warsaw, Poland	1800
11820	XEBR	El Heraldo de Sonora	Hermosillo, Mexico	1345
11825	—	R. Tahiti	Papeete, Tahiti	0600
11835	CXA19	R. El Espectador	Montevideo, Uruguay	0220
11870	HCJB	L.V. de los Andes	Quito, Ecuador	0500
11875	—	R. Nacional de Nicaragua	Managua, Nicaragua	0400
11900	—	R. Malaysia	Kuala Lumpur, Malaysia	1050
11920	—	R. TV Ivorienne	Abidjan, Ivory Coast	2045
11930	—	VOA	Tinang, Philippines	1500
11949	ZPA5	R. Encarnacion	Encarnacion, Paraguay	0100
11950	—	V. of the Philippines	Manila, Philippines	1350
11965	—	Deutsche Welle Relay	Kigali, Rwanda	2100

19-Meter Band—15100 to 15450 kHz

kHz	*Call*	*Name*	*Location*	
15110	ZL21	R. New Zealand	Wellington, New Zealand	0505
15135	—	R. Iran	Tehran, Iran	2000
15145	ZYK33	R. Jornal do Comercio	Recife, Brazil	1350
15160	—	R. Ankara	Ankara, Turkey	2200
15160	—	R. Budapest	Budapest, Hungary	0110
15165	—	R. Denmark	Copenhagen, Denmark	2045
15170	—	R. Amman	Amman, Jordan	2330
15185	OIX4	Finnish Bc. Co.	Pori, Finland	1800
15200	—	Austrian R.	Vienna, Austria	2000
15240	—	R. Pakistan	Karachi, Pakistan	2030
15245	—	R. TV Nationale Congolais	Kinshasa, Congo	2200
15260	—	BBC relay	Ascension Is.	0200
15270	—	Syrian Bc. Corp.	Damascus, Syria	1930
	ETLF	R. Voice of the Gospel	Addis Ababa, Ethiopia	1515
15280	ZL4	R. New Zealand	Wellington, New Zealand	0430
15285	—	R. Lebanon	Beirut, Lebanon	0230
15290	—	R. Clube Mozambique	Lorenco Marques, Mozambique	0800
15300	—	R. Japan	Tokyo, Japan	1430
15305	—	Swiss Bc. Corp.	Bern, Switzerland	0200
15315	—	R. Sweden	Stockholm, Sweden	1400
15335	—	A.I.R.	New Delhi, India	1415
15345	—	N.H.I.	Athens, Greece	2100
15410	—	Deutsche Welle	Cologne, Germany	0100

16-Meter Band—17700 to 17900 kHz

kHz	*Call*	*Name*	*Location*	
17655	—	Cairo Radio	Cairo, UAR	0030
17700	—	R. Berlin International	Berlin, Germany	1230
17720	BED39	V. of Free China	Taipei, Taiwan	0300
17790	—	BBC	London, England	1300
17795	—	Swiss Bc. Corp.	Bern, Switzerland	1830
17825	—	VOA	Tinang, Philippines	1500
17845	WNYW	R. New York Worldwide	New York, N.Y.	2200
17855	—	R. Havana Cuba	Havana, Cuba	2000
17900	—	R. Moscow	Kiev, USSR	0100
17945	—	R. Pakistan	Karachi, Pakistan	1330

13-Meter Band—21450 to 21750 kHz

kHz	*Call*	*Name*	*Location*	
21475	—	R. Berlin International	Berlin, Germany	1215
21485	—	A.I.R.	New Delhi, India	1000
21500	—	R. Brazzaville	Brazzaville, Rep. Congo	1330
21520	—	Swiss Bc. Corp.	Bern, Switzerland	1400
21525	—	Kuwait Bc. Svc.	Kuwait	0900
21570	—	Vatican Radio	Vatican City	2300
21645	—	ORTF	Paris, France	1745
21690	—	W.I.B.S.	St. George, Grenada	2200

White's Emergency Radio Station Listings for Florida Statewide

SCIENCE AND ELECTRONICS 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 81 for our 1969 program. Our 1970 brand new schedule will be announced in the next issue.

If you desire to obtain similar lists from other areas in the United States that have not been 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.

All frequencies are megahertz (MHz) unless otherwise noted.

MIAMI POLICE DEPT.

Biscayne Pk.	KBD928	155.67			
El Portal	KAT760	155.67			
Homestead	KIB23	154.89			
	KIE837	155.19	458.75		
	KIK46	458.75			
Miami	KIB751	27.255	155.19	155.67	453.05
	KID361	155.49			
	KBF848	155.67			
	KGY301	155.67			
	KID381	453.30	453.35	453.45	453.50
		460.05	460.10	460.125	
	KIS39-40	458.30	458.35	458.45	
	KJF87	458.75			
	KCT641-3	155.37			
Miami Shores	KAT757	155.67			
S. Miami	KAT758	155.67			
(walkie-talkies:	453.75)				

MIAMI FIRE DEPT.

Dade City	KBE340	154.28			
Homestead	KIB329	153.89			
	KIR40	458.95			
Miami	KBK811	158.82			
	KGY300	153.89			
	KIB329	153.89	154.31	453.10	453.15
		453.20	460.525	460.55	
		460.575			
	KBW841	154.28			
	KCU29	458.10			
	KFG85	458.10			
	KFV92	458.10			
	KJF69	458.95			
	KJF70-86	458.10			
Miami Shores	KAP742	153.89			

OTHER MIAMI DEPTS.

KIW754	453.325	453.375	453.425	453.475	453.55
	453.90				

MIAMI BEACH POLICE DEPT.

KGN543	156.03				
KIB563	156.03	156.09			
KLL680	460.40	460.425	460.45	460.475	460.50

MIAMI BEACH FIRE DEPT.

KCT269-71	154.01	
KGN542	154.01	
KLL510	453.225	453.275
KLL511	460.525	460.55

OTHER MIAMI BEACH DEPTS.

KEY902	453.25

DADE COUNTY-OPERATED STATIONS SHERIFF'S DEPT.

Bar Harbor	KLW52	158.73			
Bay Harbor	KLW56	158.73			
Fla. City	KOO91	158.91			
Golden Bch.	KVS27	158.73			
Homestead	KJZ85	158.73	158.91	158.97	159.03
Islandia	KOO95	158.91			
Medley	KLW51	158.97	159.03		
Miami	KDG915	154.80			
	KGV297	154.80			
	KLW50/54	158.73			
	KNS94	158.73	158.91	158.97	159.03
	KLW59	158.91			
	KOO92	158.91	158.97		
	KTO78	158.97			
	KCT281	453.55			
N. Bay Vlg.	KLW57	158.73	159.03		
N. Miami	KLW55	158.73			
N. Miami Bch.	KLW58	158.73			
Opa-Locka	KCU472	154.74	453.60		
	KLW48	158.73			
Perrine	KGV298	154.86			
	KDG273	154.95			
Surfside	KLW53	158.73			

COUNTY FIRE DEPT.

