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**WHITE’S RADIO LOG, Vol. 43, No. 2—Page 97**

**DEPARTMENTS**
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Some plain talk from Kodak about tape:

**Sensitivity and frequency response**

Controlling every electrical factor involved in the making and using of sound tape is a bit like trying to watch a three-ring circus... it can be done, but you need fast eyeballs. Let's discuss two critically important parameters: sensitivity and frequency response.

Sensitivity means the degree of output for a given input. We put in a 400-cycle signal and measure the output. The result: low-frequency sensitivity. A 400-cycle note recorded at 15 inches-per-second gives us a wave length that the tape "sees" of roughly .0375 inches, and by a happy coincidence this wave length penetrates the entire depth of the oxide coating, but not the support material. Everything else being equal, low-frequency response is a function of the thickness of the coating. The thicker the coating, the better the bass response. We choose 400 cycles instead of, let's say, 20 cycles because the 400-cycle note tells us just as much—and has an added advantage. An engineer can hear 400 cycles, so we have audio monitoring as well as instrumented observation on a scope face.

The high-frequency test gives us a fairly accurate picture as to just how smooth the surface of the tape is. Good high-frequency response is impossible on a tape having a rough surface. High frequencies affect fewer oxide particles. If the tape surface is rough, the low points will represent gaps in the oxide and cause a loss of H.F. response. We test our high-frequency sensitivity at 15,000 cycles. At 15 ips, the arithmetic looks like this:

<table>
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<th>inches</th>
<th>second</th>
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<th>cycles</th>
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<td>15</td>
<td>15,000</td>
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<td>1</td>
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At this high frequency we are recording only on the surface of the tape. If any roughness is present, big troubles result. For example: if you have a surface condition where the amplitude of the roughness is just .0001 inches and your recorded signal has a 1-mil wave length, you will lose 5.5 db in high-frequency response!

We are working toward a point: Kodak Sound Recording Tape is unsurpassed in smoothness, the surface varies no more than 25-50 millionths of an inch from a theoretically perfect plane.

Frequency response is the arithmetic subtraction of high-frequency sensitivity from low-frequency sensitivity. It's quite an easy matter to juggle the characteristics of an oxide around so that frequency response is nice and flat. If your oxide has poor high-frequency sensitivity, you can degrade L.F. sensitivity, and thus effect a flat response. But is the resulting L.F. loss worth it? We don't think so. That's why we designed our coating to give us superior low- and high-fre-

Next time we'll chat about a few other basic considerations.

Kodak Sound Recording Tapes are available at all normal tape outlets: electronic supply stores, specialty shops, department stores, camera stores... everywhere.

FREE! New comprehensive booklet covers the entire field of tape technology. Entitled "Some Plain Talk from Kodak about Sound Recording Tape," it's yours free on request when you write Department 8, Eastman Kodak Company, Rochester, N. Y. 14650.

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APRIL 1965—
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VOLUME 18 No. 2

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APRIL, 1965
SOLDERING TIPS
FOR HI-FI KIT BUILDERS

AVOID USING TOO MUCH SOLDER
Apply just enough solder to make a secure connection. Excess solder may fill up tube sockets, freeze switches or cause short circuits.

USE A DUAL HEAT GUN
Use the low heat trigger position to prevent damage when soldering near heat-sensitive components. Switch to high heat only when needed.

Weller Dual Heat Guns are invaluable for making fast, reliable, noise-free soldered connections. They’re just as essential to hi-fi kit builders as they are to professional TV and radio service technicians. Two trigger positions permit instant switching to high or low heat. Tip heats instantly and spotlight comes on when trigger is pulled. Long reach tip gets into tight spots.


WORLD LEADER IN SOLDERING TECHNOLOGY

POSITIVE FEEDBACK

Julian M. Sienkiewicz, Editor
WA2CQL/2W5115

Some day in the future, present-day, 1965, CB ticket holders will be referred to as the pioneers of the Citizens Radio Service—those who endured, made their voices heard, and finally conquered the organizational chaos peculiar to all fellowships dedicated to the greatest good for the greatest number.

A latest plan for channel allocation—of channels 22A and 22B, specifically—has been advanced by the automobile industry. The Automobile Manufacturers Association has announced establishment of plans for a nationwide communications network to aid motorists in distress.

The system, to be known as H.E.L.P., for Highway Emergency Locating Plan, calls for the use of CB radio equipment in private passenger cars. Motorists in need of aid would make their needs known on Channel 9, which will be monitored by a round-the-clock monitoring station within the 10 to 20-mile range of the equipment. Monitoring personnel

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APRIL, 1965

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Positive Feedback

would include volunteer citizen teams, police agencies, road service stations and hospital emergency rooms. The AMA pointed out that of the well over two million units of CB gear already in use, approximately half are in motor vehicles.

AMA officials said the plan grew out of a growing concern by government agencies and highway safety groups over the lack of emergency communications facilities for motorists. They pointed out that this lack will become even more apparent as the nation expands construction of its limited access roadways. In seeking a solution to the problem, various states and areas have experimented with systems of roadside telephones, solar powered emergency signal systems, roadside radio transmitters and emergency road patrols.

"Such systems, while commendable, may not be the most practical or economically feasible in attempting to cover the nation's entire road system," an AMA representative said. Therefore, the industry was asked to aid in developing improved systems. In developing the plan, a special AMA engineering task force has been working more than a year in cooperation with leading radio manufacturers, volunteer citizen groups, and at least one CB publication.

A number of volunteer groups are successfully operating smaller programs in various parts of the country, AMA said, and would be urged to join H.E.L.P. to effect a coordinated plan throughout the nation.

In addition to having the benefit of an effective emergency communications channel, motorists equipped with CB radio will be able to use the other channels for their business or personal communications. Even non-equipped vehicles will benefit from the program through "Good Samaritan" motorists with the required equipment who broadcast on their behalf. AMA said that rapid expansion of the H.E.L.P. program might eventually require assignment of special protected channels limited to automobile emergency use.

The auto industry is petitioning FCC to study a proposal for the assignment of two such "clear channels" (22A and 22B) to encourage optimum utilization of H.E.L.P. installations and reduce mutual interference stemming from use of channels shaved with regular CB stations.

A H.E.L.P. spokesman said that design
engineers already are working to develop specialized auto radio equipment so that the highway emergency communications concept can be expanded. Because the range of the equipment is limited and will be used by individual motorists only for short periods of time, the engineers feel that the "unused message capacity" could be used to a safety advantage by messages to motorists from police and highway authorities.

Present aims of the program according to AMA, is to encourage motorists' installation of equipment, establishment of a nationwide monitoring system by proper groups, and to gain support for the plan from groups interested in promoting highway safety.

Information on the program can be obtained from H.E.L.P., 320 New Center Building, Detroit, Michigan 48202. CB manufacturers, clubs, dealers, and individual operators are invited to request this data. Of course, feel free to mention RADIO-TV EXPERIMENTER when writing.

**BCB DX'ing.** If you want to get started in BCB DX'ing then I suggest you turn to 830 on your AM radio dial some evening and listen to Class 1-A clear channel station WCCO. With main studios in downtown Minneapolis and transmitter at Coon Rapids, Minn., WCCO can be heard just about nation-wide most evenings. Don't believe me? Well sit yourself down and tune up your AM listening rig to 830. On 9-9:30 P.M. CST, WCCO broadcasts a quiz game program, "Honest to Goodness" several times a month. The station telephones distant listeners who have sent in their phone numbers by post card and asks the questions that listeners anywhere in the nation can reasonably answer. A prize of $8.30 is awarded for each correct answer and the prize is jacked up $8.30 with each miss.

Besides enjoying WCCO's programming, you can obtain one of their QSL cards.
WCCO likes to hear from its listeners from distant points who have made tapes of their broadcasts. They prefer 7½-ips, and who knows, you may hear your own tape rebroadcasted. Of course, WCCO replaces the tape you send along with a letter and QSL card.

Interested, get started now. Send tapes to WCCO RADIO, Mr. Gordon A. Mikkelsen, 625 Second Avenue South, Minneapolis 2, Minn. Good DX’ing.

The February-March Issue. A reader asked if the Auto Sentinel on page 75 can also be used with 12-volt electrical systems. The answer is, of course, yes. All that is necessary is that you specify 12-volt DC coils for relays K2, K3, and K4; for relays K1 and K2, order Amperite 12C30 and 12C120 relays, respectively; and for solenoid K6, order the same solenoid but specify 12 volts.

10-80 Receiver. We have to say whoops! twice on the schematic diagram for the receiver. Make these changes in your copy: Capacitor C3, the coupling capacitor between Coils L1, and L2, in the front end of the receiver should have a value of 5-mmf, NOT 5-mf. Pick up this correction in your parts list as well. Secondly, ground the junction point common to C7, C8, and the low end of R3, the 100,000-ohm potentiometer.
IN this issue of Radio-TV Experimenter three exceptional titles will be reviewed in detail by the ol' Bookworm. All three are worthy of the space given to them in this issue, however, the first review is particularly noteworthy because of its universal appeal to all readers in the field of science—and science fiction.

Is Something Calling? At this moment there is a possibility—perhaps even a probability—that signals from other civilizations, other worlds in outer space, are impinging on our planet, according to New York Times Science Editor Walter Sullivan, author of We Are Not Alone. So startling was this idea that when the National Academy of Sciences sponsored a meeting at Green Bank, West Virginia, in 1961, to discuss the problem of communication with other worlds, it did so privately, in fear of sensational publicity. What the meeting brought to light, and the background for its prognostications, are given in full detail in We Are Not Alone.

Among the topics discussed is the question closest to us, inhabitants of planet Earth: Is There Life on Mars? No object in the heavens has been the subject of such bitter controversy in recent years. Even in this era of deep space probes, when we are about to discover the truth about Mars, a remarkable diversity of ideas continues to flourish. The inevitability of manned exploration of Mars was stressed at a meeting organized by the Space Science Board of the National Academy of Sciences in the summer of 1962. And, with six American vehicles scheduled...
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BOOKMARK
to be fired toward the planet, having started late last year and continuing through 1975, we should soon know.

Other key questions: Is Our Universe Unique? and The Solar System: Exception or Rule? are the subjects of chapters in which the theories of earlier scientists culminate in the reasoning of our contemporaries. Harlow Shapley, former head of the Harvard College Observatory, has written: "As far as we can tell the same physical laws prevail everywhere. The same rules apply at the center of the Milky Way, in the remote galaxies, and among the stars of our solar neighborhood. In view of a common physics and chemistry, would we not also expect to find animals and plants everywhere? It seems completely reasonable; and soon we shall say that it seems inevitable."

In a chapter: The Uniquely Rational Way, Mr. Sullivan discusses the possibility of other civilizations trying to contact our planet. In 1959 a proposal for a listening program envisaged that intelligent beings in another world could signal us. Giuseppe Cocconi and Philip Morrison, professors at Cornell University, suggested that it might be wiser to look for signals from a civilization more advanced than ours rather than to try to send signals ourselves. It was logical to assume that superior civilizations would send automated messengers to orbit each likely star and await the possible awakening of a civilization on one of that star's planets or even on a moon.

If we contemplate the resources of biological engineering, which we have not begun to tap yet, it is conceivable that some remote community could breed a subrace of space messengers, brains without bodies or limbs, storing the traditions of their society, mostly to be expended fruitlessly but some destined to be instruments of the spread of intragalactic culture. Such a messenger may be here now, in our solar system, trying to make its presence known to us.

Among the other topics which Mr. Sullivan takes up are: Puzzle of the "Slow" Stars; Creation or Evolution? Building Molecules; Wax and Wiggles; Protect Ozma; and Celestial Syntax.

In his concluding chapter, What If We Succeed? he notes the opinions of theologians from a number of denominations on the possibility of life superior to and perhaps
different from ours. Discovery of beings superior to ourselves in moral, spiritual and artistic ways, as well as technologically, would shake the foundations of religion and philosophy. But we might, through them, also look ahead millions of years into the future, learning from other worlds to avoid pitfalls, cure disease, live in peace, and become part of the vast community of intelligence in our galaxy.

We Are Not Alone is a McGraw-Hill book aimed at the scientist or well-read technician. If electronics is your game, and you would like to touch the far out, look for Mr. Sullivan's book at your favorite bookstore. Your ol' Bookworm predicts that this text will hit the best sellers list and poke its way to the top ten. If you have trouble finding it, write directly to: McGraw-Hill Book Company, Dept. 731, 330 West 42nd Street, New York, New York 10036. (The EDITOR strongly recommends this book to his readers.)

For Advance Servicemen. Color receivers, printed circuits, transistors, the all-channel UHF-VHF tuner—these are but the more dramatic examples of the continuing advances in television manufacture. They also exemplify the constant need of the service technician to update his knowledge and skills. Recognizing this need, the Electronic Industries Association (EIA) has sponsored a comprehensive next text titled Advanced Servicing Techniques, Volume I. Written by Paul B. Zbar and Peter W. Orne, this illustrated volume is a new release of John F. Rider Publisher, Inc., New York.

This book, ideally suited for both the advanced student and the working technician, provides valuable information for understanding and servicing color and black-and-white receivers. Emphasis throughout is on

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systematic, industry-approved troubleshooting procedures, utilizing the latest test instruments.

The authors treat the color set as a black-and-white receiver to which specialized color circuits have been added. The receiver is presented as a system of related functional sections that must be individually analyzed. Trouble symptoms arising in each section are presented with procedures for finding the defects they represent. The test equipment used in troubleshooting and aligning each section is also examined.

Volume II of Advanced Servicing Techniques in the Electronic Industries Association series will be published by the time you read this review. This volume gives complete coverage of maintenance, repair and troubleshooting procedures for home audio equipment such as: stereo amplifiers, record changers, tape recorders, and home intercom systems.

Volume I will sell for $8.25 and Volume II will sell for $5.95. Detail information can be had by writing directly to the publisher: Hayden Book Company, John F. Rider Publisher, Inc., Dept. R31, 116 West 14th Street, New York, New York 10011.

For Color TV Technicians. The new edition of the RCA Pict-O-Guide has been completely revised and up-dated to include the latest advances in color TV and servicing. Written expressly for the service technician, this comprehensive book is an invaluable guide in troubleshooting and servicing color TV receivers. Produced under the guidance of John R. Meagher, RCA's nationally recognized authority on practical television servicing, the Pict-O-Guide includes many true-false
life color photographs and illustrated step-by-step procedures. For example, the new book demonstrates proper color mixing by showing the results of color mixing on the TV screen.

The Pict-O-Guide discusses in depth setup procedures for new TV receivers, and presents greatly simplified instructions for purity, convergence, and black and white adjustments. The troubleshooting portions of the guide have also been expanded to give the reader the benefits of RCA's many years of experience in color TV servicing. In addition, oscilloscope wave-forms are shown throughout the book to help familiarize the technician with the electrical characteristics of the receiver.

The Pick-O-Guide contains twelve fact-filled chapters which highlight the following: Learning to Mix Colors—Discusses the proper adjustments for the beam currents of the three electron guns in the color picture tube. Compatible Color TV—Describes the basic principles of compatible color television which should be known by the proficient service technician. Receiver Setup—Contains over 30 pages on the all-important setup procedures required after delivery of any color set. What the Operating Controls Do—Instructs the service man on the effects of the Tint and Color controls. Using Color Test Equipment—Emphasizes the importance and use of equipment such as the dot/crosshatch/color-bar generator, and how such equipment eliminates hit-or-miss attempts in repairing color circuits. Using the green stripe signal in testing receivers. Troubleshooting Black-and-White Defects—Unique to Color Receivers. Trouble Shooting the Color Sections of the Receiver. AFPC Checks and Adjustments—How to correct for loss of color synchronization and other problems in the AFPC circuitry. When to Install a New Tricolor Picture Tube. Service Techniques—What a proper color bench setup should include, and many other tips which the serviceman will find useful. If the Receiver Needs Alignment—Describes when alignment is required, and exactly how to do it best.

Copies of the new RCA Pict-O-Guide may be obtained from your local RCA Tube-Parts Distributor, or by sending $5.75 to RCA, Commercial Engineering, Dept. RTVE 31, Electronic Components and Devices, Harrison, New Jersey.
NEW products

Allied Radio Solid-State FM-AM Tuner Kit KG-765

Allied Radio, makers of the Knight-kit line, have come up with a sure winner in their new all-transistor stereo FM-AM tuner kit, Model KG-765. The KG-765's specifications (kit and wired units) are—Power Output: IHFM Music Power, 70 watts; 35 watts per channel; 140 watts peak. Continuous Sine Wave Power, 28 watts per channel. For use with 8, 16-ohm speakers. Frequency Response: ± 1 db, 20 to 25,000 cps at rated power output. Distortion: Harmonic, 0.5%; IM, less than 1%; measured at rated power output. Hum Level: Tuner, −80 db; Magnetic Phono, −68 db; Tape Head, −60 db. Channel Separation: 40 db. Inputs: Tape Head (NAB); Magnetic Phono (RIAA); Tuner: Aux 1; Aux 2. Lists at $99.95 for kit; $149.95 wired. Brown metal case, $4.95; economy wood case, $6.95; de luxe wood case, $12.95. (Write to Allied Radio Corporation, Dept. 2RT2, 100 N. Western Avenue, Chicago 80, Illinois for complete details.)

Transistorized Organ Comes in Kit Form

A kit version of the new Thomas "Coronado" BL-3 all-transistor organ has been introduced to the kit builder's market by the Heath Company—in the assemble-it-yourself form the kit builder can save up to $449. Boasted as "a professional organist's dream with a beginner's simplicity," this organ kit features 17 true organ voices; two full-size 44-note keyboards; 28 notes of chimes; 13-note heel & toe pedalboard, range C through C; Color-tone Attack, Repeat and Sustain percussion—the only organ to give you all three; Reverb; a built-in 2-speed Leslie ro-
tating speaker plus a 2-unit Main speaker system which uses 12" speakers; new Stereo Chorus control to create interesting "stereo effects by using both speaker systems simultaneously; Vibrato; Treble Accent; Manual Balance to adjust relative volume of the two manuals; Pedal Volume; Expression Pedal; headset outlet for private play; an all-transistor 75-watt EIA peak music power amplifier; 5-year warranty of the transistor tone generators; factory-assembled, full-bodied walnut-finished hardwood cabinet with matching bench. You don’t have to be an electronics wizard to build it, nor a professional organist to play it. Heath has reduced assembly to simple-to-perform steps that require no special skills, knowledge or tools—takes around 70-80 hours. A pre-tuned tone generator is even included so you can tune the organ yourself by a counting method—no special “musical” ear needed. Called Model GD-983, the new Heathkit organ is priced at $849 which includes the matching bench. A lower-priced organ kit, Model GD-232A is also available at $349.95. (Complete details and information concerning both organ kits are available free, by simply dropping a note or postcard with your name and address to the Heath Company, Dept. 31RE, Benton Harbor, Michigan 49023.)

3-D Sight Booster
For Experimenter

With today’s fast-paced, intricate technology
Solid-state CB mate

The best way to ring up more 10-2's with the new solid-state transceivers is by using one of the new low-impedance Sonotone Ceramikes®. They are designed specifically for all-transistor transceivers. Transmission is loud and clear, and Ceramikes are built to take abuse. Get the low-impedance "CM-3050" or the "CM-3050M" with Magnetic Mount, today. Also Models "CM-30" and "CM-30M" for tube transceivers. Prices start at $15.75. Write for Free catalogue SAH-7.

NEW products

and the importance of delicate, precise work in one's business, profession or hobby, a sight-booster is often a vital necessity. Available now is a low-priced slip-on binocular magnifier that quickly returns its cost over and over. A quick, easy adjustment of the head-band to accommodate head size, and Magna-Sighter is in place—and stays in place—even over regular glasses. To resume normal vision, just lift the head a little. No need to remove the Magna-Sighter. Like magic, lower the head and object enlargement is over 2½ times—leaving both hands free to work. Featuring the finest ground and polished prismatic lenses, Magna-Sighter has no moving parts, nothing to wear out, nothing to replace. Light in weight and heavy on performance, its enthusiastic acceptance by government agencies and famous names in industry testifies to its value and usefulness.

Offered on a 30-day money-back guarantee, Magna-Sighter is priced at just $9.95. (To place an order or obtain more information write Fairchild Optical Company, Dept. TV31, 1555 West Howard Street, Chicago 26, Illinois.)

All-in-One Receiver
High Fidelity System

To meet the ever-growing popular demand by audiophiles for an all-in-one receiver, Allied Radio has come up with the new
Knight Model KN-370 stereo multiplex FM-AM tuner/amplifier. Model KN-370 combines on a single chassis a powerful 35-watt-per-channel stereo amplifier, individual FM and AM tuning sections, multiplex circuitry that automatically switches to stereo, dual preamplifiers, with a full set of front panel controls and input jacks. Massive potted output transformers and four 7591A push-pull output tubes reduce distortion providing crystal sharp frequency response. Unit comes complete with built-in AM loopstick and FM line-cord antenna. However, inputs are provided for external 50 and 300-ohm FM antennas plus external wire AM antenna. FM section IHF sensitivity is 2.5 microvolts for 30 db of quieting; IF bandwidth is 300 kc. AM section sensitivity is 4 microvolts for 20 db of S/N ratio; selectivity is 8 kc. The KN-370 houses 20 tubes, 12 diodes, and 7 silicon rectifiers. Price: $279.95, less case. Walnut wood case, $23.95; brown metal case, $12.95. (The KN-370 is described in the 1965 catalog (#240) available free on request from Allied Radio Corp., Dept. 317, 100 North Western Ave., Chicago 80, Illinois.)

Amateur SWL Receiver Wired or Semi-Kit

New on the scene is Lafayette's Model HA-230 low-cost, 8-tube communications receiver for the ham and SWL'ers. The HA-230 features separate "always on" transformer which supplies constant heater voltage to the mixer and oscillator stages for frequency stability. Four Bands cover 550-1600 kc; 1.6-4.8 mc; 4.8-14.5 mc and 10.5-30 mc. Other features include 8-tube superhet circuit with 1 RF and 2 IF stages; easy-to-read illuminated slide rule dial with logging scale; built-in Q-multiplier for phone operation, 1 microvolt sensitivity for 10 db S/N ratio, selectivity 60 db at 10 kc, 0.8 kc at 6 db (with Q-Multiplier); front panel headphone jack; BFO and antenna trimmer, audio output 1.5 watts for 4 or 8 ohm external.
NEW PRODUCTS

speaker (optional). Available wired for $89.50 and as a semi-kit for $74.50, stock nos. 99-2522WX and 99-2521WX, respectively. (For more information write to Lafayette Radio, Dept. R31T, 117 Jericho Turnpike, Syosset, L.I., New York.)

Automatic Tape Recorder
Does Some Thinking

The problem with the pre-recorded tape market has not been the price of pre-recorded tape, but the inconvenience of playing pre-recorded tapes. The superior sound quality of music on tape has not been enough to compensate for the nuisance of changing reels every 15 or 20 minutes when they are played on a manual tape recorder. Concord's Model 994 changes this. Now a single pre-recorded tape (7½ ips) can play for 40 minutes on the 994 without interruption and will repeat automatically if desired. Two pre-recorded tapes may be combined on a single 7 inch reel to play for 80 minutes continuously without interruptions or programmed to repeat and replay. One of the unusual features of the Concord 994 is its built-in "Electronic Memory." This memory enables the user to program the tape recorder for such manual or automatic operations as: single play, automatic reverse, and continuous play or record. The 994 can be programmed to play for any length of time, half-hour, hour, or all day, as desired. Among the many unusual automatic features of the 994 are: automatic threading, automatic reverse play, automatic reverse recording, automatic sound-on-sound recording, automatic stop at any point, and automatic tape lifters. The preamplifiers of the Model 994 are solid state and the unit includes a stereo 15 watt
amplifier together with four speakers (2 woofers and 2 tweeters) and two cross over networks. The speaker systems are integrated in the lid of the unit and may be separated for maximum stereo effect. Operation is simplified by the use of full pushbutton controls. The recorder is designed for use as either a compact portable or for installation and play through an existing hi fidelity music system. The Concord Model 994 is priced to sell at $399.50 list. (Concord would be happy to send you the complete specifications for the 994. Just write to Concord Electronics Corp. Dept. TE71, 809 North Cahuenga Boulevard, Los Angeles 38, California.)

