HOW TO REJUVENATE YOUR OLD RIG

FEBRUARY-MARCH 75¢

Science and Electronics

Formerly Radio-TV EXPERIMENTER

WHITE'S RADIO LOG
- AM Stations
- Worldwide SW
- Police/Emergency

SUPER STABLE RECEIVER
Tunes aircraft, hams, police!

LOVER'S LAMP
One whistle and you're on!

MAGNETIC BEAM BALANCE
A handful of parts, and a meter becomes a sensitive lab scale

see page 55

REGULATED DC SUPPLY
For every solid-state project

SCIENCE EXTRA
A MATHEMATICIAN'S MUSICAL MUSINGS
He discovers that music is much more than just a one, and a two, and a...

February/March 1970

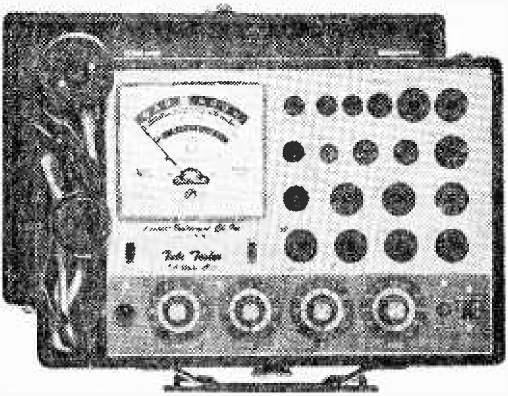
Science and Electronics

★ Cover Highlights

Cover illustration by Len Goldberg

The New 1970 Improved Model 257 **A REVOLUTIONARY NEW**

TUBE TESTING OUTFIT



COMPLETE WITH ALL ADAPTERS AND ACCESSORIES, NO "EXTRAS"

- 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.

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 **$52.50**

NOTICE *We have been producing radio, TV and electronic test equipment since 1935, which means we were making Tube Testers at a time when there were relatively few tubes on the market, way before the advent of TV. The model 257 employs every design improvement and every technique we have learned over an uninterrupted production period of 34 years.*

Accurate Instrument Co., Inc.

SEND NO MONEY WITH ORDER

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Pay Cash or in EASY MONTHLY PAYMENTS AFTER 15 Day Trial!

Try it for 15 days before you buy. If completely satisfied remit $52.50 plus postage and handling charge. (If you prefer you may **PAY MONTHLY ON OUR EASY PAYMENT PLAN.**) If not completely satisfied, return to us, no explanation necessary.

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2435 White Plains Road, Bronx, N. Y. 10467
Please rush me one Model 257. If satisfactory I agree to pay at the terms specified at left. If not satisfactory, I may return for cancellation of account.

Name______________________

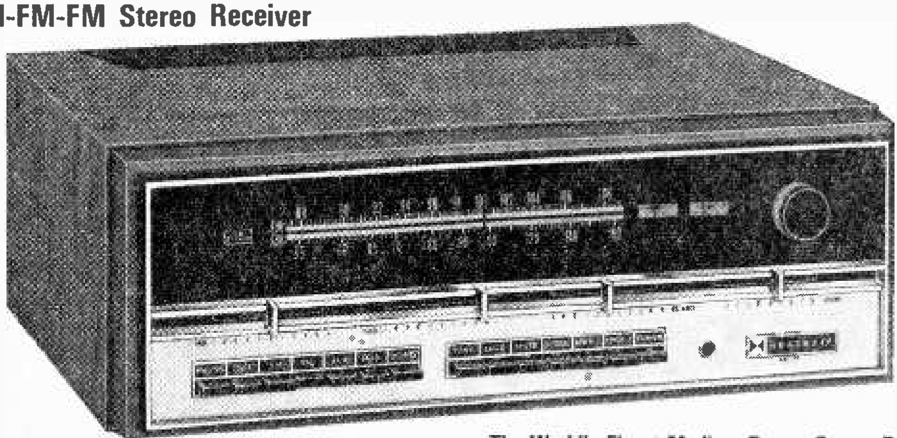
Address______________________

City______________ Zone________ State________

☐ **Save Money!** Check here and enclose $52.50 with coupon and we will pay all shipping and handling charges. You still retain privilege of returning after 15 day trial for full refund.

Great Gift Ideas From The

Announcing The New Heathkit® AR-29 100-Watt AM-FM-FM Stereo Receiver



The World's Finest Medium Power Stereo Receiver... Designed In The Tradition Of The Famous Heathkit AR-15...$285.00*

Quietly distinctive when not in use . . . its impressive midnight black and chrome face unmarred by dial or scale markings. A touch of the power switch and the dial and scale markings appear.

All solid-state design . . . 65 transistors, 42 diodes and 4 Integrated Circuits.

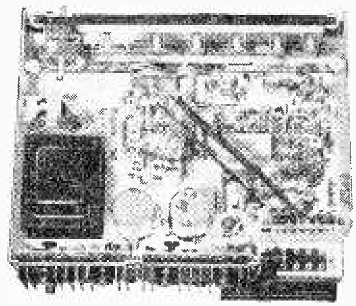
Assembled, aligned FET tuning unit.

Advanced 9-pole L-C Filter for greatest selectivity . . . a first in the industry.

Plug-In Circuit Boards for easier assembly, easier service . . . another first in kits.

Built-In Test Circuitry for voltage and resistance checks without external instruments during construction and after.

Massive Power Supply . . . just loafs along at 100 watts output.



• All solid-state design • 100 watts music power output at 8 ohms • 7-60,000 Hz frequency response • Less than 0.25% Harmonic & 0.2% IM Distortion at full output • Transformerless, direct-coupled outputs with dissipation-limiting circuitry for output protection • Ball-bearing inertia flywheel tuning • Advanced L-C filter gives 70 dB selectivity and elimination of IF alignment • Assembled, aligned FET FM tuner for better than 1.8 uV sensitivity • New Mute Control attenuates between-station FM noise • New Blend Control attenuates noise on FM-Stereo stations • SCA filter • Linear Motion Controls for Bass, Treble, Balance & Volume • Individually adjustable input level controls for each channel of each input keeps volume constant when switching sources • Switches for 2 separate stereo speaker systems • Center speaker capability • Two front-panel meters for precise station tuning • Stereo indicator light • Stereo headphone jack • Swivel AM rod antenna • 300 & 75 ohm FM antenna inputs • Massive, electronically regulated power supply • New Modular Plug-In Circuit Board designed for easy enjoyable assembly

Another Design Leader . . . reflecting the heritage of the world-famous Heathkit AR-15. A new milestone in audio history is here: the world's finest medium power stereo receiver . . . the Heathkit AR-29.

The Finest Stereo Amplifier In Any Receiver . . . delivers a full 100 watts music power, 70 watts continuous — drives even the most inefficient speakers. A giant fully regulated & filtered power supply, 4 individually heat-sinked and protected output transistors and the best specs in the industry add up to unmatchable audio fidelity.

The Heath Mark Of Quality: FM Stereo Performance . . . now more apparent than ever. The assembled, aligned tuning unit uses FET circuitry for high overload capability, low cross modulation and 1.8 uV sensitivity. Three IC's in the IF give greater AM rejection, hard limiting, excellent temperature stability & reliability. Another IC in the Multiplex section performs four different functions . . . assures perfect stereo reproduction.

Kit Exclusive: 9-Pole L-C Filter . . . delivers an ideally shaped bandpass with greater than 70 dB selectivity, superior separation and eliminates IF alignment forever.

AM That Sounds Like FM. Three FET's in the AM RF section combine superior sensitivity with greater signal handling capability to give the finest AM reception available. A built-in AM rod antenna swivels for best signal pick-up.

Kit Exclusive: Modular Plug-In Circuit Board Construction . . . for simplified assembly . . . easier, faster service.

Kit Exclusive: Built-In Test Circuitry lets you not only assemble, test & align your new AR-29, but also *completely* service it — without external test equipment.

You Be The Judge. Compare the specifications . . . exciting styling concepts . . . the dozens of features . . . the price. You'll find that the new Heathkit AR-29 is, indeed, the world's finest medium power stereo receiver. Order yours soon.

Kit AR-29, (less cabinet), 33 lbs............................**$285.00***
Assembled AE-19, oiled pecan cabinet, 10 lbs................**$19.95***

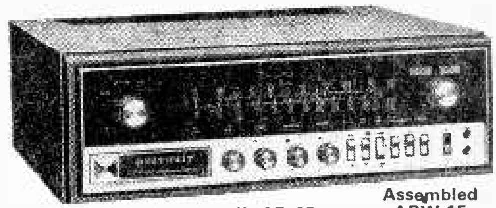
PARTIAL AR-29 SPECIFICATIONS — AMPLIFIER: Continuous power output per channel: 35 watts, 8 ohms. **IHF Power output per channel:** 50 watts, 8 ohms. **Frequency response:** —1 dB, 7-60,000 Hz, 1 watt level. **Power Bandwidth for constant 0.25% THD:** Less than 5 Hz to greater than 30 kHz. **Total harmonic 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)

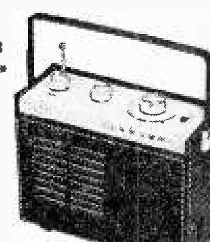
Assembled ARW-15 $540.00* (less cabinet)

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



Kit GR-88 $49.95*

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 GD-48 $59.95*

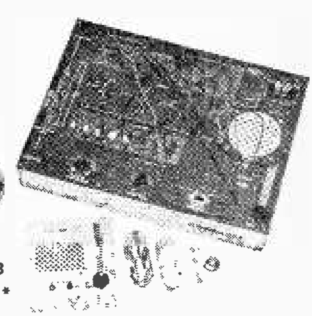
HEATHKIT GD-48 Metal Locator

• 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-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.



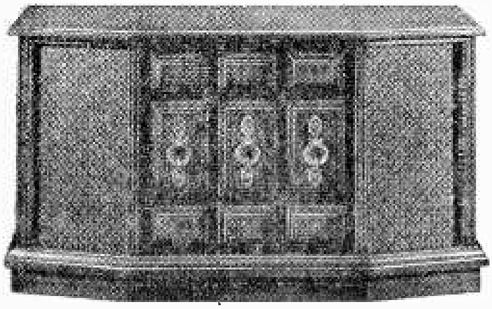
Kit JK-18 $19.95*

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.

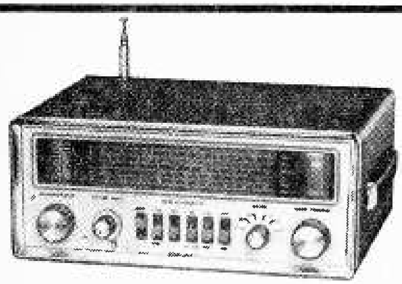
Component-Quality 4-Speed Automatic Turntable with such professional features as Cue/Pause control, Anti-Skate control, adjustable stylus pressure and famous Shure diamond stylus magnetic cartridge.

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
Kit GR-78
$129^95*

NEW
Kit GD-209A
$149^95*

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)

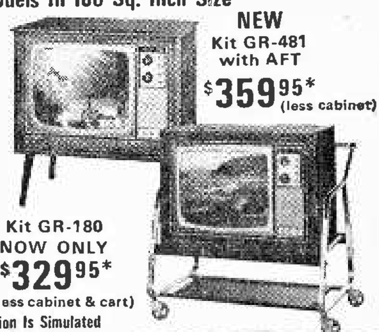
Kit GR-295
$449.95*
(less cabinet)

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

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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.

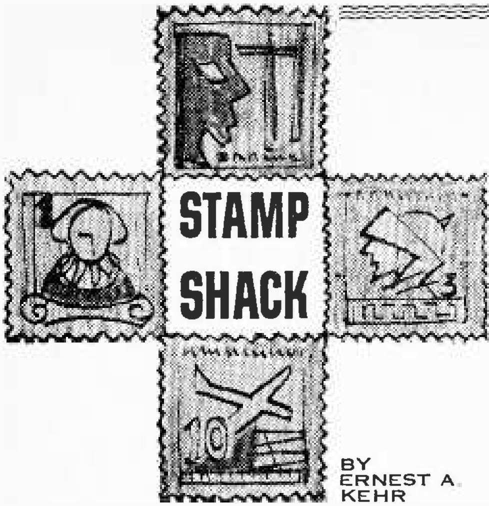
Jockey Shortz was disqualified after a saliva test disclosed that his plug had been doped. An official became suspicious when, he said, "I detected his mount with a Blonder-Tongue." On several other occasions Shortz has been suspected of checking his horse with a cheater cord.

● 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. ■



STAMP SHACK

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.