Fla. City	KBY528	453.70	453.80	
Miami	KIM654	33.70		
	KGP675	153.77		
	KBY519-27	453.70	453.80	
	KCR938	453.70	453.80	
	KCR940	453.70	453.80	
	KDE263/5	453.70	453.80	
	KIM654	453.70	453.80	
N. Miami Bch.	KBY517	453.70	453.80	
Opa-Locka	KBY518	453.70	453.80	
S. Miami	KJD899	153.77	453.70	453.80
Surfside	KDE264	453.70	453.80	
Virginia Gdns.		453.70	453.80	

OTHER DADE COUNTY AGENCY STATIONS

KEM595/453.85 KIR227/453.65 KRQ72-4/458.65
KSZ50-1/458.65 KTN89/458.65
154.085 158.865
453.525 453.925 453.975

MISC. OTHER FLORIDA STATIONS & NETWORKS

Everglades Fire Control net: 31.78
U.S. Weather Bureau (Jax, Miami, Tampa) 162.55
State forestry networks: 151.16 151.295 151.34 159.24 159.27 159.285 159.30 159.33 159.375 159.39 159.42 159.45 453.65 453.95 458.65 458.95
Game & Fresh Water Fish Comm. net: 151.415 172.275
Central & Sthn. Fla. Flood Control nets: 30.94 169.475 171.075
Jacksonville Port Authority: 155.055 155.715

American Red Cross	Jacksonville	KFO766	47.42
	Jacksonville	KEO369	155.16
	Orlando	KFT643	47.42
	Pensacola		47.42
	Tallahassee	KFZ841	47.42
	Tampa	KFO765	47.42

Florida East Coast Railway: 160.53
Seaboard Coast Line: 160.29 160.59 161.10
Univ. of Fla. PD, Gainesville KIE831 155.31
FSU PD, Tallahassee KIK314 155.31
SFU PD, N. Tampa KCQ233 158.85
State Dept. of Agriculture net: 158.865

State Environmental Lab.	Winter Haven		171.85
Sunland Training Center	Buckingham	KBM910	155.40
	Marianna	KLK532	154.025
Monsanto Co. FD	Pensacola	KLO489	154.145

STATE LAW ENFORCEMENT AGENCIES

Channels/Stations:
37.30 KJ1430 KGP789
45.06 (Highway Patrol) KAV733 KBQ738 KBV731-4 KBX376 KBZ941 KCO299 KCR971 KEY959 KFN559-60 KFY387 KGT617-9 KIA285 KIB471 KIB472-4 KIB479-87 KIB490-1 KIC734 KIC854 KID295 KID490 KID533 KID680 KIJ281-2 KIK502 KIM776 KIM939 KIP346 KIQ722 KIR486-7 KIR620 KIW246 KIW553 KJN747 KLG645 KLK645 KLU 468 KLW285
45.10 (Beverage Dept.) KFY412 KGJ672 KGV216 KGW783 KIS435 KIV747-8 KIW304 KIW586 KIW904 KIW978 KJB875 KJF963 KIW977
45.42 (Div. Corrections) KBE342-3 KBL757 KFT238 KFX230 KGW698 KI1794 KIJ666 KIK222 KIM752 KIN318 KIN946 KJY745
45.46 KLJ285-7
45.82 KFS997
154.95 KIL349
156.15 (repeater) KJF24
453.10 KHM80 KYH39
453.50 KTU89
458.10 KHM81 KYH38
458.50 KTU90
460.15 KLP923-9
460.20 KLP923-9
460.25 KLP924-6 KLP928-9
460.30 KLP924-6 KLP928-9
460.35 KLP924-9

Locations/Stations:
Arcadia KIK502
Avon KIN946
Belle Glade KBL757 KIK222
Bradenton KI3474
Brooksville KIA680
Bushnell KFT238
Campbellton KIR486
Chattahoochee KGP789 KI1794 KIN318 KJ1430
Crestview KIA285
Cross City KIB472
Daytona Bch. KGT619 KGW783
Deland KIB483
Eastpoint KJF24
Everglades KFN560
Ft. Lauderdale KIM776
Ft. Myers KIB481
Gainesville KAV733 KJY745
Havana KBZ941
Highland City KIB480
Inglis KCR971
Jacksonville KBV731-4 KFN559 KIB485 KIW246 KLJ286 KLP926
Lake Butler KGW698
Jennings KIR620
Lake City KIB486
Lake Placid KGT617
Lakeland KTU90
Leesburg KEY959
Live Oak KIV747
Lowell KBE342
Madison KGT618
Marathon KID533 KIW586
Marianna KIB490 KIM752
Melbourne KIB484
Miami KBX376 KFS997 KIW978 KLU468
Monticello KIR487
Naples KLG645
Ocala KIB491 KIW904
Okeechobee KBE343
Orlando KIC854 KJN747 KLJ285 KYH38
Pahokee KIB479
Palatka KIB471
Panama City KIC734
Pensacola KGJ672 KIB473 KLP923
Perry KIW553
Pinellas Pk. KIM939
Quincy KBQ738
Raiford KIJ666
St. Augustine KID680 KLW285
Sarasota KGV216
Starke KIP346
Sunshine Skyway KIJ281-2
Tallahassee KCO299 KFX230 KFY387 KIL349 KIW304 KLK645 KLP924
Tampa KFY412 KIB487 KLJ287 KLP928 KTU89
Tavernier KIS435
Wausau KIV748
W. Hollywood KLP929
W. Palm Bch. KHM80-1 KIB482 KJB875 KLP927
Winter Garden KIW977 KLP925 KYH39
Yeehaw KID295
Yulee KIQ722
portable KID490 KFJ963

TURNPIKE AUTHORITY

Channels/Stations:
155.37 KFI592 KIM778
156.18 KAU728 KCW688-90 KDY446-8 KFF376 KIM285-8 KIM291-2 KIM295
156.24 KAU728 KCW687 KDJ442 KFI513 KGY296 KIM283-4 KIM289-90 KIM293-4 KIY284
159.12 KCW680-6 KCY211 KIM274 KIM276 KIM279 KIM281-2 KLD822
159.18 KCW680-6 KCY211 KIM275 KIM277-8 KIM280 KIM283 KLD822
(UHF: 453.575 453.625 453.675 453.725)

Locations/Stations:
Boca Raton KIY284
Broward Co. KDY446 KIM284 KIM287-8 KIM293 KIM295
Dade Co. KIM289
Ft. Pierce KCY211 (+UHF)
Jupiter KIM274
Kenansville KCW684
Kissimmee KDJ442
Lake Co. KCW680 KLD822
Lake Worth KIY283
Martin Co. KIM280-1
Okeechobee KCW690
Orange Co. KCW689 KGY296
Orlando KCW681-2 KFI592 (+UHF)
Osceola KCW683 KCW686
Palm Bch. Co. KDY448 KIF513 KIM275 KIM277 KIM282-3 KIM291-2
Pompano Bch. KAU728 KIM294 (+UHF)
St. Lucie Co. KDY447 KIM285-6 KIM290
Sumter KCW687-8
Vero Bch. KCW685
W. Palm Bch. KIM276 KIM778

*SERVICE/USE CODES:

AV Aviation Authority
CD Civil Defense
FD Fire Department
HA Housing Authority
LG Local Government
MC Mosquito Control
PA Port Authority
PD Police Department
PI Bur. Public Instruction
PW Public Works
RB Roads & Bridges
SD Sheriff's Dept.
ZC Zoning Commission