Rotorless Antenna Rotates Beam

A totally new approach to Citizen’s Band beam antenna design, using no mechanical rotator, has been announced by the Antenna Specialists Co. Technically designated a sector phased omni-beam CB base antenna, the Scanner, Model M-119, employs all-electronic techniques to focus and rotate the beam. The antenna itself remains completely stationary. The Scanner is really three antennas in one. One of the three is used to radiate power, while the remaining two form a screen to reflect and focus the beam. Beam rotation is accomplished instantly by switching the radiating job from one element to the next. The beam patterns of the new antenna provide full-circle scan coverage with directional gain of 7.75 db.—the equivalent of 30 watts output from a 5 watt source. Noise and other interference from points outside the beam pattern are greatly reduced by the new
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**NEW products**

design. An important bonus of the all-electronic beam is its great compactness. Elements of the Scanner extend only three feet from the mounting boom, while an average five-element rotator-driven beam, for the same wave-length, measures 12 feet from the boom. The compact design provides, among other things, much better wind resistance—over 100 mph, plus a safety factor. Elimination of the rotator, and its associated hardware and accessories, brings the cost of the new antenna well below that of conventional rotator-driven arrays; an average of 30% lower cost, according to the manufacturer. *(Price data is not available at time of publication. However, full details can be had by writing to The Antenna Co., Dept. RE31, 12435 Euclid Avenue, Cleveland, Ohio 44106.)*

**CB Watt-Stretcher Compressor**

The new CB/ham Compressor from Galaxy Electronics is guaranteed to boost "talk power" for greater range. The unit literally boosts your output 3 or 4 times and prevents "fading out," allowing your signal to be heard when others are lost. Because of the 5-watt limitations for CB'ers, output power is normally far below the 5 watts. The Galaxy Compressor automatically amplifies the low levels of your speech allowing more powerful, clear transmissions and maximum use of your 5 watts. The unit is completely transistorized and adaptable to most AM and SSB transmitters for Citizens Band and Amateur equipment. The unit is wired for push-to-talk operation and requires one 9-volt battery (not supplied); sells for $24.95. Optional 115-volt AC power supply costs only $6.95. *(Interested? Then write to Galaxy Electronics, Dept. Rt1, 10 South 34th Street, Council Bluffs, Iowa.)*
ASK ME another

By Leo G. Sands

RADIO-TV EXPERIMENTER brings the know-how of electronics experts to its readers. If you have any questions to ask of this readerservice column, just type it on the back of a 4½ postal card and send it to "Ask Me Another," RADIO-TV EXPERIMENTER, 505 Park Avenue, New York, New York 10022. The experts will try to answer your questions in the available space in up coming issues. Sorry, the experts will be unable to answer your questions by mail.

Bum Signal Indicator

Can you give me a diagram for an over-modulation indicator for a CB set?
—A. T., Skykomish, Wash.

The over-modulation indicator shown can be used with a CB set or low power ham rig. Tube V2 is a 6X4 or dual diode, or it can be semiconductor diodes. The meter may be a DC voltmeter or a 0-1 DC milliammeter. The primary of transformer T is the modulation reactor. The meter needle will "kick" when the modulation exceeds 100% at which time the voltage to the RF amplifier is actually negative instead of positive.

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Besides its impressive altitude ability, Skyrocket is very capable as a trainer for basic stunting. It can also carry a 2-pound camera for taking aerial photographs.

The plane is made mostly of balsa, and the full-scale plans permit easy assembly on a building board. About all you'll need to build Skyrocket is a modeler's knife, dope and some silk or nylon covering material. An empty condensed-milk can serves as the gas tank. The model mounts a .45 to .60 engine.

Skyrocket is as thrilling a model to fly as any plane you could easily build!

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APRIL, 1965
"The meter is a marvelously sensitive and accurate instrument." U. S. Camera

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The computer gives F stops from .7 to 90 and lists exposure time from 1/15,000 sec. to 8 hours. 43° angle of acceptance, 4 range selection; EV-EVS-LV settings. Large (4½") illuminated meter, paper speed control knob for use with enlargers and now has a new battery test switch.

Take It From the Outlet
I have a miniature transmitter that uses a 90-volt battery which lasts only a week. What equipment should I use to get 90 volts DC from a regular house outlet?

—L. R., Detroit, Mich.

You can try a larger capacity battery or build a rectifier power supply as shown in the schematic diagram. The value (1000 to 5000 ohms) and power rating 1- or 2-watt) of resistance R depends upon the amount of current your transmitter draws. Try various values until you get 90 volts across capacitor C with the transmitter turned on and operating.

Modulation Limiter
How can I add a modulation limiter to a CB set?

R. L., Passaic, N. J.

You can buy a modulation limiter-preampifier and connect it between the microphone and the CB set microphone input. Or you might try a Raysistor (made by Raytheon) to control the gain of the modulation amplifier as shown in the schematic diagram. Switch S is part of the transmit-receive switch or relay that disconnects the speaker from the combination output transformer-modulation reactor. Connect a 15,000-ohm potentiometer (R) across the secondary of the output transformer and to the lamp side of the Raysistor. Eliminate the microphone preamplifier plate load resistor and connect the light sensitive resistor of the Raysistor in its place.

(Continued on page 28)

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(Continued from page 24)

As the modulation level increases, the resistance of the light sensitive resistor decreases and reduces the gain. This circuit is used in the new U.S.L. Contact 23 CB set. You may have to add an audio stage to get sufficient gain for good limiter action. After the modification you should have the transmitter checked out by a licensed operator to make sure it can’t be overmodulated.

Bye Bye, 35Z5GT

Can I replace a 35Z5GT tube in an AC-DC radio with a silicon or selenium rectifier?
—G. L., San Carlos, Calif.

Yes! Just pull the tube out of its socket and leave it out. Connect the rectifier (CR) across socket terminals in 5 and 8 with polarity as shown in the diagram. Connect a 50-ohm, 5-watt resistor (R1) across 2 and 3, and a 200-ohm, 10-watt resistor (R2) across 3 and 7. The resistors take the place of the tapped tube heater. The resistors will run hot so be sure the set is well ventilated. You will obtain one added feature not bargained for and that is the surge resistance through the other heaters will be much less than previously. This is so because the cold resistance of the heater string will be higher with the resistors in the circuit in place of the 35Z5GT. However, the hot resistance of the heater string will be the same. The radio will take a few more seconds to warm up than previously.

70-Volts of Audio

My amplifier has 4-, 8-, and 16-ohm and 70-volt output terminals. What is the 70-volt output used for?
—L. J. E., Everett, Wash.

In a 70-volt sound system the amplifier gain is set so that the audio output voltage between the common and 70-volt output terminals is approximately 70 volts. The volume level is adjusted at the speakers by selecting line transformer taps as shown in the diagram. The line transformers may have a
tapped secondary (T2), a tapped primary (T3), or it may be an autotransformer (T4).

The power fed to each speaker depends upon the voltage applied to it and its load impedance. For example, if Speaker A has an impedance of 4 ohms and is connected to the 2-volt tap on T2, it will consume one watt since power in watts is equal to \( P = \frac{E^2}{R} \) and here \( E = 4 \) and \( R = 4 \). If set to the 6-volt tap, the speaker power will be 8 watts, and so on.

The three types of transformers shown perform the same function—they step down the 70-volt signal to the required level. The taps permit adjustment to the voltage ratio which is proportional to the turns ratio.

Speakers A, B and C may all be operated at different sound levels. The number of speakers that can be connected across the 70-volt line is limited by the power capability of the amplifier. For example, a 50-watt amplifier could feed 8 watts to speaker A, 10 watts to B, 2 watts to C and have 30 watts to spare for additional speakers.

On some amplifiers the 70-volt output terminal is merely window dressing and is the equivalent of a 500-ohm line output. A true 70-volt amplifier has excellent output voltage regulation permitting removal or addition of a speaker without affecting the sound level of other speakers. It is easy to work with 70-volt sound systems since we deal with volts and watts without being concerned with impedance matching.

---

70-Volts of Audio

Bye Bye, 35Z5

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APRIL, 1965

29
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THE GABBY

By K. C. Kirkbride

Electronics in the form of hydrophones, acoustic spectrographs, and SCEPTRON "language" computer are the tools being used to solve the riddle of the talkative Dolphin's language!

Continued overleaf
Many a truth has been spoken in jest but has it been spoken in whistles, chirps, pops, clicks, squeaks, moans, groans, whines, and the Bronx cheer? American engineers plying electronic techniques to study the conversational propensities of *tursiops truncatus* (the dolphin to you!) contend the answer to this puzzle is an emphatic yes!

For a series of tests applying hydrophone, and sound movies, tape recorder and sonic spectrographic analysis have recorded the eight-foot-long, bottle-nose dolphin talking to fellow dolphins and one dolphin talking to man.

**Florida's Marineland.** It all began when Curator A. F. McBride of the fabulous Marineland of Florida near St. Augustine invited some dolphins to household in his Marineland pools. His staff, amused at tursiops' gay sense of prank and humor (at sea he will sneak up behind a fish, nip its tail and pull backwards), thought, why not teach this gay fellow some tricks?

It wasn't long before the Florida trainers were putting their 300-pound guests through the jumps—some as high as sixteen feet in the air. They taught bottlenose to play basketball, tow a raft, put out a fire, jump through flaming hoops in chorus-girl style. Each dolphin, like humans, has a distinct personality, different from all other dolphins. Some will learn one trick, not another. All become bored quickly if asked to perform the same trick too often.

**Moanin' Real Low.** When the trainers heard their bright, temperamental pupils muttering to one another when asked to perform the same old trick day after day, they wondered, could these fellows really be "talking" in sound signals to each other? The trainers watched a seemingly bossy bottlenose snap his jaws, wave his head excitedly, frightening his more sensitive kin into swimming for cover at the far corners of the pool.

Certain "whistles" and "barks" accompanied nervous, excited behavior. The same moans, groans, squeaks, pop-pop-pops and "raspberries" sound-tracked moods of hunger, danger and courting. One moan seemed to mean a dolphin was warning another. A high "squeak" signalled "come here." Curator A. F. McBride said he suspected "three (dolphin) noises have 'language' value."

The trainers thought the response of the dolphins to human vocal instruction suggested these mammals from the sea understood human meanings; sometimes seemed eager to talk to man.

**Go West, Tursiops.** On the West Coast, Lockheed engineers were working on antisubmarine warfare research, studying the dolphin's sonar habits. They read the McBride findings, thought if they could possibly translate dolphin "language", the smart animal might tell them what gives under the sea.

In Lockheed and Marineland-of-the Pacific pools, engineers Dr. John Dreher and William Evans placed highly sensitive transducer hydrophones in their pool, rigged sound movies, tape recorders and acoustic spectrographs to snoop on friend tursiops.

**Moans.** With their electronic gear, the Lockheed men could record on tape and cylindrical graph the moans, groans, pop-
A dolphin moves in to accept rubber suction cup discs over each eye (far left). With the suction discs in place (they cause no pain or discomfort), the dolphin must rely totally on its senses of hearing and sonar-sounding to maneuver through obstacle course. At right, dolphin with "blindfold" on maneuvers past underwater hydrophone without so much as bumping it.

Luck, a trained dolphin, gives Robert Hawkins (right) samples of the sounds that scientists believe comprise a true dolphin's language. Hawkins is the inventor of SCEPTRON (left), a miniature computer that can memorize, distinguish between and react to sights and sounds. The tiny fiber array reacts to outside stimulus and records them.

pop-pops and clicks of the dolphin. Dreher and Evans recorded the bottlenosed-fellow in all his living activities—seeking food, playing games, teasing his trainers, courting, angry, afraid.

They matched sound-tracks with action and emotion, found one "beep" signified a dolphin was courting. Both male and female sounded the same signal but the male "beeped" first. If one was in trouble, it would sound a stress signal and all other dolphins within listening range would stop chattering, rush ambulance-speed to the stressed animal, push him to the surface of the water, sometimes to "shore."

Moans and Groans and Whines. Linking activity to moans and groans, the Lockheed men worked out a dolphin alphabet, defined a vocabulary of 32 dolphin words and assigned related meanings.

They recorded baby dolphin whistles on an acoustic spectrograph, found the young dolphin could whistle only seven of the 32, suggesting the young learned from pappa just as humans do. The spectrograph hinted too, an international dolphin language existed as the same words appeared on the graph "spoken" by dolphins of different species.

Bottlenose Gets Around. In Coconut Grove, Florida, a neurophysiologist named Dr. John C. Lilly put two dolphins in adjacent tanks in his Communications Research Institute, listened by hydrophone and tape recorder to them whispering back and forth like children.

Studying further dolphin conversations, he found most dolphins waited for a fellow dolphin to finish a sentence before answering. He would hear click exchanges between two animals with little overlap. Occasionally he heard a "duet," two animals whistling simultaneously, matching frequencies so well he could hear beat frequencies between the
two emissions. This he thought similar to the human habit of repeating a word as the other person says it.

Lilly believed the dolphins sounded off in high frequencies, possibly through a series of sound-producing slits in the larynx leading into the animal's blowhole. No two dolphins "spoke" alike and many of their words sounded strangely human.

Talk Up. The Florida physiologist wondered, if dolphin words could sound human, why couldn't the dolphin, with proper encouragement, learn to repeat human speech? With this in mind, Dr. Lilly invited a young dolphin named Elvar to leave his happy home in the oceans and live in the laboratory tanks at the Institute.

During the first months of his visit, Dr. Lilly had to admit, Elvar was not a very pleasant guest. He was shy, aloof, subdued, indifferent to his human hosts, burying his bottlenose in the water and refusing to moan or groan. But Dr. Lilly didn't intend to let tursiops defeat him. Everyday members of the Institute staff stepped into the tank room to pay respects to their guest and talk to him in spite of his rude manners. Relating action to words, they raised their voices so the words would penetrate the water. At times, they admitted feeling pretty silly talking to a small whale that didn't even have the courtesy to answer.

But as the months wore on Elvar started to moan softly, then muddle, whine, squeal as any proper dolphin will do. And as he moaned, his human friends noticed his voice changing. He was moaning in high falsetto sounds, like a small child, in frequencies above those the normal human adult would use. Spectrographic sonic analysis showed Elvar's lowest frequencies at this point were between 1,000 to 2,000 cycles per second.

Elvar Talks. Dr. Lilly slowed the tapes of his recorder down by a factor of two to four, listened again. Now he heard sounds he had never before heard from any other dolphin. He heard definite resemblance to the human voice!

Dr. Lilly decided it was time to take the next step. He sent his associate, Alice Miller, to the tank room. As she stood at the edge of the tank, she spoke to Elvar. Elvar grinned in true dolphin style, filled his mouth full of water, squirted it at her, threw back his head, and laughed.

As Alice Miller hit the edge of the tank she cried out "stop it." Elvar, proving he could be as obedient as his fellow animal, immediately squirted water again. Alice Miller hit the side of the tank again, cried out the second time, "stop it."

On the fourth "stop it," Elvar opened up his blowhole, started to chirp very loudly in short sharp sounds. Playing back these latest Elvarisms on tape, Dr. Lilly heard a high-pitched "weeeeee."

"Stop It." After the fifth "stop it," Elvar said something at normal tape speed that sounded like a two-part, very short, high-pitched sound. Slowing the tape by a factor of two, Dr. Lilly now heard a very definite, human-like "stop it" spoken by Elvar in proper English. Elvar next repeated "bye-bye," the hydrophones and tape units picking
up the components of the words as Elvar repeated them immediately after Miss Miller.

Alice Miller next told Elvar to say "more Elvar." He faltered at first on this one, but as Alice repeated, he finally chirped a high-pitched run-together "more-var." Alice Miller tried again. This time Elvar lifted his proud bottenose head, beamed a broad dolphin smile at the lady and spoke in high-pitched human-tones "More Elvar."

Audio electronic spectrographic analysis showed Elvar had been steadily lowering the frequencies of his speech to accommodate his human listeners—from 1,000 down to 450 cycles within the past weeks—and that he could at will pitch back to higher frequencies two to four times the normal upper human frequency range.

Other Voices. Dr. Lilly himself now stepped into the tank. He first asked Elvar to repeat the words he already knew, such as "speak, up, louder, more." Then Dr. Lilly told Elvar to repeat after him the word "squirt." The Doctor added the word "water," asked Elvar to say the phrase "squirt water."

Elvar practiced "wa" separately from "ter," then dolphin-smiled at Dr. Lilly, spoke the two words in succession in clear human tones, even rolling the "r's." For this, his crowning performance, Elvar had brought his lowest pitch down to about 200 cycles, a new low for his lowest frequencies.

And he had proved he could not only repeat human phrases but could also analyze and repeat individual characteristics of the human voice. For "squirt water" was spoken in male-like brusque tones contrasting sharply with those he used in response to Alice Miller's feminine voice.

The Profit Motive. Sperry-Rand engineers say they know how to increase the dolphin's vocabulary. Feed human word-sounds into a Sceptron—Sperry Rand's miniature quartz-fiber brain cell—connect it to a mackerel dispenser so when Dolphin pronounces a new word correctly, he is automatically awarded a mackerel.

And as Mr. Tursiops is a known gourmet when it comes to mackerel, it is this writer's prediction it won't be long before the dolphin discards his moans, groans, and squeaks for human speech.
Any radio buff worthy of the name knows there's a world of excitement to be found in the VHF (very high frequency) range of the radio spectrum, but all too few of us have had a chance to get in on it. General-purpose receivers, for a number of good reasons, usually stop at about 30 megacycles—and the VHF receivers currently available as do-it-yourself projects or in military surplus hardly compare in performance with that we're used to on lower bands.

The VHF Extender is a device which can change all that for you, and let you get in on the fun for a minimum outlay of cash. Performance will be equal to that of your present SW receiver, since the purpose of the VHF Extender is simply to extend the frequency range of your present rig into the VHF region.

The VHF Extender can be used for any 4-megacycle-wide segment of the spectrum between 30 mc. and approximately 170 mc. and with only slight extra expense can be modified at will to cover a new slice should you tire of your first choice. This feature lets you listen to police, fire-department, aircraft-radio, or ham operators at will.

**Theory Before Hookup.** Before we get into the construction details of the VHF Extender, let's take a brief look at how it works. This will help you when it comes time to make the various parts-value choices needed in construction.

The VHF Extender is, primarily, a new front end for your receiver, which connects into the line between antenna and receiver itself. It translates the VHF signals down into the range covered by your existing receiver, so that while the on-the-air signal may be at a frequency of 136.040 mc. (for example), the signal fed into your existing receiver is at a frequency of 640 kc.—in the broadcast band.

Since the translating frequency is determined by a crystal-controlled oscillator, you can rely upon the dial calibration of your receiver. Thus should you be hunting a satellite signal at 136.050 mc., you could set your receiver dial to 1,050 kc. and use a 45-mc. crystal in the VHF Extender. Any signal appearing in the receiver would have to be a 136.050-mc. signal at the antenna (the 133.950-mc. image frequency is reduced greatly by the input RF amplifier circuit).

High performance in the critical VHF region is assured by the RF amplifier tube, a 6DS4 Nuvistor. The other tube, a type...
6U8A, serves as both crystal oscillator and mixer. Power for the VHF Extender can be taken from the existing receiver, if it uses a transformer. Be sure to fuse the 8+ (¼ a.) and 6.3-vac (1 a.) leads to the Extender.

Get Ready to Build. The only tools absolutely necessary to build the VHF Extender are a drill, a screwdriver, cutting pliers, and a soldering iron. A grid-dip oscillator can prove very useful, however, if you happen to have one on hand. With the GDO, you can get along without the coil tables, simply by dipping each coil to its proper frequency.

To determine the values to be used for XTAL frequency, L1/C1, L2, L3/C3, and L4, use the tables or follow these rules. L1/C1 must tune to the desired VHF frequency band. For satellite reception, for instance, they should tune to 136 mc. L2 should tune to this same frequency when installed in the circuit and with the 6DS4 plugged in. For input frequencies between 30 and 70 mc., the XTAL frequency should be equal to the frequency of the lower end of the desired VHF band, minus the frequency of the lowest desired input frequency. For best results, the 7-11 mc. portion of the existing receiver's coverage should be used, which would make the XTAL equal to input signal frequency minus 7 mc. For input frequencies between 70 and 170 mc., proceed as before but divide the result by three. For 136-mc. input and 7-mc. output, the XTAL frequency would be 136-7 or 129/3, or 43.0 mc. L3/C3 should tune to the XTAL frequency, whatever it is determined to be, and L4 should tune, to three times XTAL frequency when installed in the circuit.

If you're using the coil table rather than a GDO, simply take the values shown there.

Putting It Together. The VHF Extender is built on a 2¼" by 3" by 5¼" aluminum chassis box, using the long flat side for most parts installation as shown in the photograph. Lay out and drill the box as shown in the chassis detail drawing.

Next, select the necessary coils using data from the coil tables. Install each in its proper location. Mount the tube sockets. The 6DS4 Nuvisor socket is secured by crimping its lips over tightly against the chassis. Several short wires are then soldered to the lips, and later will be soldered to the shield plate across this socket.

Wire the filament leads as shown on the schematic diagram before installing the copper shield partition on the 6DS4 socket, and mount the two coax connectors, J1 and J2, in place. Then mount the partition (which must be made of copper or brass; this can usually be located at an auto-supply wholesaler under the name of 3-mil shim stock).

Schematic diagram for the VHF Extender.
build the VHF extender

The VHF Extender is an advanced project for the SWL experimenter. Part location is critical and should be followed closely. See photo at right and below. To make your unit identical with the author's, follow the detail drawings given in the article and follow the text without alterations.

and make the rest of the connections to the tube sockets. Refer to shield detail drawing to fabricate piece.

Note from the photos that all leads must be kept as short as possible and no wiring is "fancy". Everything must take the most direct route. This makes the lower layer of wiring tough to get to later on, so check and double check at every step to make certain your connections are correct. If your wiring looks like a tight-knit rats nest—you're doing a good job.

Wiring Differences. With all coils in place and all tube-socket-connections made, the final stages consist of wiring the coils in and connecting the links between them. Only two of these are particularly unusual. Note how the long lead from the 1N69A diode, D1, is used as its own coupling link to L3. The other end of the diode wraps around L4 in the same way. Diode D1 and L4 are omitted on the 30 to 70 mc. models; this is the "extra expense" mentioned earlier to switch to other frequency bands. The other unusual connection is the twisted-wire "gimmick", C13 coupling L4 to the 6U8A pentode's grid. In the 30-70 mc. model, this wire connects to the top of L3 instead of to L4 as shown in the schematic diagram. Be extremely careful that the two wires do not short-circuit together; they form a low-value capacitor through which oscillator voltage is injected into the mixer stages, V2A.

Turn It On. When all connections are complete and rechecked, you can apply power to the VHF Extender. The 6U8A filament should light immediately, and the 6DS4 should feel warm to the touch after a few seconds. If it is hot, remove power quickly and check wiring, especially near L5.