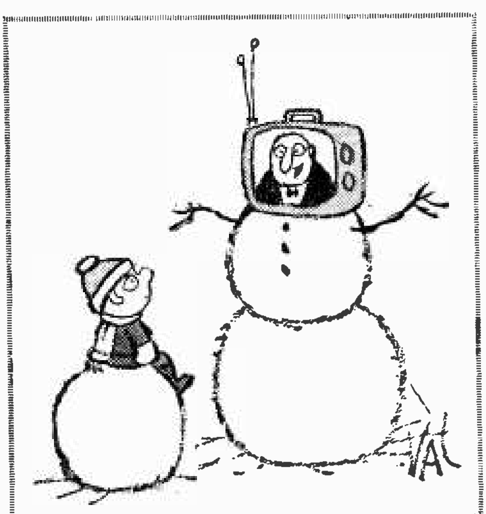
The firm, which publishes many useful philatelic accessories, has just released special "do it yourself" pages. The pages, which will fit into any standard three-ring binder, are captioned

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. ■



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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 515-1 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.*

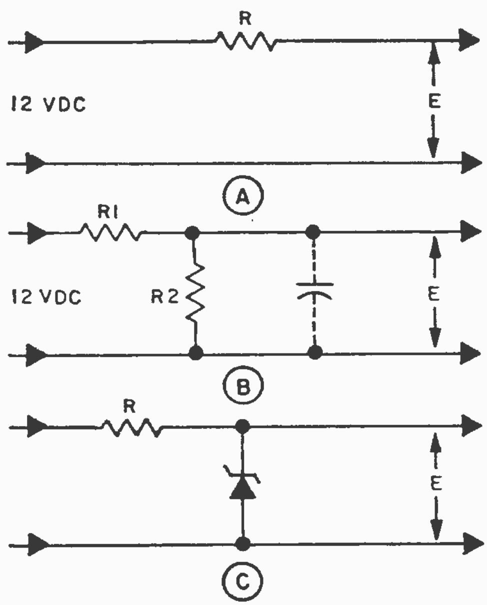
It would be a messy job and you might not be happy with it. Instead, get an outboard converter and use it with your set when it is set for AM on the BCB. Better still, pick up a pocket-portable unit. They're available with the broadcast band and the price is right.

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.

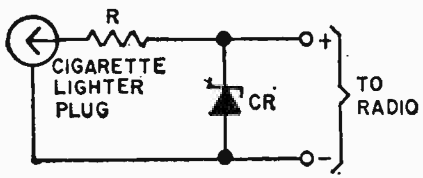
In diagram A, output voltage (E) will be 12 volts regardless of the value of R if load current is zero. In B, the ratio of R1 and R2 determines E with zero load current. In B, E remains steady as long as maximum load current does not exceed design value.

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.

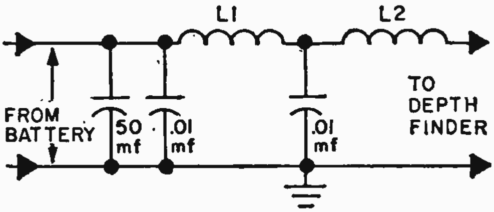
—*L. D., Onslow, Iowa*

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

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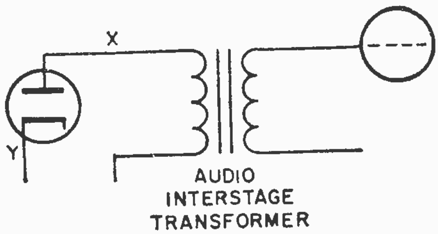
chokes for L1 and L2 and put all the components in a metal box. Values are not critical!

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

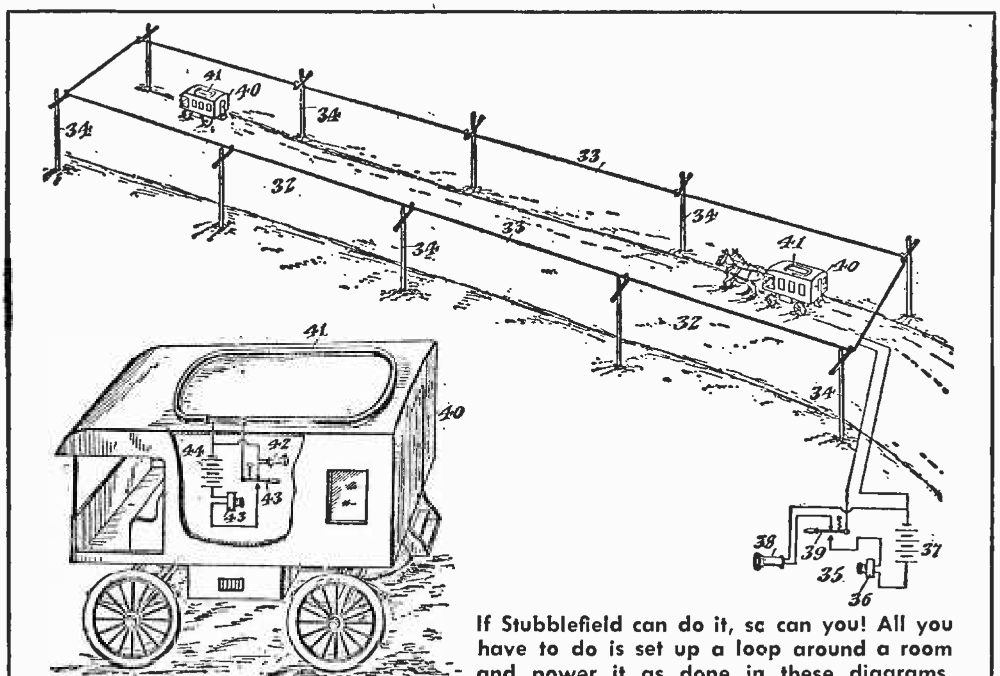
No. 887,357

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.

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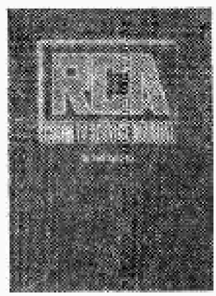
BOOKMARK
BY BOOKWORM

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)

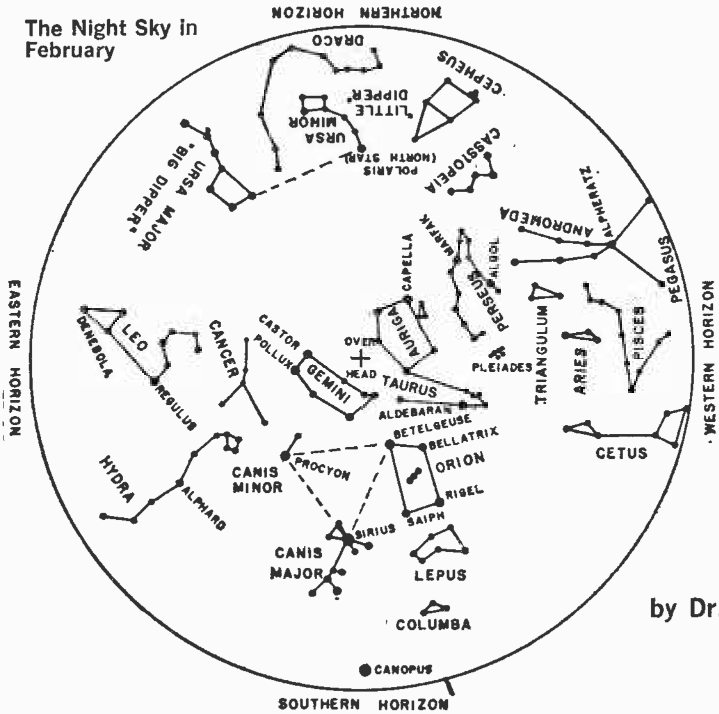


Soft cover
212 pages
$7.95

The Skies Above Us

by Dr. Roy K. Marshall

The Night Sky in February



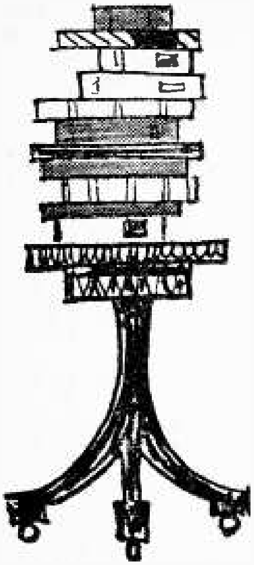
WHEN THE MOON GETS IN THE WAY

★★ 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* 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 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 "SSS." 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 tact-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.

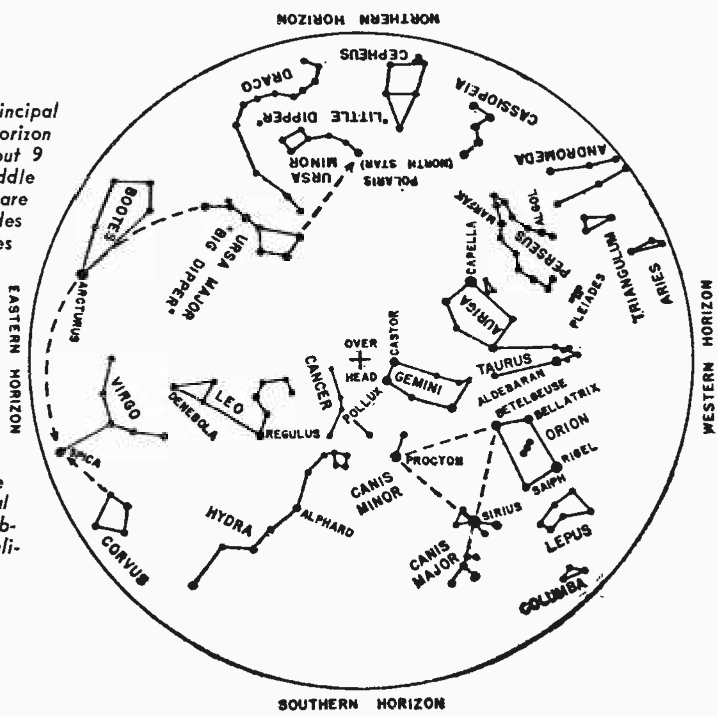
★ The path may be about as long as half the circumference of the Earth. But it can be no wider than 169 miles and, as the shadow sweeps along, it can not take longer than 7 minutes 31 seconds to pass over a given point. But this can occur only when the Earth is closest to the moon and farthest from the 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)

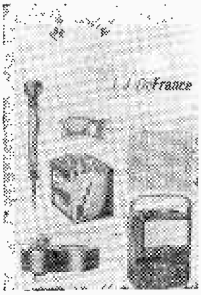
☆☆☆ The maps show the principal stars which are above the horizon at latitude 34° North at about 9 p.m. standard time at the middle of the month. These maps are practical star location guides anywhere in the United States throughout the month showing the sky at 10 p.m. on the first and at 8 p.m. on the 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. ☆☆☆



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

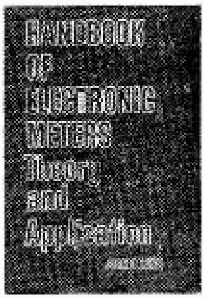


Hard cover
702 pages
$13.50

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.

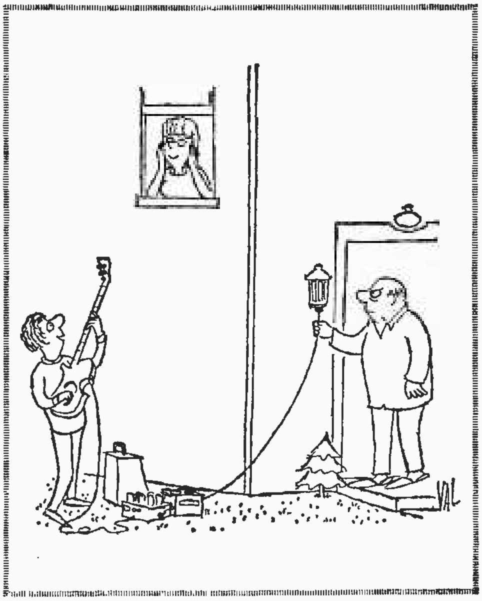
Meters. Here, in one single volume, is the most important and useful tool you can find for working with electronic meters. It's a new book entitled *Handbook of Electronic Meters*. Designed for electronics engineers and technicians, the text provides not only the "how-to" of a great variety of electronic 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.

Detailing the greatest number of meter applications available in a single handbook, this manual covers a full range of practical solid-state and integrated circuit data. It spans the entire subject, beginning with simplified presentations of operating principles and the characteristics of typical laboratory and shop meters, and accessory equipment. The descriptions include test connection diagrams for each operation and are all illustrated in block diagram or simplified schematic level, thereby offering an ideal source of easily accessible facts on meter theory and application. A valuable feature of



Hard cover
180 pages
$10.95

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.



Science and Electronics
FEBRUARY-MARCH 1970

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

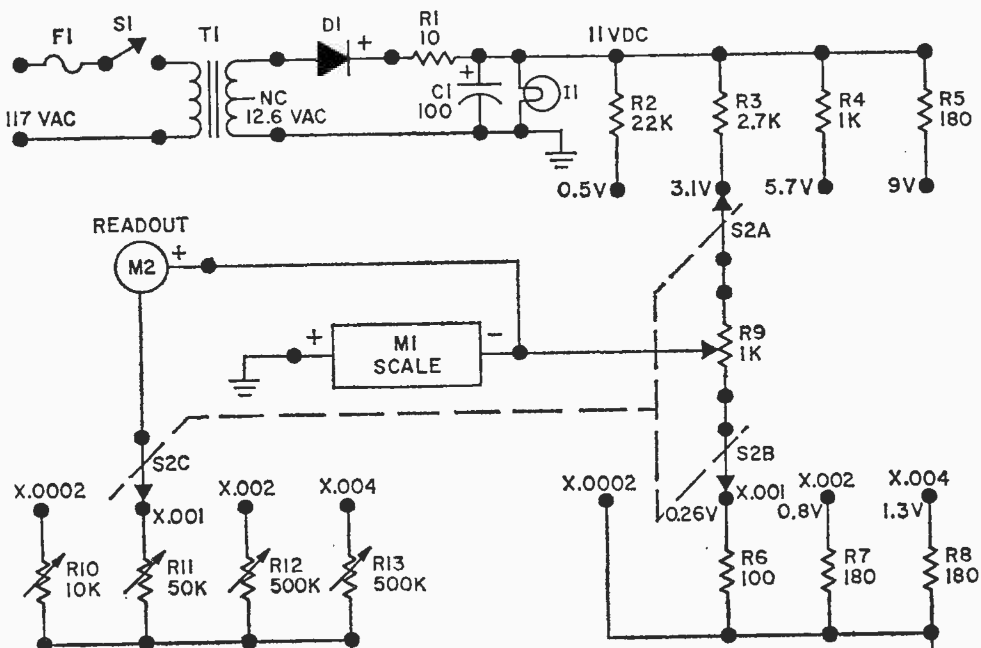
infinitesimally light in weight that they simply can't be weighed on standard scales.

