elementary Electronics

JANUARY-FEBRUARY
1973
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FOR BEGINNERS ONLY

BASIC COURSE

UNDERSTANDING MULTIMETERS

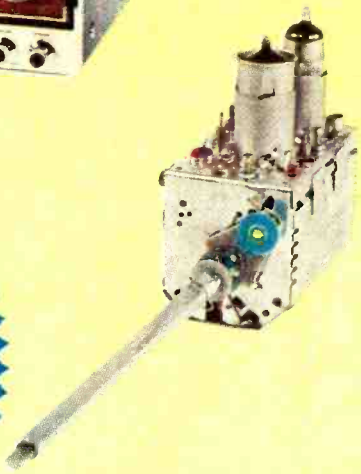
SOLID COPY CB WITH SSB

Detailed lab testing pulls out all the stops on Pearce-Simpson's Simba SSB

TIRED OF TV TUNER TROUBLES?

Our timely tips turn TV tears to dollar-saving tinsel for do-it-yourselfers

PLUS
Exciting Features
on
DXing Indonesia
The New 4-Channel Compacts
Auto Alarm for Car Tape Players
Science Travels to Jupiter
Build Pop-Up TV
and more . . .



BUILD IT IN REDWOOD FOR SASSY SOUND

Cheapie sound system offers indoor/outdoor use for stereo or 4-channel sound

DIGITAL TUNER LETS YOUR FINGERS DO THE TUNING

Enjoy FM listening from a kit you assemble—watch it work like a computer

A DAVIS PUBLICATION

If you don't happen to live near one of our 603 service centers . . .

. . . then it's really important to insist on Johnson quality! Because the proven reliability of Johnson CB radios makes it far less likely that you'll ever need service. Which is why we can confidently back our products with a full 1-year parts *and* labor warranty, with over 600 authorized service centers nationwide. And besides reliability, Johnson citizens two-way radios have a well earned reputation for truly outstanding performance. Engineered into all our Messenger radios are advanced features, like speech compression for greater "talk power" and special selectivity filters to cut adjacent channel interference. And that's why U.S.-made Johnson radios are your best CB value . . . *wherever* you live!

Prices start at under $100. Write for free catalog.

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(A) Messenger 120 Built-in Tone Alert selective calling (B) Messenger 323-M All the features of the Messenger 323 plus Dual Receive Capability (C) Messenger 125 Full 5-watts, but just 1 9/16" high (D) Messenger 111 Rugged, 12-channel mobile (E) Messenger 223 Powerful hybrid circuitry base station (F) Messenger 122 New 23-channel mobile with high visibility rotary dial (G) Messenger 124-M Deluxe 23-channel base station with Dual Receive Capability (H) Messenger 109 Professional portable with rechargeable batteries (I) Messenger 121 With PA and fast push-button channel selection (J) Messenger 323 Ultimate in 23-channel mobile performance (K) Messenger 123A All 23 channels and new improved circuitry

CIRCLE NO. 8 ON PAGE 17 OR 103

ELEMENTARY ELECTRONICS including SCIENCE & ELECTRONICS (Vol. 13, No. 1) is published bi-monthly by Davis Publications, Inc., at 229 Park Ave., S. New York, N.Y. 10003. One year subscription (six issues)—$4.00. Second class postage paid at New York, N.Y. 10003 and at additional mailing offices.

• January/February 1973 • Vol. 13 No. 1

e/e elementary Electronics

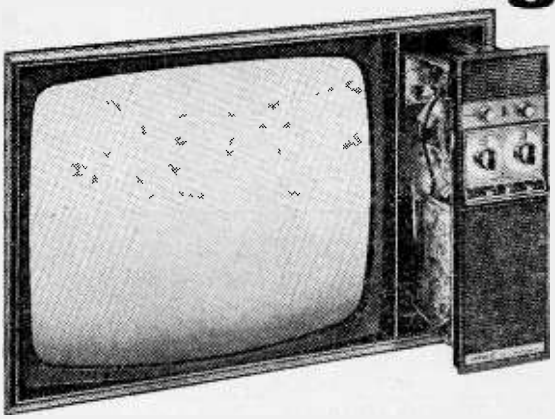
Dedicated to America's Electronics Hobbyists

Cover design by Irving Bernstein

AUTHORS IN THIS ISSUE

Peter L. Dexnis, William R. Dodd, Jr., Emma Fluffin, Emmett Fluffin, Herbert Friedman, Joe Gronk, Don Jensen, Herman F. Johnson, Kathi Martin, Jack Schmidt, Hank Scott, and the ELEMENTARY ELECTRONICS editorial staff.

FREE...demonstration lesson to prove that you can learn TV servicing at home.



Practice on a new 25" MOTOROLA QUASAR II® chassis.

TV Servicing is a satisfying career . . . and the pay is great. Qualified men are needed now to maintain the 93 million sets in U.S. homes. And prospects for the future are even brighter.

Now . . . here's an opportunity for you to prove to yourself that **you** can learn TV Servicing . . . at home, in your spare time. ICS, the world's most experienced home-study school, will send you a **FREE** Demonstration Lesson (complete with sample questions) if you will merely fill out the coupon below and mail it to us.

In addition to your free demonstration lesson, we'll send you . . . also FREE . . . a brochure that describes the 25" (diagonally measured screen) MOTOROLA QUASAR II® Color TV chassis that we include in our TV Service Training Program.

This chassis with automatic fine tuning control is ideal for training purposes because it combines solid state devices with vacuum tubes to give you both kinds of practical experience.

Credit towards a Certified Electronic Technician (C.E.T.) rating will be granted by the National Electronics Association to ICS students upon completion of the ICS Career Program in TV Service/Repair.

ICS

Since 1890
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Scranton, Pa. 18515

Approved for veterans under the new GI bill/approved for federally insured loans/Accredited by the Accrediting Commission of the National Home Study Council.

All parts carry Motorola's two year replacement guarantee!

The QUASAR II chassis comes to you in three basic sub-assemblies . . . NOT AS A KIT . . . because we want you to learn how to **repair** TV sets, not build them.

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And we're going to tell you about eight other career opportunities in Electronics and the ICS Career Programs that can help prepare you for them. All you've got to do is mail the coupon. **SEND IT TODAY!**

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YES, I want you to mail to me without obligation, the FREE DEMONSTRATION LESSON and complete literature on the career program checked below. (Please check one.)

- ☐ Color TV Servicing
- ☐ Computer Maintenance
- ☐ CATV Installation
- ☐ Telephony
- ☐ FCC License
- ☐ Communications/ Broadcasting
- ☐ Hi-Fi Sound Systems
- ☐ Industrial Electronics

Name_____ Age____

Address_____

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CIRCLE NO. 23 ON PAGE 17 OR 103

elementary Electronics

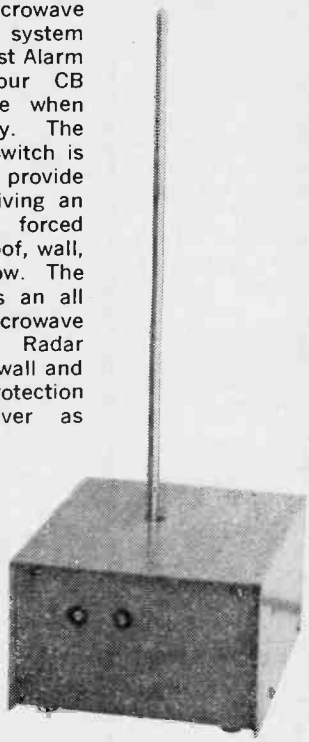
Jan./Feb. 1973 Vol. 13/No. 1
Dedicated to America's Electronics Hobbyists

ELEMENTARY ELECTRONICS is published bimonthly by Davis Publications, Inc. Editorial, Business and Subscription offices: 229 Park Avenue South, New York, N.Y. 10003. One-year subscription (six issues)—$3.95; two-year subscription (12 issues)—$7.95; three-year subscription (18 issues)—$11.95; and four year subscription (24 issues)—$15.95. Add $1.00 per year for postage outside the U.S.A. and Canada. For change of address, please advise 4 to 6 weeks before moving. Send us your current mailing label with new address. Advertising offices: New York, 229 Park Avenue South, 212-OR 3-1300; Chicago, 520 N. Michigan Ave., 312-527-0330; Los Angeles; J. E. Publishers' Rep. Co., 8560 Sunset Blvd. 213-659-3810; Long Island: Len Osten, 9 Garden Street, Great Neck, N.Y., 516-487-3305; Southwestern advertising representative: Jim Wright, 818 Olive St., St. Louis, 314-CH-1-1965 Second-class postage paid at New York, N.Y. and at additional mailing office.

Hey, look me over

Showcase of New Products

Shack Watchdog



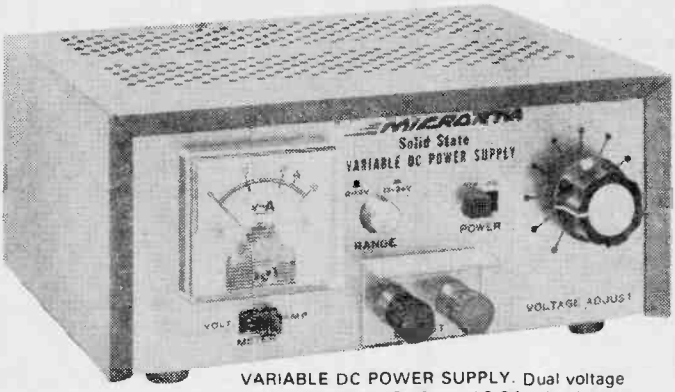
Let a new microwave motion detector system by Mountain West Alarm watch over your CB gear and home when you are away. The A5-001 Space Switch is designed to provide protection by giving an alarm due to forced entry through roof, wall, door, or window. The Space Switch is an all solid-state Microwave (UHF) Doppler Radar System. Wall-to-wall and floor-to-ceiling protection is provided over as much as 3500 square feet or a 30-foot radius. Microwave transmissions penetrate most non-metallic structures, i.e., plaster, wood and concrete (somewhat) and are reflected by metal. Installation requires only power and alarm output connections. Powered by 110 VAC or optional 12 VDC battery. Priced at less than $185.00 each. For more information, circle No. 42 on Reader Service Page.