COUNTY OPERATED UNITS

Co/City * Call MHz

Alachua Co., Gainesville
SD KIA305 154.83
SD KIA305 154.95
Bay Co., Panama City
SD KIL237 37.30
LG KDR436 154.965
Baker Co., MacClenny
SD KIC740 154.725
SD KIC740 154.95
Bradford Co., Starke
SD KIG514 154.95
LG KFK524 153.92
Brevard Co., Cocoa
SD KIB675 154.89
SD KIG499 154.89
LG KIW652 155.715
LG KCS26 158.94
LG KDA72-3 158.94
LG KSZ75 158.94
HA KGL494 453.15
Eau Gallie
LG KDA71 158.94
LG KDG21 158.94
LG KHJ40 158.94
Melbourne
LG KFM333 155.715
LG KBX89 158.94
LG KEX35 158.94
Merritt I.
LG KDG22 158.94
LG KUX37 158.94
Palm Bay
SD KI1346 154.89
LG KDA69 158.94
Rockledge
LG KFX275 155.865
LG KES99 158.94
Titusville
LG KGT517 155.715
LG KBS75 158.94
LG KDA70 158.94
LG KDG20 158.94
LG KEX34 158.94
LG KRT69 158.94
Broward Co., Dania
LG KFW71 153.755
Ft. Lauderdale
SD KIG937 154.71
SD KIG937 154.83
SD KIP442 154.71
SD 155.46
LG KFW70/2 153.755
LG KBR500 453.95
PA KAS436 156.00
CD KDG742 158.775
W. Hollywood
SD KIP441 154.71
Calhoun Co., Blountstown
SD KIK958 37.30
Charlotte Co., El Jobean
SD KIZ201 45.90
Punta Gorda
SD KIJ289 45.90
SD KEV432 155.10
SD KLU232 155.565
SD KND53 158.97
Citrus Co., Homossasa Sp.
LG KDK71 158.94
Inverness
SD KID654 45.14
LG KDN937 155.10
Lecanto
LG KBU680 155.10
Clay Co., Green Cove
SD KIF637 154.95
Keystone Ht.
SD KFK678 154.95
Orange Pk.
SD KGJ761 154.95
Collier Co., Immolakee
SD KIN850 46.02
SD KCS22 158.88
Miles City
LG KBG767 155.82
Naples
SD KIJ601 46.02
SD KCS23-4 158.88
LG KLS459 158.82
Columbia Co., Lake City
SD KIF433 154.95
DeSoto Co., Arcadia
SD KIC372 46.02
Dixie Co., Cross City
SD KIP485 155.85
Duval Co., Jacksonville
SD KJH224 453.30
SD KJH224 453.35
SD KJH224 453.40
SD KJH224 453.45
SD KVL97 458.30
SD KVL97 458.35
PI KBE489 155.76
LG KEM616 155.82
LG KGT622 155.82
Escambia Co., Century
SD KJV49 154.83
Gonzalez
SD KIN947 159.15
SD KDK716 159.18
SD KCK315 155.82
Pensacola
SD KIW42 154.83
CD KBC767 155.28
PI 46.52
LG KTX88-9 155.88
Flagler Co., Bonnell
SD KIC520 154.95
Franklin Co., Apalachicola
SD KIP556 37.30
Gadsden Co., Quincy
SD KIK393 37.30
Gilchrist Co., Trenton
SD KI1347 154.95
Glades Co., Moore Haven
SD KJD852 27.265
Gulf Co., Pt. St. Joe
SD KIH759 37.30
Hamilton Co., Jasper
SD KIL452 155.58
Hardee Co., Wauchula
SD KIG805 45.58
SD KCN356 155.04
Hendry Co., LaBelle
SD KIL246 155.595
Hernando Co., Brooksville
SD KIF340 45.14
Highlands Co., Sebring
SD KIC938 46.02
Hillsborough Co., Plant City
PI KET51 158.94
Tampa
SD KIB660 154.785
SD KGY286-7 453.30
SD KCW733 453.35
SD KOO35-7 458.30
AA KLD747 453.40
PI KCV405 154.98
PI KET52-5 158.94
SD KIB660 155.19
LG 453.475
Holmes Co., Bonifay
SD KIK982 37.30
Indian River Co., Vero Beach
SD KIT743 155.565
RB KIQ919 45.64
MC KJS853 46.56
Jackson Co., Marianna
SD KIA621 37.30
Jefferson Co., Monticello
SD KIK947 37.30
Lafayette Co., Mayo
SD KIH796 155.13
Lake Co., Tavares
SD KIB853 39.86
LG KFT570 45.40
Lee Co., Ft. Myers
SD KIC303 45.98
SD KBK529 155.655
SD KLE380 155.655
SD KHI52-4 158.91
SD KBA483 158.82
LG KBT90-1 153.86
LG KFM24 153.86
LG KNP83 153.86
LG KYT40 153.86
LG KEB73 153.86
LG KGK538 453.15
MC KIX496 158.76
Ft. Myers Bch.
SD KHI55 158.91
Lehigh Acres
SD KNF98 158.91
Sanibel
SD KHQ34 158.91
Leon Co., Tallahassee
SD KIH616 37.30

WHITE'S EMERGENCY STATIONS

Levy Co., Bronson
SD KIF638 154.95
Liberty Co., Bristol
SD KIK959 37.30
Madison Co., Madison
SD KIS862 155.61
Manatee Co., Bradenton
SD KIG803 155.79
LG KEW970 154.025
Marion Co., Ocala
SD KIB649 155.07
SD KIB649 154.95
Martin Co., Salerno
LG KDK790 155.085
Stuart
SD KIB437 154.86
LG KCR241 155.085
LG KDO264 155.085
Monroe Co., Key West
SD KIG769 45.10
LG KDW87 154.98
LG LCL210 158.76
Marathon
SD KIW586 45.10
LG KCL208 158.76
Tavernier
SD KIS435 45.10
LG KDW88 154.98
LG KCL209 158.76
Nassau Co., Boulougne
LG KD123 153.845
Bryceville
LG KD122 153.845
Callahan
LG KD126 153.845
LG KHW94 153.845
SD KJE209 45.70
Fernandina B.
SD KIB712 45.70
LG KGK611 158.775
LG KD125 153.845
LG KD127-8 153.845
LG KHW90-3 153.845
Hilliard
LG KD120-4 153.845
LG KHW96 153.845
Yulee
LG KHW95 153.845
LG KGK610 158.775
Okaloosa Co., Crestview
SD KIF502 37.30
Okeechobee Co.
Okeechobee
SD KIB703 158.73
LG KFG496 46.54
Orange Co., Orlando
SD KIN201 154.65
SD KIH341 154.74
LG KFK532 155.055
PI KAT550 155.82
ZC KIY433 158.76
Winter Garden
SD KJF202 154.65
Osceola Co., Keenansville
SD KI1832 155.25
Kissimmee
SD KIK983 155.25
SD 465.375
St. Cloud
LG KJB222 155.025
SD 460.375
Palm Beach Co.
Belle Glade
SD KJB872 45.60
SD KCC96 154.725
LG KGY529 453.25
Lake Worth
LG KJ1545 153.905
Palm Beach
SD KLJ220 155.565
W. Palm Beach
SD KLK539 155.565
SD KIW388 45.60
SD KCA68 154.725
SD KAPB7 154.845
SD KCN975 155.25
SD KDG229 155.25
SD KIS457 155.25
LG KAX583-4 153.80
LG KCW719 453.25
Pasco Co., Dade City
SD KIB662 45.14
LG KRQ89 153.845