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, 1/4-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, 1/2-watt resistor
R2—22,000-ohm, 1/2-watt resistor
R3—2700-ohm, 1/2-watt resistor
R4—1000-ohm, 1/2-watt resistor
R5, R7, R8—180-ohm, 1/2-watt resistor
R6—100-ohm, 1/2-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.



VOLTAGES MEASURED WITH VTVM.
NULL FULLY CCW. NO LOAD.

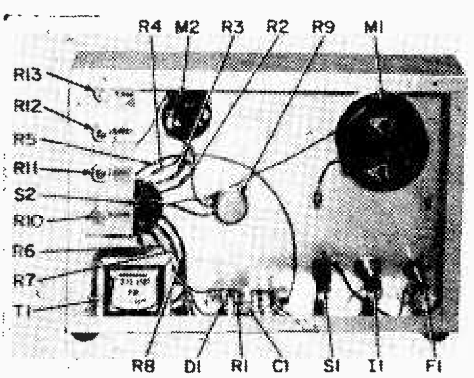
ing coil, which is attached to the pointer. The coil is suspended in a fixed magnetic field and is mounted on jeweled pivot bearings to reduce friction to a minimum. Except for the pull of the hair-spring, used to return the pointer-and-coil assembly to an established zero point when no current is flowing, 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.

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.



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.

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-

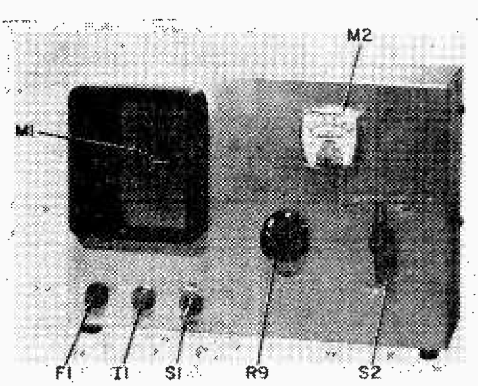
Magnetic Beam Balance

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



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.

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.

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-*u*A 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.

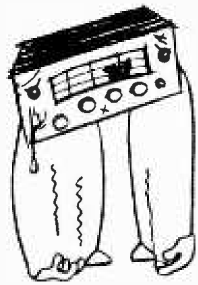
Once you've adjusted this range, proceed to the X.001 range and follow the same steps—except that the VTVM should now read 2.0 V and you will adjust R11 along with R9 instead of R10. You can expect the same possible interaction between R9 and R11 that you experienced between R9 and R10.

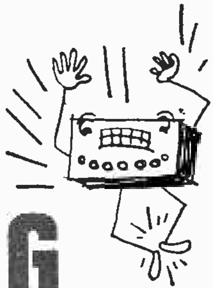
The other two positions of the range switch are adjusted in exactly the same manner. When adjusting the X.002 range the VTVM should read 4.1 volts and when adjusting the X.004 range it should read 8 volts. R12 is used for the X.002 range and R13 is used for the X.004 range. Once each range has been adjusted 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 an "air test." If the receiver operates properly, there is, of course, no cause for any further

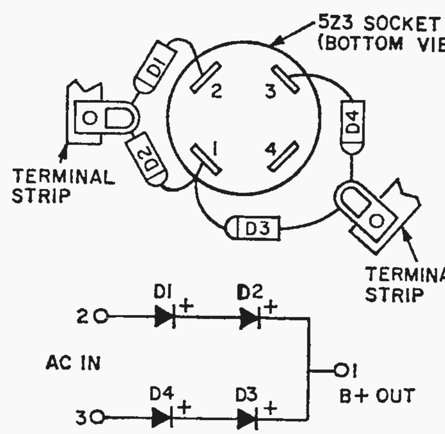


Fig. 1. Above and right, two ways to use silicon diodes to replace obsolete 5Z3 rectifier. All diodes are 800 PIV, 1 A types; resistors R1, R2, R3, and R4 at right are 470k, ½-watt units; resistors R5 and R6 are 1-ohm, 2-watt units; capacitors C1, C2, C3, C4 are standard .001-uF, 1000-V ceramics.

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

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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.

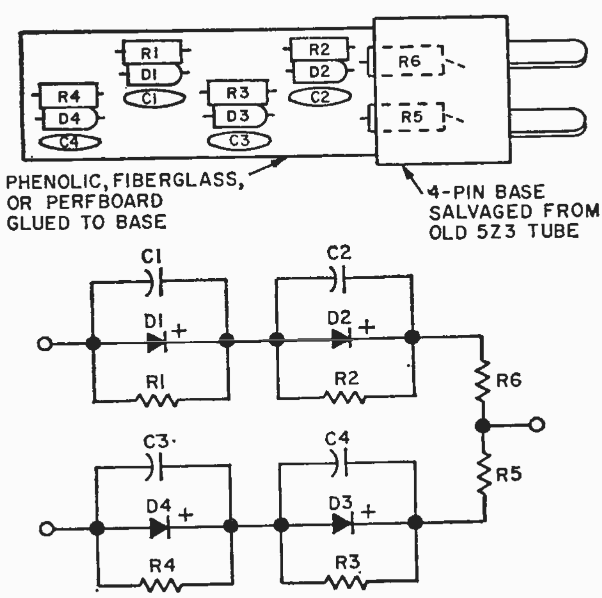
✓ **Small Capacitors.** Any capacitor can develop leakage resistance or short out entirely. If DC voltage is passing through the capacitor, or if an ohmmeter indicates leakage resistance, then the capacitor should be replaced. If the capacitor is swollen, or has the ends broken out, replace it regardless 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.

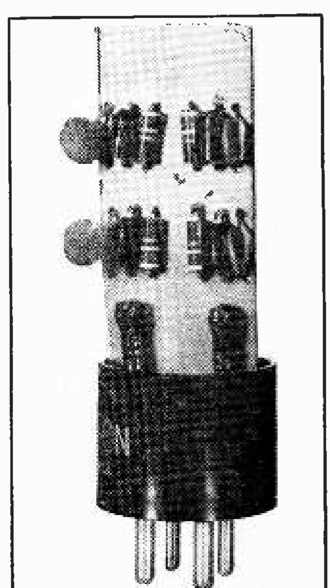
✓ **Fixed Resistors.** Heat, humidity, and (so say wizened old pros) the occult powers cause carbon composition resistors to change value. An old resistor color coded for, say, 100,000 ohms may actually be closer to 1,000,000 ohms after all these stresses have taken place. Discolored, swollen, burned, 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*)

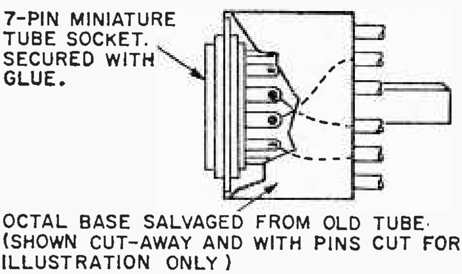




SHACK ON A SHOESTRING

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.



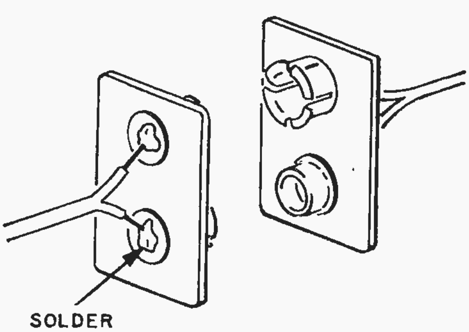
Other tube types can be replaced either by finding a direct substitute (consult one of the guides published for this purpose), or by using a newer type. This may require changing the socket or using an adapter. Figure 2 shows an adapter for replacing the old-fashioned octal socket with a standard 7-pin 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.

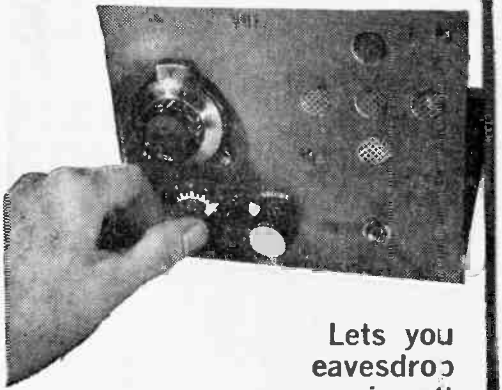
As we've already cautioned, most power and audio transformers can be replaced with standard substitutes. Even if the mechanical arrangement isn't the exactly the same, it should produce few problems. This type of substitution is often only a matter of matching up specifications and mounting styles in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

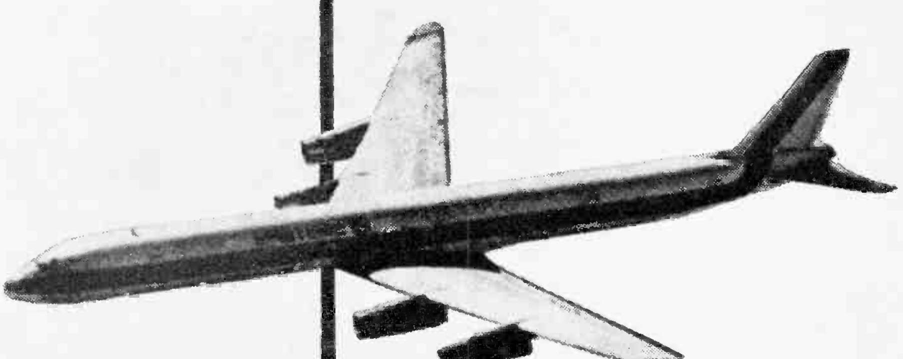
by Robert E. Kelland

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 $\frac{1}{16}$-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.

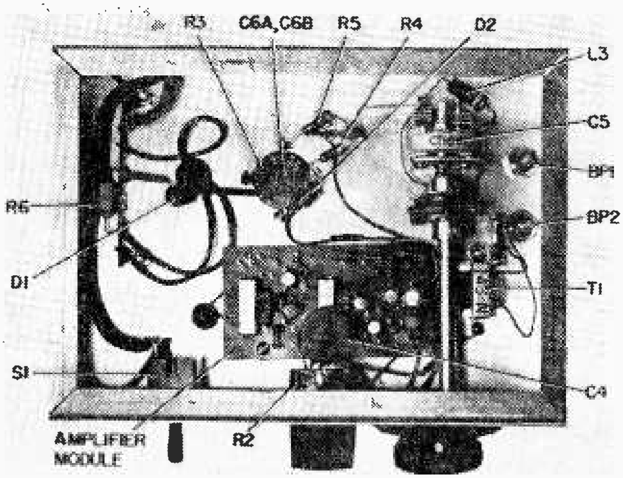
Insulated, flexible couplings were used to isolate the variable capacitors from their respective tuning knobs, to prevent any receiver instability that may be created by hand capacity when adjusting the receiver. Straight through, insulated bushings can be substituted for the flexible couplings.

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.

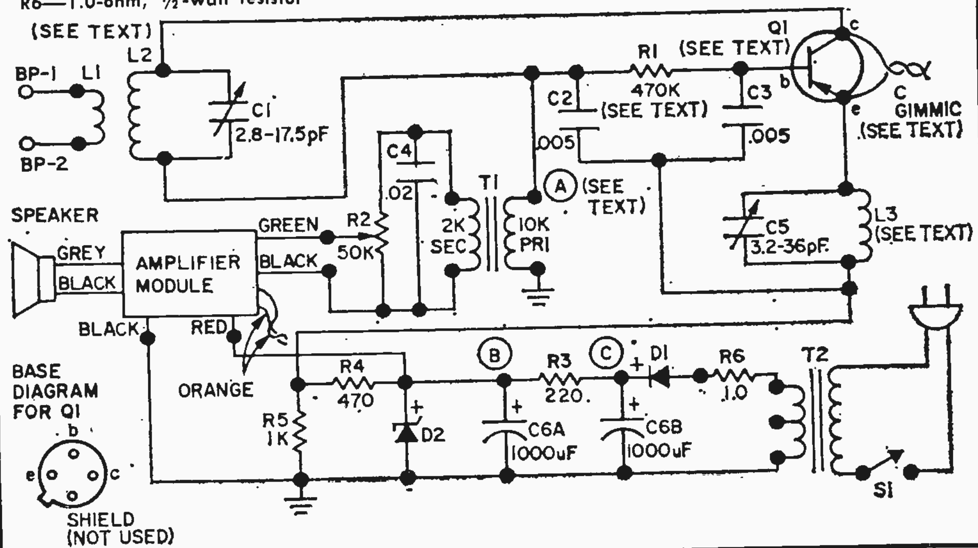
L3 is made by winding 18 turns of #30 AWG enameled copper wire around the insulated form of a very high resistance 1-watt carbon resistor. The ends of the coil are soldered directly to the resistor pigtail.