Gazebo!

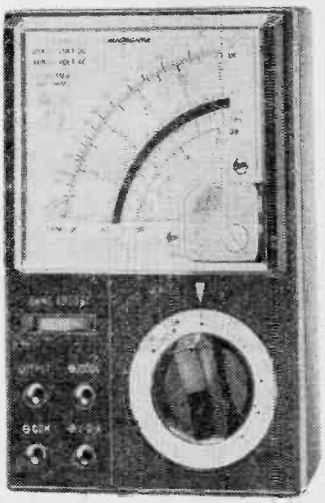
Remember the Gazebo? It's back in style—and in an entirely modern new version appropriate to the Seventies. Designed and engineered by Wheeling Corrugating Company, the Gazebo represents a sharp departure from the conventional steel utility building which is primarily intended to help the homeowner solve a storage problem. An eight-sided structure with a conical roof, the Gazebo offers functional versatility ranging far beyond the average yard building. The Ga-

RADIO SHACK IS ELECTRONIC PARTS PARADISE!

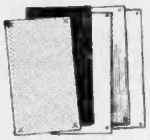
WE'RE *"THE PARTS PLACE"* FOR MAGAZINE PROJECTS AND DO-IT-YOURSELF EXPERIMENTS!



VARIABLE DC POWER SUPPLY. Dual voltage range selector for 0-12 and 12-24 volts. Input 120 VAC at 60 Hz. Output current: 1.0 amp constant over entire range with 1.5 amp surge. Control adjusts output from 0-24 volts. Equipped with circuit breaker and housed in metal case. 7-1/4 x 5-3/8 x 3". U. L. listed. **29.95**

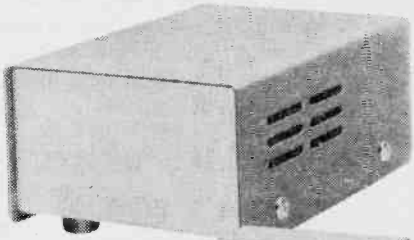


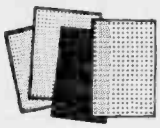
20,000 OHMS/VOLT MULTITESTER. Low-priced VOM has "expensive model" features and 17 ranges. Reads DC volts: 0-5-25-125-500-1000 at 20k ohms/volt. AC volts: 0-10-50-250-1000 at 10k ohms/volt. DC current: 0-50 μA, 0-250 mA. Ohms: 0-6k-60k. dB: — 20 to + 62. Mirrored scale. Leads, battery, instructions. 4-5/8 x 3 x 1-1/8". **11.95**



Five-Piece Panel Set — 3 perfboards, aluminum panel and bakelite panel. 1/16" thick. 1/16" holes. 6 x 3-1/2". **1.89**

Deluxe Metal Cabinets. Builders' boxes for most any project! Sturdy 2-piece construction, #18-gauge steel cover, aluminum front and real panels. Cabinets are louvered for ventilation. Rubber mounting feet. 3-1/4 x 2-3/16 x 4", **1.69**; 4 x 2-3/8 x 6", **2.59**; 5-1/4 x 3 x 5-7/8", **3.49**

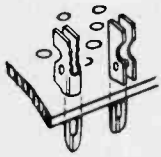




Pre-Punched Perfboards. Mixed sizes, 1½ to 3" square. 1/16" and 3/32" hole sizes. Set of 10. **1.19**

40-Piece "Twin Pack." Transistors. Popular types and packages. For RF and audio uses. **1.98**

Solderless Spring Terminals give strong, positive connection without soldering. Terminals will accept up to 8 leads. Set of 20 for **1.19**



"Push-in Terminals are made for use with pre-punched perfboards and hold multiple leads fast without staking. 1/16" diameter. 100-piece assortment. **1.59**

Perfbox® lets you build professional projects without cutting or drilling! Pre-drilled 3½ x 6" perfboard AND 2¼" speaker grille. .062" hole diameter. Bakelite case. 3-3/4 x 6-1/8 x 2". **1.89**

FREE '73 CATALOG! AT YOUR NEARBY STORE OR SEND IN THIS COUPON 118

180 pages! Stereo Hi-Fi, CB, Ham, Kits, Radios, Recorders, Tools, More!

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Radio Shack®

and ALLIED RADIO STORES

A TANDY CORPORATION COMPANY

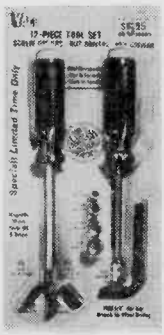
P. O. Box 1052, Fort Worth, Texas 76107

CIRCLE NO. **10** ON PAGE **17** OR **103**

HEY, LOOK ME OVER

zebo's attractive styling offers the homeowner a structure that may be used as an outdoor family room or dining pavillion. Better still, here's the shack you've been looking for—that room away from the house where you can set up your CB communications center year-'round. For complete details and interesting booklet, circle No. 41 on Reader Service Page.

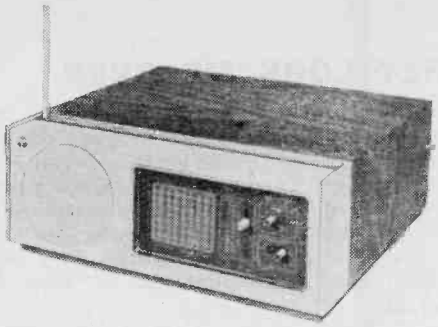
CB Tool Set



The next time you want to pry into the gizzards of your transceiver, try with Vaco's new tool set combination. The set consists of a 5-piece all magnetic screwdriver with four interchangeable tips including 3/16 in. and 9/32-in. regular slot and #1 and #2 Phillips cross slot. The magnetism is transmitted from the shank to the tip to the screw providing a screw holding driver. The other part of the combination consists of a 7-piece hex drive socket set including 1/4, 5/16, 3/8, 7/16, and 1/2-in. sockets for turning all hex head nuts and bolts. A 1/4-in. hex key wrench is included for driving sockets in recessed or hard-to-reach places. Wrench is also useful for driving 1/4-in. recessed hex head screws and bolts. The combination offering, worth a $7.00 value when sold separately, lists for only $5.95 and carries a stock number of 70191. For further information, circle No. 40 on Reader Service Page.

About Time!

A totally new concept in scanning monitors has been introduced in Teaberry's new Super Scan monitor. This emergency band monitor



utilizes digital synthesis to create a programmable FM receiver capable of selecting any eight channels of the user's choice on the Public Service Band; HF 30-50 MHz, VHF 150-170 MHz or UHF 450-470 MHz. No purchase of crystals by the customer is necessary to listen to his choice of frequencies, as is now required with all scanning monitors on the market. A program card supplied with Super Scan enables the user to have instant reception of frequencies of his choice at the time of purchase, regardless of his listening location. Furthermore, only one antenna, supplied with Super Scan, is necessary for both UHF and VHF reception. Coupled with better than .5 microvolt sensitivity is a new fixed squelch circuit, assuring top performance in all listening areas. Price is unannounced. For more information circle No. 54 on Reader Service Page.

In Sight

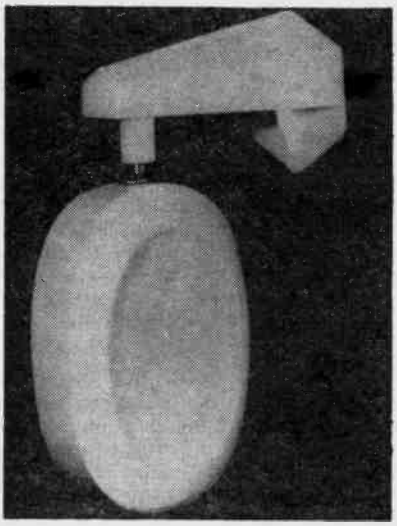
Sight-Light puts a bright beam of light directly along your line of sight. Permits bright illumination of hard-to-see into areas that otherwise couldn't be lighted and looked into simultaneously. Great for lighting tuners, gun barrels, pipes, sockets, auto parts, ears, nose, throat, etc. The double-duty Sight-Light also serves as a flashlight. Uses two "D" batter-

HEY LOOK ME OVER

ies. Made of heavy duty polystyrene with recessed viewing lens and eyepiece. Weight-10oz. Measures 12x4x6-in. Only $4.95 each, postage paid. Each unit comes with a snap-in front magnifier giving a 5X magnification. Literally hundreds of uses around the house and on the job. Write to Master Man, Dept. 192A, 1544 Red Cedar Rd., St. Paul, MN 55121.

Clean Up

The Magnetic Soap Holder is a newly developed idea for the bathroom. Attaches easily to any surface. With it the soap is simply "hung up to dry." The principle is simple. A special "tack" is inserted into the bar of soap and touched to a magnet in the holder.



This holds the soap firmly in place. Satisfaction guaranteed. $1.25 postpaid. Send orders to Stokes Enterprises, P.O. Box 373, 210 Wilderness Rd., Bristol, VA 24201.