Lacoochee
SD KIZ532 45.62
New Pt. Richey
SD KID654 45.14
LG KRQ36 153.845
San Antonio
LG KFG473 158.895
LG KLR476 453.15
Pinellas Co., Clearwater
SD KIQ881 155.64
SD KIQ881 156.09
SD KIR525 158.76
LG KIR823 153.80
St. Petersburg
SD KIG503 155.64
SD KIR621 158.76
SD KHW66 154.755
St. Pete Bch.
SD KCZ857 155.64
SD KDB395 158.76
SD KYA60 154.755
Polk Co., Bartow
SD KIA730 155.595
SD KIA730 155.70
LG KEP584 158.805
Putnam Co., Crescent City
SD KIC759 154.95
E. Palatka
LG KFF304 158.835
Palatka
SD KIL759 154.95
SD KIL759 155.55
St. Johns Co., Ponte Verde E.
SD KDZ462 39.50
St. Augustine
SD KIC244 39.50
LG KCR886 158.745
St. Lucie Co., Ft. Pierce
SD KIN499 155.79
SD KN124 155.85
LG KBA750-1 155.82
portable
LG KFZ829 155.82
Santa Rosa Co., Milton
SD KIA279 45.22
Sarasota Co., Sarasota
SD KDY327 155.43
SD KIB685 155.43
SD KGV55 159.03
Seminole Co., Sanford
SD KIG992 154.95
SD KIG992 155.535
LG KAV735 153.815
Sumter Co., Bushnell
SD KIB405 45.14
Suwanee Co., Live Oak
SD KIL288 45.22
Taylor Co., Keaton Bch.
SD KBJ639 37.30
Perry
SD KIL238 37.30
Steinhatchee
SD KUT274 37.30
Union Co., Lake Butler
SD KIH947 154.95
SD KJ1355 154.95
Raiford
SD KEL418 154.95
Volusia Co., Daytona Bch.
SD KIT657 154.95
LG KBU993-4 155.88
MC KJZ916 153.955
CD KLP872 37.26
Deland
SD KIB941 154.86
SD KIB941 154.95
Holly Hill
SD KIC281 154.95
New Smyrna B.
SD KEL388 154.95
Ormond Bch.
LG KBU995 155.88
Smyrna Bch.
MC KJZ915 153.985
Wakulla Co., Crawfordville
SD KIL218 37.30
Walton Co., Se. Funiak Sp.
SD KIE933 37.30
Washington Co., Chipley
SD KIL238 37.30

FLA. MUNICIPAL AGENCY STATIONS

City * Call MHz

Apalachicola
PD KIL595 155.43
Apopka
PD KIY379 155.01
FD KDC925 154.43
Arcadia
PD KIP567 45.94
LG KDF608 46.54
Atlantic Bch.
LG KCN848-9 154.10
Auburndale
PD KI1612 155.07
LG KCW693 154.04
Avon Park
LG KDO295-6 155.94
Bartow
PD KIA766 155.31
FD KDA731 154.385
Belle Glade
PD KIB440 156.21
LG KIY425 155.04
Boca Raton
PD KIR951 155.52
FD KBR981 154.40
LG KIR651 155.82
Boynton Bch.
PD KIP849 155.61
FD KDJ435 154.145
FD KDJ435 153.95
LG KBO563 155.10
Bradenton
PD KID220 37.10
FD KBV800 154.37
FD KBW827-8 154.37
FD KDB431 154.37
FD KIR872/4 154.37
Brooksville
PD mobiles 45.14
LG KGR261 45.20
Cape Canaveral
PD KCP602 155.64
Chattahoochie
LG KDS637 154.055
Chipley
LG KLP977 155.745
Clearwater
PD KI1631 154.725
PD KI1631 155.01
FD KDF524 154.28
FD KDF524 154.40
Clermont
LG KCR263 153.86
Clewiston
PD KFM460 154.785
LG KIV830 154.04
Cocoa
PD KIW494 155.19
FD KCT610 154.16
FD KFF217 154.16
FD KIY376 154.19
LG KJY676 153.905
Cocoa Bch.
PD KIW493 155.97
FD KDU528 154.13
FD KFN642 154.13
LG KCY201 154.98
LG KFN637 154.98
LG KIZ614 154.98
Coral Gables
PD KIC792 158.79
PD KAS745 155.04
PD KIH451 458.05
Crestview
PD KIK493 155.31
Dade City
PD KIM684 45.22
FD KJC942 27.265
LG KDN612 45.44
Dania
PD KIX348 155.55
LG KDN547 155.865
Daytona Bch.
PD KIA218 155.25
FD KCY227-9 154.175
FD KCY617 154.175
FD KIH757 154.175
LG KEO325 153.98
LG KET384 154.04
Deerfield Bch.
PD KIM223 159.21
FD KCO323 154.325
LG KBK410 158.94

DeLand
PD KIB935 158.85
FD KIJ637 154.22
Delray Bch.
PD KIB461 155.07
FD KCR882 153.95
FD KFV797 154.19
FD KFV797 154.265
FD KIH757 154.205
LG KIR950 158.88
Dunedin
PD KDP419 155.58
LG KBA460 155.94
Eau Gallie
PD KFB937 155.37
FD KCU272 154.16
Englewood
FD KIP537 46.06
Eustis
PD KIC897 39.92
LG KCX432 45.52
Fernandina B.
LG KBR640 155.10
Ft. Lauderdale
PD KIB713 155.13
PD KJU894 155.31
PD KI8713 155.97
FD KI1907 154.22
FD KI1907 154.37
FD KIQ233 154.25
FD KBQ620 154.37
FD KDV689 154.37
FD KDV690 154.37
FD KEX270-1 154.37
FD KIP447 154.37
FD KIZ241 154.37
FD KJU867 154.37
LG KEW949 153.815
LG KEW968 153.92
LG KIY387 153.92
LG KIW638 154.10
LG KJ1559 155.085
Ft. Meade
PD KIF954 155.85
LG KDK754 155.88
Ft. Myers
PD KIA407 155.535
LG KIU233 153.92
FD KBS981-2 154.43
FD KBS981-2 154.325
FD KDZ502 154.325
FD KFX387 154.325
Ft. Pierce
PD KIA929 159.21
PD KJB965 155.94
FD KBY738-9 154.22
FD KEU991 154.22
FD KEW960 154.22
LG KIV367 158.82
LG KJB965 158.955
Ft. Walton B.
PD KAQ276 155.49
IG KAR456 155.94
Frostproof
LG KFB998 158.745
Gainesville
PD KIB903 156.03
PD 460.025
PD 460.125
PD 460.275
PD 460.375
FD KCT624 154.40
LG KCQ279 155.04
LG KJR281 453.50
LG KJR281 453.75
Green Cove S.
PD KIF496 155.19
LG KDP316 155.895
Gulfport
PD KIT275 155.37
PD KDQ260 153.965
Haines City
PD KIG993 156.45
LG KDK639 155.10
Hallandale
PD KI1425 158.85
LG KGR266 154.98
LG KDG245 154.98
Hialeah
PD KIG578 154.77
FD KBW804 154.07
Holly Hill
PD mobiles 155.25
LG KEP597 154.115
FD KDG847 154.22
Hollywood
PD KIB746 155.91

PD 460.075
PD 460.175
PD 460.225
PD 460.275
LG KIS598 153.98
LG KYR50-1 155.805
FD KCW385-7 154.13
FD KFB886 154.13
FD KID294 154.13
LG KJP297 153.875
LG KRP93-5 155.835

Jacksonville
PD KAY870 155.67
PD KAY870 158.73
PD KIB246 155.67
PD KLU234 155.67
PD KHJ26 155.91
PD KFM493 158.73
PD KLU340 158.73
PD 153.755
PD KJW779 453.05
PD KJW779 453.10
PD KJW779 453.15
PD KJW779 453.20
PD KIZ478 453.55
FD KIL436 33.74
FD KL1995 154.355
FD KIB306 154.445