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

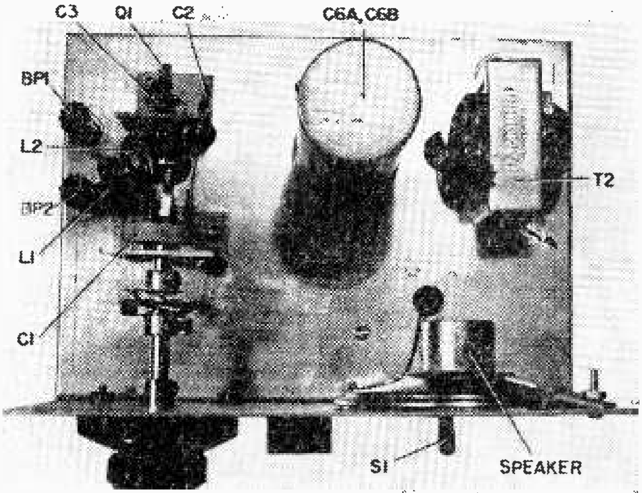
SUPER STABLE RECEIVER

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.

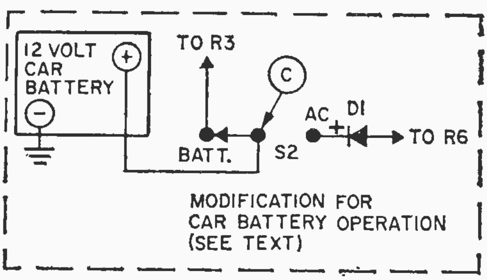


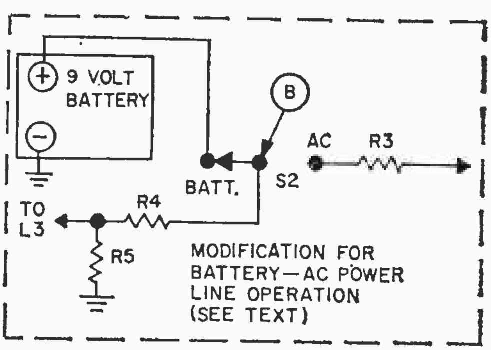
Top side view of chassis shows simple arrangement of components. Grouping at left are tuning units; T2 is at right.

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.

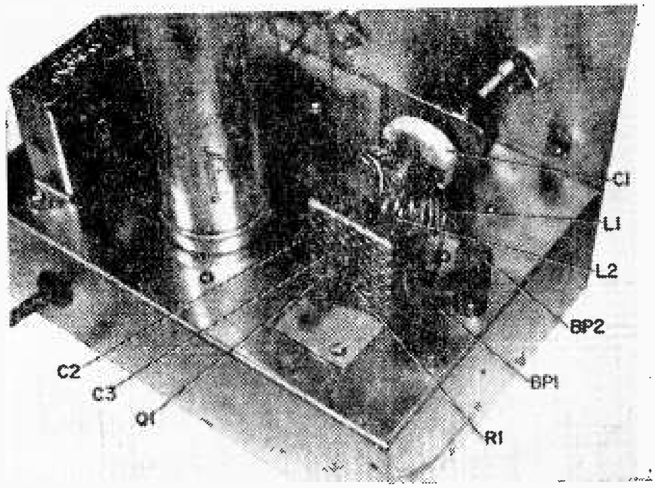
It's suggested that you make a notation of the dial setting for each station received, and also note the station's frequency. From this you can produce a calibration chart or curve covering the entire band. Remember, to a certain extent, the dial setting can be affected by the adjustment of the regeneration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

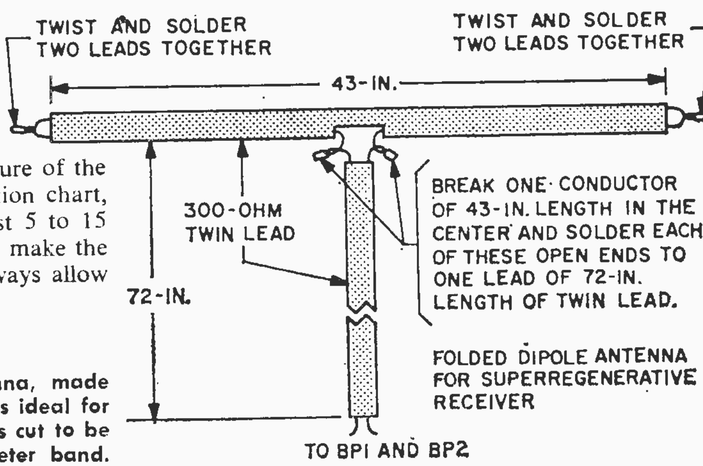
Obviously best results will be obtained by using a commercially-built antenna designed for this frequency band. A ¼- or ½-wave whip antenna will be satisfactory only for receiving strong signals.

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.

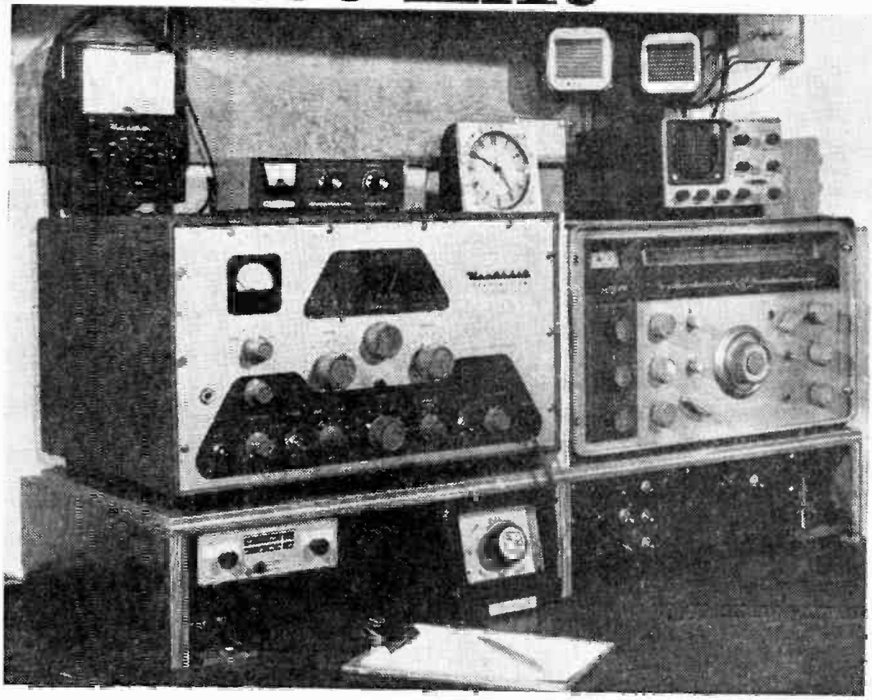
In the event you want to operate the receiver from a 9-V battery, all power supply components up to point B in the schematic are not required and battery + is connected at this point. If, by chance, you operate the receiver from your 12-V automotive battery, R3 will be required and auto battery + is 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. ■

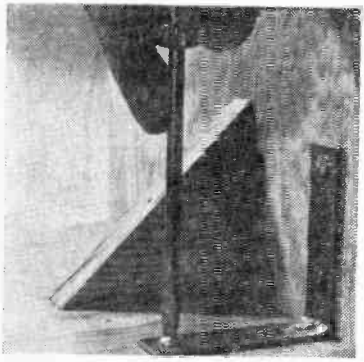


This folded dipole antenna, made from 300-ohm twinlead, is ideal for use anywhere indoors. It's cut to be used in the aircraft/2-Meter band.

Operation Face-Lift



Convenience is the keynote in this custom platform for your shack

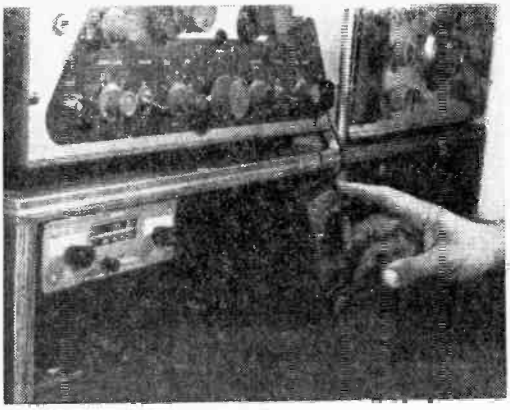


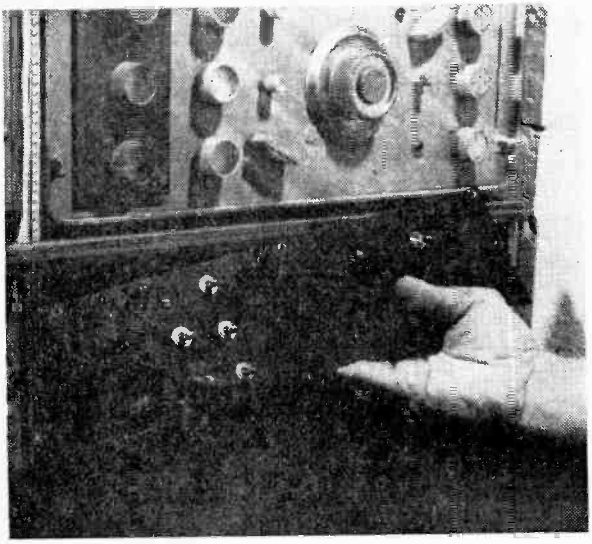
Gear can be weighty, so strive for rigidity when constructing your platform. Angle brackets and wooden braces will turn the trick —use both screws and glue on wooden braces for extra strength.

☐ 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.

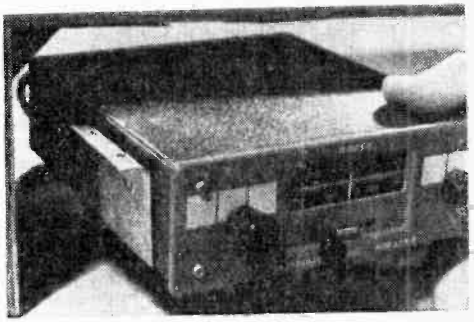
Need for this accessory is usually spawned by normal growth of the radio shack inventory. Just about the time the radio hobbyist acquires his third or fourth major piece of equipment, he begins scratching his head in bewilderment over where to put all the gear. By this time, the radio table is becoming 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

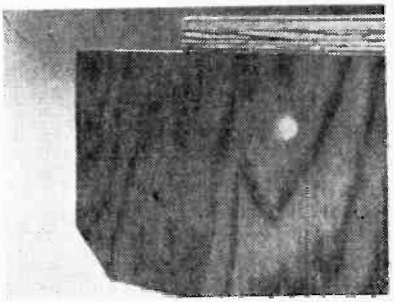
disadvantages. And it brings with it a number of convenient features which can't be obtained any other way. Purpose of such a platform is to lift the main pieces of radio gear a few inches above the table top they normally sit on and allow space beneath this gear for smaller equipment—antenna rotor controls, 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.

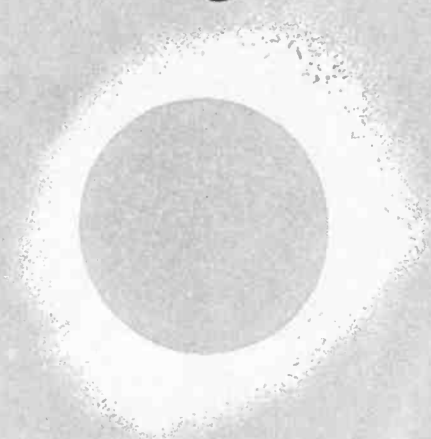
Generally, ¾-in. plywood is the best material to build the platform out of. It's strong enough, when properly braced, to hold just about any piece of radio gear you're likely

(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.

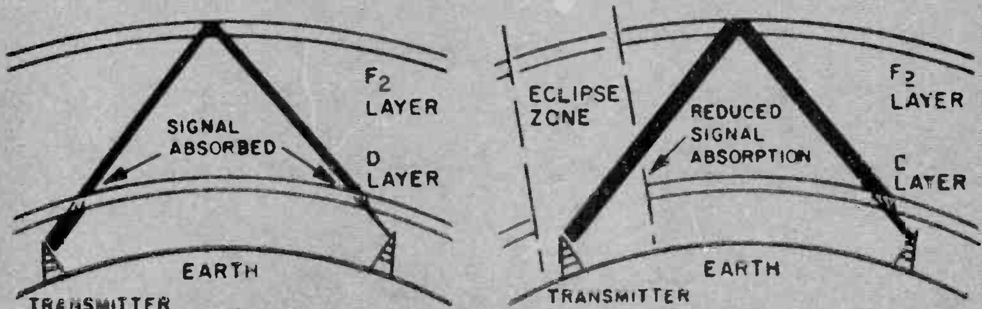
ABRUPT FLUCTUATIONS Meisel observed that the signal fluctuations in radio reception were remarkably *abrupt*. This could only mean that *localized* hot-spot sources of X-rays on the sun were being detected. The idea followed that radio signal fluctuations might be used to locate the exact positions of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

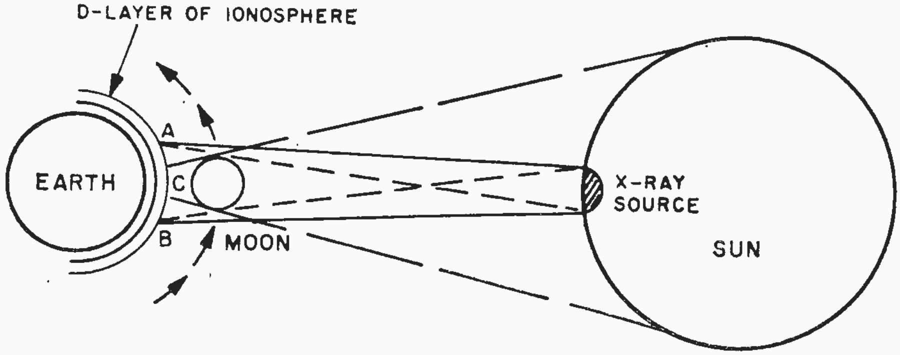
MAIL-ORDER MONITORS. To detect and locate *many* solar hot spots, Meisel realized, would call for the use of hundreds of ground monitoring stations. That seemed like a practical impossibility, until Meisel conceived the idea of enlisting the aid of shortwave radio listeners spread out all the way from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

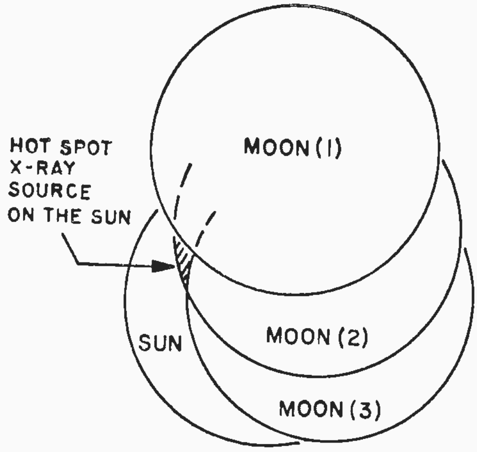
Each listener was to beam his radio into the eclipse zone and listen, for at least two hours, to a broadcast station at least 2000 kilometers away. He was to record all signal *strength* fluctuations on a chart, then send the data to Meisel, at the University of Virginia, for analysis.