If all proceeds well, connect a coaxial cable from the output jack of the VHF Extender to the antenna terminals of your receiver and tune to about 7 mc. Briefly disable the 6U8A mixer, V2A, of the VHF

Detail drawing of chassis top part's layout.
Extending by shorting pin 3 to ground with an insulated screwdriver. Noise output from the receiver should diminish at the same time. If it does not, tune L3 until the noise rises sharply and suddenly. Adjust L3 carefully for maximum noise, then repeat the previous test. Don’t be worried if a few 7-mc. shortwave signals come through during all this; they won’t when the bottom cover of the VHF Extender is in place.

Before proceeding, you will have to locate a signal in the VHF region you’re interested in. Tune it in as best you can; it may have an extremely ragged or “whistling” sound which is due to regeneration in the 6DS4 stage of the VHF Extender. Adjust the slug of L5, using an insulated tuning tool, to remove all distortion. Then tune L1 and L2 for best signal strength. You may find that readjustment of L3 (and L4) will strengthen the signal still more.

Next, unsolder either end of the 100,000-

### COIL TABLE FOR 30-70 MC.

<table>
<thead>
<tr>
<th>VHF Band</th>
<th>L1, L2</th>
<th>C1 (mmfl)</th>
<th>L5</th>
<th>7-11 Mc. Output</th>
<th>BC-Band Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>XTAL (mc.)</td>
<td>L3</td>
<td>C3 (mmfl)</td>
<td>XTAL (mc.)</td>
<td>L3</td>
</tr>
<tr>
<td>30-34</td>
<td>20A156RBI</td>
<td>10</td>
<td>4205</td>
<td>23,000</td>
<td>20A106RBI</td>
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<td>27,000</td>
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<td>38-42</td>
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<td>10</td>
<td>4204</td>
<td>31,000</td>
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<tr>
<td>42-46</td>
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<td>4204</td>
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<tr>
<td>46-50</td>
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<td>4204</td>
<td>39,000</td>
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<td>50-54</td>
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<td>10</td>
<td>4204</td>
<td>43,000</td>
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<td>54-58</td>
<td>20A687RBI</td>
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<td>4204</td>
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<td>20A827RBI</td>
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<tr>
<td>58-62</td>
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<td>62-66</td>
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<td>4.7</td>
<td>4203</td>
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<td>66-70</td>
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<td>4.7</td>
<td>4203</td>
<td>59,000</td>
<td>20A687RBI</td>
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</tbody>
</table>

Coil numbers are J. W. Miller Co. part numbers. Win' two-turn link of No. 22 hookup wire around grounded end of L1. BC-Band XTAL frequencies are for lowest megacycle of 4 Mc. VHF bands; add one mc. to XTAL for each higher megacycle desired. For instance, to cover 41-42 mc., table gives 37.4-mc. XTAL but this is upper megacycle of VHF band; add 3 mc. to XTAL frequency and use 40.400-mc. crystal.

### COIL TABLE FOR 70-172 MC (7-11 MC OUTPUT)

<table>
<thead>
<tr>
<th>XHF Band</th>
<th>L1, L2</th>
<th>C1 (mmfl)</th>
<th>L5</th>
<th>7-11 Mc. Output Only</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>XTAL (mc.)</td>
<td>L3</td>
<td>C3</td>
<td>L4</td>
</tr>
<tr>
<td>70-74</td>
<td>20A477RBI</td>
<td>4.7</td>
<td>4203</td>
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<td>74-78</td>
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<td>4203</td>
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<td>4203</td>
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<td>20A477RBI</td>
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<td>4203</td>
<td>39,000</td>
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<td>20A477RBI</td>
<td>4.7</td>
<td>4203</td>
<td>40,333</td>
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<td>4203</td>
<td>41,667</td>
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<td>4203</td>
<td>43,000</td>
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<td>20A477RBI</td>
<td>4.7</td>
<td>4203</td>
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<td>168-172</td>
<td>20A477RBI</td>
<td>4.7</td>
<td>4203</td>
<td>53,667</td>
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</tbody>
</table>

Coil numbers are J. W. Miller part numbers. L5, for bands above 132 mc. is wound on a Miller 4200 coil form with No. 24 wire, with the number of turns shown in the table. 0 value for C1 indicates part is not required.

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COIL TABLE FOR 70-172 MC (BC-BAND OUTPUT)

L1, L2, L5, and C1—same as given in Coil table for 70-172 mc with 7-17 mc. output.

L3—J. W. Miller type 20A106RBI from 70 mc. to 86 mc.; 20A827RBI from 86 to 140 mc.; and 20A627RBI from 140 to 172 mc.

C3—20 mmf from 70 to 86 mc.; 15 mmf 86-140 mc.; and 10 mmf 140-172 mc.

L4—Miller 20A156RBI from 70-78 mc; 20A106RBI 78-112 mc; 20A827RBI 112-136 mc.; 20A627RBI 136-152 mc.; and 20A477RBI 152-172 mc.

XTAL—23.133 mc. for 70-71 mc.; 23.467 mc. for 71-72 mc.; 23.800 mc. for 72-73 mc.; 24.133 mc. for 73-74 mc.; 24.467 mc. for 74-75 mc.; etc., increasing by 33 1/3 kc. for each megacycle increase of VHF band. For 136-137 mc. coverage (satellites) Xtal is 45.133 mc., and for 145-146 mc. (Novice portion of ham 2-meter band) use 48.133 mc. Output will be from 600 to 1600 kc. on BC band, with 600 kc. equal to lowest frequency in band (136.000 mc. on satellite band; 136.040 mc. satellite would come in at 640 on BC dial).

ohm resistor, R4, in the 6DS4 plate circuit, while still tuned to the VHF signal. This adjustment is best made with the strongest VHF signal you can find. Readjust L5 until the signal (with resistor disconnected) is as weak as you can get it. DO NOT READJUST ANY OTHER COILS. Then reconnect resistor R4, put on the bottom plate, and you're ready to enjoy the VHF Extender.

Switching Bands. To change to another frequency band, should you tire of your first choice, replace the crystal with one of proper frequency (see coil tables) and retune the VHF Extender as described above. If the move in frequency is not very far, you may not need to change the coils. However, if the frequency change is more than half a dozen megacycles or so, you will probably have to replace coils L1, L2, L5, and possibly L4.

(Continued on page 117)

PARTS LIST

C1, C2—See Coil Tables for values—select ceramic disc NPO type capacitor
C2, C4—180-mf., 300 WVDC or better, disc or tubular ceramic NPO type capacitor
C5, C8, C9, C10, C12—.001-mf., 1000 WVDC or better, disc type capacitor
C6—.001-mf., button-bypass, standaff capacitor (Erie Ceramic 323X5U101M or equiv.)
C73C11—100-mmf., 1000 WVDC or better, disc type capacitor
C13—Gimmick capacitor (See text)
D1—1N69A diode (Sylvania)
J1, J2—UHF coaxial connector, receptacle chassis type (Military No. SO-239 or 49194, Amphenol 83-1R, or equiv.)
L1, L2, L3, L4, L5—See Coil Tables
L6—RFC choke, 10-milli henry, ferrite core for 7-11 mc. output. Use 100,000, ½-watt resistor in place of RFC for BCB output
R1—47,000-ohm, ½-watt resistor
R2, R5, R7—100,000-ohm ½-watt resistor
R3—4700-ohm, 1-watt resistor
R4—100,000-ohm, 1-watt resistor
R6—1000-ohm, ½-watt resistor
V1—6DS4 Navistor (RCA)
V2—6U8A tube (GE)
XTAL—See Coil Tables for value, Select type with .050-in. diameter pins spaced .486-in. apart, .01 % (.005 % preferred)
1—XTAL socket (National C5-7 or equiv.)
1—2½ "x3½"x5¼" aluminum chassis box (Bud CU-2106A or equiv.)
1—Navistor socket for 5-contact tube
1—9-pin miniature tube socket with tube shield base
Misc.—Cable, wire, hardware, grommet, dials, copper shield, cement, solder, etc.

Estimated cost: $20.00
Estimated construction time: 12 hours
At last—the ol' principle of thermoelectricity has been practically applied for cooling—and heating!

By Len Buckwalter

Flick a switch one way, it blows hot. Flip it the other, it blows cold. That's only one striking feature of the electronic air conditioner. The others are just as remarkable. These units toss out nearly all the guts of the standard air conditioner—from bulky compressor and motor, to the out-size condenser. In their place is a compact, quiet package that can pour BTU's into a cold room in winter, or drain them from a hot space in summer. And it'll respond without the groan of spinning machinery.

Behind the electronic air conditioner are two words being applied to more mechanical and electrical devices every day—"solid-state." It's the field of the semiconductor: carefully doped-up metals that exhibit a dazzling array of useful qualities. It includes the transistor, diode and pin-head circuits inside high-speed computers and microminiature equipment. Now, with newly-developed properties, semiconductors are giving a big boost to the field of temperature control. A silent flow of electricity, not the
brute-force action of awkward mechanical devices, can heat/or cool.

**Where It Began.** The idea of using electrical current to produce temperature change is not new. But it began rather indirectly back in 1821 when a German named Thomas Johann Seebeck (1770-1831) was toying with some bits of metal; a bar of antimony and some brass wire. In one experiment, Seebeck applied heat to a point where the bar and wire touched. Nothing happened—that is until he noticed slight movement in a nearby compass needle. Seebeck had accomplished a milestone in electronics, but his explanation of the event, at first, was fuzzy. He thought the heat generated magnetism which affected the compass needle.

Later, it was discovered to be a 2-step affair. What Seebeck had done was to apply heat to two dissimilar metals—antimony and brass—and created a flow of current. It is now called *thermoelectricity.* It'll work with any two different metals and the application of heat. Why did Seebeck’s compass needle move? As current flowed in the brass wire it became an electromagnet and deflected needle. Seebeck’s discovery was remarkable for his time, considering that Georg Simon Ohm (1787-1854) had not yet discovered his well-known law.

The fact that heated metals can be electrical generators paved the way for the next step. Fourteen years later, Jean Charles Peltier (1785-1845) in France followed through on Seebeck’s experiment. In the spirit of basic research he reversed the process. Peltier applied an electrical current across dissimilar metals in contact with each other. When the current was applied in one direction he discovered that heat appeared where the metals contacted. Switching his electrical connections, which reversed the direction of current flow, that same junction point grew cool.

**Two Effects.** Thus the field of thermoelectricity was born. Soon the mystery surrounding those early experiments began to fall away. Both Seebeck and Peltier effects are now explained on the basis of electrical particles—negative electrons and positive protons—which form the structure of all matter. A give-and-take exchange of energy by these particles gives rise to thermoelectric effects which make possible the electronic air conditioner. First, let’s consider a simple arrangement to illustrate how heat can produce an electrical unbalance, then a current flow. It’s shown in Fig. 1. As in any substance, the metal bar consists of atoms containing electrons and protons which attempt to lock together. The bonds between them, however, are weaker in some substances. It happens in electrical conductors, such as the metal bar of Fig. 1. There are many “free” electrons which readily drift throughout the material. It is a willy-nilly movement with-

**Fig. 1. Applying heat to one end of a metal bar will cause an electrical unbalance.**
out much order. But when the heat of the candle is applied to one end of the bar, those electrons begin to absorb energy. The result is a mass migration toward the cooler end, as shown by the arrow. Protons, on the other hand, have no such mobility and are held firmly in place by the grip of the atom's nucleus. The result: the bar becomes electrically charged—plus on one end, negative on the other.

Now to apply this effect in a complete circuit and see how heat and cold may be produced. In Fig. 2 the junction of two dissimilar metals is shown being heated. As in the earlier example, electrons commence to flow away from the heat source. How many electrons appear at the ends? This depends on the particular metals. Since the electrical activity of different metals will vary, so will the amount of "free" electrons. This explains why four electrons are shown at the left in the iron, while only two occur at the right for aluminum. (Actual numbers are much higher.) To the lamp connected across the ends of the bars, this difference appears as an electrical unbalance. In fact, the lamp sees a thermoelectric "battery." The end with more electrons can be considered the negative terminal. Fewer electrons on the other end make that terminal relatively more positive. This difference in electrical pressure (voltage) causes a current flow through the bulb.

In Peltier's experiment, conditions are reversed, as shown in Fig. 3. A voltage source (the battery) is now connected to the ends of the bars. Let's see what happens in the bar at the left. The battery may be considered an electron pump, driving electrons up to the end of the bar. Here, they begin to interact with "free" electrons contained in the bar itself. The effect is repulsion, which happens when two like charges are brought together. Battery electrons drive the metal's "free" electrons toward the junction. If that junction were a good conductor, electrons would merely cross it with ease. The conducting path, however, is not a good one. Under the driving force of the battery, the free electrons strain to get across. But to make the final breakthrough, they must pick

**Fig. 2.** Diagram shows how heat creates thermoelectricity—the famous Seebeck effect.

Solid-state air conditioner is being installed in existing air duct (top right). Complete unit is shown upper left with solid-state section located in middle. Diagram at left shows how room and outside air are mixed and cooled. Only fan blower and damper move.
up additional energy from some other source. That source is the existing warmth in the area of the junction. Heat energy is sucked out of the junction region and current flows. Removing heat leaves the junction cooler than its original state. This action produced the first crude thermoelectric refrigerator in the year 1838. With a combination of bismuth and antimony, plus a power source, experimenters froze one drop of water.

For more than 100 years these concepts of thermoelectricity remained little more than lab curiosities. There were dreams of revolutionary devices of the one-jump, no-moving-parts variety; the conversion of electricity directly into heat, cold or vice-versa. And without the friction, wear and maintenance of mechanical devices. But the scientist's dream was trammelled by a single fact. Thermoelectric devices would operate only at tiny efficiency, usually less than 1 percent. They were simply impractical except for specialized measuring instruments where accuracy, not power, is critical.

The Semiconductor. The field of thermoelectricity breathed new life with the rise of solid-state technology. New materials made hash of old efficiency figures. Today we have thermoelectric devices that are dozens of times more efficient than the old metal bars. And advances are coming thick and heavy. As we'll see in a moment, it's not just due to efficiency alone. New thermoelectric coolers can go into places where old-style refrigeration units prove too bulky.

Semiconductors greatly enhance the thermoelectric effect due to "current carriers." They are electrical charges able to move with great mobility through semiconductor material. It has been found that if certain substances are doped with a very tiny amount of impurity, they become enriched with one of two possible current carrier types. In Fig. 4 is the N-type, so-called because current carriers are negative. Such carriers are actually a surplus of free electrons. With the addition of a battery and two metal plates we have the beginning of a simple thermoelectric air conditioner. The action is comparable to what happened in Fig. 3. Battery electrons flow onto the top plate and repel free electrons in the N-type semiconductor. Again, cooling occurs as electrons pick up heat energy to bridge the junction. The top metal plate, therefore, grows cold. The lower junction heats as electrons surrender energy at that point.

The Hole Story. The effect is enhanced by adding the other class of semiconductor material, the P-type. Current carriers in this substance are positive. This may appear to contradict what was said earlier about positive charges in the atom. Positive particles (protons) were described as firmly fixed in place. They still remain fixed in P-type semi-

Fig. 3. Pictorial diagram showing the Peltier effect—as electrons cross junction of dissimilar metals, the antimony-bismuth junction is cooled.

Fig. 4. Semiconductors do a much better job than metals in cooling a junction. Like Robin Hood, electrons take excess heat from the top plate and transfer it to the bottom plate.
conductor, but there is added a new concept. It is the “hole.” When the impurity is introduced to the basic substance it tends to capture free electrons. This leaves the semiconductor dotted with spaces formerly occupied by electrons. These holes, missing their electrons, exhibit positive charge. Moreover, they appear to drift. It’s like the game of musical chairs: the empty seat changes position, but no chair has actually moved. The people (or electrons) do the moving. Holes provide the P-type material with positive-charge carriers that can be driven by battery voltage.

In Fig. 5 is the P-type semiconductor in 

![Fig. 5. Not only can electrons move heat from one place to another, so can holes. Incoming electrons combining with holes cool the top metal plate and heat the bottom.](image)

action. Battery electrons introduced at the top plate commence to attract the positive holes (since unlike charges attract). As electrons and holes attempt to combine, they extract heat energy from the junction. The net effect is just as before; the top plate cools, the bottom one heats. And this continues so long as battery voltage is applied.

![Fig. 6. Pictured here is a basic semi-conductor module used in the Carrier Corp. air conditioner. P- and N-type semiconductors are used.](image)

**Getting Together.** Now we can combine both P and N semiconductors for maximum effectiveness and come up with the practical module used in the electronic air conditioner, shown in Fig. 6. The cool area is at the top, with heat generated at the bottom. The question may arise: If this module is for air conditioning, that is, for cooling purposes, why create a hot area? It’s unavoidable. This system is essentially a heat pump. It extracts heat from one part of the circuit, and must surrender it at another in order to be continuous.

This pump action can be compared to that of a conventional air conditioner. When a liquid (freon) enters the cooling coils of a standard conditioner, it draws heat from the room and evaporates. It then travels as a gas (Continued on page 117)
Inventor Robert W. Etter shows how his caller is attached to the halter of the herd's lead cow. Preset to operate many hours later, the farmer can take care of his chores till the cows find their way back home.

Caller is about the size of a cigar box, can be miniaturized. Timing device is at upper left. Device is similar to "Electronic Greeter" in December, 1964 issue of this magazine except spring-loaded timer is used in place of button.

Why the COWS come HOME!

The old farm dog who's been chasing the herd to the barn for many years may lose his job. A new device just patented by an ex-dairy farmer now does the things Rover was trained to do—and it doesn't nip the cows' feet.

The invention, a brainstorm of Robert W. Etter of Birmingham, Mich., is a compact recording device that tells Bossy when to come home for milking. It fits behind the cow's ears, and at a pre-arranged time says, "Here, Bossy, Bossy. Come, Bossy. Here, Bossy, Bossy." Or whatever the farmer wants to tell her while he's busy.

Strapped onto the halter of the lead cow, the device will lure the herd back to the barn—a great timesaver for busy farmers. It's personalized: a farmer can record his own voice or any other voice to which the herd will respond.

The gadget is about the size of a cigar box, but it can be miniaturized. It consists of an endless tape and an ordinary timing device. Two batteries operate the thing—a 9-volt for the amplifier and a 1½-volt for the motor mechanism. The timing device can be pre-set to go on and off at any time.

It'll keep repeating any message for as long as it's been set. Once the cows are in the barn, the farmer can turn the unit off.
If you thought polyester was a girl’s name, you have lost track of the new tapes

By Art Zuckerman

Once upon a time a chap intent on using his magnetic recording machine had an important choice to make when he went down to his corner audio shop:

Should he buy 600 feet of tape wound onto a 5-inch reel, or should he be a sport and go for the 7-inch, economy-size reel that holds 1200 feet?

Today, he’s got a few other options to juggle. Like, for instance, should he buy:

Acetate or polyester, straight polyester or tensilized polyester?
Regular-play, extended-play, double-play, or triple-play?
Ordinary, high-performance, low-noise, low-speed, or low-print?

The poor guy even has to ponder the relative merits of the standard, 2½-inch reel hub compared to the 4-inch hub.

If this proliferation of options has made a befuddled tape buyer out of you, take heart.

The fact of the matter is that you’ve never had it so good.

Looking Back. Sure, in the simple old days you didn’t have to knock yourself out with choices. But, on the other hand, to get a recording that wasn’t enveloped in hissy noise, you needed a machine that used the entire width of your tape in a single pass.
And if you wanted to capture all those beautiful frequencies from 50 to 15,000 cycles per second, this one-track tape had to be raced past the record head at a breathtaking—and footage-consuming—15 inches per second.

Not only was all this expensive, but it made things kind of tricky when you wanted to record a long symphony—not to mention an opera. To add injury to inconvenience, a very hot, humid day frequently left your tapes stretched out of shape, and the sound along with them. And should these tapes have been exposed to bitter winter cold, they had a nasty habit of embrittling and cracking.

Worst of all, after a few years time, some
The Kodak tape reel at the left features easy thread slot and integral splicing jig. At the right is an Ampex reel with 4-inch hub that carries 1-mil tape. The large hub is quite effective in smoothing out the tape movement.

**FACTS ON TAPE BASES (BACKINGS)**

<table>
<thead>
<tr>
<th>Backing</th>
<th>Physical Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetate</td>
<td>Relatively low strength but clean breaking; easily distorted by high humidity; sensitive to high temperatures and embrittlements at low temperatures; tendency to dry out in time.</td>
</tr>
<tr>
<td>Durol (Kodak's improved acetate)</td>
<td>Similar to acetate but 40 per cent stronger and even cleaner breaking.</td>
</tr>
<tr>
<td>Polyester (also Mylar)</td>
<td>Relatively high breaking strength but susceptible to marked stretching before it breaks and breaks stringily; highly resistant to humidity changes, temperature resistant; never dries out.</td>
</tr>
<tr>
<td>Tensilized Polyester</td>
<td>Polyester tape strengthened primarily by stretching—usually in thin-width, extra-play versions.</td>
</tr>
</tbody>
</table>

**Facts on Tape Lengths and Playing Time**

<table>
<thead>
<tr>
<th>Tape Type</th>
<th>FOOTAGE (7-in. reel)</th>
<th>Stereo Playing Time (7 1/2 ips)</th>
<th>Mono Playing Time (17 1/2 ips)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular</td>
<td>1200</td>
<td>1 hour</td>
<td>2 hours</td>
</tr>
<tr>
<td>Extra Play</td>
<td>1800</td>
<td>1 1/2 hours</td>
<td>3 hours</td>
</tr>
<tr>
<td>Double Play</td>
<td>2400</td>
<td>2 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Triple Play</td>
<td>3600</td>
<td>3 hours</td>
<td>6 hours</td>
</tr>
</tbody>
</table>

Today, tapes can be bought in (left to right) standard-length, extra-play, double-play, and triple-play sizes. Extra footage is put on a 7-inch reel by cutting thickness of tape base, and, for triple-play, by reducing the thickness of the oxide coating.

Two tape recorders, Korting 158 (left) and Uher 8000, are used to test the noise rejection of Scotch Low Noise Tape in repeated dubbings.

of your treasured recordings were frequently ruined because the tapes dried out and developed an intolerable mechanical squeal.

**Today.** Using only one-fourth the width of your tape, you can now enjoy true high fidelity reproduction at 7 1/2 inches per second, and something mighty close to it at 3 3/4 ips. Today's tapes can even sound good at 1 7/8 ips! It is possible to record as much as 1 1/2 hours of music non-stop at the highest fidelity and double that amount while still enjoying excellent fidelity.

By flipping reels, up to 3 hours of highest-fidelity stereo can be put on a single 7-inch
Tapes can be tested for relative performance on your recorder by splicing together samples of several brands onto a single test reel. Leader tape is used to separate the samples, on which identical material is then recorded.

IPS Slowdown. The most important single development was the moving of true high-fidelity performance down from the Olympian speed of 15 ips to the 7½ ips top speed of the average home recorder. This became possible when audio engineers learned how to halve the size of the already hair-thin air gaps in the tiny electromagnets we call recording heads. The tape makers then found it necessary to put much smoother, more tightly-packed oxides on their quality audio tape products.

You might compare the problem to writing on rough, newspaper-grade paper. It works fine with a broad-pointed pencil or crayon. But it can't compete with tiny, intricate designs applied by a needle-pointed artist's pen. For such work, you must have paper with a tight surface texture.

Because the new recording head gaps were so very fine, they were much more susceptible to clogging by dirt and to abrasive wear. The smoother oxides helped to reduce abrasion, and tape makers found it possible to saturate it with silicone lubricant. This also got rid of mechanical squeal. Furthermore, binding agents used to hold the coating to the base were made stronger to prevent shedding.