Jacksonville Bch.
PD KIB708 159.21
LG KIS439 158.82

Key West
PD KIB564 155.43
FD KCZ471 154.13
LG KFX375 45.56

Kissimmee
PD KIA290 158.97
LG KCR280 158.835

Lake City
PD KIB433 155.01
FD KIF863 154.37
LG KDK755 154.10

Lakeland
PD KIA275 460.225
PD KIA275 460.40
PD KIA275 460.45
PD KIA275 460.50
PD KIF995 154.19
FD KEY939 154.295
FD KEY939 154.325
PD KDL888 39.06
PD KDL888 45.28

Lake Park
PD mobiles 155.85
FD KQC284 154.19
LG KDN549 155.955

Lake Wales
PD KIC842 155.43
FD KDX377 154.145
LG KDF586 153.86

Lake Worth
PD KIA608 155.43
FD KDG814 154.235
LG KIR625 155.76

Lantana
PD KFX404 155.37
PD KFV944 155.145
FD KJB981 153.95
FD KJB981 154.265

Largo
PD KFO947 156.03

Leesburg
PD KIB533 155.49
LG KAU282 158.82

Live Oak
PD KIK696 155.07
LG KDL946 155.10

MacClenny
LG LAW757 158.76

Madeira Bch.
PD KI1277 159.09
PD KBX937 158.88
PD KDP294 158.88

Madison
PD KIM606 155.61
LG KDU471 155.88
LG KEY938 155.88

Maitland
PD KJD290 155.625
FD KJU381 154.40
FD KJU381 154.43
LG KIV963 155.94

Margate
PD mobiles 154.71
FD KJN777 154.25

Marianna
PD KIB312 155.07
LG KDV395 155.04

Melbourne
PD KIA477 158.79
FD KJU247 154.16

Merritt I.
FD KCT608 154.16

Miami Spgs.
PD KAT759 155.67

Milton
LG KIY431 158.76

Miramar
PD KAT794 156.15
LG KCV353 155.775
LG KJU317 155.775

Mt. Dora
PD KIC511 39.82
LG KDK661 158.955

Mulberry
PD KCY559 155.37
PD KBF850 155.76

Naples
LG KIV649 155.76
FD KJW439 155.145

Neptune Bch.
LG KFG570 154.10

New Pt. Richey
PD KBG761 155.37
PD KJY826 27.245
PD KJY826 27.275

New Smyrna B.
PD KI8401 154.95
FD KGK652 46.08
LG KEW984 45.60
LG KIQ922 45.60
LG KIQ922 154.115

No. Miami
PD KBD928 155.67

No. Miami Bch.
LG KBG784 453.40

No. Palm Bch.
PD KIW583 156.09

Oakland Pk.
PD KIP604 155.73
LG KAY226 155.94

Ocala
PD KIB620 155.61
LG KDZ433 154.085

Ocoee
PD KLO220 155.37
PD KDP978 154.10
PD KFD636 154.10

Orange Pk.
LG KC1595 154.995

Orlando
PD KGV239 154.80
PD KGV239 155.13
PD KI8287 155.13
PD 460.05
PD 460.10
PD 460.40
PD 460.45
FD KIB573 153.89
FD KIB573 154.43
FD KDG891 154.43

Ormond Bch.
PD KIG623 155.31
PD KIL303 155.31
LG KDG243 156.00

Pahokee
PD KIB542 155.31

Palatka
PD KIC997 155.43
FD KIS622 154.19
LG KIY385 153.80

Palm Bay
LG KGP718 155.805
FD KFK533 154.16
FD KLP895 154.16

Palm Bch.
PD KDN418 153.755
PD KIA405 155.01
FD KDP761 154.265
FD KDP761 154.34
FD KDL836 154.34
FD KFA465 154.34
FD KLL578 154.265

Palmetto
PD KAV264 159.15
FD KIR873 154.37
FD KUA785 154.37
LG KDU544 154.965

Palm Sprgs.
PD mobiles 155.43
PD KGW805 155.37
PD KGW804 154.965

Panama City
PD KIB396 158.79
LG KIR752-3 158.82

Pensacola
PD KIB775 155.61
PD KHI26 158.91
FD KIC237 154.37
FD KIL568 154.43

Perry
PD KIK255 154.65
LG KDU470 153.98

Pinellas Pk.
PD KI1218 155.07
FD KIZ365 154.145
FD KIZ365 154.34
LG KIW274 155.88

Plantation
PD KBT212 155.07
PD KGK733 155.055
FD KCR272 154.445

Plant City
PD KIB648 155.67
LG KDT306 155.805

Pompano Bch.
PD KFA462 159.09
PD KIS855 159.09
LG KIV402 154.04
LG KFB853 154.04
FD KCJ683 154.25
FD KFF322 154.25
FD KFR642 154.25

Punta Gorda
PD KI1851 155.625
LG KFF400 155.88
LG KDL919 155.88

Quincy
PD KIB807 154.845
LG KDC298 154.98

Riviera Bch.
PD KIG373 155.85
FD KLO377 154.265
LG KB1972 153.875
LG KDA350 156.015

Rockledge
PD KFT464 155.115
FD KFV933 154.16
FD KJU248 154.16

St. Augustine
PD KIE804 159.15
LG KDG228 158.94

St. Cloud
PD KIQ577 155.655
LG KIR225 155.76

St. Petersburg
PD KIA439 155.91
FD KJY886-7 46.12
FD KIB305 154.07
LG KIW306 158.82
LG KDT292 453.20
LG KGU82 458.20
LG KGV51 458.20
LG KYT49 458.20
LG KGU81 458.20

Sanford
PD KIB373 154.77
PD KIQ770-1 154.77
FD KIQ772-4 154.43
LG KIS548 45.56

Sarasota
PD KIB747 154.815
FD KDE709 46.06
FD KGY208 46.06
FD KIP536 46.06
FD KIP536 46.16
FD KIP708 46.06
FD KIX767 46.06
FD KIS545 154.31
LG KIW705 154.10

Sebring
PD KIK672 154.77
FD KBE479 154.34
LG KB1971 154.055

Springfield
LG KDE652 155.835

Starke
LG KAQ937 155.94

Stuart
LG KBG813 154.98
FD KDO232 154.01
FD KIU805 154.01
FD KLL538 154.01

Tallahassee
PD KTA566 155.19
PD KCU41 158.97
FD KFD550 154.19
FD KFK566 154.19
FD KFK689 154.19
FD KFK690 154.19
FD KIJ521 154.19
LG KIT565 155.76

Tampa
PD KIB459 155.97
PD KIB459 156.21
PD KBL389 453.05
PD KIB459 453.55
PD KIN998 453.60
PD KIB459 453.70
PD KIB459 453.80
PD KIB459 453.85
FD KFG601 154.175
FD KFG602 154.13
FD KFG602 154.175
FD KLO493 154.175
FD KLP737-8 154.175
FD KIA653 154.22
FD KIA653 154.43
FD KI1455 154.43

Tarpon Sprgs.
PD KIN847 155.49
LG KDN586 154.04

Tavares
PD KDV737 39.82

Titusville
PD KDT228 154.725
FD KFT622 154.325
FD KLO469 154.325
FD KLO470 154.325
LG KAZ304 154.10

Treasure I.
PD KIK968 158.79
LG KCZ535 153.875

Venice
PD KCN369 155.37
PD KBX502 154.04

Vero Beach
PD KIA713 155.67
FD KCN654 154.37
PW KCN834 158.76

Wauchula
LG KIW215 45.64

W. Palm Bch.
PD KIC274 159.15
FD KBY362 153.95
FD KBY362 154.265
FD KBD558 154.43
FD KGT555 154.43
FD KIC278 154.43
FD KIF722-3 154.43
LG KGV370 45.32
LG KIV709 45.44
LG KJR257 153.845

Wilton Mnrs.
PD KIK250 155.46
PD KIK250 155.58

Winter Grdn.
PD KIH456 155.79
PD KJA926 154.025
FD KFG498 154.355

Winter Haven
PD KIB776 155.55
FD KDP971 154.235
LG KIX704 155.895

Winter Park
PD KIB693 158.73
FD KDJ599 154.37
FD KC1492 158.88
FD KGT568 158.88

Zephyrhills
PD KIN420 45.66

Next Issue

Emergency Stations in Lower California

Mathematics of Music

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Beats. The throbbing or pulsating effects produced when two or more vibrational frequencies interfere with each other are called beats. Figure 10 diagrams how a beat is formed. The two dotted lines represent pure primary sound tones of slightly different frequencies.