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)

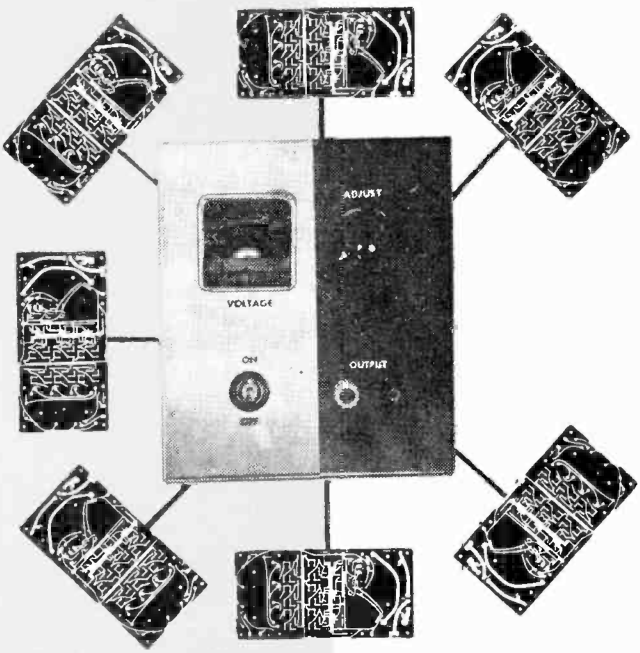


During an eclipse, solar X-rays that reach the earth's ionospheric D-layer are modulated by the moon. X-ray intensity decreases at A, minimum at C, and increases at B.



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?

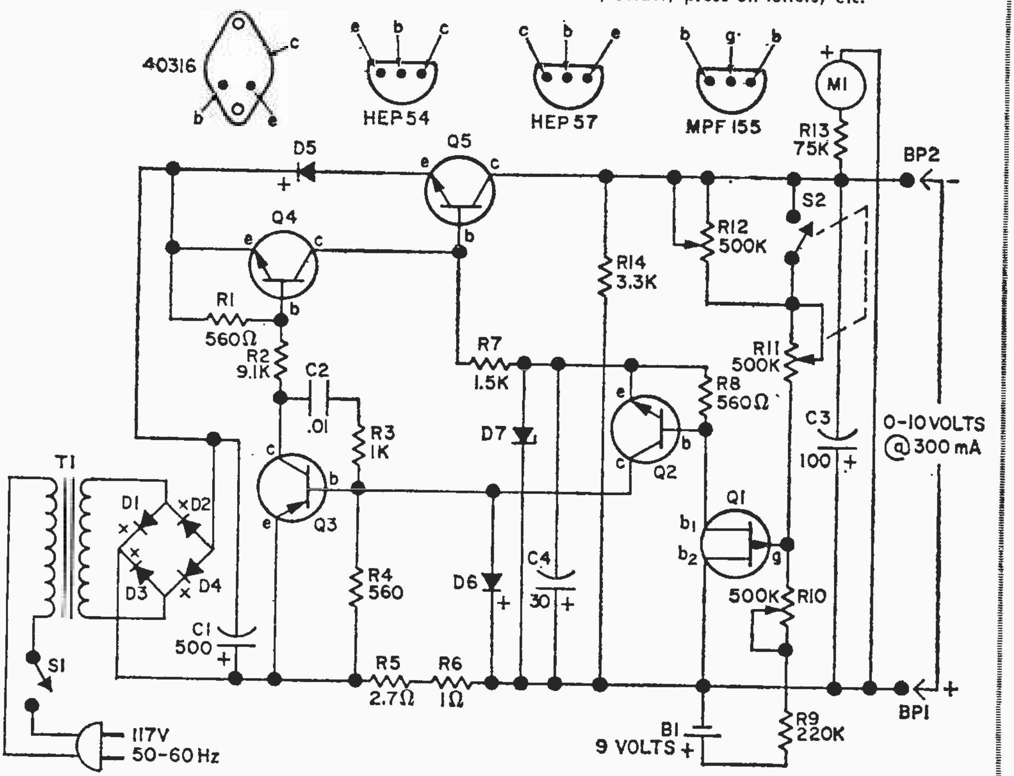
Best way to acquire this power source is build your own. As a starter, try the power supply detailed on the following pages. It's designed to have a 10-volt output at a maximum of 300 mA that is both voltage and current regulated.

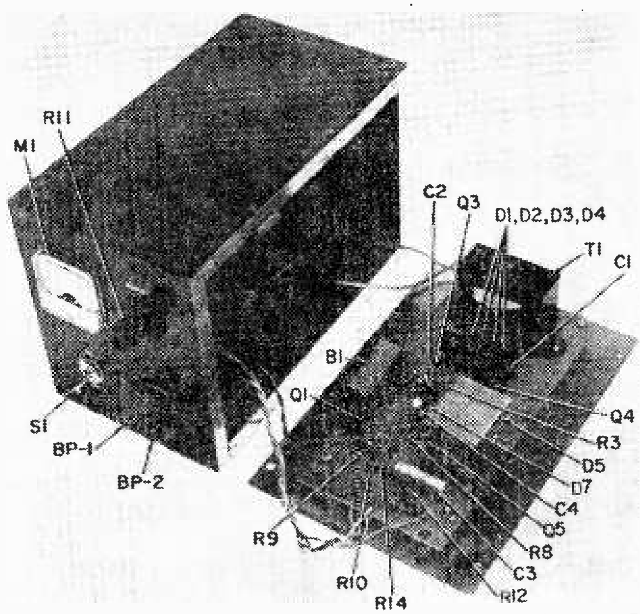
Voltage Limiting. Reference battery, B1, maintains a voltage flow through R9, R10 and R11 to the negative side of the power supply, which is at zero potential. Therefore, the gate of the FET (Q1) is positive and Q1 is turned *off*. This being the

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.

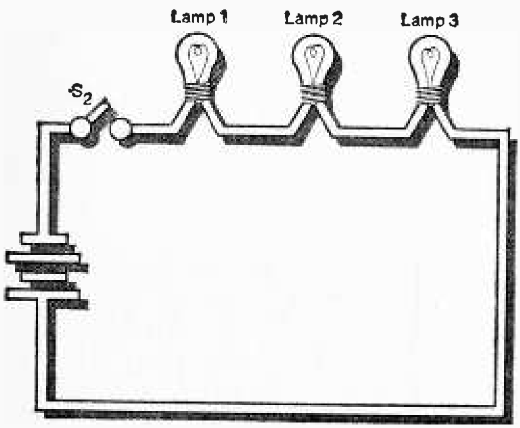
Current Limiting. In this supply, current limiting will start at 250 mA and output current won't exceed 300 mA with a full short across the output.

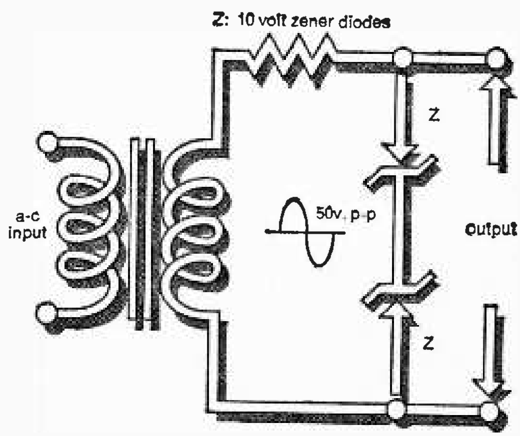
Current limiting is effected through R5, R6, and D6. A load placed across the output draws the current through R5 and R6. Normally the base of Q3 is −0.5 V with respect to its emitter, and D6 is reverse biased. When current through R5 and R6 reaches 250 mA, D6 is forward biased and conducts current into 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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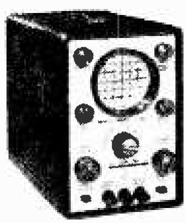

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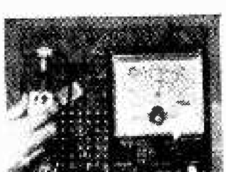

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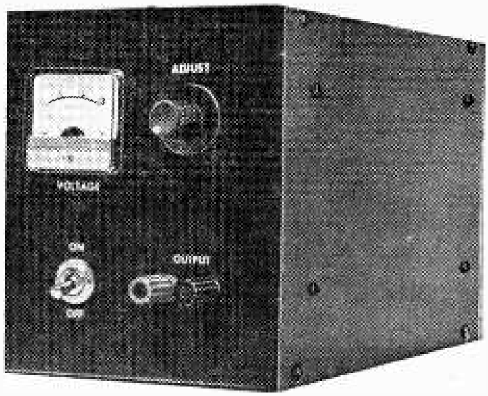
UNIVERSAL REGULATED POWER SUPPLY



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.

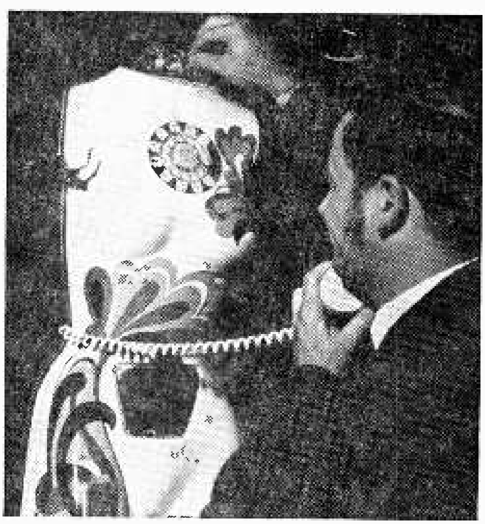
Be sure all diodes and electrical capacitors are properly polarized and all transistors are correctly connected before soldering them into the circuit.

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

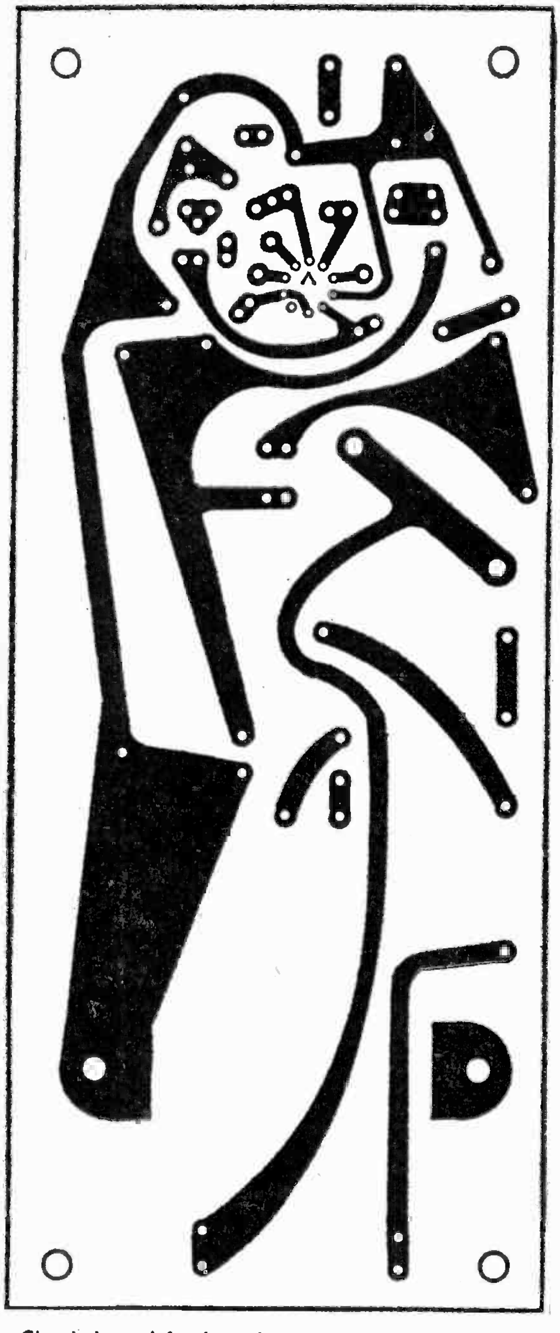
LOVER'S LAMP

. . . 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.