Getting Thinner. At the same time, the tape makers discovered how to shave a third off the thickness of the standard, 1.5-mil acetate tape. This permitted them to increase playing time 50 per cent by adding an extra 600 feet to a 7-inch reel. But acetate, never strong to begin with, became positively fragile when it was reduced to 1 mil.

Du Pont came to the rescue with Mylar, a film version of its celebrated polyester fabric known as Dacron. It takes a truly king-size tug to break this stuff. What’s more, polyester holds its shape beautifully in the most humid weather, doesn’t give a hang about the cold, and never dries out. This is because, unlike acetate, it contains no plasticizer, an ingredient that evaporates with time.

Polyester was quickly picked up by such brands as Soundcraft, Scotch, and Audiotape as their standard base for extra-play tapes. Then Audiotape pulled off a coup by shaving still another half mil, to wind 2400 feet of tissue-thin tape on a 7-inch reel. The competition soon followed, and today double-play tape is a commonplace.

Wonderful as it is, polyester has its problems, too. While it takes a heck of a yank to break it, considerably less pull will stretch it into uselessness.

If the stress is great enough, you can dis-
super tapes unreeled

tort polyester tape until it takes on the form of string. Acetate, on the other hand, will hardly stretch at all before it snaps—and it snaps clean, while polyester becomes a stringy mess before it parts.

However, thickness for thickness, it takes a good deal more pull to stretch polyester than it does to break acetate. In a 1½-mil, standard-play version, polyester is enormously stronger than standard acetate, and it is offered as a premium tape that will preserve a recording almost indefinitely.

Too Much Stretch. Even in this superior version, nevertheless, tape editors—the people who cut and splice recorded tape into final program form—are leery of polyester. They do their job by hand—"rocking" the reels. They turn them back and forth, listening for the exact point where they want to cut. Such manually-created tension can easily build up to the point where an irreplaceable recording is stretched out of shape. A snapped acetate tape can be spliced together so that no break is audible. But a stretched length of polyester must be discarded.

Kodak has endeavored to solve the problem by improving the strength of the acetate base. Its version, called Durol, will still part considerably quicker than polyester of the same thickness, but it will do so only after enduring enough stress to ruin a recorder stretch of polyester. More important, it is about 40 per cent more break resistant than standard acetate, and when it does finally go, it parts with an even cleaner break than the standard product.

But if you want double playing time, only polyester is strong enough for the necessary ½-mil base. And it's still the only tape base in general American use that can cope with extreme humidity. But the original double-play reel was so very delicate that using it on many home machines was an invitation to disaster. It just couldn't cope with the normal operating tension these recorders applied to a tape.

So the tape makers now offer a premium version known as tempered, or tensilized, polyester. This base material is pretreated, primarily by stretching, to toughen it up, and it is almost as strong as the conventional 1-mil polyester used in extra-play reels.

Thinner Oxides. The latest play in the long-play sweepstakes was first pulled off by the 3M Company, maker of Scotch tape. It introduced triple-play tape! Now you can also buy it—3600 feet on a 7-inch reel—from Kodak, Audiotape, and Soundcraft, among others.

No, this time nobody tried to shave down the width of the polyester base. Instead, the oxide coating's thickness was reduced enough to add 50 per cent to the length of a half-mil tape.

When the thin tapes first came into use, re-

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Some available specialized reels include (from left to right) a Kodak reel with easy-thread slot and integral splicing jig; an Ampex reel with a 4-inch hub; and, finally, an Audiotape reel with C-slot threading feature.
Recording engineers became increasingly aware of a problem known as print-through. Most troublesome during prolonged storage, print-through is the nasty tendency of a length of tape carrying a loud passage to partially magnetize adjacent layers of tape on the reel. The result is frequently a disturbing pre-echo and a somewhat less annoying post-echo.

The thinner the tape base, the more pronounced the print-through problem, because the magnetized oxide layers lie in closer proximity to one another. But print-through also plagues the sturdy old 1½-mil product, if it sits unused on a shelf long enough—and especially if it was recorded at maximum volume.

So, for the benefit of those who want to store valuable recordings for indefinite periods, Kodak, Audiotape, and Soundcraft offer low-print tapes that resist such cross magnetization. Their secret—a thin oxide coating on the standard 1½-mil base.

Actually, the new triple-play reels provide some low-print benefits because their coatings are relatively thin for their ½-mil bases. But this very coating thinness creates its own problem—output noticeably lower than a standard tape’s. To overcome this, such brands as Soundcraft have resorted to a higher-potency oxide to boost the output of their triple-play product.

A high-output coating on a thicker base can now come in handy when you want to record a program with a broad range of intensity. An example would be a symphony orchestra, recorded live, playing a composition ranging from the whisper of a woodwind to a maelstrom of tympani, tubas, and trombones. A high-output tape such as Kodak’s permits you to set your recording level to avoid overloads on the crescendoes and still capture the very faint passages.

**S/N Ratio.** One of the most critical factors affecting the quality of a tape recording is its signal-to-noise ratio. There is an inherent amount of noise in any electronic device. In tape recorders you hear it as hiss. If there is a wide-enough gulf between this noise and the recorded program material, you don’t hear the hiss. The size of this gulf is called the signal-to-noise ratio.

A wide magnetic track has a greater signal-to-noise ratio than a narrow one. Noise also becomes less intrusive at faster recording speeds. Every time you make a copy of a tape, a little more noise appears on the copy. So a copy of a copy of a copy is considerably noisier than an original tape.

Noise was a recognized enemy when the 3M Company developed a cartridge recorder. Their design operates at only 1½ ips, and it records only about a third the width of a tape but 0.15-inch wide, little more than half the size of a standard ¼-inch tape.

So they developed a new kind of tape to cope with their noise problem. You can now buy this Low Noise tape on a conventional reel. It is easily recognized by its unique black oxide coating. It is so effective that professionals who do a lot of dubbing—tape copying—have adopted it as a standard tool.

A low-noise benefit is also claimed by Soundcraft for its premium-priced Golden Tone tape, together with broadened frequency range. Although it isn’t touted for low-speed or copying use, it should prove valuable for such jobs.

Ampex also has gotten interested in the lower speed ranges. Its new 1000 and 2000 series recorders, in fact, sport a 1½ ips third speed. So Ampex has brought out a special low-speed tape, designed to yield the best

(Continued on page 120)

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**About the Author**

Art Zuckerman, a Phi Beta Kappa graduate of New York University, is the author of *Magnetic Recording for the Hobbyist*, a practical guide to the hobby of tape recording published last year by Howard W. Sams & Co., Inc., and Bobbs-Merrill Co., Inc. He has also written innumerable magazine articles about tape recording, high fidelity, and other electronics subjects, many of which have appeared in *Radio-TV Experimenter* and *Science & Mechanics*. At the same time, Mr. Zuckerman is the engineering & design editor of *Metalworking News*, a weekly industrial newspaper.
Now that you're planning to upgrade the hi-fi rig with a new amplifier, don't be in a rush to get rid of Old Faithful. Sure, it sounds like hell, and you think you're putting one over on the dealer who offered you a ten buck trade-in sight unseen; but Old Faithful still has lots of life left, and it can give you more long term pleasure than the ten dollars will.

What's that? Old Faithful has furshmer-geld sound; it makes Maria Callas sound like a gurgling porpoise; it's beyond repair? Come now, Honest Harry isn't giving ten dollar trade-in allowances for junk. He knows that with five to ten dollars worth of new minor components his technicians can "create" a like-new amplifier (which he'll unload for 1/2 list). So why not add the new components yourself and have an extra amplifier. Even if it's a mono job you can use it for a good quality background music system in the playroom, or maybe have some decent sound to liven up the backyard barbecues. Or maybe the community playhouse could use the amplifier so the sixth row orchestra could hear Mrs. Thelma Thespian (all 180 pounds of her) playing Juliette.

It's really quite easy to rebuild an amplifier, and contrary to myths and legends you don't have to be an advanced technician; if you can handle a soldering iron you're ready to rebuild. The secret lies in the fact that most amplifiers suffer from deterioration of minor components; rarely does the power and output transformers burn out—and all other components are minor components.

Eyeball Servicing. The key to rebuilding is looking. Turn the amplifier over and take a long, long, hard look. Does the line-cord seem dried out; is the rubber insulation cracking? Does the line-cord have a sharp bend that might result in broken strands? Unless it looks factory fresh, replace it. Look at the power resistors—anything 1 watt and larger. Are there dark bands indicating years of exposure to high heat; most likely they've changed value so replace them.

And those large power resistors in the B-plus filter. If they have solder terminals has years of heat caused the solder connections to oxidize (look gray)? Simple, just resolder the connections.

While it will be unusual to find complete breakdowns in power resistors, capacitors are another story. Remember the distortion—the breakdown on crescendos, the gurgles on the soprano. Deteriorating coupling capacitors leaking high voltage shift the grid bias.
Don't commit your ol' amp to the scrap heap—pennies and spare time will restore its fidelity

on the following tube, so take a close look at the capacitors. See the wax bubbling out of those paper jobs? Time to replace them with some modern moulded capacitors.

Remember the hiss, clicks and pops every time you switched to magnetic phono. Resistors generate noise which usually is at extremely low levels, except when they're used in low level amplifiers. Simply replace the magnetic phono preamplifier's plate, screen, grid and cathode resistors with the modern low-noise type and voila, a dead quiet amplifier.

Loss of bass (low-frequency response) and increase in hum level are other aging problems. Take a look at the B-plus filter's electrolytic capacitors; aside from affecting the low frequency response they determine the hum level. Are there indications of electrolytic leakage at the terminals? Is there a white crust (dried electrolyte) where a chassis mounted capacitor enters the chassis? No matter how slight the leakage, if you find evidence of electrolyte replace the capacitor.

Sock It with Sockets. While we're on the subject of capacitors let's mention a professional technique. Electrolytics generally have terminals packed with wires, and after one or two repairs the connecting wires become a mess of burned insulation and pretzel shaped bends. If you're replacing an electrolytic use a socket. That's right, a socket—like for a tube. Capacitor sockets are available (Allied Radio 40 H 335 and 40 H 336) which exactly fit the wafer mounting hole. You connect to the socket just as you would to the capacitor terminals; except, from then on you simply plug-in the replacements. Any time you think a capacitor needs replacement—like if the hum increase—you just plug in a new capacitor; you don't even have to pull the chassis.

 Tubes. Of course, replace the tubes. No, don't bother to check them, treat yourself to a full new set. After all, you're going to have a "new" amplifier. And you might like to really go modern by replacing the rectifier tube with silicon diodes. Silicons have no filaments so they generate no heat; the cabinet, the amplifier, and the power transformer will all run cooler. But first you must check whether your amplifier can use silicons.

Up Goes B-plus. Rectifier tubes used in old amplifiers have an internal voltage drop under load of about 30 volts. If they are

Herbert Friedman, W2ZLF

servicing tricks add new life
REVAMP THE OL’ AMP

Old Faithful—fifteen years of service, yet amplifier can be saved from scrap heap.

First thing to do is replace old power cord if it shows cracks. While you are at it, make it extra long. Add fuse holder if set has no overload power line protection.

Electrolyte leakage (white crust) at base of capacitors shows replacement needed.

To simplify future repairs and tests, capacitor sockets are substituted for mounting wafers. Note that components are connected to lugs like on tube sockets.

Capacitor sockets permit "filter cans" to be plugged in and taken out like tubes.

replaced with silicons—which have an internal drop of less than 1 volt—the B-plus will rise approximately 30 volts; so you must make certain the filter capacitors can withstand the extra voltage. For example, if the capacitors are rated 450 VDC but the plate supply is only 400 VDC obviously you can get away with an increase of 30 volts. But if the plate supply is 425 VDC an extra 30 volts is going to push the B-plus past the 450 volt limit. True, new capacitors can stand a little overload, but six months later—Boooooom!

A side benefit of SR’s is usually a little more power output—actually peak power—because SR’s having virtually no internal resistance, offer superior regulation compared to the rectifier tube. However, sometimes the extra B-plus will throw off the grid bias so the distortion increases. It’s best to test the SR’s in the amplifier before connecting them permanently across the rectifier tube socket. Scrounge-up an old rectifier tube base and connect the SR’s across the appropriate pins. Plug the assembly—as shown in the photographs—into the rectifier tube socket. If the
Another sure trouble spot (inside circles), paper coupling capacitors with wax oozing out of the cases. It is wise to replace with "ageless" moulded types.

Quick spray with contact cleaner returns performance to "noisy" rotary switches.

Many noisy tone and volume controls can be silenced with a few drops of "noise" squirted into the volume control.

amplifier gives better performance either leave the assembly in place or wire the SR’s across the socket terminals. If the amplifier sounds worse just remove the assembly, plug in the tube, and you’ve lost nothing by trying.

**Make Good Contacts.** The final step in the electronic rebuilding is to eliminate the switching and control noises. Any switch—such as the amplifier’s input selector—eventually gets noisy or gets intermittent contacts. A simple cure much easier than replacement is to spray the switch with one of the “noise” type cleaners. Work the switch back and forth a few times and you’ve got a nice quiet, dependable switch.

While controls can be cleaned by shooting no-noise into the guts with one of those special “hypodermics” which fit over the control’s shaft, it’s a sloppy, generally messy way to do it. Actually, the hypodermics are meant for use when you can’t or won’t pull the chassis. Since you’ve already got the chassis out, use an eyedropper to pour one or two drops of cleaner directly into the control. This can usually be done through the slot in the cover directly under the terminals.

If you want to check whether your amplifier can use silicon diodes in place of the rectifier tube, an adapter can be made by wiring SR’s across tube base.

You can either wire the diodes to a plug as the author did or wire them under the chassis directly to the rectifier socket.

Finished! Painted, polished, new plug-in parts, knobs can make a big difference. Add decals to the switches and controls.
REVAMP THE OL’ AMP

Don’t take our word, perform the tests before and after yourself. You will be amazed with the results. Before and after graphs at right tell our story.

Work the control several times; then connect a speaker, apply power to the amplifier and listen. Most likely the noise will disappear. If a single treatment fails to “clean” the control you’ll have to substitute a new potentiometer.

Now the foregoing techniques don’t appear difficult—do they? Nine times out of ten they’re all that’s required for a complete overhaul. When you consider that the average reliable service shop charges about $7.50 per hour just for labor, one evening’s puttering with a soldering iron can not only give you a new amplifier, it keeps quite a few dollars in your wallet.

A Testimonial. How does re-building work out? We took an old amplifier with over 15 years of service on it and overhauled it just as described in this article.

When new, the amplifier delivered 15 watts at 1% THD (total harmonic distortion), and the frequency response was flat within ±1 db from 20 to 20,000 cycles. After many years of faithful service performance had deteriorated to the state shown above. Maximum power output at 1% THD was only 8.3 watts at 1 kc., with the distortion rising to 25% at 10 watts. Both the low and high end response was down; in addition, the amplifier was unstable. There was quite a high hum level (−37 db) and a magnetic phono pickup could barely drive to normal room volume.

Now look at the rebuilt performance shown above. The frequency response is right back to specs, the noise level is down where it belongs (−57 db) and the magnetic input can handle those new low level pickups. And of course, we’re getting 1% THD at the rated output of 15 watts.

For a final touch, the long shafts which were meant to pass through a cabinet were cut short; and decals and modern knobs finished off our new utility amplifier.

Midget Extension Light

Almost daily there is a need for a tiny extension light for seeing in close quarters. Such a light can be easily made that will be self-supporting in two ways if this is desirable. Fasten a miniature lamp socket to one side of a spring-type clothespin. To the other side of the clothespin attach the magnet element from an automatic can opener. The light is complete for connecting to a battery power source. Connect alligator clips to the long lamp leads so they may connect to battery or 6.3-volt AC filament transformer. Magnet clings to iron tools for extra reach.

—Glen F. Stillwell

Radio-TV Experimenteer

56
Making your measurements without the center scale voltmeter is doing it the hard way

By L. F. Kiner

How many times have you wished you had an extra DC voltmeter? One with multiple ranges, a general purpose DC voltmeter that would read plus or minus voltages without switching or probe swapping, and still offer a reasonable degree of accuracy without undue circuit loading. Here is a unit designed to fulfill those requirements and one that will prove invaluable even to those already owning a VTVM or VOM. Basically a center-scale DC voltmeter, the builder may select his own voltage ranges when assembling and substitute resistors for those as shown in the author's model.

The meter movement, 50µa (microamperes) will not load the circuit to be tested while still providing 20,000-ohms/volt sensitivity. The use of one per cent resistors should suffice the accuracy requirements of all but the most demanding situations. A search through the junk box may be a likely spot to find these and if that is not successful, many surplus stores can supply them at very reasonable prices.

About the Circuit. There is nothing complex about a DC voltmeter circuit. It is a straightforward DC voltage measuring device with the addition of resistors to provide multiple ranges. Since we are using a zero-center meter, the instrument reflects plus or minus voltages without switching or swapping leads.
VOLTMETER

Series resistors used in the circuit are calculated from the formula:

\[ R_s = \frac{E}{I} - R_{in} \]

where,

- \( R_s \) = Series resistor in ohms.
- \( E \) = Maximum voltage (for the range selected) in volts.
- \( I \) = 50\(\mu\)A (0.00005 amps.) in amperes.
- \( R_{in} \) = Internal resistance of the meter in ohms.

The series resistors may be purchased exactly as calculated. This, however, could prove a little expensive as 1\% resistors cost the best part of a dollar bill from electronic stores. Some non-standard values would also increase the cost even more. To keep the cost down the resistors could be "scrounged" from the "junk-box," purchased from "surplus" stores or made up from series-parallel resistances. This may be a little more time consuming but will undoubtedly save some loot.

The internal resistance of the meter itself is generally available in the manufacturer’s literature or may be found (sometimes) on the meter dial. The unit used by the author is a Simpson Model 1329 and according to the manufacturer the internal resistance is 2000 ohms.

Construction. The voltmeter wiring is not at all critical and the method used by the author may be seen in the photographs. The builder should begin by laying out the components to see how they will best fit into the case or cabinet that is chosen to house the instrument. If purchased in its original box, the meter will generally have a template supplied with the meter. This is most often found on the bottom of the box and should be used in drilling the holes for the meter. The switch hole diameter is \( \frac{3}{8}'' \) and \( \frac{1}{4}'' \) holes should accommodate the banana jacks.

Adding Scales to the Meter Dial. Additional scales are added to the meter dial through the use of water decals available in most electronic supply houses. Very carefully remove the plastic front of the meter by applying pressure with the fingers. The meter dial is removed by taking out the two screws (Continued on page 95)
Transistor Take-over In Hi-Fi

By Hans Fantel

On the beach, on the bus, in the park, on the golf course, and in formerly quiet woodlands, the transistor pursues us. The raucous voice of the pocket portable is heard in the land. But only lately have transistors made notable inroads upon the hallowed precincts of high fidelity. True, a few transistor amplifiers have been on the market for some years. Pioneer designs like Harman-Kardon’s Citation A and B and the Acous-tech amplifier demonstrated as far back as 1962 that transistors could produce better sound than even the best tube circuits. But with their high price, these units appealed mostly to those hard-bitten hi-fiers who always want to be in the vanguard of technical progress, no matter what the cost. Most of the audio industry and its customers stuck with tubes.

All this changed within the last year. The
revolution has come at last. All across the board, in every price class, the hi-fi catalogs for 1965 bulge with new transistorized tuners, amplifiers and tape recorders proudly heralded in space-age lingo as “solid-state” devices. The battle has been decided. The transistors are taking over.

This dramatic shift raises several questions:

... What accounts for the sudden rush toward transistors in high fidelity?

... Why do companies previously standoffish toward transistors now go all-out for solid state?

... How successful and how reliable are recent transistor designs?

**Tubes Vs. Transistors.** Compared with tubes, the transistor has several indisputable advantages: it is much smaller; it draws less power and develops less heat; it takes less time for warm-up; it does not change its characteristics with age, and—theoretically, at least—it doesn’t wear out. Unlike the tube, the transistor does not produce erratic noises when exposed to vibration—it is non-microphonic, as the engineers say. It is sturdier than tubes and better able to withstand accidental knocks. Best of all, it is inherently hum-free, and a well-designed transistor amplifier is so “quiet” that the music seems to emerge against a background of almost complete silence.

But in the eyes—and ears—of audio designers, one transistor trait easily outweighs all other merits. Transistor amplifiers need no output transformers. The power transistors can feed their signal directly into a loudspeaker, providing the loudspeaker is properly matched to their impedance. Since the output transformer has always been something of a bottleneck in the sound path through an amplifier, its elimination in transistor circuits marks significant progress. Due mainly to the absence of the output transformer, transistor amplifiers have an edge in transient response. This results in greater clarity and transparency of sound, especially in heavily orchestrated passages. Stewart Hegeman, who designed some of the best transistor equipment now on the market, says: “Transistors can produce fantastic sound. Particularly the bass becomes very clean and articulate.”

Audio fans have coined the term “transistor sound” to describe the exceptional clarity of sound attained by good transistor amplifiers. It is a distinct quality that tube amplifiers do not possess. It provides excel-
lent definition of the individual instruments in an orchestra, adding an exciting feeling of, sparkle and brilliance to the reproduced sound.

Space Priority. With all these advantages, what has held back transistors for so long? And why, instead of jumping joyfully on the transistor bandwagon, do some manufacturers still straddle the fence, making both tube and transistor equipment?

One reason is that up to now few transistors were capable of living up to their promise. The fault lay not with the audio industry, but with the transistor manufacturers, who were too concerned with making transistors for spacecraft and computers to pay much attention to the needs of the hi-fi fan. The trouble was that these space-oriented transistors had serious limitations of frequency response in the upper range. While this didn't matter in the case of portable radios, it proved a constant headache for audio engineers trying to achieve top quality in transistor equipment. But all this changed within the last year or so when the transistor manufacturers finally came up with new types of transistors specifically tailored to the needs of the audio industry. What's more, the new transistors were cheaper, thanks to new methods of automated quality control meanwhile developed by the transistor makers. For the first time now, high-quality transistors are competitive to tubes as far as price is concerned. These are the facts chiefly responsible for the present spurt in transistorized audio.

Aside from cost and reliability, other factors have held back the rise of solid-state audio in the past. Transistors require altogether different circuits than tubes, and it took the engineers time to learn to "think" in terms of transistors.

"It's like having to learn a new language," explains one technician.

New Circuits. Learning something new is always hard and painful, and some engineers were looking for excuses to skip their lessons. Transistors, they argued, are fine for pocket radios and portable TV sets where space and weight saving are important. But why bother with transistors in hi-fi? After all, it's the speakers, not the tubes, that determine the practical size of a good stereo system.

The engineers who argued that the transistor had no place in high-fidelity are now presumably looking for some other job. Size, it turned out, is important after all. Many of
Transistor Take-over

the new transistor amplifiers and tuners are a big hit precisely because they pack a lot of performance into small, neatly styled, lightweight designs that can be conveniently tucked into tight places. Besides, the highly successful new design concept of compact stereo systems (see Radio-TV Experimenter, Feb./March, 1965) rests entirely on their smallness and low heat emission.

So while some audio companies were dragging their feet on transistor design, others were busily trying to adapt transistor circuits to the problems of high fidelity.