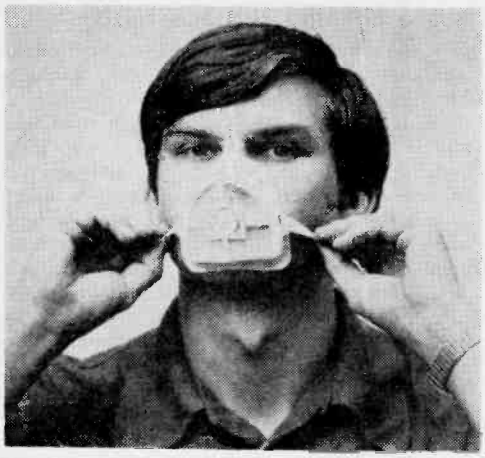
Best Price Yet

Now you can enjoy the effect of four-channel sound from your present car stereo tape player or stereo FM radio with the new Realistic Auto Quatravox 4-Channel Synthesizer from Radio Shack. A 4-channel effect is created with the Quatravox by placing the rear speakers out of phase with the front. This eliminates sound common to both stereo channels, leaving only ambient sound from the rear. The Realistic Auto Quatravox 4-

Channel Synthesizer is priced at $9.95. Includes mounting hardware, 18-ft. speaker cables and instructions. Realistic products are available at more than 1500 Radio Shack and Allied stores in all 50 states and Canada, and through Radio Shack Authorized Sales Centers, nationwide. For more information, circle No. 40 on Reader Service page.

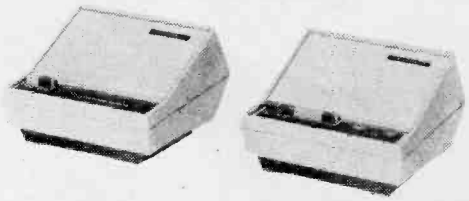
Clean Air Respirator

For hobbyists, gardeners and do-it-yourselfers, here's a new, low-cost Health Respirator face mask from Davol available at most pharmacies. Made from lightweight vinyl, the three-piece face mask protects against all pollens, non-toxic dust, paint sprays, and other environmental irritants. Filter can be removed, washed, and reused. Ideal for all kinds of farm work, gardening, home decorating, paint spraying, woodworking, and wherever airborne respiratory nuisances may exist. Costs only $2.49 each. Why not pick up a few?



Intercom Kit

Heath Company has come up with their GD-140 Intercom System for budget-priced reliable 2-way communication. Pegged at $29.95 mail order, the easily-assembled kit-system includes a Master Station and one remote



station. An extra remote station can be added. The Master station includes controls for Station 1, Station 2, Talk, Dictate and Volume . . . and the Master can call either or both remote stations. The Remote Stations

(Continued on page 105)

newscan

Electronics in the News!

MOM'S COOKING FOR SPACEMEN

When it's chow time on Skylab, astronauts who will be spending four to eight weeks in earth orbit, will have a menu which is as close to "home cooking" as modern food technology can make it. Whirlpool Corporation, under contract to NASA, has developed a food system which will compensate as nearly as possible for the astronauts long absence from the warmth and delight of home cooked meals.

Dr. Norman Roth, director of Whirlpool's Life Support Systems Division, said, "For the first time, a diet will be provided (for astronauts) which is conventional in appearance, superb in taste and, yet, satisfies the rigorous nutritional requirements of space flight. The food system is so designed that the Skylab crews will have a relatively wide range of

Astronaut Charles "Pete" Conrad (center) and Dr. Joseph Kerwin sample food prepared by Whirlpool Corporation in the wardroom of the orbital workshop, the major component of the Skylab. Conrad and Kerwin are among a number of astronauts who are participating in the crew station review of Skylab foods.

selection from a set of conventional food items, while still rigidly adhering to the 'experimental requirements'."

For the first time, astronauts will prepare their meals from an assortment of frozen as well as conventional space foods similar to

(Continued on page 107)

ASK HANK, HE KNOWS!

Hank Scott, our Workshop Editor, wants to share his project tips with you. Got a question or a problem with a project you're building—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Sorry, he isn't offering a circuit design service. Write to:

Hank Scott, Workshop Editor
ELEMENTARY ELECTRONICS
229 Park Avenue South
New York NY 10003

Just Prying

I'm an electronics hobbyist who plans to make electronics my career. In reading your column "Ask Hank, He Knows" I find great humor, and good info tips. That's what the tech mags need, more good column writers like you. By the way, are you a ham or CBer?

—W.C., Moscow, Idaho

I'm both—ham and CBer—but get very little time on the air. I do my thing with construction projects provided I can get the parts. Thanks for the kind remark.

He'll Grow Anything!

I may be new in electronics, but like the hillbilly bride on her wedding night said, "Ma, I would rather do it myself!", I would like to know if there is a book or was there ever an article that could tell me how to grow my own npn Germanium crystals?

—D.S., Las Vegas NV

Many years ago we ran an article on how to grow a crystal. However, this crystal had a water structure and was useful only for Science Fair projects. Next, we ran an article on how to make your own cat-whisker crystal. This was great except it was too expensive, difficult to do and readers by the hundreds wrote telling us to use a store-bought diode. As for growing your own germanium crystal for transistor construction, you tell me how to draw gold wire one mil thick and I'll tell you the rest.

Glad you Asked

I have an iron core, 24-in. long, 1-in. x 2-in., weight of about 16 lbs. This core has 50 turns

ASK HANK, HE KNOWS—

around it. Now, what I want to know is if I used 36 volts, how many amps would you have to use to get 1900 Gauss?

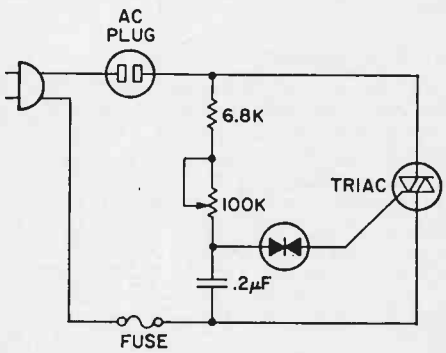
—M.S.G., Borrego Springs, CA

To properely answer this question, I would have to know the thickness of the iron laminations, the ferrus content of the iron and impurities, the time of day and what you had for breakfast. In other words, you have supplied insufficient information. Now, I have a 1970 4-door Buick with electronic solid-state ignition that bucks on mornings after a rain. Question—what was the relative humidity?

Lotta Noise

Recently I built a 600 Watt lamp dimmer using the circuit enclosed. Then I discovered it produced static on radios even if they were run on batteries. Is there something I can do or add to the circuit to decrease or eliminate the static?

—R.L., Monterey CA



Your best bet is to operate the dimmer under water, salt water is best. Seriously, you need a heck of a lot of filtering. Assemble the unit in a steel box, and ground it to the outlet box. Next, filter the outputs and inputs with line filters. Automotive alternator feed-thru capacitors may do. But, considering the trouble, and the expense, it may be cheaper to buy a commercial unit.

Good Buy

I recently purchased a Hallicrafter S-120 receiver and am desparately in need of a manual for it. Could you advise me where to find one? Also, I would be interested in your opinion of my purchase. Is the S-120 adequate for SWLing and ultimately for use in a ham shack or should I start saving for a new one. Thenk you very miuch.

—J.W., Sheppard AFB TX

The S-120 is good SWL communications receiver for the novice and serious listener. After you've logged all you can hear on the S-120, both you and the receiver will need an overhaul.

(Continued on page 22)

ELEMENTARY ELECTRONICS

READER SERVICE PAGE

• The Editor of ELEMENTARY ELECTRONICS offers readers an easy way to get additional information about products and services advertised in this issue. Also, if you would like more information about any new product mentioned in our column "Hey, Look Me Over," it's yours for the asking. Just follow the instructions below and the material you requested will be sent to you promptly and at no cost.

• The coupon below is designed for your convenience. Just circle the numbers that appear next to the advertisement or editorial mention that interests you. Then, carefully print your name and address on the coupon. Cut out the coupon and mail to ELEMENTARY ELECTRONICS, Box 886, Ansonia Station, New York, N.Y. 10023. Do it today!

JANUARY/FEBRUARY 1973 — Void after May 31, 1973

ELEMENTARY ELECTRONICS

Box 886, Ansonia Station, New York, N.Y. 10023

Please arrange to have literature whose numbers I have circled at right sent to me as soon as possible. I understand that this is a free service offered by the magazine.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70

• Please limit circled items to 12 maximum.