Initially, the compressions and rarefactions of air, represented by the "waves," reinforce each other to produce a composite sound (solid line) of greater amplitude than either primary sound. But as the two primary tones drift out of phase, they oppose each other so as to create a short period of minimal amplitude, or even total silence. This is the beat. The phase shift then continues to again produce a period of reinforcement, followed by another beat, and so on.

The number of beats per second is equivalent to the difference in the frequencies of the two primary sounds. For example, frequencies of 256 and 254 Hz sounding together produce two beats per second.

In 1873 Professor H. von Helmholtz published his classic mathematical study of the nature of sound and music. Helmholtz had observed that a beat frequency of up to five or six per second produces a pleasing sound, but as the beat frequency increases above this level, the effect becomes increasingly unpleasant. When the beat frequency becomes so rapid that the individual beats cannot be distinguished (above 20 per second), the music still exhibits a dissonance generally termed "roughness."

As the beat frequency is increased even more, the roughness fades away until it disappears when a beat frequency equivalent to a minor third is obtained. The roughness reappears again only when the beat frequency is close to the octave, and once more disappears when the octave interval is made exact. As any musician knows, octave notes must be played correctly or pronounced dissonance is immediately evident.

The beat effect is the basic cause of musical dissonance. But it should be noted that beats are often used to good effect as well. For example, beats are used to provide the so-called *voix celeste* of an organ; this is a soft tremulous tone produced by a labial stop of 8-ft. pitch. Before the advent of electronic instruments, piano tuners were dependent on beat phenomena when tuning pianos.

Much of the musical "quality" obtained when a number of musical instruments play together can also be attributed to beats. For example, it would be very easy to amplify the sound of one violin to make it as loud as ten violins. And yet it isn't done, even though this would reduce musician salaries considerably. Why? Ten violins can't be tuned to absolute perfection with each other which means that the slightly "incorrect" tunings lead to the production of beats which create a tonal quality not attainable with one violin incapable of beating against itself.

Overtones. Throughout the preceding discussions we have been concerned wholly with pure tones and combinations of pure tones. But musical notes as created by instruments or the human voice are not pure in a vibrational sense; they are in fact complex mixtures of related vibrational frequencies. For example, an instrumental A is not just a frequency of 261.7 Hz; it is that plus many other frequencies called *overtones.* As will be apparent from Fig. 11, the various overtones of a fundamental can be calculated by multiplying the fundamental frequency by 2, 3, 4, etc.

The components that make up a complex sound structure are called *partial tones,* or

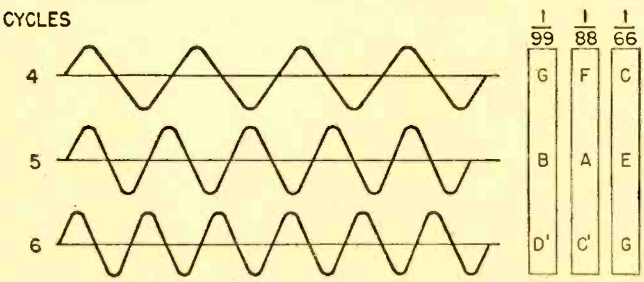

Fig. 9. Best way to understand triad ratios is to view them in terms of what's actually going on during a given time period. Here, while note C goes through four cycles, E will go through five cycles, and G through six.

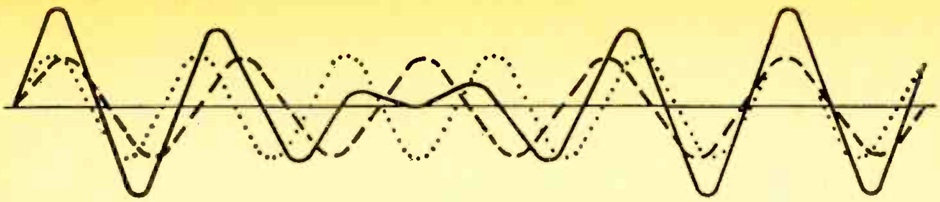

Fig. 10. Artist's representation of how beat is formed. Phase of two tones is basic here, since notes will tend to either reinforce or cancel one another.

simply *partials*. The *fundamental* is the partial having the lowest frequency; the higher frequencies are *upper partials* or *overtones*. When the frequencies of the overtones are exact multiples of the fundamental, the partials are called *harmonics*. When they are not exact multiples, they are called *inharmonic partials*.

Dissonance. An octave is a musical interval of the highest possible consonance, or to put it another way, an interval having the least dissonance. Why this should be so is made evident by Fig. 11. Compare the fundamental and overtone frequencies of the "low rate" (middle C) with those of the octave note C^1. Note that every frequency in the higher octave matches exactly some overtone of the low note. (The fourth octave overtone would match the 9th overtone of the low note.) If you accept the fact that the low note, C, would exhibit no dissonance if sounded alone, you can see that the addition of the octave C^1 adds nothing that is not already present, and therefore cannot produce dissonance.

What about the beating effect between the overtones themselves? The smallest frequency difference is 262 Hz (524 − 262); this beat frequency is too high to produce a sensation of musical roughness or dissonance.

What happens when the higher note is lowered a semitone to produce an interval of a seventh? The situation is now very much different. Note one of the overtones of the seventh matches an overtone of the low note. Moreover, the difference between certain overtones is now much smaller. For example, the beat frequency between the seventh fundamental (494 Hz) and the first overtone of the low note (524) is 30. This beat frequency is in the range that is most likely to produce dissonance. And facts confirm theory; the seventh is recognized as an extremely dissonant interval.

Now drop down to the fifth. Note that the first and third overtones of the fifth correspond to the second and fifth overtones of the low note. This correlation is conducive to the consonance, or lack of dissonance, associated with musical fifths.

The Surface Only. The mathematics of music as a whole—or even of a single aspect such as dissonance—is so complex that only the briefest introduction can be given here. But let's consider one more musical curiosity mainly to whet the appetites of those who think they might enjoy delving deeper into this fascinating subject.

Study Fig. 12. Note that in the upper half of the chart all of the selected tone intervals have almost identical beat frequencies. Yet the fifth and major third are consonant, while the tone is dissonant and the semitone is even more dissonant. Why? Good question.

In the lower half of the chart a number of identical semitones ($C^{\sharp}$-C) in different

DISSONANCE AND CONSONANCE FREQUENCY RELATIONSHIPS

	Low note	High note		
		Octave	5th	7th
Fundamental	262	524	392	494
First overtone	524	1047	785	988
Second overtone	785	1570	1178	1482
Third overtone	1047	2094	1570	1976
Fourth overtone	1309	2617	1963	2470
Fifth overtone	1570			
Sixth overtone	1832			
Seventh overtone	2094			

Note: all frequencies have been rounded to the nearest whole numbers.