Hot Subject. Surely there was no lack of problems to be solved. For instance, until quite recently, power transistors would blow out as easily as a match. In fact, they blew out faster than the fuses that were supposed to protect them from overloads. Many of the early transistor amplifiers conked out the first time the volume was cranked up all the way. Only lately have adequate safeguards been devised that assure the transistor will actually last its long potential life-span. Also, transistors used to react quite temperamentally to even slight changes in temperature. On a hot day, or in a tight place with little ventilation, they'd literally wilt and raise hob with all the nicely calculated performance data of their circuits. It took quite a bit of engineering ingenuity to devise circuits to compensate automatically for these thermal variables, but the best of recent transistor units are fully stable in any climate.

All this tends to make first-rate transistor equipment rather complicated. In top-notch designs, it takes about four transistors to do the job of one tube. Hence, the greatest present challenge in transistor hi-fi is economic.

Eliminating Distortion. At first, it seemed that all good transistor equipment would have to be very expensive. Whenever short cuts were tried in order to lower the price, the perceptive listener could usually notice it in the sound quality of the product. The trouble was just the opposite of that encountered in tube amplifiers. The transistor jobs sounded fine as long as they were yelling their lungs out at top volume. But as the volume was reduced, a certain harshness crept into the sound. This was due to distortion produced in transistorized output stages. These stages operate in what engineers call Class B operation—that is, each transistor develops power for only a small fraction of the time. This prevents the transistor from overheating and burning out. By a sort of switching action, the two transistors in the output stage take turns at the job, so that the signal is bounced back and forth between them in a kind of push-pull action. That way continuous signal amplification is achieved. But where in conventional tube-type push-pull circuits there is partial overlap between the separate push-pull cycles (Class AB operation), the transistors are usually designed to make a clean cut-off. As a result, the bouncing back and forth of the signal between the output transistors must be very accurately timed. Otherwise, a time gap results between the two halves of the push-pull cycles—a brief interruption of the signal—which causes harshness of sound, particularly in solo instrument passages.

For a while this difficulty threatened to give all transistor amplifiers a bad name. Die-hard engineers in the tube camp were smirking placidly while the transistor boys scrambled to cope with the problem. Finally, they figured out feedback patterns to cancel most of this troublesome distortion. This was the last thing needed. Transistor technology was ripe for dominance in the hi-fi field.

Transistor Amplifiers. It stands to reason that the best sound of which transistors are capable is found chiefly in the more expensive units, but good transistor amplifiers are now available in all price classes. Starting in the low-budget range, both the major mail-order houses—Lafayette and Allied Radio—offer some attractive bargains. Lafayette's LA-340, for example, is a fully transistorized stereo amplifier delivering 20 watts (IHFM) per channel for only $79.95 factory-wired. Knight-Kit has among its low-cost models the handsome KG-320, which delivers 16 watts per channel for $59.95. A truly exceptional value is Knight-Kit's KG-870 with 35 watts per channel and highly versatile control facilities for $99.95 ($149.95 factory-wired). It delivers the kind of sweet-clear sound one normally hears only in amplifiers costing twice as much. And Heathkit, who pioneered transistor circuitry in kits, also offers a well-designed 35-watt per channel kit, the AA-22, for $99.95. Jointly, the Heathkit and Knight-Kit designs present a real price breakthrough, offering uncom-

(Continued on page 123)
Have you ever touched an electric appliance and felt a mild, tingling sensation at your fingertips? If you have, you know what "leakage current" is. And you can thank your lucky stars that some other part of your body wasn't well grounded at the time.

Thousands of people are killed every year as a result of receiving a severe electric shock. A prime source of fatal shocks in the home is leakage current from faulty electrical appliances and fixtures. You may live for years in a home that contains numerous shock hazards and never get a shock, simply because you never happen to be touching a good ground and the faulty appliance or fixture at exactly the same instant.

A nasty shock from an automatic washer prompted the author to build the electronic shock tester described in this article. Its circuit is similar to those used to test appliances coming off the assembly line for excessive leakage current.

Easy to Build. The electronic shock tester can be assembled in less than an hour by even a beginner. Using all new components, it can be built for under $4. There is no need for calibration, nor any "bugs" to iron out of the circuit. It is so easy to operate that practically anyone can be taught how to use it.

The shock tester detects any part of an appliance or other electrical device which would allow current to flow through a person touching it and ground at the same time. Electric toasters, for instance, frequently allow a small current to flow if a person touches the metal case and, say, the kitchen sink.

Leakage Current. This leakage current may result from such things as inadequate insulation, poor circuit design, apparent cost-cutting which eliminates components essential for electrical safety, or from poor quality-control inspection procedures on the assembly line. Other appliances—particularly washing machines, cooking devices, lamps and lighting fixtures—often develop current leaks after years of use and abuse.

Consider, for example, the hazard presented by an electric broiler which has somehow come off the assembly line with a short
APPLIANCE SHOCK TESTER

Circuit. Its outer metal shell is thus as "hot" as the power line to which it is connected. You touch this shell and don't feel a thing, until you accidentally ground yourself at the same time. If you're lucky, you may walk away with only a bad burn.

Remember, a ground is any conductive material which, at some point, enters the earth, or which touches another conductor that, in turn, enters the earth. Grounds are more common than most people think. They include metal water pipe, gas pipe, drain pipe; as well as any metallic device connected to any of these, such as a faucet, sink, bathtub, radiator, warm-air convector, furnace or kitchen range. A damp concrete basement floor and an outside patio are also good grounds, since there are moisture paths through them to the earth underneath. And, of course, if you're wearing ordinary shoes and standing on damp bare earth, your body is well grounded.

Severity of a Shock. A number of factors regulate the severity of an electric shock. These include the path of the current through the body, the duration of the shock, and the age, sex and physical condition of the victim. But the most important factor is the strength of the current involved. This is generally measured in terms of milliamperes.

The human body is extremely sensitive to electric current. Some people can sense a flow of current through them as small as 0.2 ma. Most women and children, and about half of the adult male population, can sense a leakage current of about 1 ma. They feel it in the form of a heating, tingling, or throbbing sensation at the point of contact.

While mild shocks, by themselves, are not likely to cause any injury, they can produce a "startle reaction" if they occur unexpectedly. This could cause a person to jump back against a hot kitchen range or to drop a dangerous power tool—something that could lead to injury.

When an adult is exposed to a leakage current much above 5 milliamperes, the intensity of the shock may be in excess of the "let go" current. This is the level at which muscular contractions induced by the electricity are so severe that he cannot release his grip on the shock-causing object. The resulting continuous shock can lead to fatigue, collapse, and ultimately death.

Studies at the University of California have shown that different people have different thresholds for "let go" current. They are generally higher for men than for women. Children are believed to have the lowest threshold of all.

How the Tester Works. The heart of the electronic shock tester is a small, type NE-2 neon lamp. It takes approximately 84 volts to make this lamp fire. Once this happens, the lamp will stay lit at a much lower voltage.

The NE-2 lamp is wired in series with a
Identify the three external probes on the tester to correspond with the schematic diagram.

The tester is so easy to use, you should be able to check every electrical and electronic gadget in your house in an evening.

67½-volt battery and four resistors. Three simple probes tap the circuit at three different points. One side of the circuit is grounded by a long lead wire, which can be clipped to a water faucet or some other convenient ground. The components are mounted inside a non-conductive case.

Now, the neon lamp will not ordinarily fire because the battery's voltage is below the lamp's breakdown or starting voltage. However, when one of the probes is touched to an appliance leaking current, the additional voltage present with the leakage current will fire the neon lamp—R2, R3 and R4 regulate the sensitivity of each probe.

Building the Tester. There are no critical instructions connected with building the electronic shock tester. Nor is the placement of parts critical. They can be mounted in any convenient non-conductive container—even cast in a block of epoxy. The author chose a type of plastic box in which two spools of fishing line are sold. Any size 67½-volt battery may be used, if handy. To insure the tester's accuracy, only 5% tolerance fixed-composition resistors should be used. Probes can be made from anything ranging from phono jacks to nails with soldered connections.

Using the Tester. It's easy! Simply clip the ground wire to a good ground. Clean the case of the appliance or device you want to test. Place it on a dry, nonconductive surface. Make sure it isn't touching anything. Plug it in and switch it on.

The first probe of the electronic shock tester is sensitive to currents 0.2 ma and stronger. Carefully touch it to the appliance's case at various points. If the neon lamp lights, the appliance is leaking a 0.2 ma or greater current. If it doesn't light, the appliance is leaking a current less than 0.2 ma. You'll find that most appliances leak a small amount of current, so don't be surprised if the neon lamp lights.

Remove the first probe from the appliance. If the neon lamp stays lit (and it often does), (Continued on page 96)
It’s the voltage in your TV that you

By M. Robert Beasley

A young child touches a metal TV stand that is electrically charged because of a malfunction in the set and is electrocuted. And the most alarming aspect of this senseless tragedy is that it is not a rare one. Each year all too many people, both young and old, receive fatal electric shocks from television sets.

Manufacturers and the Underwriters’ Laboratory have eliminated most of the dangers that may have existed in earlier television models due to design. But there is always the possibility of a dangerous condition due to malfunction. There are several precautions that can be taken to disarm sets of their lethal voltage if they become defective and potentially dangerous.

Hot Chassis. Television sets of the transformerless type, with the metal chassis connected to one side of the power line, have one wire of the electrical power line leading into your home grounded at the power station and again at a point where the line enters the house. When electric cord plugs of these TV sets are inserted into the wall outlet so that the wire that is connected to the metal chassis goes to the grounded wire there is no danger. But when the plug is reversed in the wall outlet, the chassis is connected directly to the voltage wire of the power line and the chassis is at that potential. Under such circumstances, a person who simultaneously touches the chassis and an externally grounded conductor such as a radiator or water pipe, literally places his body across the power line. If the current path is through the chest, the result will most often be fatal.

Insulated Chassis. To eliminate the danger of a hot chassis, manufacturers set the chassis in wooden cabinet, or placed heavy insulation between the chassis and outer case on metal cabinets. Mounting screws or metal parts that contact the chassis are either enclosed or otherwise made inaccessible. Insulating bushings and washers are also used to prevent direct contact between the chassis and outer case. Some sets have a low voltage capacitor connected between the hot line and

As you can see at the far left, the exposed chassis of the television receiver does not invite inexperienced fingers. Even though the set is disconnected, there can be several thousand volts present. Controls at the left, as all controls on your television, are insulated from chassis.
can’t see, or feel . . . until it’s too late

KILLER

the chassis to eliminate hum. But, to the 60-cycle line voltage, this connection is essentially an open circuit.

But an insulated chassis is not enough to prevent a possible fatal shock. A hot metal part, such as an isolation capacitor, could still be exposed, a chassis insulator could be shorted, insulation in a wooden cabinet could be defective, or, with either a wood or metal cabinet, the insulating control knobs could be removed exposing the metal shafts. Under such circumstances, where the line cord plug connects the chassis to the voltage line, there is danger of shock.

Safe Chassis. There are several ways hot chassis can be eliminated. Polarized wall outlets can be installed wherever the TV is likely to be plugged in, and the conventional two-prong plug on the end of the receiver line cord can be replaced with a corresponding polarized plug. Polarized plugs can only be inserted into corresponding outlets in such a way that the chassis will be connected to the grounded side of the power line, which eliminates all danger of a hot chassis. The disadvantage of modification is that outlets equipped with polarized connections cannot be used for other appliances with standard two-prong plugs.

Another device that affords protection against hot metal cabinets, but doesn’t present the drawbacks of polarized outlets, is the three-prong adapter. It is plugged into the wall outlet with the pigtail end of the third wire securely fastened to the center screw of wall outlet plate. The third wire of the corresponding three-wire receiver cord is connected to the metal chassis. This arrangement results in a blown fuse—not a shock hazard—if a short circuit occurs in the receiver.

A bit more expensive, but safe and easy, is the installation of an isolation transformer between the wall outlet and the receiver line cord plug. The isolation transformer, available at most electrical stores is simply plugged into the outlet, and the receiver line cord plug is inserted into the other side of the transformer.

Safety Precautions. The sources of serious, all too frequent, and often fatal electrocutions are many. One is the attempt on the part of the untrained persons to make repairs or adjustments on their television. Although the television may be completely disconnected from the power source, high voltage is still temporarily stored within the set. This voltage can be as high as 23,000 volts with all sets having at least 14,000 volts. Several thousand volts should be sufficient reason to attempt repairs or adjustments only if you are thoroughly familiar with television receivers. Not only is the tinkerer exposed to physical danger, but he could cause costly damage to the set.

(Continued on page 96)
As you well know, modulation quality and RF power output contribute most to a CB rig’s get-out ability. Regardless of the quality of the antenna system, if you don’t feed RF into the antenna you’re not going to get RF out of it. And even if you squeeze every “skoomph” of RF into the antenna, no one’s going to hear you if your signal’s a mess of squeaks, hash, and hum.

One of the easiest ways you can be sure of maximum RF output and good modulation is to use a tuning monitor; a device permanently connected to the transmission line which indicates the tuning condition and allows you to monitor the modulation.

Simply a Signal Sampler. This tuning monitor is tailor made for the CB’er. While it’s simple and rock-bottom in cost, it does the job of instruments many times more complex and costly. Resistor network R1-R2 takes a small sample of RF from the transmission line; D1 rectifies the RF and the resultant DC is fed to meter M1. Since the DC is representative of the RF voltage (and current) on the transmission line (which is representative of the RF power output) M1’s reading indicates the transmitter tuning—when M1 peaks the transmitter is tuned. No need for SWR meters, field strength meters, etc.

Component values are chosen so a rig with maximum output—about 3.5 watts—will indicate almost full scale; while a 1 watt output (from old rigs in need of service) will indicate about one-third scale.

Once the transmitter is tuned the meter reading can be adjusted to a convenient value by rotating R3 (say half-scale); then, a change in the power output such as caused by a defective tube or a change in the antenna loading will be immediately apparent as a change in meter reading. By using an easy to remember reference—such as half scale—there’ll be no question about a change in the reading.

J1 permits the signal to be monitored
with a headset, or the modulation can be fed to a tape recorder so it can be analyzed critically. (It is often difficult to hear defects if you are monitoring while talking. By listening to a tape playback you're more likely to notice power-line hum, RF hash, etc.)

Construction. The unit is built on the main section of a 5 1/4 x 3 x 2 1/4 inch Minibox. J1 and J2 are standard PL-259 type coaxial jacks. If your equipment uses phono or automobile radio type plugs just substitute matching jacks. While any O-1 ma. meter can be used for M1, the one specified here, an “S” meter, is recommended because it's the most inexpensive.

The J1-J2 jumper should be heavy bus-bar of at least #18 gauge. If you don't have a scrap of bus-bar around, twist together four of five lengths of solid hook-up wire and apply solder until you have one solid, heavy, wire.

Diode D1 is easily damaged by heat, so use a heat sink, such as an alligator clip on each lead when soldering.

Notice carefully the wiring to J3. J3 is a two circuit phone jack—not a shorting type. The normal-thru connection (lug 2) is not connected to the grounded jack frame when the phone plug is removed. Use of a shorting type jack will result in the meter being inoperative.

Using the tuning monitor. Normally, the most powerful transceiver will drive the meter almost to full scale. However, a high standing wave ratio (SWR) on the feedline can result in a high RF voltage at the point where the monitor is connected to the transmission line. Under these circumstances the meter might well be driven off-scale. If this occurs, simply reduce sensitivity with R3 until you make the necessary repairs.

For best modulation monitoring, the headphones should be of good quality—with an impedance of 2000 ohms or higher. Earphone volume is determined by R3.

When tape recording, adjust the recorder's gain control to approximately its usual setting. Then, adjust R3 for the proper recording level. Don't run R3 wide-open and try to adjust the recording level at the recorder. On most recorders the volume control is after the microphone preamp and a wide-open level from the monitor will overload the preamp. If your recorder has sufficient gain, feed the monitor's output into the recorder's high level input—you'll get a better recording.

April, 1965
Much time can be saved, and possible aggravation avoided during a photographic setup with this control unit; it centrally locates control of all your lights at the tripod!

A setup usually involves positioning photofloods as subject lights, backlights, and perhaps, either auxiliary or assorted color lights, to illuminate your subject. Adult subjects wait patiently while you turn on all of these lights, frame the subject, study the shadows, and then finally make the exposure. Adult subjects, or more so, inanimate objects, are very cooperative during this preparation time; they realize the importance of lighting (and shadow) in the finished photograph, and they are patient. Children are often not so patient—have you ever gone back under the hood after making a tour of the lights to find that, in a split second, your subject has disappeared! Well, with one switch conveniently mounted on the tripod beneath the camera controlling all your lighting, perhaps you can catch that fidgeting young'un before he gets away.

With this control all photofloods are only used when needed and can be quickly switched off when not in use. When I have to walk around and over wire and cables to turn off the floods one by one, my tendency is to leave them on. There is an obvious savings if the floods are only used when needed.

**This Photographer's Approach.** With the FLOOD CONTROL switch off, the left set of receptacles on the junction box is designed to have 115 vac connected to it. Standard lamps plugged into these receptacles are used to get a rough idea of subject framing, focus, etc. The subject, either person or pet, doesn't have to stare into bright floods. Just before snapping the shot, I switch on the floods, take a light reading, make a few final adjustments, and—click—subject and photographer are pleased.

**Construction and Wiring.** The control unit is packaged in two boxes. The one is a 2 1/4-inch deep electrical junction box that is used because of its rugged construction.
The junction box, left, and the miniature cabinet housing the Flood Control switch comprise the complete control unit. As shown in the schematic diagram, the phone plug from switch S1 connects at junction box at jack J1. The power cord from the junction box connects to 115 vac; then it's just a matter of plugging in your lights.

Schematic diagram of the control unit indicates function of relay K1 in circuit.

**PARTS LIST**

- F1, F2—15-ampere, 3AG fuses and fuse holders
- I1—115-vac, snap-in neon panel light
- J1—Phone jack, closed-transfer 1 (Mallory 703B or equiv.)
- K1—Advance relay, d.p.d.t., 15-amp. continuous (Newark 24P913 or equiv.)
- P1—Phone plug, 90-degree, (Switchcraft 220 or equiv.)
- S1—S.p.s.t. toggle switch, 6 amp. at 125 volts
- 1—Cabinet, grey hammetone, 3 1/4" x 2 1/4" x 1 1/2" (Bud Minibox CU-2101A or equiv.)
- 1—Electrical junction box, 2 1/4-inch deep with cover for two receptacle sets (Order from Sears and Roebuck Co. Chicago, Ill.)
- 2—Duplex outlets, grounded, 15 amp 115 volt (Sears 34H5925)
- 1—Coil lamp cord, white No. 18, 25 feet (Allied Radio 48TT767)
- 1—Coil extension cord, 300 volt, No. 16, 25 feet (Allied Radio 48TT509)
- 3—Spring clips ½-inch (depending on tripod) (Allied Radio 17L498)
- Misc.—Clamps, wire, solder, etc.

Estimated cost: $14.00
Estimated construction time: 3 hours

Holes are drilled in the knockouts to hold the fuses, relay, and phone jack. The drill center diagram shows the location and size of these holes. It is easier to wire the six switching contacts before mounting the relay in the junction box. All wire used in the relay junction box was cut from a 25-foot coil of No. 18 zip cord. This cord is split into two separate wires and used to wire the junction box. The remaining zip cord is wired to the 90-degree plug to form the control cable that connects to switch S1 in the Flood Control unit.

As shown in the wiring photographs, the two upper and lower contacts of relay K1 each have a 7-inch wire soldered to their terminals; a lug is attached to the other end of the wires. Solder a 3-inch wire to each of the center contacts. Use caution when wiring the relay to keep its exposed terminals from touching one another and the junction box.

The two receptacle sets should be wired before they are mounted to the top cover since the connecting screws are not accessible to

**will save running from light to light—tripping as you go**
PHOTOFLOOD LAMP CONTROL UNIT

Interior of the junction box is compact indeed, and each component has its designated space. Take care to keep terminal lugs properly aligned and you’ll have no short circuits.

the screwdriver once they are mounted. The neon power on indicator lamp, I1, is connected across the power line as shown in the callouts photograph. The 15-ampere, 3AG fuses are connected ahead of the indicator lamp. A cable clamp should be used to secure the heavy duty ac power cable as shown in the junction box photograph.

The second box is a Minibox that mounts on a tripod leg in the most convenient position for the photographer. It houses FLOOD CONTROL switch S1. The s.p.s.t switch is rated at 5 amperes at 125 volts. The switch shown happens to have a safety cover since it was recruited from a war surplus miscellany box. Three spring clips are mounted on the rear cover of the Minibox to secure it to the tripod; choose size to fit your tripod.

Discarded Portable Becomes Test Speaker

A patch cable consisting of two flexible leads, insulated alligator clips, and phone plug lets you tie into AC/DC radio and TV hot chassis without any danger of shock.

If you own an old tube-type radio portable that’s ready for the garbage can, you’re in for a windfall by simply converting it to a portable test speaker. Scrap all of the set’s guts except the PM speaker and output transformer. Now scrounge up open-circuit and closed circuit phone jacks (see schematic diagram), phone plug, wire, and two alligator clips with rubber sleeve insulators. Wire up the portable case as shown in the schematic diagram and label the cabinet’s front panel so you will know which jack is which. Now wire up a patch cord using 3 feet of rubber test lead lengths to the phone jack and install the alligator clips to the wire’s free ends. Now you can connect the test set to speaker terminals or into audio plate circuits.
The CB Underground

By C. M. Stanbury II

July 2, 1965—6th meeting of STARR convened 8:00 P.M. at Col. Mayer's clifftop lodge. All security precautions were followed.

There are only 10 of us in STARR (Society To Annihilate Radio Regulations) but it was a real way out bit with plenty of kicks. Outside our mobile rigs were all under cover in the Colonel's mammoth garage. Inside the members were arranged in a circle, dressed in royal blue uniforms with 5-pointed silver star insignias on the shoulders and silver hoods too. Except Mayers (KMZ-43431) who as our leader sat in the center with silver uniform and royal blue hood.

The colonel raised his hands for silence. "STARR 3, you may lead us in the pledge tonight."

That's me. We use these STARR tactical calls on the air, too! I stood up. "We pledge to defy all federal radio authority, to destroy the FCC, and to promote general CB chaos. May STARR keep me steadfast."

He nodded and I sat down. "STARR 4, you may report on operation 5A."

She got up from the chair next to mine. I'd seen her several times without the hood. A big blond amazon with perfect proportions. Beautiful if you like Vikings, and I do. Incidentally STARR 4 is Mayer's daughter. "I, STARR 4, parked behind some trees just outside the FCC monitoring station while STARR 3. . . ." She pointed to me "... cruised around a mile away and made continuous insulting remarks about FCC monitors over the air. His transmission lasted well over an hour thus violating several regulations. As soon as the monitoring station sent out a mobile unit, I warned STARR 3 via our secret illegal radio channel and he immediately left the air. Thereby frustrating federal law enforcement."

Like I said, STARR came up with some real way out capers. There was also the time STARR 4 and myself out of uniform (on a date) found some poor FCC monitor's car in a parking lot. Just like that she says, "siphon off the gas!" Which scared me a little because we might have got involved with the cops, but for her I did it.

The Colonel sat down and began his weekly pep talk. "The initial phase of our pro-
gram has been completed.” Softly, at first, but he upped his volume as he went along. “I have given you practice in basic sabotage. You have demonstrated that you can take orders.”

He didn’t know about our clandestine dates, we were never supposed to learn each other’s identities.

“And you all know what is at stake. The Commission is censoring free speech. It is doing this, mind you, in the face of Section 326 of the Federal Communications Act, which states ‘Nothing in this act shall be understood or construed to give the Commission power of censorship over the radio communications or signals transmitted by any radio station.’”

I never went much for legal theories and technicalities. That’s how I lost my CB license—and a hundred bucks to boot—in the first place.