Name (Print Clearly)_____

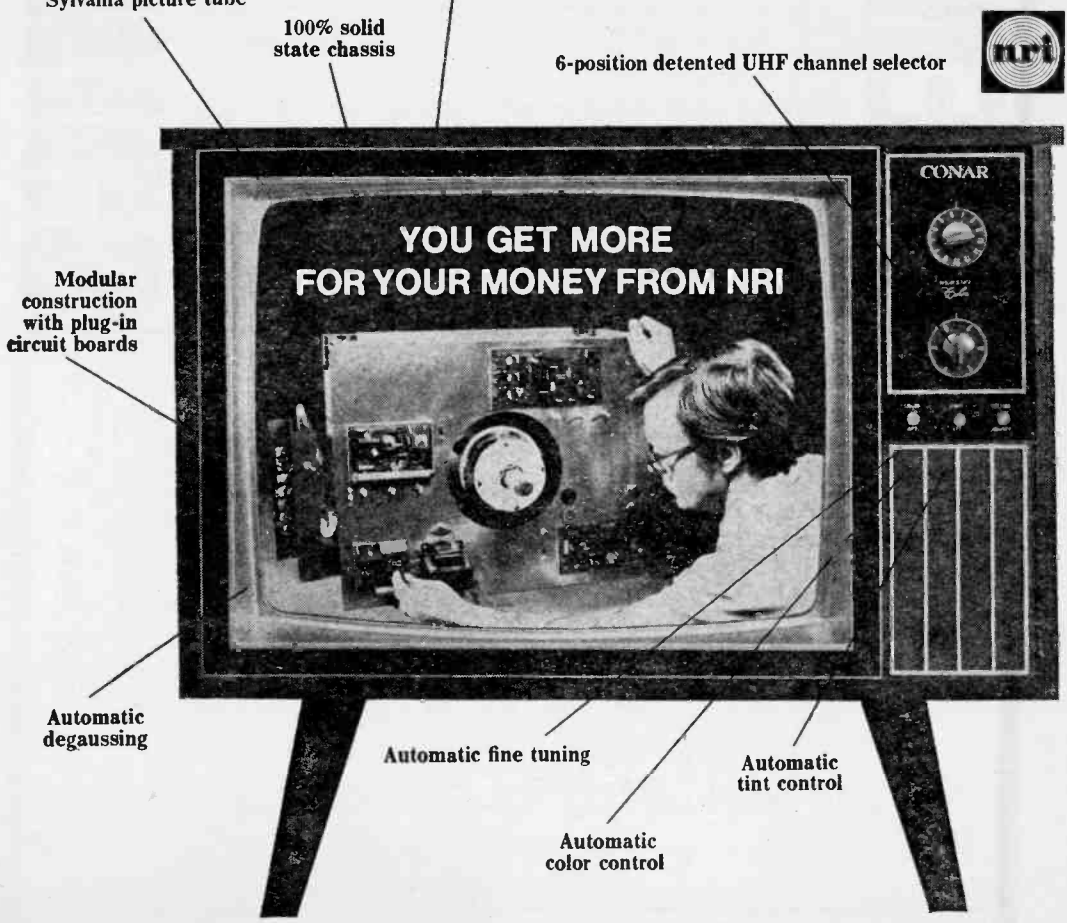
Address_____

City_____ State_____ Zip Code_____

NOW you can train at home building a NEW 25″ Solid State Color TV engineered by NRI for learning and trouble-shooting

So much better for learning TV servicing than any hobby kit, because NRI designed and created it as an educational tool.

Unlike hobby kits which are designed for creating a TV set as the end product, NRI built its exclusive 25″ Solid State Color TV kit as a real training kit. You can introduce and correct defects . . . for trouble-shooting and hands-on experience in circuitry and servicing. The kits include a wide-band oscilloscope, color bar crosshatch generator, transistorized volt-ohmmeter and other valuable equipment that can soon have you earning $5 to $7 an hour servicing color sets in your spare time.



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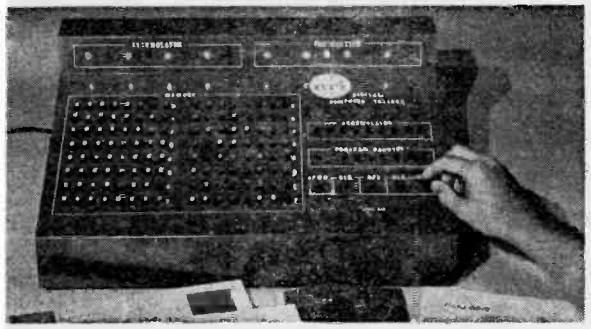

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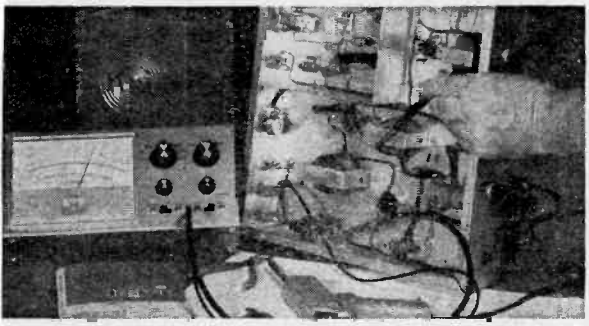
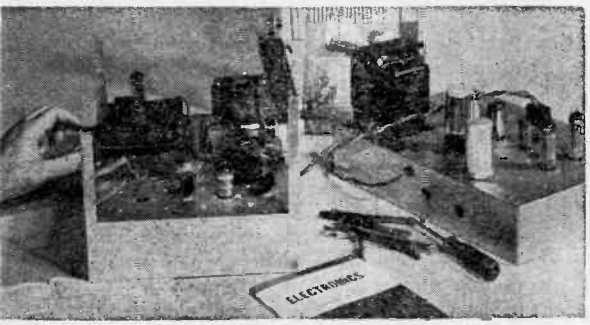


FIRST to give you true-to-life experiences as a Communications Technician. Every fascinating step you take in NRI Communications training, including circuit analysis of your own 15-watt, phone/cw transmitter, is engineered to help you prove theory and later apply it on the job. Studio equipment operation and trouble shooting become a matter of easily remembered logic.



FIRST to give you completely specialized training kits engineered for business, industrial and military Electronics Technology. Shown is your own training center in solid-state motor control and analog computer servo-mechanisms. Telemetering circuits, solid-state multivibrators and the latest types of integrated circuits are included in your course.

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Washington, D.C. 20016

ASK HANK, HE KNOWS—

(Continued from page 16)

This should take several years. Nope, the S-120 is not the best for ham bands, although it can be used. By the way, The Hallicrafters Company address is 600 Hicks Road, Rolling Meadows, Illinois 6008. Drop them a line and ask for your manual. Also, get their opinion on using the S-120 on ham bands. By the way, I use the S-120 as a second receiver. I use it to check the bands when I wait for a station ID to come in on my prime rig. Every listening post should have two rigs—not counting emergency band monitors.

> Sorry, boys, I can't provide designs for circuits nor can I comment on them. Diagrams from the "top of my head" and comments on same may be wrong. Only detailed analysis or circuit set-up can be relied on and time prohibits that.
>
> *Hank Scott*

Buy Cheap, Pay Later

About 6-8 years ago my parents bought a stereo phono (amplified, w/speakers) on a deal from Reader's Digest. It was a package deal including several records. The unit was simply called "cyclophonic" by Reader's Digest. My parents have lost all info on it, and wondered if you could help me in getting some new info on it (schematic's, etc.). If you know who it's made by, or their address, would you kindly let me know?

—R.Y., Livonia MI

Why don't you bug Reader's Digest? They are a good, consumer-oriented organization and should be happy to assist their customers. As to who made the unit, it could be anyone from St. Joe, Michigan to Hong Kong.

Skylook Gain

How can a CB antenna increase the wattage of a CB rig?

—J.M., Raritan NJ

Your question is the type I would have asked when I started in electronics. After all, how can a few pieces of wire amplify a signal? Actually, Jim, the antenna gathers the signal that would be scattered all over and beams it into a general direction. This characteristic puts more signal in a given direction than there would be normally. Hence, the antenna has a gain of so many times what it would be if it were not directional. Antenna gain is great provided you want the directional quality.

The Boss Had a Partner

I just retired as a TV repair benchman for a large service outfit in New York City. I repaired a lot of sets at home in my spare time,

(Continued on page 104)

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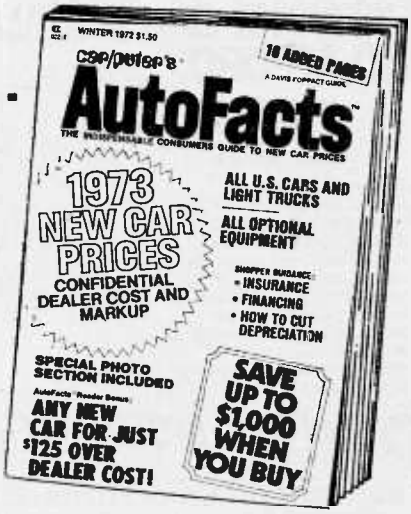

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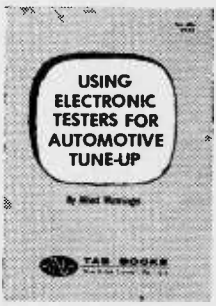
☐ Do you need an all-in-one manual providing complete information and operating instructions on electronic devices used for auto tune-up? Then pick up a copy of *Using Electronic Testers for Automotive Tune-Up* by Albert Wanninger. Starting with simple voltage and continuity checks, the author continues through the more involved procedures, employing oscilloscopes and specialized testers, and ends with



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complete automotive tune-up on console-type analyzers. Brief discussions of how the equipment operates is included to make the meter indications more meaningful to the technicians. The author devotes full coverage to tune-up kits, individual instruments, and console analyzers which, with one set of test leads and one hook-up, can perform multiple tests. Published by Tab Books, Blue Ridge Summit PA 17214. For more information, circle No. 58 on Reader Service page.

One-Two-Three-Four. Why not eliminate the majority of problems surrounding the servicing of mechanical and electronic home-entertainment equipment? The solution is the 1-2-3-4 servicing method which is explained in Forest H. Belt's new book, *1-2-3-4 Servicing Stereo Amps*. The book begins with a basic discussion of the fundamentals of the 1-2-3-4 servicing method. The author shows an easy way to service electronic equipment by dividing it into four distinct divisions—sections, stages, circuits, and parts. Then he analyzes the four important servicing steps—diagnose, locate, isolate, and pinpoint. Several chapters familiarize the reader with stereo music systems, kinds of stereo systems, specifications and measurements, two- and four-channel stereo, transistor circuit operation, and various stages in transistor amplifiers. Remaining chapters tell how to apply the 1-2-3-4 servicing method to stereo amplifiers.