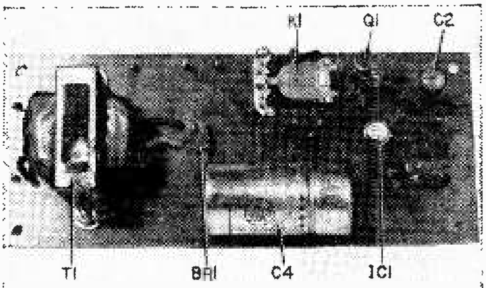
Of course, if you're not romantically inclined or if you score without need for electronic contrivances, our Lover's Lamp makes a great lighting control for such things as hot studio lights. You can set up your lighting arrangement with low wattage "cool" lamps, then turn the floods *on* anytime you 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.

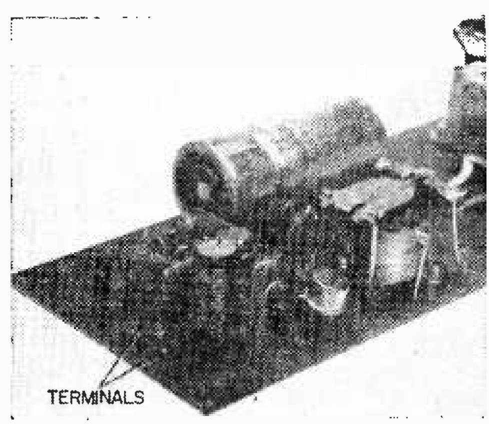
The component holes are drilled with a #57 bit, those for IC1's socket with a #54 bit. The holes for T1 and K1 and any other components depend on the particular item; #6 screw body holes should do for T1 and #4 screw body holes for K1. Connections between the cabinet components and the PC board are made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

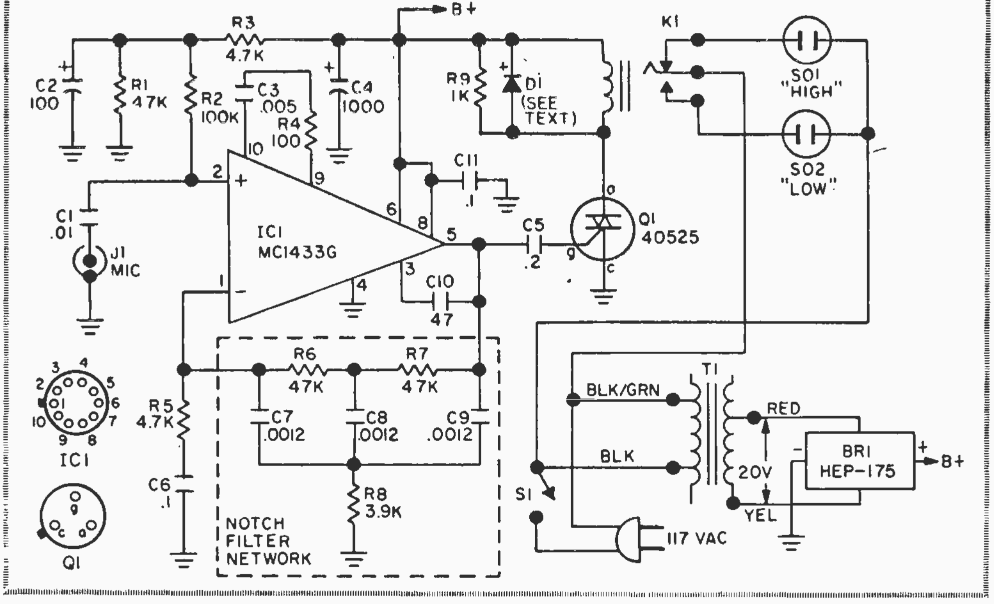
Circuit Modifications. You may safely substitute any 24 VDC relay for K1 as long as it doesn't require more than 35 mA. for operation.

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

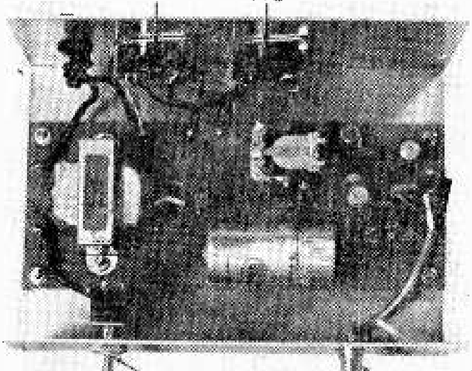
BR1—Bridge rectifier (Motorola HEP-175 or equiv.)
Capacitors—All 75 VDC unless otherwise indicated
C1—.01-uF subminiature (Lafayette 33 E 69055)
C2—100-uF, 15-V electrolytic
C3—.005-uF subminiature (Lafayette 33 E 69048)
C4—1000-uF, 25-V electrolytic
C5—.2-uF subminiature (Lafayette 33 E 69097)
C6, C11—.1-uF 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

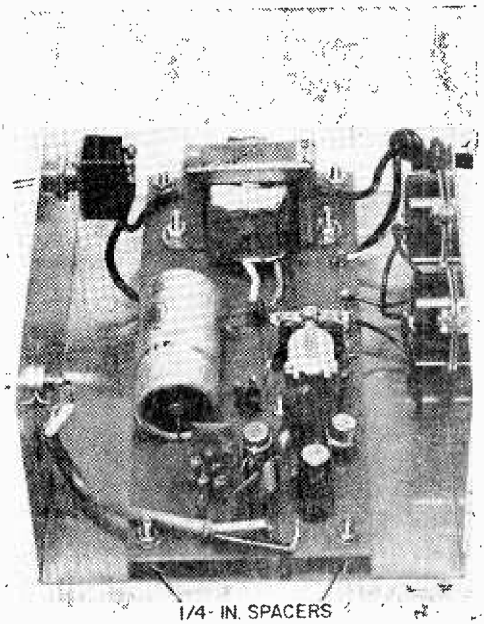


Completed PC assembly fits easily in base of 3 x 5 x 7-in. aluminum cabinet. Use at least #18 wire to connect up SO1 and SO2.

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.

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?

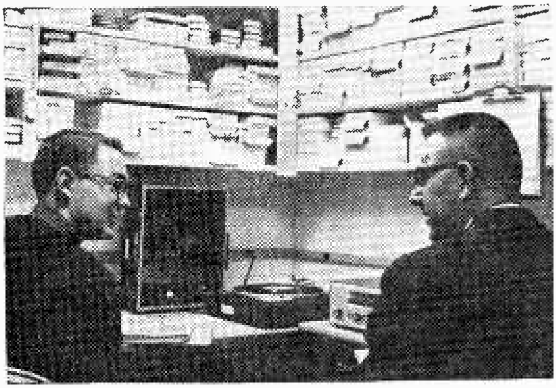
Just as some of the airlines provide taped music and conversational programs to make flights more pleasant, some educators are now experimenting with "cultural enrichment" on a school bus.

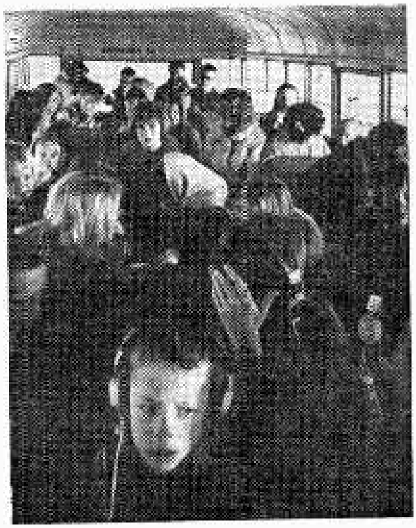
At this time the idea is unique with the Board of Education of Gunnison, Colorado, and the children who enjoy a "talking" school bus. But soon the idea will spread because of so much success in Gunnison.

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.

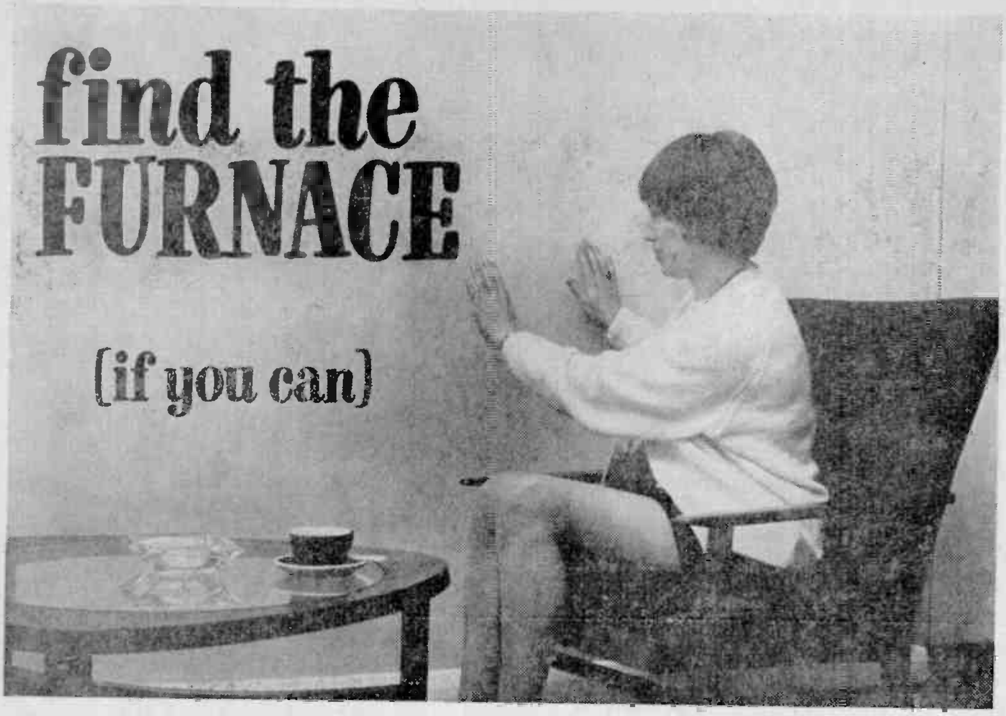
Mr. James R. Raine, who is also a project director, said he is trying to get funds for

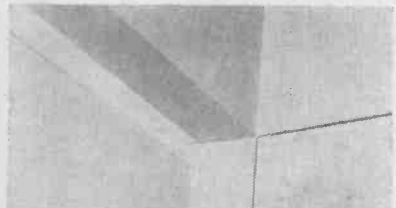
(Continued on page 109)

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)





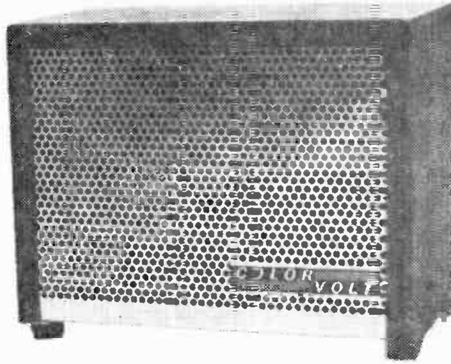
Technician applies decorative paint over wall that has been fitted with paint-it-on central heating system.

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

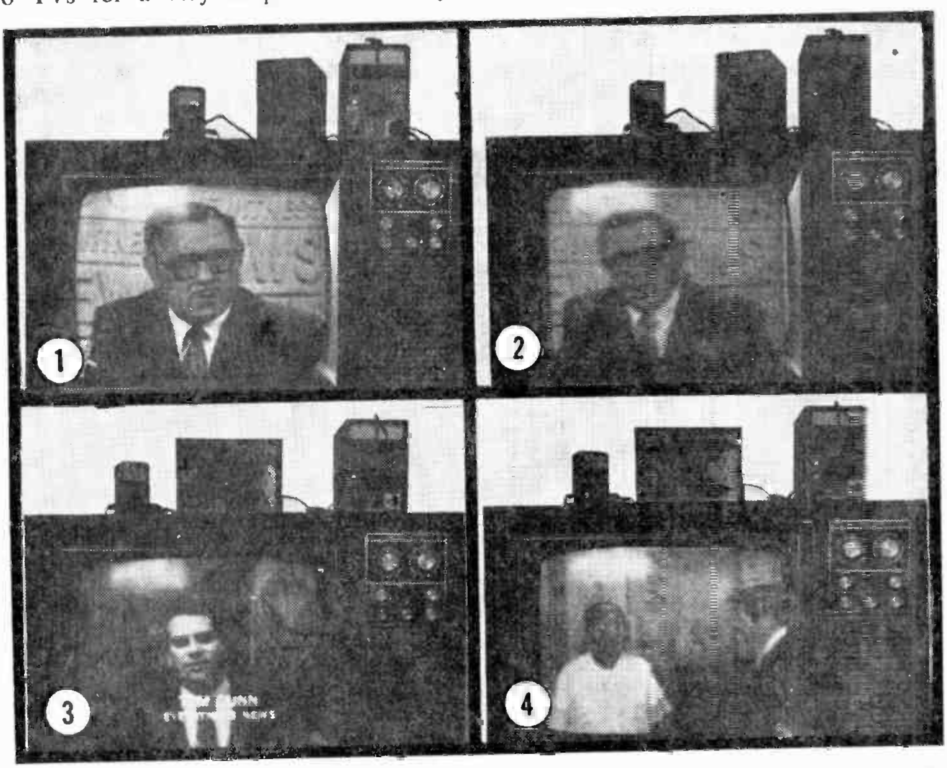


SOLA ELECTRIC COLORVOLT

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.