Mayers droned on. “The Act further states ‘and no regulation or condition shall be fixed by the Commission which shall interfere with the right of free speech by radio communications.'”

I reached out and took STARR 4’s hand, but she pulled away. At these meetings, this Viking was all business.

Mayers got up and crossed to the far side of the room. “We’re now ready to tackle our first major project.” He pulled back a curtain exposing some crates. He carried the smallest one over to the group and opened it. Inside was some sort of portable rig.

The whole thing began to remind me just a little of those grade B spy movies on the late show. Especially with Mayers’ lodge on a cliff overlooking the sea.

He handed it to his daughter. “STARR 4, will you explain this device to the group.”

She nodded, held the gleaming silver box up so we all could see. “An activator! Pow-
Harmon-Kardon SR-300
Transistorized
FM/Stereo Receiver

Elpa PE-34 Manual
Stereo Turntable

Bozak E-300K-Urban
Enclosure Kit, B-207A
2-Way Speaker

From the very beginning of the hi-fi boom one of the chief annoyances was, and still is, the disparity between showroom sound and home conveniences. Too often, the system which is finally chosen on the basis of hours of listening tests proves a decided inconvenience in the home. Perhaps the amplifier or receiver is so big it just doesn’t fit in the space allotted in the bookshelf. Or the turntable is so sensitive the arm “jumps” if someone walks too fast across the floor; or in the attempt to squeeze the most sound into a tight budget utility (unfinished) cabinets are purchased which brings on a sense of embarrassment when company comes.

Yes, the problem is so commonplace that this month we decided to test a complete hi-fi system chosen on the basis of livability. We assumed the following needs: First, and most important, the system must be child-proof, capable of withstanding the man-handling of young children and toddlers. Second, it must be easy and convenient for all family members to use; if a child wants to hear Winnie The Pooh he must be able to operate the equipment without calling for Daddy. Third, while rugged, the system must deliver hi-fi, not just good sound. And lastly, the equipment must blend harmoniously in a modest size living room with contemporary (modern) styling; the sort of place the women’s magazines call “a young married’s home.”

Armed with a knowledge of exactly what we wanted the usual hours of showroom shopping was reduced to about 20 minutes, and we weren’t subjected to “hi-fi nerves”—that effect which sets in after hours of showroom listening when everything starts to sound as if it was made in Heaven.

Our equipment choices were the Harman-Kardon SR-300 FM Stereo Receiver, the Elpa PE-34 turntable, the Bozak 207A speaker and the Bozak Urban E-300KU speaker enclosure kit.

The SR-300 is an all transistor FM only (no AM) stereo receiver using what can be called “family design.” There is no confusing multiplicity of controls, only the bare minimum. Volume, tone and balance controls are dual function—a single knob controls both channels. The only other controls are the tuning knob, input selector, and the rumble, scratch and contour (loudness) switches. The front panel is actually no more complex than a single mono receiver. Also, there are no concealed or rear panel controls.

As shown in test graphs and the accompanying tabular test results, the amplifier performance is quite good, the measured frequency response being better than the claims. Since only the 4 ohm music power rating is given in the manual (and since we consider IHF music power to be a meaning-
less rating having no meaningful relation to actual performance) we tested the amplifier for continuous sine wave into 4, 8 and 16 ohms. The power outputs shown are for each channel at less than 1% THD (total harmonic distortion); typical of transistor amplifiers it can deliver about 50 per cent more power at corresponding higher distortion. Also typical of transistors the power output depends on the speaker load impedance.

Two sets of input jacks are provided: RIAA magnetic phono and tape/auxiliary. A third set of jacks is for feeding the amplifier signal to a tape recorder.

There are no speaker phase or reversal switches. The instruction manual details the proper speaker connections, and once you have them there's really no need to change them.

For owners of old 78-speed records, the low and high-cut-out filters can kick all the "scratch" and excess bass out of shellac discs.

As far as the ear is concerned the amplifier is exceptionally smooth and noise free. With the volume wide-open no hum or noise can be discerned through the auxiliary input, while only the faintest hiss can be heard when the magnetic preamp is switched in. Even at the setting for deafening sound levels no noise is apparent.

The FM tuner's performance is in keeping with the amplifier's, though it may take a while to get used to the tuning meter if you've just switched from a tube type tuner. There is no extravagant sensitivity which permits listening to stations buried in the noise level. The maximum usable sensitivity is about 4 microvolts—certainly adequate. Even though a transistor front-end is used there is no "hiss overlay" on the signals, even weak ones; the quieting is up to tube standards.

The tuning meter is a bit unusual in that it reflects the true signal strength; all signals don't come barreling in at the top of the meter scale. Weak signals read downscale and average signals slightly above midscale. Rare is the signal that "pegs the needle." We mention this so you don't confuse true meter readings with poor performance (we know users like to feel their gear is so sensitive it pulls in all signals at "full strength," but it just isn't so).

Two conveniences are provided for the stereo enthusiast. First, the mode switch can be set permanently to FM Stereo; when mono is broadcast the receiver plays mono. If stereo broadcasting is commenced the receiver plays stereo. Should a stereo station be so weak the stereo broadcast is buried in

For owners of old 78-speed records, the low and high-cut-out filters can kick all the "scratch" and excess bass out of shellac discs.
noise the mode switch can be set to mono—providing a better signal-to-noise ratio. The second convenience is the full time stereo indicator lamp. When the mode switch is in the mono position the lamp is on at all times to remind you that you aren’t set for stereo; there is no change in the lamp’s brilliance as you tune across the band. As soon as the mode is set to stereo the lamp extinguishes and only goes on when stereo transmissions are received. Should you be tuned to a station which broadcasts stereo only part time, the lamp will remain off until stereo transmissions are resumed.

The overall FM performance is good. Stereo separation is equal to contemporary equipment and tuning ease is notably good.

We should mention one tuning, or rather, reception effect which we don’t know is common to all models or just the one we had. When a stereo station’s signal was just marginal, that is, when it could be received well one minute and then blotted with noise (like from a passing car) the next, the stereo indicator would flicker. After several hours of listening we decided the flicker was an asset since it told us were were not going to enjoy stereo; so we just set the mode to mono and sat back and relaxed. We found the flicker effect a decided asset, and feel that if it’s common to all models it should be mentioned in the instruction manual.

Out of its optional walnut cabinet the SR-300 offers a clean, neat, easy-to-dust surface.

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**ELPA PE-34**
**Manual/Stereo Turntable**
($72.00 Net; Base $6.00)

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The Elpa PE-34, a newcomer to the hi-fi field, was chosen strictly on the basis of its *childproof arm*, which is raised and lowered by a mechanical-pneumatic action. At no time is the arm raised or lowered by hand. When positioned in the rest the arm is firmly locked by the locking lever and it cannot be deliberately jarred or pulled out of the rest.

To release the arm the locking lever is pushed towards the rear. The arm is then positioned over the record and it stays clear of the record until the locking lever is pulled forward; then the arm is very slowly lowered to the record. When the last band has been played the arm automatically raises off the record and stays there until it is returned to the rest. Once the arm is lifted clear of the record it cannot fall back—it must either be lowered by the locking lever or returned to the rest. Short of deliberately breaking the arm mechanism it is impossible to damage a record by dropping the arm.

The arm has an adjustable counterweight for static balance which seems to work with virtually all cartridges except the Ortofon SPU-T. The Ortofon is too heavy for the normal counterweight adjustment, and the weight must be slipped back—off its threads—in order to balance the Ortofon. Lighter cartridges such as the Shure M44-5 (used in the test) work very well and should be considered when purchasing the turntable.

A spring loaded calibrated slider adjusts the stylus pressure in the 0-6 gram range. When checked against a known accurate pressure gauge the slider’s calibration was
within 1/4 gram, certainly accurate for all users.

The motor uses a combination belt and idler drive providing the four standard speeds. Wow, flutter and speed variation is inaudible. For some reason, perhaps to allow for the purist who insists on setting his own pitch, the motor speed is variable slightly above and below normal. The speed control is right next to the on-off switch and it is easily changed in the process of turning the motor off. We found it necessary to tape the speed control in position.

Any desired stylus pressure to 6 grams can be set by moving the slider—shown covering 1-gram mark—to the appropriate marking.

Finger points to the strobe disc which is an integral part of the turntable mat. Second knob from right is variable speed control.

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BOZAK B-207A
2-Way Speaker
BOZAK E-300K-URBAN
Enclosure Kit
($94.50 & $54.50)

The Bozak B-207A speaker system is a notably smooth sounding woofer speaker with wide angle high frequency dispersion caused by two coaxially mounted tweeters facing outward. It is the high frequency dispersion which is the “extra” feature as it is often impossible to locate a speaker in a small living room so it radiates directly into the listening area. (Few of us have those 40 x 40 (Continued on page 124)
Perhaps you have not yet had occasion to troubleshoot the alternator in your car. When the occasion does arise, you are going to need more than just the voltmeter and ammeter you used for that old DC generator—you'll need a diode tester also. Your alternator contains six or seven diodes, or silicon rectifiers, that comprise the circuit that converts the alternator output to direct current, and supplies it to the battery as required. Either a shorted or open-circuited diode will lead to electrical system difficulties resulting in a dead battery if you don't habitually check your ammeter. The effect an open-circuited or shorted diode has on the circuit is shown in the two electrical flow diagrams.

BY JAMES A. FRED
DIODE TESTER

Build It Now. Why not have a diode tester on your workbench now so it's ready to hunt down a culprit diode before your battery needs charging. This one's a simple, easy to use, inexpensive device that will test for open, shorted, or even leaky diodes. Its indications are easily interpreted to obtain the condition of the alternator diodes, or other diodes used in radio, television and battery chargers for example.

Construction. Prepare a cover for the instrument case by drilling holes for the indicator lamps, push-button switch, test probe leads, and transformer mounting hardware. Drill another hole in the end of the case for the AC line cord. After securing the components on the panel cover, begin wiring the remaining resistors, diodes, and test leads referring to the schematic diagram. Note that when you use the 24-volt step-down transformer listed in the parts list, resistors R1 and R2 should be 75 ohms. The resistors shown here are 100 ohms since a 36-volt transformer salvaged from a M-H oil burner stack control was used to supply the tester voltage.

The tester can be given a smart and professional appearance by labeling the front panel with decals. You can check out your work on the tester in the following manner. Connect the tester to the line voltage, and press the pushbutton switch S1. Now short the two test clips together and observe that both indicator lamps, I1 and I2, light. If only one bulb lights, the other diode is probably connected backwards in the circuit. Note that each rectifier is connected with a different polarity to the common point.

Using The Tester. A diode under test should be connected in the diode tester circuit as shown in the schematic diagram. Failure to connect the diode with the correct polarity will result in erroneous indications.

Diode tester schematic diagram shows placement of alternator diode. Analysis of circuit will yield results in table opposite.

建它现在。为什么不在你的工作台上放一个万用表呢，这样在你的电池需要充电之前就能找到故障点。这个仪器很简单，容易使用，且价格便宜，可以测试开路、短路甚至漏电的二极管。它的指示很容易解释，可以用来判断整流器二极管或其他用于收音机、电视机和电池充电器等的二极管的状况。

构造。准备一个仪器的外壳，通过在外壳上钻孔来安装指示灯、按钮开关、测试探头和变压器安装硬件。在面板上安装好部件后，开始布线剩余的电阻、二极管和测试探头，参考 schematic diagram。请注意，当您使用零件列表中列出的24伏特降压变压器时，电阻R1和R2应为75欧姆。图中所示的电阻是100欧姆，因为从M-H燃油燃烧器的控制头回收的36伏特变压器被用于为测试仪供电。

该测试仪可以赋予一个智能且专业的外观，通过使用贴纸来标识面板。您可以在测试仪上检查您的工作。将测试仪连接到电源，并按下按钮开关S1。现在将两个测试夹子短路，并观察两个指示灯I1和I2是否都亮。如果只有一个灯亮，那么另一个二极管可能是反向连接的。请注意，每个整流器连接到公共点时极性不同。

使用测试仪。测试仪中测试的二极管应遵循示意图所示的方式连接在测试仪电路中。如果不按正确极性连接二极管，则将导致错误指示。

测试仪示意图显示了整流器二极管的位置。分析电路将得出结果。
The indications you will normally receive when using the tester are listed in the following table.

<table>
<thead>
<tr>
<th>Indicator Lamps Lighted</th>
<th>Indicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>The diode is open-circuited and unusable</td>
</tr>
<tr>
<td>Red</td>
<td>Reverse leakage through the diode under test; discard diode</td>
</tr>
<tr>
<td>Red and Green</td>
<td>The diode is shorted and unusable</td>
</tr>
<tr>
<td>Green</td>
<td>Diode is conducting properly</td>
</tr>
</tbody>
</table>

In addition to checking a diode with its polarity in mind, you should be sure that one end of the diode is disconnected from its circuit or, again, erroneous readings will result. Your alternator diodes will most likely be the type shown in the accompanying illustration (p. 82). Brass case of diode is the cathode; sometimes it is marked with a black bar. The copper wire is the anode; sometimes the anode end of the diode is marked with an arrow head. If you run across a diode with the letter R in the type number, it must be connected in reverse since it was manufactured with its polarities reversed.

**Under the Hood.** Since one end of a diode under test must be disconnected from its circuit, and since you must have access to both ends for the tester probes, at least a partial disassembly of your alternator is necessary to check the diodes. In checking the Autolite alternator shown in the accompanying illustration (p. 82) stator and diode and plate assembly are removed from the rear housing. This leaves each diode in its heat sink but effectively disconnected from the circuit. Connect the anode (A) test clip from the diode tester to the negative stud. Agitate the connections gently while testing the diodes to check for a possible intermittent condition. Touch the cathode (K) test
DIODE TESTER

Actual rectifying portion of diode is small metallic disc or square of pure silicon treated with controlled impurity. Installation of disc determines whether diode is negative or positive. Observe the polarity.

COPPER WIRE TERMINAL
WELD
"GETTER" MATERIAL
SOLDER
SILICON CRYSTAL WAFER

Access to the Autolite alternator diode assembly, described in text, is easy. When soldering or unsoldering diodes always use heat sinks to avoid damaging the diode. Here, pliers function to carry heat away.

clip to each of the three stator wires that connect the positive and negative diodes together. Now move the anode test clip to the positive stud and repeat the test for the other three diodes. For your particular automobile, check the service manual for the alternator disassembly procedure for obtaining access to the diodes.

Under the Chassis. The diode tester need not be kept in the garage—it can be used in radio or TV work as well. It can be used to check power diodes rated at 150 milliamperes or more. It shouldn’t be used to test signal diodes such as video detectors since it will ruin them.

The diode tester is a very worthwhile piece of test equipment that, at such a low do-it-yourself price, you can’t afford not to have.

PARTS LIST

D1-D2—Silicon Rectifier diodes (Mallory Type T or 1N2091)
R1-R2—75- or 100-ohm, 10-watt wire wound resistors (see text) (Newark Electronics 13F510 or 13F511, respectively)
51—Push-button switch, s.p.s.t. (Allied Electronics 34B432)
T1—115- to 24-volt stepdown transformer (Burstein-Applebee 1BB506)
TB1-TB2—2-terminal terminal strips
T—Bakelite instrument case 2 5/16" x 3 5/16" x 1 3/16" (Newark Electronics 26F145)
Misc.—Test clips and insulators, line cord, test leads, grommets, mounting hardware, wire, solder, etc.

Estimated cost: $7.00
Estimated construction time: 2 hours
**A photocell and a DC ammeter comprise the heart of this **FUNctional device designed to keep your emergency lights ever ready to throw a beam

**FLASHLIGHT**

**TESTER**

By James A. Fred

I don't know how many flashlights you have at your house, but we have eight. One for each member of the family, one in each automobile, and two spares in working order. Check your house! You may have several more. In factories, police stations, hospitals, fire stations, and other institutions, it is no surprise to find fifty or more flashlights ready for use. When the urgent need for a flashlight's benevolent beam is needed in your household or on the job, are your flashlights ready to deliver at 100% efficiency? One sure way to know for sure is to build the Flashlight Tester and find out.
FLASHLIGHT TESTER

The Flashlight Tester is a "black box" at which you point a flashlight and immediately discover whether or not its output has decreased from normal output, and if so, how much. An added voltage test feature with batteries loaded to a specific current drain detects weak batteries no matter what size.

**Design Considerations.** Most flashlights use some type of 1.5 volt dry cells that come in several standard sizes. The larger the battery, the more power or current the battery can deliver. There are also lamps worn on the head that use either 1.5 or 6 volt batteries and camp-type lanterns that use 6-volt batteries. These batteries supply a great deal more current than the common flashlight varieties. The meter in the Flashlight Tester will indicate up to 500 ma., but the load control's R1, designed into the unit, will only safely carry 250 ma. If you desire to load a 6-volt battery and draw up to 500 ma., then it will be necessary to use a larger aluminum box and put in a 25-watt power rheostat for a load control. However, a 250 ma. load will usually prove to be sufficient for most 6-volt batteries.

A table listing all the common flash-light batteries and their recommended loads is given in this article. This table was compiled from information supplied by one of the larger battery companies. Several new and old batteries that we had on hand were checked and found that the specified loads would separate the good and bad batteries.

**How It Works.** The flashlight tester performs two separate functions. (Refer to the schematic diagram.) By setting selector switch S1 to position 1, it is possible to rotate load control R1 and set up any desired current load. Shunt resistor R4 placed in parallel with the 0-1 ma. meter, M1, converts it to a 0-500 ma. meter. The load control, R1, can be used to load any 1.5 volt battery to the load specified in the table, and can—*with care*—be used to load a 6-volt battery as well.

Position 2 on selector switch S1, still keeps the load on the battery, but now our 0-1 ma. meter becomes a 0-10 volt D.C. meter. The 10,000 ohm resistor, R2, in series with meter M1, is a voltage multiplier resistor and converts the 0-1 ma. meter to a voltmeter. Now, with the load control set to the proper current drain when at position 1, you can now read the battery voltage under load, on position 2. If a 1.5 volt battery reads less than 1.1 volt, throw it away. Likewise if a six-volt battery is less than 4.4 volts, discard it, too.

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**Schematic diagram of the flashlight tester shows switching circuits for the two tests.**

<table>
<thead>
<tr>
<th>S1 Positions</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery Load</td>
<td>B1—3-volt battery, two size AAA cells in series</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery Volts</td>
<td>BP1, BP2—Binding post, 5-way; one red and one black (Lafayette 99G6121 and 99G6120 or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light Output</td>
<td>M1—0-1 ma. meter; DC movement; 2½&quot; wide face</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PC1—Photocell (GE type A33 or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R1—75-ohm, 5-watt, wire-wound potentiometer (Mallory VW75 or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R2—100,000-ohm, 5 watt, 5% resistor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R3—20,000-ohm linear taper potentiometer with S2 integral part of unit (Mallory type U26 and US26 s.p.s.t. switch or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>R4—3-ohm, 10-watt, adjustable, wire-wound resistor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1—3-pos., 2-pole rotary switch (Mallory 3223J or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2—5 s.p.s.t. switch (see R3 above)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1—Aluminum chassis box, 3&quot; x 4&quot; x 5&quot; (Bud CU-2105A or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1—Dial plate (Mallory 390 or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1—Dial plate (Mallory 373 or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1—Battery holder to mount 2 size AAA cells (B1) (Keystone 138 or equiv.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Misc.</td>
<td>Surplus fluorescent starter, jewel bushing (see text), wire, solder, hardware, rubber feet, etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Estimated cost: $12.00
Estimated Construction time: 4 hours

---

*Radio-TV Experimenter*
Aluminum chassis box (3"x4"x5") provides good spacing for all the tester components.

**Light Check.** Now comes the quick check on the amount of light your flashlight is putting out. Photocell PC1 is really a variable resistor whose resistance varies with the amount of light falling on it. Its resistance is very high when it is dark, and very little current passes through to actuate the meter. When the light from a flashlight falls on it, the resistance goes down and the meter reading goes up. The photocell is mounted behind a hole in the front of the box. A light shield keeps room light from hitting the photocell and causing false readings. It takes direct light to make an appreciable reading on the meter. Selector switch S1 is set to position 3 for this test and sensitivity switch S2 is on. With the light shining on photocell PC1, sensitivity control R3 is used to adjust the meter to a full scale reading.

**Boxing It.** The completed flashlight tester is housed in an aluminum box 3" x 4" x 5" in size, although using a larger load control for R1 than this design shows (as previously mentioned) you will need a larger box. The photocell light shield for PC1 is made from a fluorescent light starter and a \( \frac{3}{4} \)\text{in} diameter bushing cut from the mounting bracket of a pilot light jewell assembly. The inside diameter of the bushing is a perfect fit for the G.E. photocell A33. A drop or two of cement will hold PC1 in the bushing. Refer to detail drawing for assembly information.

The adjustable resistor mounted on the inside lid of the box is the millimeter shunt, R4. Its purpose is to convert the 0-1 ma. meter M1, to read from zero to 500 ma. The 10,000 ohm \( \pm 5\% \) resistor (R2) is used as a voltmeter multiplier. The assembly and wiring is straightforward and should present no problems if the schematic diagram and photographs are followed.

**Adjustment.** After carefully double checking the wiring, it is time to adjust ammeter shunt R4. The simplest method is to connect another millimeter (part of a VOM) in series to binding posts BP1 and BP2, and a 1.5-volt battery with the selector switch set at position I. Adjust the load resistor, R4, to minimum resistance and complete the external circuit, adjust load control until the external ammeter (on the VOM) reads 250 ma. Now adjust the slider strap on shunt resistor R4 until the 0-1 ma. meter, M1, in the tester reads .5 ma. or mid-scale. By multiplying the .5 reading by 500 you will have a reading of 250 ma. After mentally multiplying the readings on this scale a few times by 500 you will find yourself just naturally converting the readings as you observe the meter.

**Light-tight use of bushing and shield in detail drawing of photocell installation.**

Some experimenter's may want to recalibrate the scale face plate in the meter. This is a good idea but remember Sienkiewicz's meter law (postulated by the Editor) which states, "any experimenter who disassembles a panel meter is sure to wreck at least one meter in his lifetime, and the wrecking usually occurs during the first few disassemblies." So be very careful. Leave the original markings on the scale since they will be used to indicate volts (discussed later).
FLASHLIGHT TESTER

Using the Tester. Now you are ready to use the flashlight tester. Insert a pair of test leads into the binding posts BP1 and BP2, set the selector switch S1 to position 1, set the sensitivity switch S2 to off, and turn load control R1 to its CCW end of rotation. Consult the Recommended Battery Load Table and choose the current value for the size battery you are using. Apply the test prods to the battery (observe polarity) and adjust load control R1 until the meter reads the proper current given in the table. Remember the meter reads 500 ma. full scale. Now switch to position 2 on selector switch S1. Now the meter becomes a 0-10 volt meter and you must mentally convert the 0-1 readings to 0-10 volts. Remember, the voltage limits under load are 1.1 and 4.4 volts for 1.5- and 6-volt batteries, respectively. If you are unable to adjust the load control for the recommended reading this means that the battery is no good and further testing is unnecessary.

To measure the amount of light being put out by a flashlight, set selector switch S1 to position 3. Hold a flashlight with its lens against the end of the light shield, turn on the light and also turn on the sensitivity control. The meter will start to read. Move the flashlight around until you get a maximum reading on the meter. Now if the flashlight has new batteries installed, advance the sensitivity control until the meter reads full scale which we shall call 100%. Note the reading on the sensitivity control dial scale, and record it for future reference on the flashlight case. The next time you want to check this flashlight put its lens against the light shield and adjust for maximum reading with the sensitivity control set on the above recorded reading. Whatever the reading now is you can express as a percent of the original value. For example, if the meter now reads .6 ma., this will be 60% of the original value of light produced with the new batteries.