Fig. 11. Dissonance and consonance frequency relationships between middle C and its various overtones. Underlines indicate frequencies having exact counterparts.

Mathematics of Music

Continued from previous page

octave ranges are compared. Observe that the beat frequency is lowest in the lowest octave range and that this produces the least amount of dissonance.

But it doesn't follow that the greatest amount of dissonance occurs in the octave range having the highest beat frequency. For the C♯-C semitone at least, the greatest dissonance is observed in the octave range producing a beat frequency of about 31. Why? Another good question.

Intrigued? Then in all fairness, this warning. If you have enough curiosity to dig out the answers to these two questions, you'll almost surely be hooked forever by the mathematics of music—and not because it will help you play the piccolo any better. Perhaps it's because the arbitrariness of music adds a certain spice to the game of musical mathematics. Just when you're sure that two plus two equals four, you find that it actually equals 3.99 or 4.01—and you want to know why. ■

CONSONANCE AND DISSONANCE IN RELATION TO BEAT FREQUENCIES

Tone interval	Tones	Frequencies	Beat frequency	Sound quality
Fifth	G_2-C_2	98.0— 65.4	32.6	Consonant
Major 3rd	E_3-C_3	164.8— 130.8	34.0	Consonant
Tone	D_4-C_4	293.7— 261.7	32.0	Dissonant
Semitone	C_5♯-C_5	554.6— 523.4	31.2	Dissonant (more than tone)
Semitone	C_6♯-C_6	1109.2—1046.8	62.4	Dissonant
Semitone	C_5♯-C_5	554.6— 523.4	31.2	Most dissonant
Semitone	C_4♯-C_4	277.3— 261.7	15.6	Dissonant
Semitone	C_3♯-C_3	138.6— 130.8	7.8	Dissonant
Semitone	C_2♯-C_2	69.3— 65.4	3.9	Least dissonant

Fig. 12. Consonance and dissonance in relation to beat frequencies. Note that beat frequency itself apparently has little bearing on whether sound is consonant or dissonant.

New Products

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dering heat with no danger of overheating. It continues at the lower wattage until a higher heat is required, then the relay cuts in again for as long as needed. Initial input is 180 watts and it operates at 40 watts. Heating elements may be changed without tools. Iron-plated or ⅛-in. plug-in tips are inserted by loosening one set screw, and you can match the tip to your job. Price is $9.95 and more dope can be had from Wall Manufacturing Co., Kingston, N. C. 28501.

Neat Lil Radio

Heath Company has brought out a solid-state AM/FM table radio, the GR-48, a bargain at $39.95 in kit form. The GR-48 has switchable automatic frequency control (AFC) and 5-*u*V sensitivity. Automatic gain control on AM keeps the volume constant under varying signal strengths. There are built-in AM and FM antennas. The cabinet is avocado green with a color-coordinated grille. The dial is back lighted and all controls are front-panel mounted. There's a 3 x 5-in. oval speaker. The circuit goes together on a single circuit board, and the AM/FM tuner is supplied factory-aligned.

Want to know more about the GR-48? Then drop a line to Heath Co., Benton Harbor, Mich. 49022.

Ask Me Another

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volt heater which might work. You'll have to replace the five-in tube sockets with a seven-pin miniature type.

☆ The Skies Above Us ☆

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the sun, is being devoured by an evil monster. Very early in most civilizations throughout the world, the sun was assigned the position as the giver of all light and life. The Mayan priests in Yucatan recorded many solar eclipses over several centuries, including an annular eclipse on Aug. 17, 342 A.D., whose path crossed this same area where our eclipse of March 7 enters Mexico.

★ Only a dozen minutes after totality begins on the south coast of this thin part of Mexico, the umbra leaves the land and heads across the Gulf of Mexico toward western Florida. We'll follow it along the way, but here I should hold out some consolation to those who can't get away from home. This eclipse will be visible as partial, outside the path of totality, over all of North and Central America (except Alaska) and in South America down to a line from mid-Peru to Guyana (formerly British Guinea, if your map is an old one).

★ Now, to get back to the umbra, it picks up speed across the Gulf and enters Florida east of Tallahassee at about 1:16 EST, at 1800 miles an hour; it is then only 85 miles wide and totality lasts 3 minutes 10 seconds. Into the southeast corner of Georgia it goes at 1:19 and along the coasts of that state and South and North Carolina, then leaping into the Atlantic around Norfolk at 1:36 p.m., with a speed of 2100 miles an hour, a path 80 miles wide and 2 minutes 49 seconds required to pass a given spot. As a last good-bye to the U.S., the umbra next barely touches the island of Nantucket at 1:47, but the speed is 2400 miles an hour and totality lasts only 1 minute 37 seconds.

★ Again the path lies over water, then there's a swift trip along the coast of Nova Scotia and across Newfoundland into the North Atlantic, where the tip of the shadow's finger leaves the earth about 600 miles south of Iceland, some two hours after first touching Mexico and about three and a half after the beginning out in mid-Pacific.

★★ As for observing this important event, a few words to the wise. First of all, when there is no total eclipse where you are, never look at the sun without protection (regular sun glasses are *not* protection). Welder's glasses, if you can see nothing else through them but the very brightest of lights, close up, will be safe. But don't use binoculars or a telescope for viewing unless the filter covers the whole front end; at the eye-end, the concentrated heat of the sun will crack the filter. For two or three dollars, you can buy a #12 welder's helmet window, which is quite safe for naked-eye viewing (or again over the front of binoculars or a small telescope); these are usually about 2 x 4 in. in size and can be cut into two squares. It's worth the investment.

★ A telescope or binoculars can be used to project an image of the sun, by holding a card several inches behind the eyepiece and focusing the sun's image sharply on it. In this way several eclipse viewers can watch at one time.

★ When you are so fortunate as to be in the path of the total eclipse, use one of the techniques described above, both before and after the brief minutes of totality. But when the black lunar disk hides all the bright sun, leaving only the corona visible—that enormous outermost envelope of our star—take all filters away and drink in the fantastic sight, for you may never see it again. Perhaps I can best hint at its appearance by quoting from my write-up of the only total eclipse I've ever seen—on July 9, 1945, from the village of Wolseley, Sask., to which I had flown 2000 miles and set up three tons of equipment in the hope of seeing and photographing the corona for only 34 seconds!

> *"I had read descriptions by scientists and popular writers and had looked at hundreds of photographs of the phenomenon. In other words, there was considerable preparation for what was to be seen. But there is no description and no pictorial representation that begins to express the awe-inspiring beauty of the sight! The sheer delicacy of the stuff of the corona was startling; the decided three-dimensional effect was a complete surprise. . . . The assembled villagers paid their tribute to the beauty of the corona with cheers and a great burst of applause at the reappearance of the sun and, for several minutes afterward, many of them were seen to be peering into the sky with looks of unbelief on their faces . . ."*

★ If you can at all make it, get close to the center of the total path on March 7 and take a chance on the weather for the sight of a lifetime. ■

Operation Face-Lift

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to have, yet not be excessively weighty. It's easy to work, and when sanded smooth and varnished or stained, becomes a very attractive piece of radio shack furniture.

Upright supports also can be ¾-in. plywood. But take care to cut the edges square so they'll make neat, strong joints, with no wobbling or teetering when attached to the top of the platform.

Begin planning your platform by arranging your equipment on a table top in the position you'll want to arrange it on the platform. Measure side-to-side and front-to-back dimensions of the entire arrangement to determine the size of the top for the platform. Don't jam the cabinets tightly together when you do this—leave about ¼-in. between adjacent units.