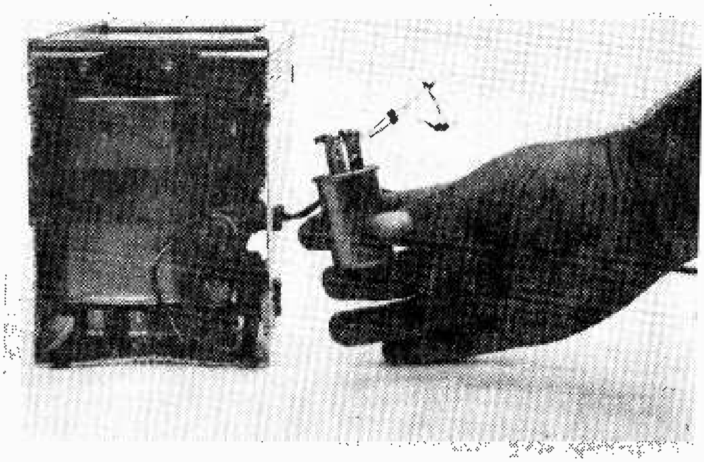
Volts and Loads. The ColorVolt's output is by no means rock steady. Over a 90 to 130 volt input range the regulator held the output voltage between 115 and 120 volts. Even so, this is sufficient for good color presentation.

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.

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. ■



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.

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.

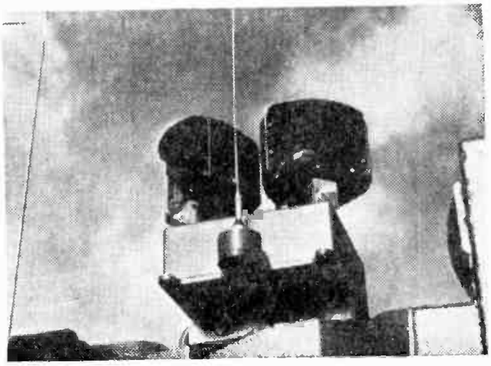
INFRARED MOCKFARE

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.

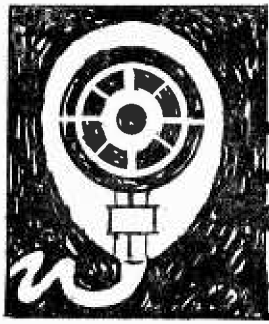
Because of the danger and the high cost of live shells (roughly $180.00 each), mock tank battles with real ammunition were no privates' picnic. Therefore, the simulator was developed by a British firm to give tank crews practical experience in full-scale armored warfare under realistic conditions. The 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.

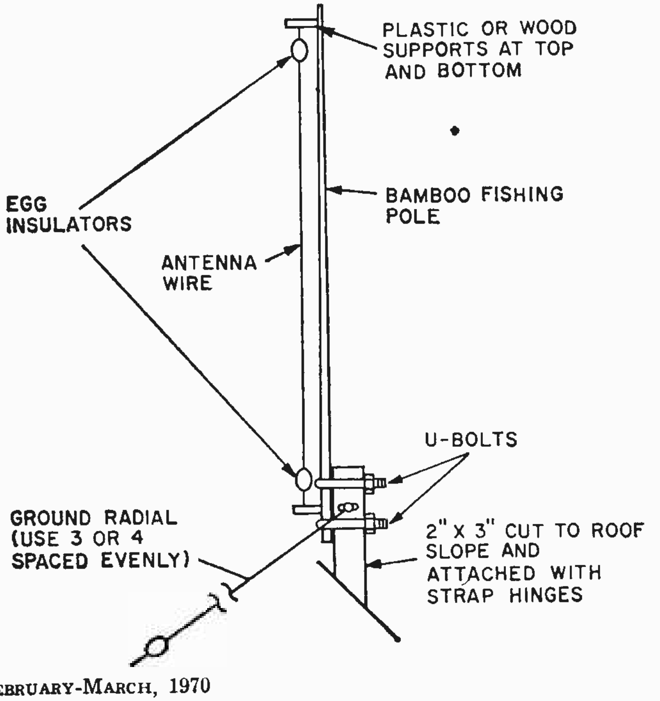
Thanks to the Direct Distance Dialing system that Ma Bell is now providing in most areas, there's a quick and simple way to get this number—and it doesn't cost a cent!

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!

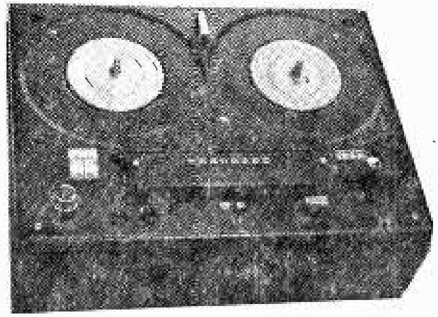
"Is a higher reading on this meter an indication of a properly tuned antenna? Absolutely not!

"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



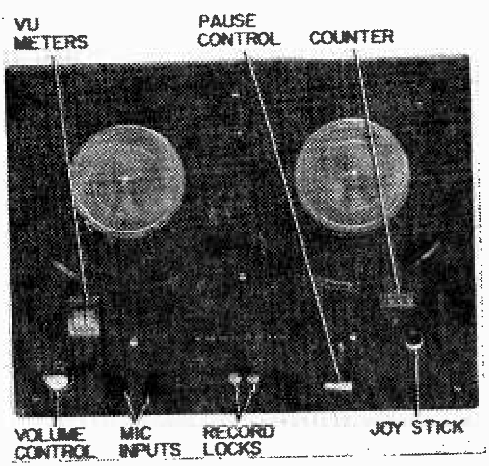
TANDBERG MODEL 1641X
Cross-Field Bias
4-Track Stereo Tape Deck

□ 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.

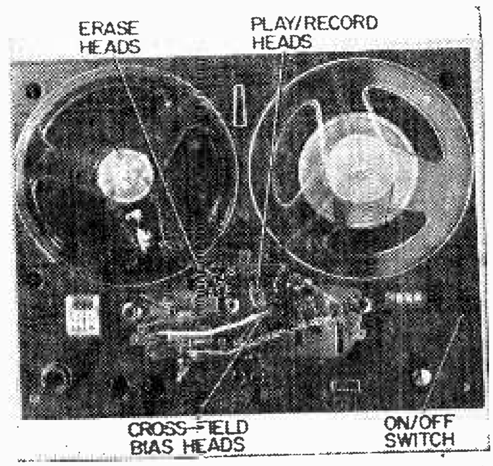
The 1641X is a 4-track stereo recorder with inputs for low-impedance microphone, magnetic pickup, and line (tuner, etc.). Three speeds (7½, 3¾, and 1⅞ ips) are provided, with automatic equalization by the speed selector. Independent volume controls and VU meters are featured, along with independent record 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.

LAB CHECK

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).

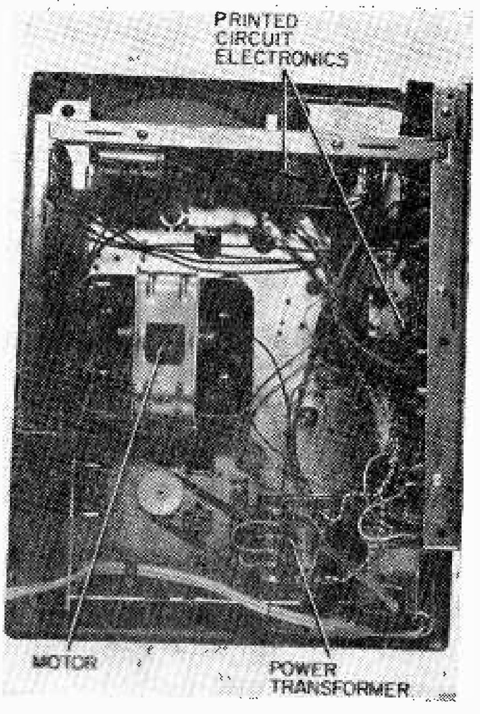
No Magic Eyes. Unlike earlier Tandberg recorders, the 1641X has no "magic eye" record level indicators. In their place, the 1641X has VU meters. But unlike conventional recorder VUs which are frequency-equalized to show a flat input level even after the record equalization, the 1641X's meters are unequalized.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

28	784	21952	5.2915	[illegible]	148.16	1.9473	.03571429	87.9645	615.7522
29	841	24389	[illegible]	[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	[illegible]	[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:

Note	Frequencies (Hz) 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

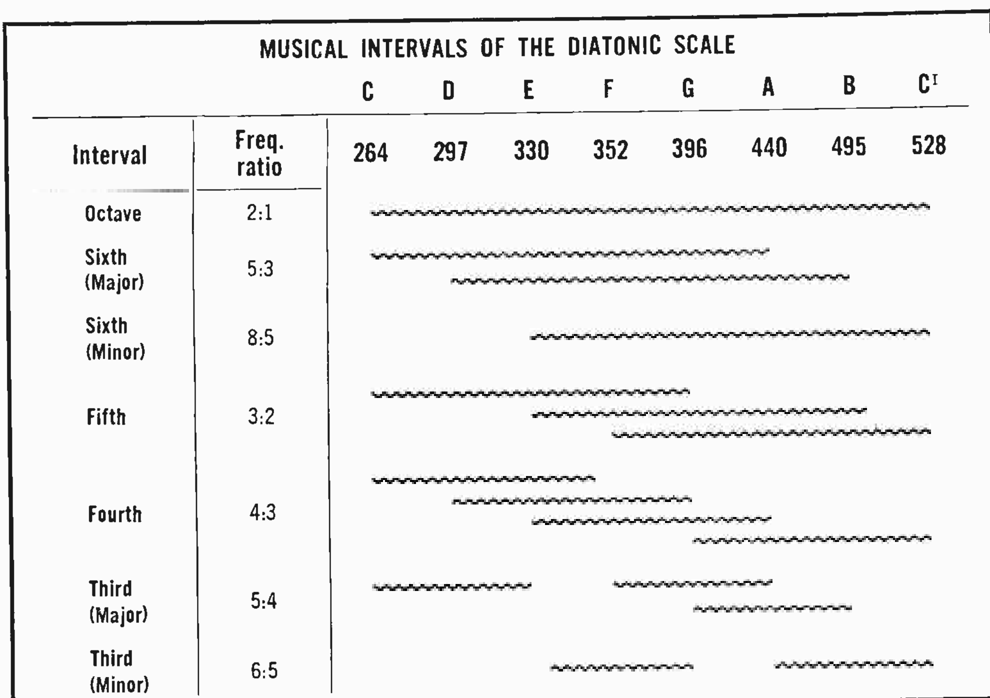


Fig. 1. Musical intervals and their frequency ratios for diatonic scale. Since interval ratios are constant, they can be used to find frequencies for scale in another key.

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^I	D^I
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	$\frac{9}{8}$			$\frac{9}{8}$		$\frac{9}{8}$		$\frac{9}{8}$	
Major tone intervals		$\frac{10}{9}$			$\frac{10}{9}$				
Semitone intervals			$\frac{16}{15}$				$\frac{16}{15}$		

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	Eb	F	G	Ab	Bb	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

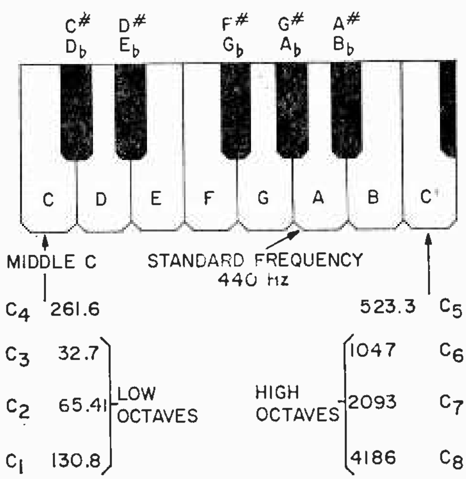


Fig. 4. Equal temperament scale now in common use allows no difference between sharps and flats (D♯ and E♭ are thus identical).

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.