After you have the flashlight tester in action and have taken reference readings on all your flashlights, you will find that even first graders will be able to check their own lights unassisted. In industrial organizations the flashlight tester will prove to be invaluable as a preventative maintenance tool.

RECOMMENDED BATTERY LOAD TABLE

<table>
<thead>
<tr>
<th>Type</th>
<th>Eveready</th>
<th>Burgess</th>
<th>RCA</th>
<th>Ray-O-Vac</th>
<th>Mallory</th>
<th>Bright Star</th>
<th>Rating (Volts)</th>
<th>Load Current (Ma.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>912</td>
<td>7</td>
<td>VSO74</td>
<td>400</td>
<td>M-24F</td>
<td>58</td>
<td>1.5</td>
<td>20</td>
</tr>
<tr>
<td>AA</td>
<td>915</td>
<td>2</td>
<td>VSO34</td>
<td>—</td>
<td>M-15F</td>
<td>59</td>
<td>1.5</td>
<td>25</td>
</tr>
<tr>
<td>C</td>
<td>935</td>
<td>1</td>
<td>VSO35</td>
<td>1LP</td>
<td>M-14F</td>
<td>11M</td>
<td>1.5</td>
<td>80</td>
</tr>
<tr>
<td>D</td>
<td>950</td>
<td>2</td>
<td>VSO36</td>
<td>—</td>
<td>M-13F</td>
<td>10M</td>
<td>1.5</td>
<td>150</td>
</tr>
<tr>
<td>Ignition</td>
<td>6</td>
<td>6</td>
<td>VSO06S</td>
<td>6</td>
<td>M-905</td>
<td>6</td>
<td>1.5</td>
<td>250</td>
</tr>
<tr>
<td>Lantern</td>
<td>509</td>
<td>F4H</td>
<td>VSO40C</td>
<td>941</td>
<td>M-908</td>
<td>460</td>
<td>6</td>
<td>250</td>
</tr>
</tbody>
</table>
Every ham on occasion has need of a small low power transmitter he can operate during main transmitter repair, use for a temporary schedule on some band he doesn't frequent, or perhaps take along on a trip. If you've been working strictly phone, you may need some CW practice or, perhaps your license renewal date is near and some CW operation is mandatory. If you operate the DX or VHF bands exclusively, you may want to try a little low-band CW when your favorite bands are non-cooperative. Not much power is needed for CW work on 160 meters. Even the novice ham can often make use of a little 80 or 40 meter CW squeaker.

**Pick Your Band.** The little rig will operate on any band for which you will supply a crystal and output tank circuit. A 6AW8A triode-pentode combination tube is used; it is a type popular in citizens band equipment. As shown in the schematic diagram, the triode section is connected as a Pierce crystal oscillator; the pentode section, as a follow-up RF amplifier. This type of oscillator is untuned and it can be changed quickly from one band to another simply by plugging in the appropriate crystal. Only the output pi-network need be tuned in changing frequency or band. The circuit, simple and straightforward, will provide reliable trouble-free operation. The full-wave power supply uses silicon rectifiers.

**Compact Package.** The entire transmitter, including power supply, is built on a chassis that is a part of a miniature utility cabinet (6" x 6" x 6"). Placement of the components is indicated in the chassis photograph. Note that the six largest components mount snugly and neatly on the top of the chassis. Beneath the variable condenser C1 is the coaxial receptacle J2 for connecting the output signal to the antenna. The output pi-network trimming capacitor C2 is mounted firmly to one side of receptacle J2. A hole in the front panel, provides access for adjusting the trimmer capacitor.

The five-prong coil socket is mounted at the rear of the chassis. Consequently, coils can be changed readily by reaching in the open cabinet back. Barker and Williamson MCL coils are used for L1. The center pick-up loop is not used. If you wish, you can wind your own using standard five-prong coil forms or the self-supporting Air Dux type. The crystal has been mounted on the front panel for ease in switching bands.

**Wiring.** Except for the pi-network circuit, all the wiring is beneath the chassis as shown in the photograph of the underside. The silicon rectifiers are shown positioned in their mounts directly beneath the power transformer. The dual filter capacitor fits snugly at the rear of the chassis. In the central area is the wiring for the supply voltages and the various dropping resistors and bypass capacitors. The radio-frequency wiring is near the side, keeping the radio-frequency circuit well isolated. As a result, the transmitter has a clean CW note with no additional shielding necessary.

**Tuning.** After you have wired the transmitter check your work carefully. Insert a crystal and coil for the desired operating frequency. It is advisable to place a load on the transmitter output whenever it is turned on: Connect a dummy load to the output before applying power—either a composition 50-ohm resistor or a #47 pilot bulb.
### One Tube Five Watter

**PARTS LIST**

- **C1**—10- to 365-mmfd. variable condenser, (Lafayette 32G1103 or equiv.)
- **C2**—100 to 580-mmfd. mica trimmer capacitor, (Lafayette 32G1103 or equiv.)
- **C3** through **C8**—1000-mmfd. ceramic capacitors
- **C9**—500-mmfd. mica capacitor
- **C10**—40-40mmfd. dual section electrolytic filter capacitor, 450 w.v. (Lafayette 34G5613)
- **D1** through **D4**—Silicon rectifier diodes 750 ma, 400 PIV @ 25 C; 500 ma, 400 PIV @ 90 C, (Lafayette 19G4209 or equiv.)
- **J1**—Telegraph key phono jack (and plug)
- **J2**—RF coaxial receptacle (and plug) (Lafayette 32G2003 and 32G2004, respectively)
- **L1**—Barker and Williamson MCL plug-in coil. Specify 10, 15, 20, 40, or 60 meters.
- **L2**—20 henry filter choke (Stancor C-1515)
- **L3, L4**—2.5 mh RF choke (J. W. Miller 6302)
- **M1**—0—25 DC milliammeter (Lafayette 38G-6014 or equiv.)
- **R1**—100,000-ohm, ½-watt resistor
- **R2**—22,000-ohm, 2-watt resistor
- **R3**—39,000-ohm, ½-watt resistor
- **R4**—15,000-ohm, 2-watt resistor
- **R5**—100,000-ohm, 1-watt resistor
- **R6**—10-ohm, 1-watt resistor
- **S1**—S.p.s.t. toggle switch (Lafayette 99G6150 or equiv.)
- **T1**—Power Transformer; Pri: 115 vac, 60 cycle; Sec: 250 vdc, 25 ma; 6.3 vac (Allied 62G008 or equiv.)
- **V1**—6AW8-A, high-mu triode—sharp-cutoff pentode tube
- **X1**—Oscillator crystal for desired Amateur band
- **1**—Miniature utility cabinet (6"x6"x6") with attached chassis (1½""x4½"x5½") (Lafayette 12G8038)
- **Misc.**—Crystal and diode holders, dial knob and plate, tube and coil sockets, mounting hardware, terminal strips, wire, line cord, solder, etc.

Estimated cost: $29.00
Estimated construction time: 12 hours

---

Side view of the transmitter shows placement of parts above and below the sub-chassis.

The DC milliammeter, M1, is very useful in gaining the most from your transmitter. When the transmitter is properly loaded, the plate current falls somewhere between 12 and 18 milliamperes for most antenna styles. Optimum loading into a 50-ohm load usually draws about 15 milliamperes. Normal plate supply voltage is 320 volts; and the screen grid voltage is about 150-180 volts.

**Antenna.** The little transmitter was operated with various types of antennas, including an 80 meter dipole, 40-meter Windom and various random lengths of wire.

Schematic diagram of the one-tube five-watter shows connection of triode section as oscillator and pentode as RF amplifier.
Top view of transmitter sub-chassis indicates simplicity of the circuit. Only the half dozen major components mount on cabinet's sub-chassis. Coil L1 is mounted near the rear of the sub-chassis so it may be easily replaced to change the operating band of the transmitter. Crystal is located on front for easier replacement.

Operation was restricted to mainly 160, 80, 40, and 20 meters. For operation on 20 and 15 meters it is advisable to reduce the value of the pi-network capacitance by taking capacitor C9 out of the circuit.

In tuning up on the 160, and 80 meter bands the output trimmer capacitor, C2, is first set to maximum. The input capacitor, C1, is now resonated. C2 is decreased gradually for best antenna loading while retuning C1 when necessary to maintain resonance. For 40-meter and higher band operation, begin with output trimmer C2 at minimum.

Front panel of one-tube five-wattter is shown above. Key is connected to jack J1. Underside of sub-chassis, left, is not wired with components held to a specific location; but, in general, keep the radio frequency wiring near the side of the chassis (bottom of photograph). Power supply wiring, diodes and holders are visible on other side.
We remind readers again that our forecasts are valid for short-wave broadcast stations only. It takes into account all the special factors, technical and otherwise, which govern this type of listening. Further, the bands listed will not always produce the strongest signals, but will provide the most worthwhile results. For example, at 1500 thru 1800 listener's standard time Africa will actually be loudest on 31 and 41 meters. However many more countries will be available on 49 and 60 which is what really counts. These bands are used extensively in Africa (and throughout the tropics) for regional broadcasting which accounts for higher activity.

A similar paradox applies to African reception between 1800 and 2100 listener's standard time. We should also point out that West Coast SWL's will probably be only able to take advantage of this second major opening to Africa. During the first period however WC'ers should watch for two specific 90-meter signals—Radio Clube de Moçambique on 3215 kc and Radio Highweld (a new commercial service of Radio South Africa) on 3250 kc.

During the next three years short-wave conditions will rapidly return to normal; we will see some spectacular upper frequency openings. Right now, you'd better get those low frequency Africans while you can.
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APRIL, 1965
Jest to the Ham Fest

By H. E. HOLLAND

"Only 8,642 hours to go before the next big Ham Fest."

"We're on the right road. I can see the tower Bill's always bragging about."

"I want some pictures of you on the way to the Ham Fest, dear... smile!"

"Them ham fellas? Yeah, over the fence and on top that loooong hill."

"I don't mind coming with you... it's just the long wait to go home."
The meter terminal lugs provide convenient mounting points for the wired vectorboard.

**PARTS LIST**

- **M1**—50-0-50 microampere DC center-scale 4½" meter (Simpson Model 1329, 3½" model slightly cheaper, or equiv.)
- **R1**—5,000,000-ohm, ½-watt resistor, 1%
- **R2**—3,000,000-ohm, ½-watt resistor, 1%
- **R3**—1,000,000-ohm, ½-watt resistor, 1%
- **R4**—500,000-ohm, ½-watt resistor, 1%
- **R5**—300,000-ohm, ½-watt resistor, 1%
- **R6**—100,000-ohm, ½-watt resistor, 1%
- **R7**—50,000-ohm, ½-watt resistor, 1%
- **R8**—30,000-ohm, ½-watt resistor, 1%
- **R9**—10,000-ohm, ½-watt resistor, 1%
- **R10**—5,000-ohm, ½-watt resistor, 1%
- **R11**—3,000-ohm, ½-watt resistor, 1%

(Use IRC Type DCC Epoxy-coated resistors to keep cost down)

- **S1**—Single-pole, 12-position rotary switch (Centralab 2001 or equiv.)
- **J1, J2**—Banana Jack, one red and one black (E. F. Johnson 108-902 and 108-903, respectively, or equiv.)
- **MI**—50-0-50 microampere DC center-scale 4½" meter (Simpson Model 1329, 3½" model slightly cheaper, or equiv.)
- **S1**—Plastic case: 6½" x 5½" x 2½" (H. Davies 260, Allied Radio 87P886, or equiv.)
- **J1, J2**—Cover for plastic case: 6½" x 5½" (H. Davies 261, Allied Radio 87P888, or equiv.)
- **M1**—Knob (H. Davies 2150 or equiv.)
- **Misc**—Vectorboard, wire, solder, decals, etc.

**Estimated cost:** $28.00  
**Estimated construction time:** 4 hours

...continues...

The schematic diagram shows how the meter face will appear. Select the size decals that most closely resemble the original numbers and apply them as directed by the decal manufacturer. Using care and not hurrying may provide a pleasant surprise when you're done. To replace the meter face reverse the above procedure.

**Caution.** It would be well at this time to point out to those not too familiar with this type of instrument that when you're using the lower voltage ranges employ caution at all times and avoid applying excess voltages. It is suggested that the builder always start at a higher range than required and switch down until a reading is obtained that satisfies the user.

**In Conclusion.** The complete circuit diagram and parts list are given for the unit as built by the author. The reader may duplicate this or substitute his own voltage ranges taken to calculate the new required resistances. The total construction time should take approximately three hours—this would include layout, drilling and wiring.

This DC center-scale voltmeter lends itself particularly to the balancing of push-pull stages as employed in high-fidelity audio amplifiers. Proper use of this instrument in adjusting each push-pull stage for zero-plate-voltage difference can result in rather startling reductions in distortion figures.

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**April, 1965**

www.americanradiohistory.com
Appliance Shock Tester

Continued from page 65

extinguish it by shorting out its leads with your finger. Next, touch the second probe to the appliance. It is sensitive to currents 1 ma and stronger. If the neon lamp comes on again, the appliance is leaking a 1 ma or greater current. This means that the appliance is a borderline shock hazard. It should be checked over, and possibly grounded.

Extinguish the neon lamp and repeat the test, using the third probe. This probe is sensitive to currents 5 ma and above. If this causes the neon lamp to light, the appliance is a serious shock hazard. This amount of leakage current is approaching the 'let go' threshold—especially that for a child—and is potentially dangerous.

It should be emphasized that any appliance can develop a serious shock hazard as its insulation ages or parts shift mechanically.

There is at least a fair chance that you will find several appliances, light fixtures, power tools or other electric devices in your home with excessive leakage currents. Proper servicing can make some of these safe again. Others, because of their poor design, will remain a shock hazard. It may be possible to ground them. If not, it is wise to discard them.

Unsafe New Appliances. Consumers Union, a non-profit organization, regularly checks new products for, among other things, potential shock hazards. The majority of products rated Not Acceptable by CU on the basis of this test have carried nationally-known brand names. Many of these same products also carried seals of approval from a number of well known testing organizations.

You cannot always rely on brand reputation and seals of approval alone, when it comes to judging the safety of a product. Last-minute modifications made during production, lack of adherence to standards of quality on the assembly line, or just plain carelessness can result in a faulty—potentially dangerous—product in your home.

Periodically test every electric device in your home. Make sure they’re safe and in good operating condition. Finally, show your wife how to use the electronic shock tester. After all, she spends a good deal more time at home than you and is generally the first to discover a faulty appliance.

The Hidden Killer

Continued from page 67

Common sense and four simple rules will keep Killer Voltage safely confined where it belongs—at work in your TV:

1. Don’t take the chance of connecting the ground wire to the hot wire of incoming power. Install polarized outlets, use a 3-prong system or connect an isolation transformer between the wall outlet and the TV line cord plug.

2. Don’t position TV sets near natural ground sources. Sets should be placed a safe distance away from water pipes and radiators to make it impossible for anyone to touch the set and the ground source simultaneously. Even if the set develops a malfunction or a short circuit, the person touching the case or frame will probably not be seriously injured if he is not well grounded.

3. Never remove the insulated control knobs. Parents frequently remove insulated control knobs as prevention against children using the set without permission. This exposes the metal control shafts which are in contact with the chassis.

4. Never take the back off a TV set. Only those who are technically qualified should remove the protective back from the TV. Under no condition should the back be left off the set. Curious youngsters, inquisitive family pets, and anyone making accidental contact with exposed components, are all subject to a lethal shock.

As a final safety measure, make sure that your TV antenna is effectively grounded. When antenna and mast are properly grounded, they serve as a lightning rod giving your home added protection. Remember, keep electricity harnessed and working for—not against—you.

It’s Dad’s CB antenna. Bet I’ll catch something now!"
An up-to-date Broadcasting Directory of North American AM, FM and TV Stations. Including a Special Section on World-Wide Short-Wave Stations

This is the second part of White's Radio Log, now published in three parts twice each year. This format permits the Editors of Radio-TV Experimenter to offer to its readers two complete volumes of White's Radio Log each year, while increasing the scope of the Log and inserting station changes as they occur.

In this issue of White's Radio Log we have included the following listings: U. S. AM Stations by Location, U. S. FM Stations by States, Canadian AM Stations by Location, Canadian FM Stations by Location, and the expanded, up-to-date World-Wide Short-Wave Section.

In the June/July issue of Radio-TV Experimenter, the Log will contain the following listings: U. S. AM Stations by Call Letters, U. S. FM Stations by Call Letters, Canadian AM Stations by Call Letters, Canadian FM Stations by Call Letters, and the expanded World-Wide Short-Wave Section.

In the event you missed any part of the Log published earlier this year, you will have a complete copy of White's Radio Log by collecting any three consecutive issues of Radio-TV Experimenter during 1964. The three consecutive issues comprise a complete volume of White's Radio Log that offers complete listings with last minute station change data that can not be offered in any other magazine or book. If you are a broadcast band DX'er, FM station logger, like to photograph distant TV test patterns, or tune the short-wave bands, you will find White's Radio Log an unbeatable reference.

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<th>C.L. Kc.</th>
<th>Location</th>
<th>C.L. Kc.</th>
<th>Location</th>
<th>C.L. Kc.</th>
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<td>WOKZ 1579</td>
<td>Athens, Ga.</td>
<td>WGAU 1340</td>
<td>Atlantis, Pa.</td>
<td>WDRZ 1240</td>
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<tr>
<td>Altona, Man.</td>
<td>CFAM 1290</td>
<td>Athens, Tenn.</td>
<td>WBDL 1470</td>
<td>Atlantic, N.Y.</td>
<td>WRFH 966</td>
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<td>Atlanta, Ga.</td>
<td>WRAK 1090</td>
<td>Atlantic City, NJ</td>
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<td>Alvina, Okla.</td>
<td>KALC 1360</td>
<td>Atlanta, Tex.</td>
<td>WLAB 1430</td>
<td>Atlantic City, N.J.</td>
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[www.americanradiohistory.com](www.americanradiohistory.com)
World-Wide Short-Wave Stations

The World-Wide Short Wave Stations section of White's Radio Log is, as its name implies, a log, that lists stations actually monitored by listeners in the United States, Canada and overseas. It is not intended to be a listing of all shortwave transmitters licensed as such listings contain numerous inactive transmitters, and low powered stations which are rarely heard by DX'ers. The stations listed here, therefore, are those most often reported and consistently heard during the past few months. Many have been monitored by DX CENTRAL, the official Radio-TV EXPERIMENTER monitoring post in New York City.

Because of the fact that this log represents actual monitoring reports rather than data taken from published program schedules received from the stations, you may find that frequencies (and operating times) given here differ from official listings. This is because foreign short-wave stations frequently operate several kilocycles away from their assigned (and announced) frequencies. In addition, the schedules of these stations are often changed and the changes are not published in the schedules until many months later. We feel that the type of log which White's Radio Log is presenting represents a very realistic picture of the current status of short-wave broadcasting, and is something which cannot be obtained elsewhere.

For the DX'er. If you care to roam the bands for DX, we present here some information which will be of invaluable use to you in tracking down DX stations.

Although the current radio propagation conditions have made the high frequency bands (11 and 13 meter bands) relatively poor for DX'ers, the other bands are generally good during certain periods of the year. As a general rule, the following bands are "hot for DX" during the daily and seasonal times indicated:

- 60-meter band=Winter nights.
- 49-meter band=Winter nights.
- 41-meter band=Winter nights.
- 31-meter band=Nights, all year.
- 25-meter band=Nights, all year.
- 19-meter band=Days all year, and Summer nights.
- 16-meter band=Days, all year, and Summer nights.
- 13-meter band=Days, all year.
- 11-meter band=Days, all year.

In our listings, a station or frequency marked with an asterisk (*) indicates a non-broadcast station or frequency. This might include aeronautical, maritime, military, or other type of transmission, either in regular AM or single sideband (SSB). In instances where many non-broadcast stations use the same frequency, we have given you a clue as to the type of stations to be found there, rather than pin down only one station.

QSL Cards. Many beginners in the hobby of listening for distant stations (or "DX'ing," as it is commonly known) aren't aware of the fact that merely hearing the stations is only half of the battle—getting the prized "QSL card" from the station can be just as much fun and equally rewarding too.

"QSL cards" are postcards sent out by just about every broadcasting station upon receipt of correct reception reports from listeners. To the listener who sends in the report to the broadcaster, the QSL card is a means of proving that he actually did hear the station in question, and it is also a colorful means of decorating the walls of the listening post. Most of these QSL cards are gayly colored and quite attractive.

On the other end of the situation, the broadcasters are usually pleased to send out these cards because it encourages people to listen to them and also to write to their engineering department. These reports are valuable to let the station know how well it is being received in various parts of the world, if it suffers from interference, if its signals fade, if it is being jammed, etc. They can also determine the size of their listening audience in given parts of the world.

To get a QSL card, however, means more than just sending a broadcaster stating: "I heard your station today, please send a QSL card." Such a report (and they are plentiful) is less than useless to a broadcaster and never brings a QSL card.

Here is how to be just about assured of getting one of these cards for your collection. First, listen to the station for at least 15 minutes—write down everything you hear, such as names of songs, topics of discussions, commercials, names of station personnel mentioned over the air. If you cannot understand the language being used, you can still list the type of programming. For example: "0715- Dance recording played featuring flute," or "0719- Woman read..."
news bulletin apparently about Viet Nam.”

When you have completed your listening you are then ready to send your report. Include in the report the date you heard the station, the time of day (stations prefer you to use Greenwich Mean Time, but this isn’t absolutely necessary), the details of the program material you heard, the strength of their signals, if they were interfered with by another station, the frequency you heard them on, and information on the type of receiver and antenna which you use. It is helpful to pass along to the station any comments which you have about their programming, such as: “I enjoy your musical programs,” or “I would like to hear some folk music of your country played in the evenings,” etc.

As a further addition to your signal report, add a short paragraph about yourself and your interest in DXing. Tell how many stations you have heard, how many countries, how many QSL cards you have received. You can tell the station your age or occupation, or, if you go to school, where you go and the grade you are in.

The station can usually be sent a letter without any street address on the letter, in the event you did not get their address over the air. A letter addressed to “The Voice of America, Washington, D. C.,” or “Radio Sweden, Stockholm, Sweden,” will be delivered promptly. It is not necessary for you to enclose return postage for reports sent to broadcasting stations which are operated by governmental agencies, however return postage sent to small commercial broadcasters (especially in Central and South America) can sometimes be the deciding factor in whether or not you will receive that prized QSL.

**Let Us Know.** Listeners are invited to submit their loggings to us for publication in the Shortwave section of **White’s Radio Log.** Be sure to include the following information for each station you report: approximate frequency, callsign and/or station name, city and country, and time heard in Eastern Standard Time, 24 hour clock. Address your reports to: DX CENTRAL, White’s Radio Log, c/o RADIO-TV EXPERIMENTER, 505 Park Avenue, New York, N. Y. 10022, U.S.A.

**Time To Listen.** All times shown in White’s Radio Log are in the 24 hour EST clock system. For example, 0800 is 8:00 AM EST, 1200 is noon EST, 1800 is 6 PM EST, and so on. For conversion to other time zones, subtract 1 hour for CST (0800 EST is 7 AM CST), 2 hours for MST, 3 hours for PST.

The following abbreviations are used in our listings: BC—Broadcasting Company, Corporation, or System; E—Emisoras; R—Radio or Radiodiffusion; V—Voice or Voz.