Next, decide what equipment you will want to install on the bottom side of the platform. Dimensions of this equipment will determine how high the platform should be above the tabletop. Ordinarily 4 or 5 in. is adequate, but it can be more than this if you have bulky equipment to place under the platform. Allow about ½-in. above the highest item you intend to put under the platform—more if ventilation is needed for gear containing tubes.

Block That Sag. If the equipment on top is very heavy, you'll need at least one center support, cut to the same dimensions as the end supports, in the middle of the platform. These supports should be attached to the platform top with long wood screws and preferably also with angle brackets or scrap pieces of wood cut exactly square and attached inside at the corners. These are necessary to ensure that the supporting pieces remain square to the platform top, and to prevent the supports from working loose in future months as equipment is rearranged or removed for service or modification.

Attach the angle brackets with wood screws, and attach wood braces with both wood screws and wood glue.

Wood screws should also be used directly through the platform top into the supports, with glue applied to the joint before the screws are tightened. Use flathead screws, and countersink them slightly below the surface of the top and sides, then fill this space with Plastic Wood or other filler. When the filler is dry, sand it smooth and finish with varnish or stain for a neat, professional-appearing job.

The end supports should be cut so they extend about 3 in. beyond the rear edge of the platform. This prevents the platform from being pushed tightly against the wall behind your operating bench; it also allows space between the back of your equipment and the wall for cables and accessory plugs on the back of the equipment. What's more, it leaves room for you to reach back there to check connections and make adjustments without moving the platform and all the equipment on it. About 1 in. of the bottom corner at the rear end of these supports can be mitered off to allow space for line cords and other wiring.

Lagged And Anchored. If you wish to mount small equipment items permanently to the underside of the platform or to the side or center supports, this equipment can be attached with angle brackets or with sheet metal straps attached to the platform with wood screws. Alternatively, shelves can be made of ¼-in. plywood or Masonite and mounted to cleats attached front to back on the vertical supports.

As you can see, the entire platform can be built in an evening or two, and it will add significantly to the enjoyment you receive from your radio gear.

When you get finished with your platform designed to your very own needs and taste, take a picture of it and send it off to the Editor. He'd like to see what you can do. ■

Magnetic Beam Balance

Continued from page 34

lightweight object? It's very simple—just place the object to be weighed on the weighing platform, being careful that it doesn't rub against the meter's face plate. Turn the power switch *on* and adjust the null control until the pointer, which has been forced down against the lower limit pin by the weight of the object, is just balanced in the middle of its excursion from minimum to maximum between the two limit pins. Take a reading on M2. Since there is a direct correlation between the weight of the object being weighed and the amount of current required to balance the pointer, the M2 readings can be converted directly to weight units. ■

Radio Astronomy by Mail

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of numerous small hot spots and at least one large intense source of X-rays on the edge of the solar disc.

Says Meisel: "Hopefully the technique will prove as accurate in pin-pointing the major sources of intense X-rays as high altitude rockets and satellites, but without their high cost." The ultimate goal of the experiments is a better understanding of solar activity and its effects on Earth. Improvements in long distance radio communications would be one result of the identification, location and prediction of the major hot spots.

What will the hundreds of participants get from their efforts? A "thank you" card from Meisel, and the personal satisfaction of knowing that they have participated in a worthwhile research project.

All Was Not Well. A number of participants also learned, much to their chagrin, that the paths of research are not always smooth. For example, one participant was forced to terminate his monitoring abruptly because of a cry of help; turns out that he is a member of a "rescue squad" that was called into action during the height of the ecplipse. Another participant reported his inability to monitor any station because his family strenuously objected to having the radio turned on at 4 a.m. A Californian wrote cryptically: "Due to an exasperating set of circumstances beyond my control, I was unable to obtain any radio observations."

Perhaps the most revealing plaint came from a participant who *did* complete his monitoring, but under conditions of extreme hardship. He wrote (good naturedly): "Had I known that I was going to listen to two hours of Beatle records, I never would have started." And yet he might well have expected something like that since he had been asked to monitor a hot spot. ■

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(Act of October 23, 1962; Section 4369, Title 39, United States Code)

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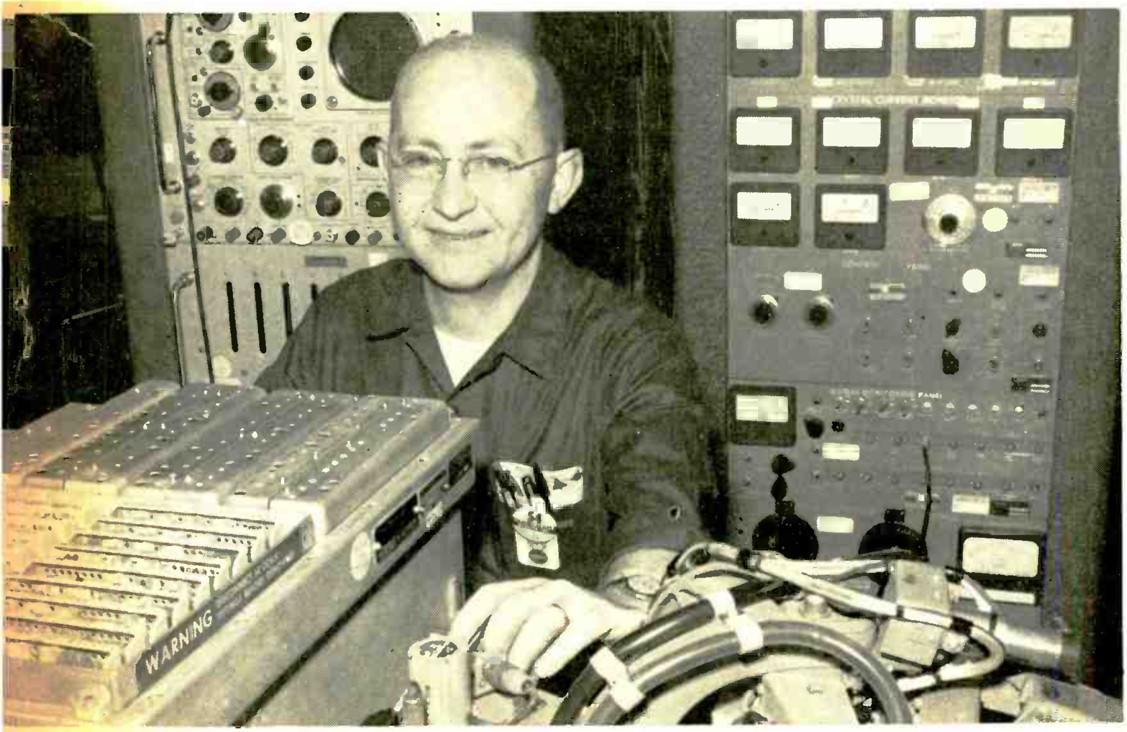
What Did That Bus Say?

Continued from page 63

another bus because this one has been so successful. He looks at the project from the standpoint of a passenger on that bus himself each day. "Traveling so many miles, so many days a week for so many hours, and so much land outside the window with scenery that is monotonous, would bore an adult, much less a child." Says Mr. Raine. "As a result of the program the children now fill in those lonely hours cramped together in a bus, by participating in a program that brings them all together in a common interest. They have an appetite for literature and other subjects now that they seemed not to have had before the installment of the tapes." ■

". . . and I suppose it hums now because it's so happy you worked on it?"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