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

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'	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
C^1	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^{1}E^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

	W.P.
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

	W.P.
KENI Anchorage, Alaska	5000
KOY Phoenix, Ariz.	5000
KAFY Bakersfield, Calif.	1000
KRAI Craig, Colo.	5000
WAYR Orange Park, Fla.	1000d
WGGA Gainesville, Ga.	5000
KMVI Wailuku, Hawaii	5000
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

	W.P.
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
WGAN 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

	W.P.
WAAX Gadsden, Ala.	5000
KCNO Alturas, Cal.	5000d
WFSO Pinellas Park, Fla.	500d
WACL Waycross, Ga.	5000
WKYX 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

	W.P.
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

	W.P.
KHAR Anchorage, Alaska	5000
WRAG 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

	W.P.
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

	W.P.
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

	W.P.
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

	W.P.
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

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

650—461.3

	W.P.
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

	W.P.
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

	W.P.
KBOI Boise, Idaho	50000
WMAQ Chicago, Ill.	50000

680—440.9

	W.P.
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

	W.P.
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
KSTL 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

	W.P.
WLW Cincinnati, Ohio	50000

710—422.3

	W.P.
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

	W.P.
KUAI Eleele, Hawaii	5000
WGN Chicago, Ill.	50000

730—410.7

	W.P.
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

	W.P.
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 Blountston, 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 Humbolt, 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. 500d
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
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
WCKD 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
WREO 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
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. 500d
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
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. 1000d
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
WKDZ 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
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, Ga. 1000d
WGGH 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
WGHM 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
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 Guymon, 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
WDCJ 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
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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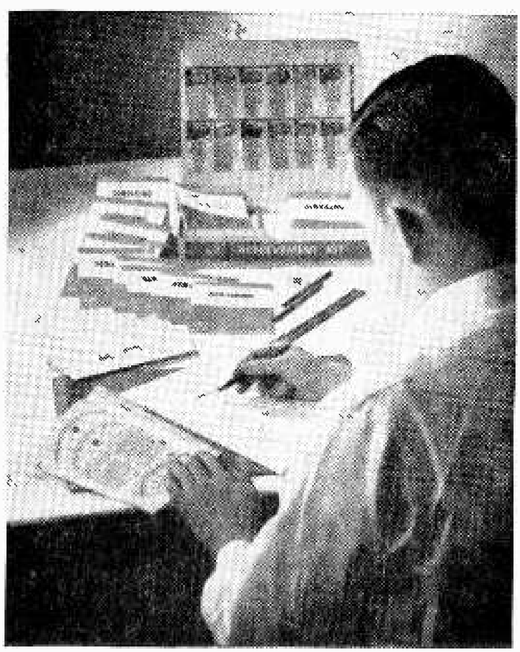

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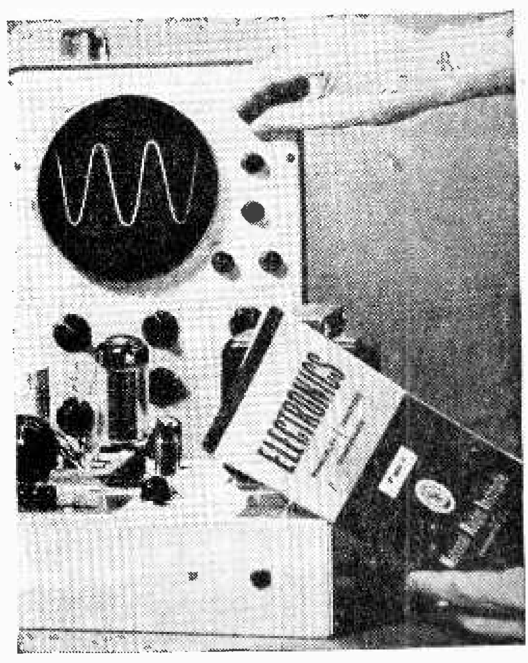

WHITE'S RADIO LOG

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
KVDC	Casper, Wyo.	1000

1240—241.8

kHz	Wave Length	W.P.
WEBJ	Brewton, Ala.	250
WPRN	Butler, Ala.	1000
WULA	Eufaula, Ala.	1000
WDWL	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
KRDY	Sacramento, Calif.	1000
KRNO	San Bernardino, Calif.	1000
KSDN	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
WWCD	Waterbury, Conn.	1000

kHz	Wave Length	W.P.
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.	1000
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
WALD	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

kHz	Wave Length	W.P.
KGY	Olympia, Wash.	1000
WKDY	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

kHz	Wave Length	W.P.
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

kHz	Wave Length	W.P.
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

kHz	Wave Length	W.P.
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

kHz	Wave Length	W.P.
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

kHz	Wave Length	W.P.
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
KJDY	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	Potosi, 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
KKGF	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.	
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
WDAL	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	Bastrop, 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	5000
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
WGDH 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
WJLD 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
KVOY	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
WCDH	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
KNOR	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

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

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
KODO	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
WCDJ	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

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
WIDN	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

WHHY	Montgomery, Ala.	5000
KDOT	Scottsdale, Ariz.	5000d
KHDG	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

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
KNOC 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

kHz Wave Length	W.P.
WLEC Sandusky, Ohio	1000
KWHW Altus, Okla.	1000
KGFF Shawnee, Okla.	1000
KSIW Woodward, Okla.	1000
KEED 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
KDON 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

kHz Wave Length	W.P.
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.	1000
KYOS Merced, Calif.	5000
KWIZ Santa Ana, Calif.	5000
KSEE Santa Maria, Calif.	1000
KCMS Manitou Springs, Colo.	500
KPOB Pueblo, Colo.	1000d
WKNO 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

kHz Wave Length	W.P.
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

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

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

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

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

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
WADK	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

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
WMAD	Madison, Wis.	5000d
WEVR	River Falls, Wis.	

1560—192.3

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
WTOD	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

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
WDNL	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		
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
WNJH	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		
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
WDBL	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		
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-

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.

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).

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	VLBBD	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	Time
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	Time
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	Time
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	Time
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 KIB474
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 KAP87 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
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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."

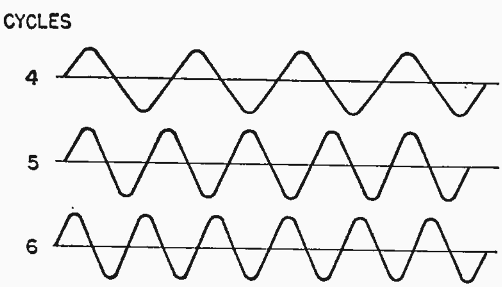
As the beat frequency is increased even more, the roughness fades away until it disappears when a beat frequency equivalent to a minor third is obtained. The roughness reappears again only when the beat frequency is close to the octave, and once more disappears when the octave interval is made exact. 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



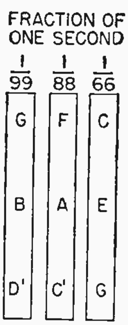


Fig. 9. Best way to understand triad ratios is to view them in terms of what's actually going on during a given time period. Here, while note C goes through four cycles, E will go through five cycles, and G through six.

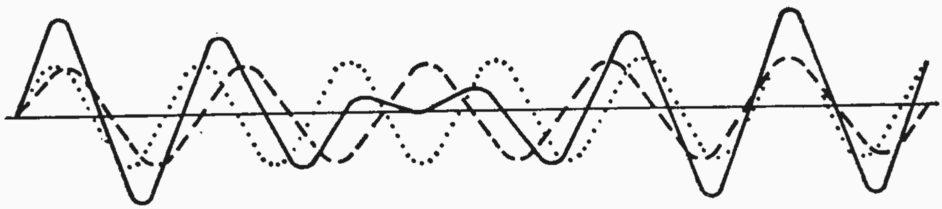


Fig. 10. Artist's representation of how beat is formed. Phase of two tones is basic here, since notes will tend to either reinforce or cancel one another.

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♯-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

Continued from page 18

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-uV 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

Continued from page 17

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 goodbye 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

Continued from page 45

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

Continued from page 48

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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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?"

Famous Patent

Continued from page 20

ventor refused to allow anyone to examine the contents of the box and would not divulge the secret of his invention.

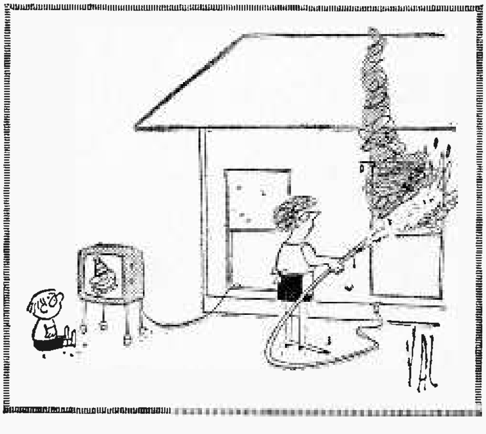
Stubblefield had come from relative obscurity in the farming community of Murray, Kentucky, a short time before. There, his electrical experiments had earned him a local reputation as an eccentric genius. He is reported to have given public demonstrations of his invention, transmitting voice and music through the "ether" even before the turn of the century. Coming east in 1902, he exhibited his invention in Washington and, a few months later, in Philadelphia; each time refusing to explain how the device worked. For several years he even refused to apply for a patent. Despite his unwillingness to reveal the secret of his experiments, the publicity from his demonstrations attracted investors and a corporation was formed to exploit his discoveries. Finally, in 1907, he was persuaded to file a patent application. The attempt to commercialize his inventions failed—perhaps because of the inventor's secretive and suspicious nature—and his apparatus is reported to have disappeared under questionable circumstances.

Apparently believing he had somehow been cheated out of his invention and denied recognition as a great inventor, Stubblefield returned home. The disillusioned inventor withdrew from society to live out his life as a recluse in the hills of western Kentucky. There, in a two-room hut he built by hand, he isolated himself from the world and refused visitors. Over the years, nearby residents began to tell strange tales about the eccentric hermit. Rumors were related of weird lights appearing around the hut at night. Passersby told of hearing voices, apparently from out of nowhere, when they ventured near the Stubblefield property. The inventor, himself, was seldom seen. The outside world had all but forgotten Nathan B. Stubblefield by 1928, when death by starvation overtook him in his lonely mountain shack.

The patent, shown on the accompanying pages, remains as evidence of his unsuccessful attempt at fame. The patent drawings disclose the "secret" of Stubblefield's invention. His "Wireless Telephone" involves a principle quite different from that of radio. It is based on a less common method known as *induction telephony*. In this system, the transmitter is a battery-powered telephone-type circuit containing a large coil of wire. The magnetic field emanating from the coil varies in a pattern corresponding to the speech fed into the microphone. This varying magnetic field induces a corresponding voltage (and resultant current) in the coil of the receiver circuit. Here, the varying current is converted back into speech in the same manner as in a telephone receiver. The method is apropriately called "wireles telephony" since there are no wires connecting the two stations. The coils of the transmitter and receiver function as the primary and secondary of a huge air-core transformer. The inventor has also provided a switching arrangement so that each station can be used either as a transmitter or receiver.

Although it has taken a back seat to other means of communication, there may be a bright future ahead for induction telephony. Within the past few years, researchers at General Motors Corporation have developed a method of using it to direct traffic on busy highways. In the GM system, as a car passes over a section of highway surrounded by a loop of wire (transmitter coil), a message is transmitted to a receiver coil on the car. According to General Motors, this low frequency inductive coupling has several advantages over conventional high frequency radio transmission methods. It is easily adapted to very short range transmission and will not interfere with or be affected by other radio services.

Copies of Nathan B. Stubblefield's Wireless Telephone 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. 887,357. ■



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If you like electronics—and are trapped in a dull, low-paying job—the story of Eugene Frost's success can open your eyes to a good way to get ahead.

Back in 1957, Gene Frost was stalled in a low-pay TV repair job. Before that, he'd driven a cab, repaired washers, rebuilt electric motors, and been a furnace salesman. He'd turned to TV service work in hopes of a better future—but soon found he was stymied there too.

"I'd had lots of TV training," Frost recalls today, "including numerous factory schools and a semester of advanced TV at a college in Dayton. But even so, I was stuck at $1.50 an hour."

Gene Frost's wife recalls those days all too well. "We were living in a rented double," she says, "at $25 a month. And there were no modern conveniences."

"We were driving a six-year-old car," adds Mr. Frost, "but we had no choice. No matter what I did, there seemed to be no way to get ahead."

Learns of CIE

Then one day at the shop, Frost got to talking with two fellow workers who were taking CIE courses . . . preparing for better jobs by studying electronics at home in their spare time. "They were so well satisfied," Mr. Frost relates, "that I decided to try the course myself."

He was not disappointed. "The lessons," he declares, "were wonderful—well presented and easy to understand. And I liked the relationship with my instructor. He made notes on the work I sent in, giving me a clear explanation of the areas where I had problems. It was even better than taking a course in person because I had plenty of time to read over his comments."

Studies at Night

"While taking the course from CIE," Mr. Frost continues, "I kept right on with my regular job and studied at night. After graduating, I went on with my TV repair work while looking for an opening where I could put my new training to use."

His opportunity wasn't long in coming. With his CIE training, he qualified for his 2nd Class FCC License, and soon afterward passed the entrance examination at North American Aviation. "You can imagine how I felt," says Mr. Frost. "My new job paid $228 a month more!"

Currently, Mr. Frost reports, he's an inspector of major electronic systems, checking the work of as many as 18 men. "I don't lift anything heavier than a pencil," he says. "It's pleasant work and work that I feel is important."

Changes Standard of Living

Gene Frost's wife shares his enthusiasm. "CIE training has changed our standard of living completely," she says.

"Our new house is just one example," chimes in Mr. Frost. "We also have a color TV and two good cars instead of one old one. Now we can get out and enjoy life. Last summer we took a 5,000 mile trip through the West in our new air-conditioned Pontiac."

"No doubt about it," Gene Frost concludes. "My CIE electronics course has really paid off. Every minute and every dollar I spent on it was worth it."

Why Training is Important

Gene Frost has discovered what many others never learn until it is too late: that to get ahead in electronics today, you need to know more than soldering connections, testing circuits, and

"CIE training helped pay for my new house," says Eugene Frost of Columbus, Ohio

Gene Frost was "stuck" in low-pay TV repair work. Then two co-workers suggested he take a CIE home study course in electronics. Today he's living in a new house, owns two cars and a color TV set, and holds an important technical job at North American Aviation. If you'd like to get ahead the way he did, read his inspiring story here.

replacing components. You need to really know the fundamentals.

Without such knowledge, you're limited to "thinking with your hands" ...learning by taking things apart and putting them back together. You can never hope to be anything more than a serviceman. And in this kind of work, your pay will stay low because you're competing with every home handyman and part-time basement tinkerer.

But for men with training in the fundamentals of electronics, there are no such limitations. They think with their heads, not their hands. They're qualified for assignments that are far beyond the capacity of the "screwdriver and pliers" repairman.

The future for trained technicians is bright indeed. Thousands of men are desperately needed in virtually every field of electronics, from 2-way mobile radio to computer testing and troubleshooting. And with demands like this, salaries have skyrocketed. Many technicians earn $8,000, $10,000, $12,000 or more a year.

How can you get the training you need to cash in on this booming demand? Gene Frost found the answer in CIE. And so can you.

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