**TNX.** We are indebted to the following DX’ers who added their loggings to those of DX CENTRAL, the official RADIO-TV EXPERIMENTER monitoring station in New York City, to bring you this month’s listings:

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<th>Name</th>
<th>Location</th>
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**FREQ. | CALL | NAME | LOCATION | EST**

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<td>(marine encl)</td>
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**FREQ. | CALL | NAME | LOCATION | EST | LOCATION | EST**

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<th>Cap Hatien, Haiti</th>
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60 Meter Band—4750 to 5060 Kcs/s

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49 Meter Band—5950 to 6200 Kcs/s

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6090  | LRY1    | RAE                   | Buenos Aires, Ar. | 1500 |
| 6095  | —       | BBC                   | London, England  | 1735 |
| 6100  | BED29   | V. Frei China         | V. Frei China    | 2150 |
| 6100  | HCS4    | V. del Volante        | V. del Volante   | 0000 |
| 6110  | GSL     | BBC                   | London, England  | 1200 |
| 6120  | VHEH    | V. Evangelique        | V. Evangelique   | 0000 |
| 6130  | GWA78   | BBC                   | London, England  | 0145 |
| 6130  | R. Nac de Espana |                | Madrid, Spain    | 2000 |
| 6130  | VUD     | All India R.          | All India R.     | 1445 |
| 6135  | R. Havana | —                     | Havana, Cuba    | 0000 |
| 6150  | GRW     | BBC                   | London, England  | 0145 |
| 6160  | CBNX    | BBC                   | London, England  | 1200 |
| 6180  | GRO     | BBC                   | London, England  | 1745 |
| 6190  | BR    | —                     | —                | —    |
| 6195  | E. Official |                  | Luanda, Angola   | 0200 |
| 6210  | R. Peking | Peking, China        | Peking, China    | 1605 |
| 6210  | TGH75   | R. Costa Rica         | Peking, China    | 1605 |
| 6240  | WJG     | Memphis*              | Memphis, Tenn.  | 2020 |
| 6250  | R. Est. | —                     | —                | —    |

31 Meter Band—9500 to 9775 Kcs/s
Electronic Air Conditioning
(Continued from page 45)

to a condenser where it is compressed back into a liquid. During this phase, heat is given up and blown outdoors. Similarly, the thermo-electric unit draws heat from one region and surrenders it to another.

Doing It Today. Now we can consider the diagram of a practical thermo-electric air-conditioning system now in use. It appears in Fig. 7. In the center are the numerous modules with their semiconductor material strapped together. Electrical power is introduced at the right. According to the earlier description, the top plates of each module grow cold, as the bottom surfaces heat. The cooling cycle begins as air to be conditioned (from the room) is drawn through the top duct, or air-heat exchanger. The cool surfaces of the duct extract heat from the air.

The second part of the process is drawing heat from the module assembly. This is done by a water-heat exchanger at the bottom. A circulation of water is used here as a heat sink. The water is then led to coils which release the heat.

Controlling operating temperature is considerably simplified. Instead of on-off action, common to standard units, cooling is smoothly regulated by changing the electrical current flow. And in winter, a reversal of current flow reverses the whole process for heating. During this function, the air duct at the top is warmed by the thermo-electric modules. This system was created by Carrier and installed in Racine, Wisconsin, for the offices of S. C. Johnson & Son (the wax people). It was selected over the conventional air conditioner for several reasons. The company wished to cool 28 offices, but didn't want to mar the internal or external appearance of the building. (It was designed by Frank Lloyd Wright.) Conventional systems were deemed unacceptable; they meant cutting through outside walls or elaborate disguising of equipment which couldn't be hidden in a basement. Regular piping and ductwork meant considerable expense, loss of man-hours and much inconvenience. Compact thermo-electric units, each fitting into overhead space, solved the problem.

Where Can I Get One?" Although Johnson's installation is proving successful, electronic air conditioning on a big scale is still over the horizon for the bigger consumer market. Despite its present state of development, there is still an intense search for materials that will bring its price down to competitive levels. Another wrinkle to be overcome is the relatively long time required to reach maximum cooling temperature. This is no problem in nuclear submarines, where thermo-electric conditioners cool on a continuous basis. Nor is it a limitation for special applications in the research lab where such devices are used for "spot" cooling. But there are signs of increasing consumer applications, even now. You can purchase a small portable thermo-electric refrigerator for auto, boat or camping use. Some hotels have already installed ice-cube coolers in each room. If the scientists are correct in their forecasts, the silent, maintenance-free electronic air conditioner is definitely out of the dream stage.

VHF Extender
(Continued from page 40)

To change from low-band to high-band operation, you must either add D1 and L4.

Don't be alarmed at the thought of using the VHF Extender and a standard short-wave receiver to listen to the FM signals of most commercial VHF communications gear. The VHF gear must now use restricted bandwidth for its transmissions, and as a result you can get very clean copy from the FM signal with an AM receiver simply by tuning a trifle to one side of the signal itself.

Going Mobile. And the VHF Extender can be used with auto radios, too, by using the "BC-Band" component values in the coil tables and supplying 150 volts DC from an external supply.

It should be pointed out that VHF projects are the most difficult to construct and require considerable skill and craftsmanship on the part of the builder. The VHF Extender is not a beginner's project and should not be attempted by a novice experimenter. Cleanliness counts—use just enough solder; scrape off excess rosin; beware of cold solder or rosin joints. Construction time is not important—do not race the clock to get the job done.
1. This catalog is so widely used as a reference book, that it's read most as a standard by people in the electronics industry. Don't you have the latest Allied Radio catalog? The surprising thing is that it's free!  

2. The new 516-page 1965 edition of Lafayette Radio's multi-colored catalog is a perfect buyer's guide for hi-fi, experimenters, kit builders, CB'ers and hams. Get your free copy, today!  

3. Progressive "Edu-Kits!" Inc. now has available their new 1965 catalog featuring hi-fi, CB, Amateur, test equipment in kit and wired form. Also lists books, parts, tools, etc.  

4. We'll exert our influence to get you on the Olson mailing list. This catalog comes out regularly with lots of new annalsurplus items. If you find your name hidden in the pages, you win $5 in free merchandise!  

5. Unusual scientific, optical and mathematical values. That's what *Edmund Scientific* has. War surplus equipment as well as many other hard-to-get items are included in this new 16-page catalog.  

6. Bargains galore, that's what's in store! Poly-Poke Co. will send you their latest eight-page flyer listing the latest in merchandise available, including a giant $1 special sale.  

7. Whether you buy surplus or new, you will be interested in *Fair Radio Sales Co.*'s latest catalog—check full of buys for every experimenter.  

8. Want a colorful catalog of goodies? John Meshna, Jr. has one that covers everything from assemblies to zener diodes. Listed are government surplus radio, radar, parts, etc. All at unbelievable prices.  

9. Are you still paying drugstore prices for tubes? *Nationwide Tube Co.* will send you their special bargain lists of tubes. This will make you light up!  

10. Burstein-Applebee offers a new giant catalog containing 100's 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.  

12. VHF listeners will want the latest catalog from *Kuba Electronics*. All types and forms of complete receivers and converters.  

13. Here's a beautifully presented brochure from *Altec Lansing Corp*.*. Studio-type mikes, two-way speaker components and other hi-fi products.  

14. For the love of mikes! *Astatic Corp.* has lots. Studio types, ham types, recording types, etc. See its catalog sheets for the details.  

15. A name well-known in audio circles is *Acoustic Research*. Here's its booklet on their AR speakers and the new AR turntable.  

16. *Garrard* has prepared a 32-page booklet on its full line of automatic turntables including the Lab 80, the first automatic transcription turntable. Accessories are detailed too.  

17. Two brand new full-color bookletst are being offered by *Electro-Voice, Inc.* that every audiophile should read. They are: "Guide to Hi-Fi Outdoor High Fidelity" and "Guide to Compact Loudspeaker Systems."  

18. Speakers and enclosures from *Argos Products Co.* feature a new and novel well-mounting system. To find out more, *Argos* will be happy to send literature.  

19. A valuable 8-page brochure from *Empire Scientific Corp.* describes technical features of their record playback equipment. Also included are sections on basic facts and stereo record library.  

20. Tape recorder heads wear out. After all, the head of a tape deck is like the stylus of a phonograph, and *Robins Industries* has a booklet showing exact replacements. Lots of good info on how the things are built, too.  

21. *Wharfedale*, a leading name in loudspeakers and speaker systems, has a colorful booklet to send to you on its product line. Complete with prices, it's a top-notch buyers guide.  

22. A wide variety of loudspeakers and enclosures from *Ultral Electronic* lists sizes shapes and prices. All types are covered in this 16-page heavily illustrated brochure.  

23. Here's a complete catalog of high-styled speaker enclosures and loudspeaker components. *University* is one of the pioneers in the field that keeps things up to date.  

24. When a manufacturer of high-quality high fidelity equipment produces a line of kits, you can just bet that they're going to be of the same high quality! *H. B. Scott, Inc.* has a catalog showing you the full-color, behind-the-panel story.  

25. An assortment of high fidelity components and cabinets are described in the *Sherwood* brochure. The cabinets can almost be designed to your requirements, as they use modules.  

26. Very pretty, very efficient, that's the word for the new *Betacom* intercomable tape for stores, offices, or just for use in the home, where it doubles as a baby-sitter.  

27. TAPE Recorders and Tape  

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

29. "The Care and Feeding of Tape Recorders" is the title of a booklet that *Sarkes-Tarzian* will send you. It's 16-pages jam-packed with info for the home recording enthusiast. Includes a valuable table of recording times for various tapes.  

30. You can learn lots about tape recorders. Big tape recorders for studios, little tape recorders for business men, all kinds of tape recorders from *American Concertone*.  

31. Become the first to learn about *Noreico's* complete Carry-Corder 150 portable tape recorder outfit. Four-color booklet describes this new cartridge-tape unit.  

32. *Sony* full line of tape recorders, microphones and accessories is illustrated in a new 16-page full color booklet just released by *SuperScope, Inc.*, exclusive U.S. distributor.  

33. If you are a serious tape audiophile, you will be interested in the new *Viking of Minneapolis* line—they carry both reel and cartridge recorders you should know about.  

34. *Shure Bros.* catalog.  

35. Tone-arms, cartridges, hi-fi, and stereo preamps and replacement tape heads and conversions are listed in a complete *Shure Bros.* catalog.  

36. HI-FI Accessories  

37. An entirely new concept in customizing electronic tubes has generated a new replacement line. *Gold Lion* tubes give higher output and lower distortion than ordinary production high-fidelity tubes.  

38. KITS  

39. Here's a firm that makes everything from TV kits to a complete line of test equipment. *Conan* would like to send you their latest catalog—just ask for it.  

40. Here's a 100-page catalog of a wide assortment of kits. They're highly-virtuallly, *K & Heath Co.* will happily add your name to the mailing list.
43. Want to learn about computers the easy way? Brochure from Digestion Electronics describes its line of transistorized kits.

AMATEUR RADIO

45. Catering to hams for 29 years, World Radio Laboratories has a new FREE 1965 catalog which includes all products deserving space in any ham shack. Quarterly flyers, check CB antenna catalog. Full of electronic bargains are also available.

46. A long-time builder of ham equipment, Hallicrafters, Inc. will happily send you lots of info on the ham, CB and commercial radio equipment.

47. Here's a goodly assortment of literature covering the products of the Dow-Key Co. They make coaxial relays, switches, and preamps for hams and CB'ers.

CITIZENS BAND SHORT-WAVE RADIO

48. Hy-Gain's new 16-page CB antenna catalog is packed full of useful information and product data that every CB'er should know about. Get a copy.

49. Want to see the latest in communication receivers? National Radio Co. puts out a line of mighty fine ones and their catalog will tell you all about them.

50. Are you getting all you can from your Citizens Band radio equipment? The Cadre Industries has a booklet that answers lots of the questions you may have.

51. Antennas for CB and ham use as well as for commercial installations is the specialty of Antenna Specialists Co. They also have a generator for power in the field.

52. When private citizens group together for the mutual good, something big happens. Hallicrafters, Inc. is backing the CB React teams and if you're interested in CB, circle #53.

53. A catalog for CB'ers, hams and experimenters, with outstanding values. Terrific buys on antennas, mike and accessories. Just circle #54 to get Grove Electronics free 1964 Catalog of Values.

54. Interested in CB or business-band radio? Then you will be interested in the catalogs and literature Mosley Electronics has to offer. Also see items 46 and 47.

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56. Bailey Institute of Technology offers courses in electronics, basic electricity and drafting as well as refrigeration. More information in their informative pamphlet.

57. National Radio Institute, a pioneer in home-study technical training, has a new book describing your opportunities in all branches of electronics. Unique training methods make learning as close to being fun as any school can make it.

58. Interested in ETV? Adler Electronics has a booklet describing educational television and this goes into a depth study of ETV in all its ramifications. There's a good science fair project here for someone!

59. For a complete rundown on curriculum, lesson outlines, and full details from a leading electronic school, ask for this brochure from the Indiana Home Study Institute.

60. Facts on accredited curriculum in E. E. Technology is available from Central Technical Institute plus a page catalog on modern practical electronics.

61. ICS (International Correspondence Schools) offers 236 courses including many in the fields of radio, TV, and electronics. Send for free booklet "It's Your Future."

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63. A complete booklet and price list giving you the inside data for Schober Organs are yours for the asking.

64. If you can use 117-volt, 60-cycle power where no power is available, the Terado Corp. Trac-Electric 50-160 is for you. Specifications are for the asking.

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69. Interested in tackling a TV kit? Arkay International, Inc. will send you full literature (including a schematic) of this truly educational kit. It's used in many of the electronic schools.

70. The first entry into the color-TV market in kit form comes from the Heath Company. A do-it-yourself money saver that all TV watchers should know about.

71. The smallest television set to date is featured in this beautiful prepared brochure from Sony Corp. You'll be amazed at the variety this firm offers.

72. Get your 1964 catalog of Cisin's TV, radio, and hi-fi service books. Bonus—TV tube substitution guide and trouble-chaser chart is yours for the asking.

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75. Want to find rapid solutions to complicated math problems? Solve interest and ratio, log and trig problems with 10-scale slide rule. Alynco will send complete information.

TOOLS

78. Learn about Xcelite's line of pliers and snips, specialized for radio, TV and electronic work. Xcelite's hand tools offer many advantages worth looking into—get bulletins N464 and N664.
possible frequency response at 3 3/4 and 7 1/2 ips.

The lower the speed and the smaller the gap length of the recording head, the more important it is for the tape to hug the head closely. This fact led Ampex to wind 1200 feet of pliant, 1-mil polyester tape onto a 7-inch reel and price it like an equivalent-length reel of 1 1/2-mil acetate. The hub of this special reel has a 4-inch diameter, instead of the normal 2 3/4 inches. Besides making the tape fill the reel, this outside hub smoothes out speed irregularities that frequently crop up in popular-priced recorders toward the end of a reel.

**What's Best for You.** How do the super tapes perform? Pretty much as billed. But, like all tapes, their performance will vary from one machine to another, because different brands of home recorders use different bias frequencies. Bias is a high-frequency signal fed to the record head to reduce distortion and improve recording quality.

A good way to find out what tapes work best on your recorder is to invest in sample reels of those that interest you, then make up a test reel by splicing together equal lengths from each sample and recording the same material on each specimen. To tell each specimen from its neighbors, separate them with a length of leader tape.

This writer used just such a procedure to compare the sound quality of a number of specialized tapes. The comparison reel was played on a Uher 8000 Royal quarter-track stereo recorder and fed into a home hi-fi amplifier and speaker system. Here's what we found:

Scotch Low Noise tape and Kodak's High Output tape gave, without a doubt, the cleanest, clearest sound at every speed from 7 1/2 to 15 7/8 ips. for the sample types sampled by the author.

Kodak's High Output tape provided a noticeably stronger signal than the other types. As used on the Uher, though, it appeared to have a bit more background noise than the other tapes. But Kodak points out that this tape works best when your recorder is matched to it by adjusting the bias. If you can adjust the bias on your recorder, Kodak's High Output tape would probably offer the best signal-to-noise figure for your machine.

Two reels of Scotch Low-Noise tape were used to make successive copies back and forth between a Korting 158 quarter-track stereo recorder and the Uher 8000. We managed to get more than five generations away from the original recording without hearing significant degradation of sound quality.

In normal recording and playback, Soundcraft's Golden Tone tape, a premium-price offering, was second only to the tapes mentioned above. Amper's Low-Speed tape, did quite well at its 3 3/4 and 1 3/4 ips design speeds and demonstrated very impressive bass response at both 3 3/4 ips and the standard hi-fi speed of 7 1/2 ips.

Low-Print tapes by Kodak and Soundcraft delivered somewhat less output than the other tapes because of their thinner oxide coatings. But their sound quality was good.

Of triple-play tapes tested, Soundcraft’s came closest to standard tapes in output strength, and it had excellent sound quality. Audiotape triple-play tape ran it a close second.

**What This Means to You.** If you do cut-and-splice editing, use standard 1 1/2-mil acetate. Where you edit by dubbing—or do considerable copying and recopying—invest in a Low-Noise or similar tape. This is also good advice for top quality at lower speeds.

Low-print tapes at this writing come only on an acetate base. But if you plan to store a tape recorded at peak signal for a prolonged time period—and you can control storage humidity and heat—this is a good tape to consider. Long life under less-controlled climatic conditions is better assured with a polyester tape. Just try to be a bit more judicious in your level setting to reduce the danger of print-through.

And, of course, polyester is a must in tropic areas or the far North.

What about the merits of standard-, extended-, double-, and triple-play tapes? This depends on three things:

- How much recording time do you need?
- How important is higher-speed quality for the job at hand?
- How gently do you and your recorder treat thin tapes?

Whatever your recording problem, today you can be pretty sure to find the tape that will solve it. Which is a lot more than you could say for the good old days.
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commonly high performance per dollar invested.

From these inexpensive units, transistor amplifiers take a sizable price jump into the $200 region. One of the outstanding designs in this price class is the KLH Model 16, delivering 45 watts per channel with an exceptionally sweet, warm, natural sound. The tag is $219.95, which makes it a kind of “best buy,” along with Lafayette’s LA-900, which delivers 30 watts per channel for $189.50. In the same performance class are Harman-Kardon’s Model A1000T (35 watts per channel) and Scott’s Model 260 (40 watts per channel) priced at $369.95 and $259.95, respectively. The power ratings may seem rather low for equipment in this price range. However, this is offset by the fact that transistors recover far more quickly than tubes from stress imposed by momentary peak loads. From a musical point of view, transistors therefore have a greater effective power reserve at a given wattage rating than their tube counterparts.

Beyond this level of unquestioned excellence is a group of transistor amplifiers that represent the ultimate state of the art. Transistor amplifiers in this group cannot be considered as commercial products in the ordinary sense, for they are not primarily designed “for a market.” Rather, they represent their designers’ private passion to push back the limits of the possible—the striving for the imaginable best. It may take a keen ear to tell the difference between these “ultimate” designs and those in the middle-price class. But if they are used with the best available loudspeakers, turntables, and cartridges, the difference—though small—is quite noticeable.

Representative units of this kind are the Acoustech Model I transistor power amplifier and the Model II preamplifier which jointly yield 40 watts sine wave power per channel with a frequency response from 5 to 50,000 cps at full output with less than 0.5 percent distortion—all for $734. And Harman-Kardon’s all-transistor combination of the Citation A preamp and Citation B power amp provide 40 watts per channel sine wave power with a frequency response of 1 to 100,000 cps and 0.5 distortion for $519.80 (factory-wired).

Confronted with such specifications, you might ask: “What is the point of extending frequency response so far above and below the audible range? You couldn’t hear those frequencies anyhow.” The answer is that this extended range permits the amplifier to handle sudden sound bursts, called transients, with greater clarity. Transistor amplifiers with very wide frequency response (above 25,000 cps) are usually characterized by extremely clear sound texture, other factors being equal.

Another advantage of transistor units is their exceptionally low hum level, which permits the music to be heard against a background of almost complete silence. Some of the better transistor amplifiers have hum levels 80 and even 90 db below the signal level (at full output).

Transistor Tuners. One of the neatest items among transistorized tuners is the brand-new KLH Model 18 all-transistor stereo tuner. No bigger than a cigar box, it offers excellent sensitivity, selectivity, and ease of tuning for $129.95 (factory finished). Its novel circuitry is extremely stable so that it won’t need frequent realignment to stay in top performing condition. Low-cost kit designs are also available, notably the Heath AJ-33 ($99.95) and AJ-43 ($119.95), either of which also provide broadcast reception.

Among higher priced tuners, Harman-Kardon’s F-1000T ($299.95), Fisher’s TF-300 ($329.50), Scott’s Model 312 ($259.95) all boast excellent specifications and are providing convincing evidence that the problems of RF circuit design for transistors have been successfully solved.

The transistor’s conquest of audio has been easiest in the tape recorder field. Tape recorders do not have to develop the high power levels that audio amplifiers must furnish and they do not have to deal with tricky RF circuits, as must FM tuners. On the other hand, compactness, sturdiness, and low power drain, three main virtues of the transistor, are a vital advantage in designing portable tape machines. So it is hardly surprising that the fully transistorized tape recorder is now the rule rather than the exception, and it becomes unnecessary to single out individual designs.

When you consider that only three years ago, only three companies were making transistorized hi-fi gear (a grand total of six different models), the present picture proves that the transistor take-over in audio has been completely successful.
Lab Check
Continued from page 78

At right base is being attached to bottom of cabinet. Note strings holding the unit together while glue sets. Above, speaker and acoustical material in place—now screw back on.

living rooms shown in hi-fi magazines.)

As is the case with any speaker, frequency curves are meaningless since each speaker has its own individual coloration, and you must make the decision yourself. But we highly recommend you listen to the 207A before you buy a speaker or speaker system.

Trying to keep the total system cost within that mythological figure called the “young married’s budget,” we had our choice of a small, finished, general purpose enclosure or the kit version of the Bozak Urban E-300U—which meant we had to do our own finishing. Since speakers usually sound best in a cabinet specifically designed for a given speaker we decided to go along with the kit. The completed kit is exactly the same as the finished models except for a savings of about $30. The cabinet is an infinite baffle which preserves the speaker’s smoothness, tonal balance, and excellent transient response.

The kit is assembled like any other piece of fine furniture: with screws and glue. While the assembly is notably easy—less than one hour—there’s a major problem. Bozak assumes you have furniture clamps for gluing. Now not everyone has furniture clamps, and if one must purchase the clamps the savings are wiped out—it might even cost more in the long run. We got around the clamps by devising our own clamp system. As shown in the photograph, we attached cup hooks to the inside surfaces of the enclosure and held the assembly together with string purchased in a 5 & dime store—and it worked just as well as the clamps.

The enclosure is made of 3/4-inch compacted-wood with a walnut veneer. It comes complete with matching legs and grill-cloth. You can lighten or darken the veneer with commercial finishing products.

The front panel is pre-cut for a 15 inch speaker and for a midrange, should you desire to add one at a later date. We found the cabinet equipped with only the 207A speaker gave a most pleasing sound. Nothing spectacular, no shattering “pumping lows” or ear straining highs, just a smooth natural quality—just that old fashioned kind of music you hear when seated before the recording group.

**OUR IMPRESSIONS.**

- We were more than surprised at the total success of our selections, particularly how well the entire system met our assumed needs. Perhaps, if we'd done extensive showroom shopping and selected each component individually, we might have attained similar results. We can therefore recommend, that before you step through the door of your local showroom, you have the hi-fi system planned down to the minutest detail—you’ll be most likely to get the system you want at the first try. You can be sure that the components in this system review will function equally as well in other systems—this is a typical characteristic of quality audio components.
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