Soft cover
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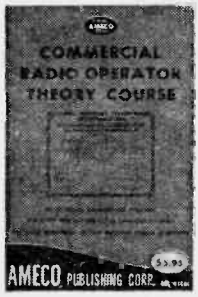
The text is supported with numerous illustrations and schematics. Published by Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268. If you wish, circle No. 60 on Reader Service page.

Electronics Self-Taught. Life is easier when you get a good job in electronics, and in many cases a good job has a prerequisite of a Second or First Class Radio Telephone License. Ameco's *Commercial Radio Operator Theory Course* fills the bill in preparing you for the FCC exams. The FCC issues study guides for the various examination elements. These study guides contain a series of questions that cover



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the scope of the material required for the FCC examinations. All of the information called for by these study guides is thoroughly discussed in this course. In addition, the course is complete in its coverage of radio theory. It starts at the very beginning of basic electricity and continues on through radio transmission and reception. Get the complete facts from Ameco Publications Corp., 314 Hillside Ave., Williston Park, NY 11596 or circle No. 59 on Reader Service page.

Tuning in the Bands. Here's a book everyone should read—*Understanding & Using Radio Communications Receivers* by John Schultz. The text begins with a study of the electromagnetic spectrum, how radio waves are propagated, and the obstacles and disturbances which affect receiver reception. Then the author analyzes various receivers, tells how circuits have been improved for greater sensivity, compares the advantages of each type, taking into consideration the price and performance of new receivers, kit assemblies, and used or surplus

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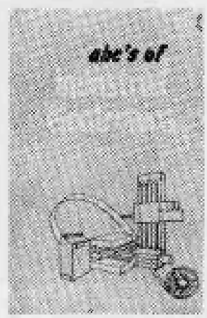
equipment. Characteristics of various antennas, from simple directional to extra-large and anti-noise antennas are studied in detail, as are modulation systems—AM, FM, SSB, and keyed CW. There's much more, so why not pick up a copy by writing to Tab Books, Blue Ridge Summit, Pa., 17214. or circle No. 58 on Reader Service page.

Beginner's Special. Introducing *ABC's of Industrial Electronics.* First Edition, by J.A. Wilson. This book presents an easy-to-understand analysis of the field of industrial electronics. It explains how industries use electronics to control machines and manufacturing processes, some difficult, if not impossible, to control by old-time manual methods. Chapter 1 discusses the three basic control system elements: a transducer, a switching component, and an amplifier. The second chapter covers the power supply systems. Chapter 3 is dedicated to amplifiers and their uses, while the next two chapters deal with logic systems and logic circuits. In addition, the concluding chapter exposes the electronics technician to the numerical control systems, methods of programming machine operations with punched or magnetic tape. For more information, write to Howard W. Sams & Co., Inc., 4300 W. 62nd Street, Indianapolis, Indiana 46268, or circle No. 60 on Reader Service page.



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● ***Review in Brief***

Complete Guide to Reading Schematic Diagrams by John Douglas-Young, published by Parker Publishing Co., Inc., West Nyack, NY 10994; discover the functions of every circuit, purpose of every part, at a glance with help from this basic text; spiral bound, soft cover, 264 pages, $9.95. ■

DX central reporting

A world of SWL info!

By Don Jensen

□ The "star" system just doesn't seem to apply to shortwave broadcasting. Think about it. How many shortwave personalities can you think of? A handful, maybe, like the Voice of America's Willis Conover, a few DX program hosts and that's about it. Perhaps the only real radio personality produced by shortwave broadcasting was Eddy Startz, the genial "Holland Dutchman" who for 40-odd years hosted the "Happy Station" program from the Netherlands.

As a young man, this multi-lingual ex-longshoreman hooked up with the fledgling Philips Co., a Dutch electronics firm that was then experimenting with shortwave broadcasting. For years his weekly "Happy Station" program went out over pioneer SWBC station PCJ. After the war, he continued the program on the station, which by then had become today's *Radio Nederland.*

Over the years, Startz developed his own unique program, a blend of listenable music and his distinctive personality. A world traveler, Eddy told of his meetings with people in all walks of life around the globe. He created on the air a familiar fantasy world of imaginary barnyard animals with whom he conversed. Startz-isms, which listeners came to know and enjoy, included his most famous phrase, an invitation to his audience to join him in "a nice cuppa tea."

Though the "Happy Station" program continues over *Radio Nederland,* it does so without the septuagenarian Startz, who retired from broadcasting in 1970.

A few months ago, Startz visited the United States and Canada, giving many of his old radio friends on this side of the "pond" a chance to meet the man behind the well known voice.

Startz was the keyncte speaker at the seventh annual convention of the Association of North American Radio Clubs (ANARC), held in mid-July at Wakefield, Mass., near Boston. For those who've been in the DXing game for a few years, quite a few in some instances, it was a nostalgic hour, as Eddy recounted stories of bygone days in international broadcasting.

But Eddy had more to say than that. The man who always, through his "Happy Station"

LITERATURE LIBRARY

101. Kit builder? Like weird products? *EICO's 1973* catalog takes care of both breeds of buyers at prices you will like.

102. *International Crystal* has a free catalog for experimenters (crystals, PC boards, transistor RF mixers & amps, and other comm. products).

103. See brochures on *Regency's* 1973 lineup of CB transceivers & VHF/UHF receivers (public service/business bands—police, fire, etc.)

104. A pamphlet from *Electra* details the 6 models of the Bearcat III, a scanning monitor receiver.

105. *Dynascan's* new B&K catalog features test equipment for industrial labs. schools, and TV servicing.

106. Before you build from scratch, check the *Fair Radio Sales* latest catalog for surplus gear.

107. Get *Antenna Specialists'* cat. of latest CB and VHF/UHF innovations: base & mobile antennas, test equipment (wattmeters, etc.), accessories.

108. Want a deluxe CB base station? Then get the specs on *Tram's* super CB rigs.

109. Take off insulation neatly and quickly with *Xcelite* Wire Stripper-Cutters. Three models are shown, adjustable for all commonly used solid and stranded insulated wires.

110. *Bomar* claims to have C/B crystal for every transceiver... for every channel. The catalog gives list of crystal to set interchangeability.

111. A *Turner* amplified mike helps get the most from a CB rig. This free brochure describes line of base & mobile station models.

112. A fully illustrated brochure from *Midland* gives readers a look at their new, complete line of radio monitoring receivers and CB transceivers.

113. For *everything* in electronics—get the 1973 catalog from EDI (Electronic Distributors, Inc.). 152 pages of leading brands at bargain prices.

114. Get all the facts on *Progressive Edu-Kits* Home Radio Course. Build 20 radios and electronic circuits; parts, tools, and instructions included.

115. *Olson Electronics'* 188-p. fully-illustrated 1973 catalog has leading national brands, all in the electronic product categories.

116. *Trigger Electronics* has a complete catalog of equipment for those in electronics. Included are kits, parts, ham gear, CB, hi fi and recording equipment.

117. Get the free, new twenty-four page *HUSTLER* CB and Monitor antenna catalog featuring improved antennas and accessories for base station and mobile operation.

118. *Teaberry Electronics* has information on CB radios—Twin "T," Big "T," Mini "T" II, and Five by Five; also information on Scan "T" Monitor radio receiver.

119. *Burstein-Applebee's* new 1973 catalog has over 280 pages of Radio-TV/Electronics bargains. Selling for $2, it is offered free to our readers.

120. For a colorful leaflet on the Golden Eagle Mark III SSB receiver and the Mark III SSB transmitter, write to *Browning Laboratories.*

121. *Edmund Scientific's* new catalog contains over 4000 products that embrace many sciences and fields.

122. *Cornell Electronics'* "Imperial Thrift Tag Sale" Catalog features TV and radio tubes. You can also find almost anything in electronics.

123. *Radio Shack's* 50 Anniv. cat. has 180 pages, colorfully illustrated, of complete range of hi fi, CB, SWL, ham equip. and parts (kits or wired) for electronics enthusiasts.

124. It's just off the press—*Lafayette's* all-new 1973 illustrated catalog packed with CB gear, hi-fi components, test equipment, tools, ham rigs, and more.

125. *Mosley Electronics, Inc.* is introducing 78 CB Mobile Antenna Systems. They are described and illustrated in a 9-page, 2-color brochure.

126. *RCA* Experimenter's Kits for hobbyists, hams, technicians and students are the answer for successful and enjoyable projects.

127. You can become an electrical engineer only if you take the first step. Let *ICS* send you their free illustrated catalog describing 17 special programs.

128. *Avanti* antennas (mobile and base for CB and VHF/UHF) are fully described and illustrated in new catalog.

129. A new free catalog is available from *McGee Radio.* It contains electronic product bargains.

130. Semiconductor Supermart is a new 1973 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors.—all from *Circuit Specialists.*

131. *Heath's* new 1973 full-color catalog is a shopper's dream—chockful of gadgets and goodies everyone would want to own.

132. *E. F. Johnson's* 1973 line of CB tranceivers and CB accessory equipment is featured in a new all-line brochure. Send for your free copy today.

133. If you want courses in assembling your own TV kits, *National Schools* has 10 from which to choose. There is a plan for GIs.

134. Free 1973 Catalog describes 100s of Howard W. Sams books for the hobbyist and technician. It includes books on projects, basic electronics and many related subjects.

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programs, tried to bring people of all nations together in friendship, made a passionate plea for broadcasting today. He deplored the use of the shortwave frequencies for political broadcasts, propaganda techniques, and, especially, jamming of other stations.

He urged listeners around the world to join in an effort to pressure shortwave stations to end the battle of the airwaves, to expand and improve entertainment and informational programming.

While Startz's address was a highlight of the three-day ANARC meeting, there were plenty of other activities of interest to the DXers gathered.

There was the awarding of ANARC's Man of the Year plaque to August Balbi of Los Angeles, known to many as the "dean of DXing", for his hobby activities of many decades. There were how-to-do-it DXing talks, panel discussions on SWLing topics, demonstrations and displays of the latest receivers and listening gear, plus the chance to talk with other SWLs from across the country.

ANARC, as you may know, is the organization which links all the major DXing clubs in North America. However, its convention was open to club members and non-members alike. If the idea of attending a DXer's convention appeals to you, we'll give you the word on the 1973 ANARC gathering as soon as that information becomes available.

Tip Topper

This month, let's turn our attention to South America, to one of the lesser known countries on that continent, Guyana. If the map on your wall is more than a few years old, that pink wedge of land on South America's northern coast is probably labeled British Guiana. But with independence, Guyana it has become.

There are two shortwave services located in Guyana's capital, Georgetown, and they have similar names. The older is the Guyana Broadcasting Company, Ltd., a commercial venture that identifies as Radio Demerara.

Just a couple of years old is the second, the Guyana Broadcasting Service, which announces itself as "GBS" or "Action Radio." Most DXers will find this the easiest to log.

GBS is an independent Guyana corporation which is designed as the nucleus of a future government public broadcasting system. Besides an FM outlet, directed to audiences in the immediate Georgetown area, and of course, impossible to hear Stateside, and a medium wave outlet on 560 kHz, GBS has a 10,000 watt shortwave transmitter which can be heard on 3,290 kHz.

That signal, fed to a vertical incidence aerial array, often can be heard by SWLs in the U.S. and Canada. It can be logged during the evening hours until 0345 or 0445 GMT, depending on the day of the week. But here at DX Central we find the odds of getting good reception are greater during the wee hours of the morning, right after GBS signs on at 0845 GMT. If you tune earlier, say from around 0815 GMT or so, you'll hear the station's interval signal played repeatedly.

At that time of the morning you'll hear announcements in English, but don't be surprised if you also hear the announcer in a foreign language too, plus some East Indian type music. Guyana, you see, has a very sizeable East Indian, Hindi-speaking population.

The Guyana Broadcasting Service is a prompt and good verifier. Reports sent to chief engineer Maurice O. Denny, in care of GBS, 68 Hadfield St., Georgetown, Guyana, should bring a letter verifying your reception.

Bandsweep

(Frequencies in kHz, times in GMT): ***800***—Other than Canadians and border Mexicans, how can we log foreign medium wave stations, ask many of our newer readers? One good bet during the evening hours is *Transworld Radio's* PJB, with 500 mighty kilowatts, broadcasting from *Bonaire*, Netherlands Antilles. It should be audible if Canada's CKLW, Windsor, doesn't give you too much interference. . . . ***3,300***—A country saved! *Radio Belize* in British Honduras, a tiny dot in Central America, has returned to shortwave just when it looked like that particular country was lost to DXers. Mid-evening is a good time to tune in most parts of the country and since we can't say how long they'll remain on shortwave, go to it now! . . . ***4,700***—Here's one for the "pros" only. Bolivia's Radio San Miguel, way out in the boondocks near the Brazilian border, is ultra rough to log, but can be done when conditions are right to Latin America. . . . ***6,224***—We'll throw this one in just for fun, 'cause if you should hear it on this side of the Atlantic, it'll be the first time! *The Gnomes of Ulster* station (that's right, *Gnomes of Ulster*) is a clandestine, flea-powered sometimes-station in Northern Ireland. It's said to operate on this frequency every now and again. . . . ***7,240***—Other than *Radio Moscow*, QSLs from other Russian stations are often a hit or miss proposition. But if you should hear the Soviet station at Kiev on this frequency, send a report. Recently Kiev has responded with a few QSLs of its own . . . ***11,948***—Paraguay has the reputation of being the hardest of the South American countries to log on shortwave. Best chance is probably *Radio Encarnacion*, broadcasting in Spanish, naturally, from about 2230 until 2300, when Radio Canada clobbers the frequency. (Credits: A.R. Niblak, Indiana; Dan Ferguson, West Virginia; John Campbell, Texas; Gregg Calkin, Mexico; Alan Roth, New York, National Radio Club, Box 99, Cambridge, Mass.)

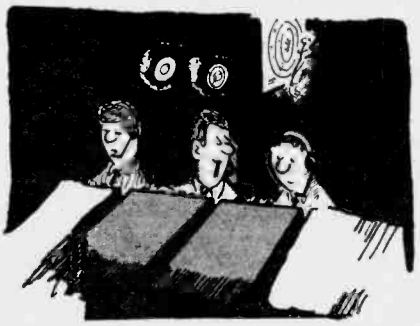
Backtalk

Eric Soll of Philadelphia passes along a

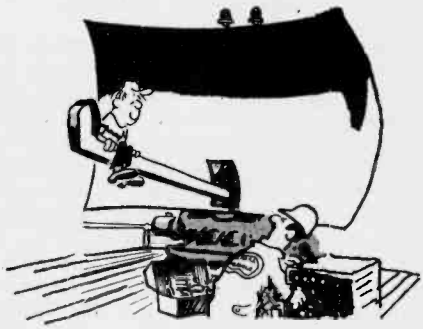
(Continued on page 104)

RADAR REFLECTIONS

by Jack Schmidt



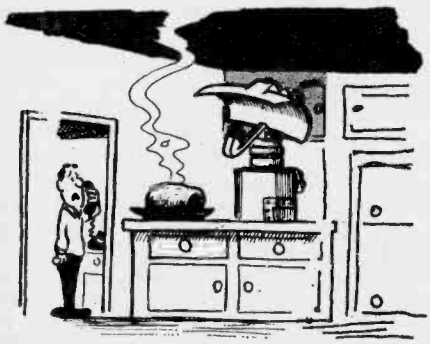
"Position 1 is **long range**, Position 2 is **Sector Scan**, 3 is **Glide Slope**, and 4 is the pro game from the stadium."



"Okay, kid, three more revs, then I've got to get this baby on the air."

"Six mallards, bearing 047 degrees!"

"Radar, radar, oh so bright, where, oh where, are we tonight?"



"I can't return it now, Ed... Helen is using it to make dinner."

"It's a fake, Harry, but you should see it slow down the hot rodders."

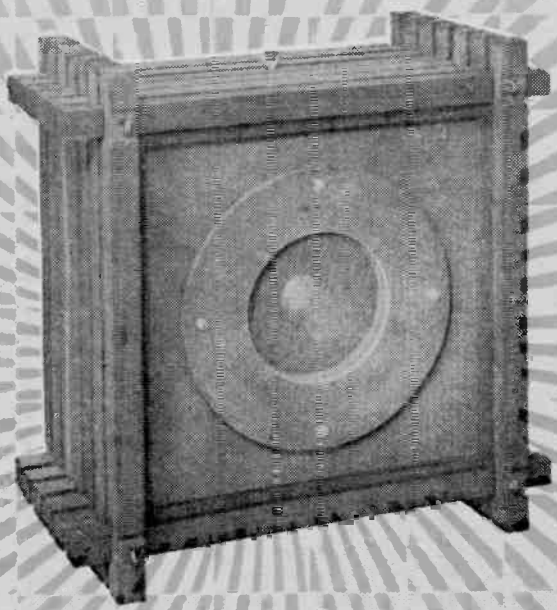
elementary Electronics JANUARY-FEBRUARY 1973

Here's e/e's easy-to-build...

Basket of Sound

Our redwood speaker opens the outdoors to Beethoven or Rock. Build it with an inexpensive planter box from your local garden nursery

by Herman F. Johnson



Would you like something different in a loudspeaker? Here is one like none other. It is so radically different from those oiled walnut, small box speakers we usually encounter, it may be compared to the commercial varieties only by its size. In appearance, it is equally at home in a small listening room or in a 4-channel arrangement around a swimming pool. Or, hang it beneath the eaves of your house, preferably at an inside corner, to enhance the low frequency response.

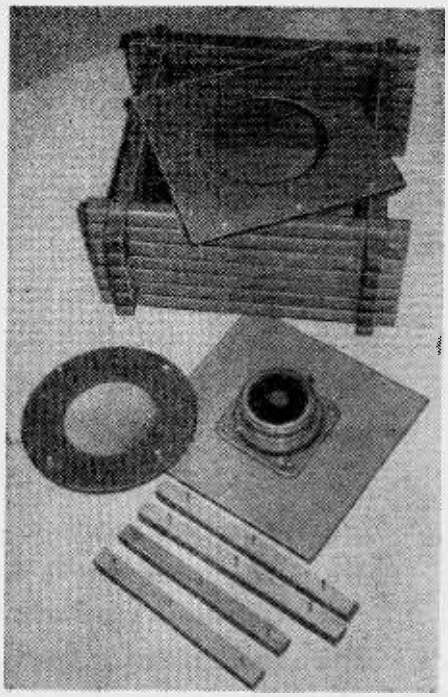
Everyone likes small size loudspeakers because of their portability. When you attempt to build one from scratch however there is rarely enough room inside to hold a screwdriver! Finishing an enclosure to suit one's decor can also be quite a problem. But one way to avoid construction difficulties, yet build a better-than-average small speaker, is to start with a pre-assembled box or two (or four). That way most of your effort is simply fitting a speaker baffle.

Green Thumb Ground Supply. One type of box that is suitable for a speaker enclosure can be found in your garden nursery store. The redwood planters. They are sturdily built to hold soil for a number of years. Redwood is less susceptible to warping than other forest materials, and planter boxes are usually made of ¾-in. board securely joined. The planter employed in this application has side walls that are 5/16-inch thick, and the bottom is a ¾-inch solid board. Inside dimensions are 9¾-in. square by 6-in. deep. About an inch of the

depth is lost when speaker mounting pieces are installed, but a sufficient volume of about 480 cubic inches remains available for the speaker.

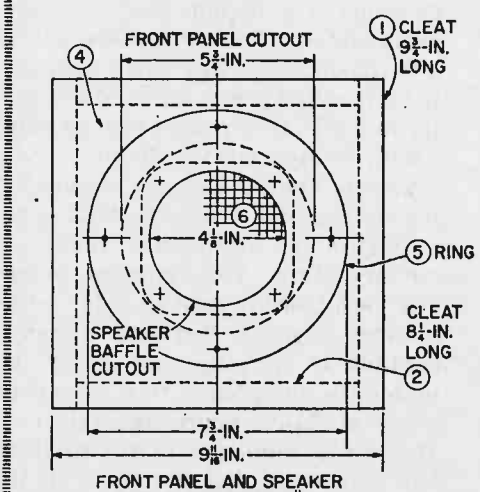
Construction. It is a good idea to inspect the inside areas of the box to determine if there are any crevice openings along the inside corners. Seal these openings while running a bead of caulking full length along all the mating surfaces. Silicone rubber is ideal for this purpose, though other non-hardening caulking may be used. It is important that a speaker enclosure be made airtight to insure adequate low frequency sound.

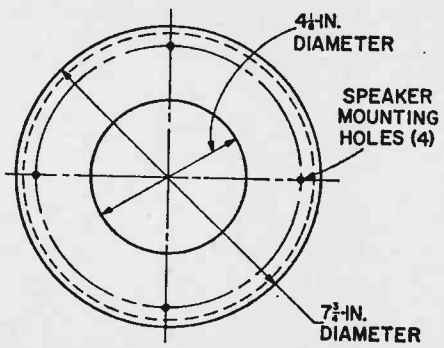
Pencil-line the perimeter inside the box ¾-in. from the edge of the open end with an adjustable square. This will locate the front face of the cleats after you cut them to length (piece numbers 1 and 2 in the drawing). Fit the cleats in place for a snug fit. Then pencil-line the perimeter once more using the inside edge of the cleats as a guide. These locator lines are a help when you are ready to glue the cleats in place. Plastic resin glue is the best bonding agent for this purpose, it is stronger than the wood when dry. You will find sufficient room to drive one inch long nails through the cleats to compress the glued joints and hold them in place.



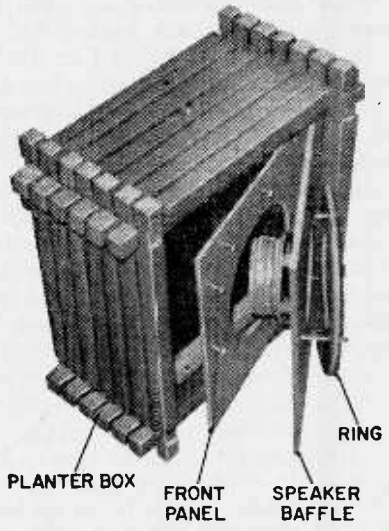
Your redwood planter comes completely put together ready to be turned into one great indoor/outdoor speaker. Sounds great, too!

Gate the Drain Source. All planter boxes have at least one drain hole in the bottom. Install a terminal strip over the hole and caulk this opening on the inside after a length of speaker hook-up wire has been installed. However, if you intend to use the





Mark a perimeter line inside the planter box ¾-in. from the outside edge. This is to locate the front face of the 4-cleats (No. 1 and 2) after you cut them to their correct size. Fit the cleats in place and draw another perimeter line to help locate them when they are later glued into place.



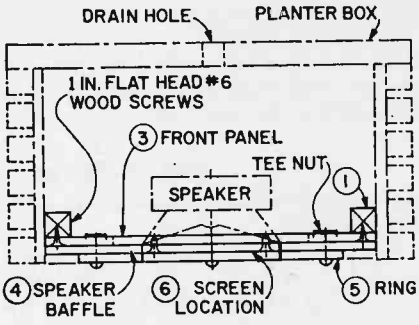
Fan-out view of front area illustrates how simple construction really is. Front ring is added to improve enclosure's appearance.

speaker outdoors, it is best to plug the drain hole with a wood dowel or a cork. Then designate a side as the underside and drill a ¼-in. hole about two inches from the open end for hook-up wire.

Standard ¼-inch hardboard is ideal for mounting the speaker to the front face of the planter. This material has a smooth flat surface on the front and a waffle-like pattern embossed on the back. Note in the photograph that the speaker is mounted with three parts—front panel, speaker baffle, and a front facing ring (piece numbers 3,4 and 5 respectively). Mark the hole locations and cut-outs on the smooth face and make the cuts. Your front panel should make a snug fit inside the box, but your speaker baffle should fit loosely in the opening. It is a good idea to clamp these two parts together when drilling the four outside mounting holes. Then, all four holes in the front panel should be redrilled to fit the tee nuts.

Speaker Mountings. Locations for the four machine screw holes in the speaker baffle should be templated from the speaker's frame with the speaker centered over the 4⅛-inch diameter cut-out, while holes in the ring can be templated from the four holes in either the front panel or the speaker baffle. The flat heads of the screws should be flush with the surface of the hardboard. When assembling these parts note that tee nuts are pressed into place on the embossed side of the front panel. The front panel is then glued and screwed to the cleats (embossed side toward cleats). Your speaker is back-mounted to the smooth surface of the baffle. This provides a seal without the use of a gasket. Note that the speaker baffle covers all of the flathead wood screws in the front panel. The ring has been added for esthetic reasons, to cover flat head screws and bolts and to secure the fiberglass cone protector screen. Only four round head screws are exposed at the front.

Before the front panel is permanently installed, fill the inside cavity with 5 layers of one-inch fiberglass. The front two layers should be cut out in the center to clear the magnet structure of the speaker. High compliance speakers operate most efficiently in small enclosures when damped with fiberglass. *(turn page)*



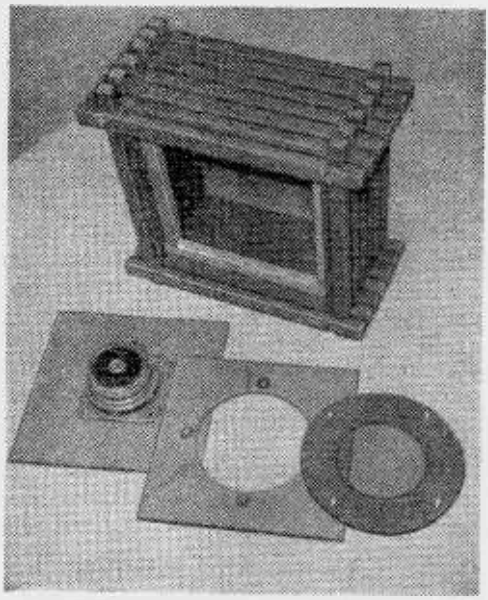
Planter box drain holes should be plugged to prevent turning your enclosure into a bird's nest if you put it to use outdoors.

OPTIONAL FINISHING

If the speaker is to be used outdoors, it is advisable to give all of the hardboard pieces a coating of resin sealer. A pleasing front appearance can be had by coating the embossed surfaces of the speaker baffle and the ring with a color-toned penetrating sealer to match the prefinished planter. If the redwood color is not appealing, you can paint-decorate all of the outside surfaces, or give it a coating of charcoal resin sealer to obtain a dark, woodsy finish.

e/e BASKET OF SOUND

For ease of handling or support for hanging the speaker, predrill a hole, centered on the top surface, to receive a ⅛-in. screw eye, or install four small screw eyes since wire hangers are furnished with the planter listed in the Bill of Materials.



Ready for final assembly. An Altec 405A speaker with its smooth frequency response and weatherproofing treatment is suggested

Sound Source. Dimensions given in the drawing will fit a 4-inch Altec 405A. There are several high compliance 4 or 5-inch full range speakers available that can be expected to operate with satisfaction in this application. However, the Altec speaker is recommended for this system if it is to be used outdoors. It is a speaker that has gained wide acceptance among audiophiles who demand fine music and voice reproduction in their automobiles since its high efficiency provides low frequency output and smooth frequency response equal to many larger speakers. And, a water-resistant cone prevents distortion during periods of high humidity. Smooth distribution is provided by its shallow cone and aluminum center dome. High efficiency in a speaker is very important when it is necessary to connect it at a location that is likely to be up to 125 feet from the source of audio power. Do not use antenna lead-in wire; the wire size is too small. A ¼-in. diameter #16 gauge vinyl-jacketed cable such as Belden 8471 is recommended for outdoor cable runs. It may be used up to 125 feet with less than 15 percent loss of audio power.

Tie a knot in the cable or build up its diameter by tightly wrapping rubber tape about a foot from the end, then solder the speaker terminals and caulk the inside where the cable enters the enclosure. Push the baffle-speaker assembly into the front panel opening and insert the four round head screws and tighten them. Now you're ready to lie back and enjoy good listening from your own hanging basket. ■

Bill of Materials for Basket of Sound

Key to Drawing	Description
1	Fir cleat, ¾-in. x ¾-in. x 9 1/16-in. Two required.
2	Fir cleat, ¾-in. x ¾-in. x 8¼-in. Two required.
3, 4, 5	Masonite hardboard, ¼-in. thick. Three square feet required.
6	Grill cloth. One square foot required.
	8-32 Tee nut. Four required.
	8-32 x ½-in. flat head machine screw. Four required.
	No. 6 x 1-in. flat head wood screw. Ten required.
	Fiberglass damping material. Four square fet of 1-in. material required.
	8-32 nut and washer. Four required.
	Redwood planter, No. HB1-12 or similar. (Distributed to garden nurseries by Germain's, Inc., 4820 50th Street, Los Angeles CA 90058) About $4.
	Altec 405A 4-in. wide range speaker. (Altec-Lansing, 1515 South Manchester Avenue, Anaheim CA 92803) About $12.

BUILD IT FAST...

AUTO ALARM FOR YOUR CAR TAPE PLAYER

by Herbert Friedman

The police estimate that in a large city such as New York the life expectancy of an unattended Corvette is about 10 minutes—after that it has a new "owner." The life expectancy of a mobile cassette or 8-track tape player is about 24 hours, for they are really hot resale items.

Actually, most of the fancy tape player lock-alarms are useless—they are too obvious, too easily bypassed, and are often stolen along with the tape player! Our AutoAlarm sounds a car's horn continuously if anyone removes the tape player. And once triggered, the horn can be turned off only by the AutoAlarm's switch.

All it takes is a few dollars worth of experimenter's components to throw together an AutoAlarm that will give you just about as much protection as you can get because it doesn't *look* like an alarm. Tucked away in the glove compartment or under the seat, a single wire runs to the tape player's case—a wire that looks as if it's an ordinary ground wire.

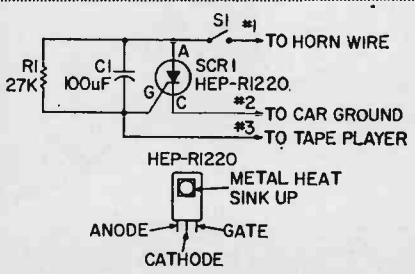
The entire AutoAlarm is assembled directly on the back of a SPST slide switch. The assembly can then be installed in any small metal or plastic cabinet. Silicon Controlled Rectifier SCR1 can be just about any type rated at 25 PIV (peak inverse volts), 5-Amps

(Continued on next page)

AUTO ALARM

or higher, such as the HEP-R1220.

To identify the SCR leads, lay it flat on the table so the side with the metal rim (around the mounting hole) faces up; the side *without* a rim should be against the table. The SCR leads will now conform to the layout shown.



This simple circuit can be wired quickly. Switch S1 is closed for normal operation.

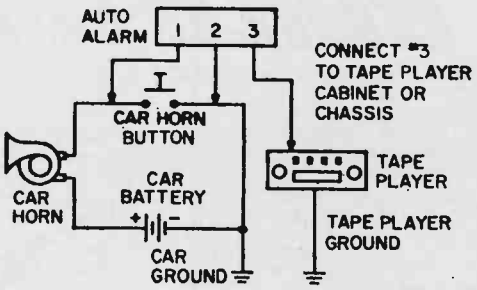
PARTS LIST FOR MOBILE TAPE AUTO ALARM

C1—100 uF electrolytic capacitor 15 VDC or better
R1—27,000-ohms, ½-watt resistor
SCR1—HEP-R1220 or equiv (see text)
S1—SPST slide switch (alarm off)
Misc.—Metal or plastic cabinet, wire, hardware, solder etc.

No wiring precautions are necessary other than to doublecheck that the C1 polarity is correct; its positive terminal connects to SCR1's anode (A) terminal.

The other figure shows how to connect the AutoAlarm. Note that AutoAlarm wire #2, from SCR1's cathode, must connect to the car body (ground) while the #3 wire also connects to ground *but* through the tape player's case. Wire #1 connects to the horn control wire which generally enters at the bottom of the steering column (sometimes in the engine compartment, sometimes under the dash).

How It Works. There is a positive voltage from the car battery across a horn button when it is open. By closing the horn button, the circuit is completed and the horn will sound. This positive voltage is applied to SCR 1's anode. The SCR's gate is grounded through the tape player's case, so the SCR is normally off. When the tape player is removed from its mount, the auto-Alarm's #3 wire is disconnected from

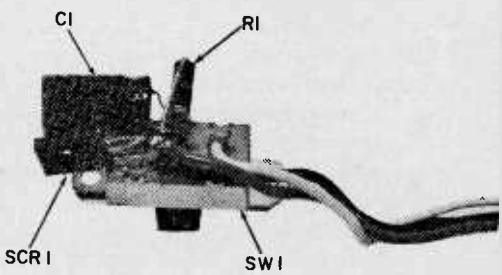


Intermediate solenoid found on most autos in place of horn in our simple diagram does not alter operation. Connect #1 to button. Remember, the curved side of electrolytic capacitor symbols, such as C1, represents the terminal that must be connected to the negative voltage (with respect to the plus capacitor connection). In this circuit, it means the negative terminal of capacitor C1 must be connected to the gate terminal of Silicon Control Rectifier SCR1 at left.

ground. The SCR gate is no longer grounded, so current can flow through R1 to the gate. The SCR turns on, effectively shorting its anode to its cathode. This means the horn control wire is now grounded, so the horn will sound.

Once the horn is sounded it can only be turned off by opening switch SW1.

To make it easy for the thief to trigger the AutoAlarm we suggest that the #3 wire be 22 or 24 gauge stranded—thin enough to be easily broken when the player is removed. The #1 and #2 wires should be 18 gauge stranded.



Here you can see just why we say, "Build it fast." And a simple three point installation means you install it fast, too! Count 'em, just four components and some wire make up this protective device that can save you a lot of grief over a lost, expensive player.

So the next time you park your wheels in a rough place, lock the car and take the keys with you. You can't expect to protect your tape player when the whole car is heisted! ■

The Gadgets that make HEADPHONE LISTENING MORE ENJOYABLE

The photo-bug can buy dozens of accessories for his camera to improve pictures he takes. The tape-nut has a choice of many gadgets that help put a little more quality into his recordings. And there are accessories for hi-fi headphones that deliver better performance and convenience; accessories that allow multiple listening, that free your main amplifier for other uses, or even allow phone monitoring where the equipment has no headphone jack.

While it is true that you rarely see "headphone hardware" items in hi-fi showrooms (because they are "slow movers"), they do exist, and they'll help you get just a little extra enjoyment out of your equipment.

For example, assume you have one of those "solid hardwood" console stereos available through department stores. Few consoles have headphone jacks, so if you want to enjoy the intimacy

LITTLE KNOWN HI-FI COMPONENTS AND ACCESSORIES ARE IN THE AUDIO SALON—IF YOU CAN FIND THEM

by Lars Jorgensen

e/e HEADPHONE GADGETS

of headphone listening you must either butcher the panel and do some wiring, or you can use headphone hardware such as a *headphone coupler* or a *stereo control box.*

The Easy Way. A headphone coupler is a rather simple and inexpensive device consisting of a metal sleeve housing a phone jack and protection resistors. Two pair of wires out the back end of the shell connect to the amplifier's speaker terminals. Just plug in the phones and you're set to listen with headphones.

Headphone couplers are priced under $2 and are available under a variety of brand names from many so-called "hi-fi parts and record tape stores."

If you want to kill the speaker while monitoring through phones you must move up to the more sophisticated *headphone control box*, which is priced between $5 and $10.

A low-cost control box is nothing more than the coupler, but it has a built-in switch that turns off the speakers, and it might have a volume control. Some of these basic control boxes get extra fancy and provide two volume controls, one for each channel.

If you like to share your listening pleasure with a friend, you can get a control box with two output jacks, each having a separate tone control. Again, this model lets you shut off the speakers.

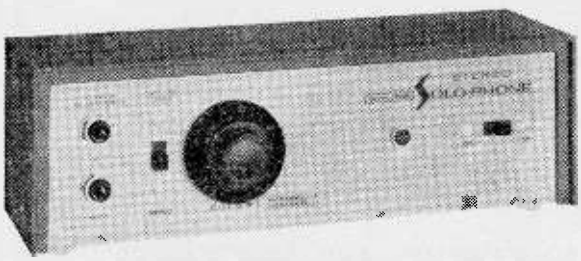
2-Set Couplers. Most of the major headphone manufacturers such as Superex, Koss, Radio Shack and Lafayette Radio offer a wide assortment of one- and two-output control boxes and couplers.

For those who need an extra headphone output but have no need for the other control-box features—because they're built into the amplifier, there are real cheap "Y adaptors," which are patch cords with a stereo plug on one end and two stereo jacks on the other. A "Y adaptor" sells for several dollars less than the cost of do-it-yourself components and wire.

And speaking of patch cords, don't overlook extension cords that allow you to range far and wide from the amplifier. Extension cords are available in lengths from 10 to 25 feet; the longer ones are available in coil-cord, so they're small until you want them long.

The "Load" Down. Moving well up the price ladder you'll run across some unusual but useful accessories. Heading the list is the Koss Model T-1 *monitoring box.* A monitor box solves the problem of how to use low-impedance hi-fi headphones with the high-impedance headphone outputs found on many tape recorders. If you've ever tried to use hi-fi phones on a recorder with a high-impedance monitor output, you're sure to recall that the volume fell to nothing, caused by the low-impedance phones "loading down" the monitor output.

The monitoring box alleviates the loading problem by inserting a "matching transformer" between the recorder's monitor output and the phones. One side of the matching transformer matches 600- to 10,000-ohm monitor output impedances; the other side of the transformer matches low-impedance 4- to 16-ohm hi-fi phones. If in doubt, give it a try, because the monitor box will work with just about every modern recorder worthy of the term "hi-fi."



Shure SA-1 Solo-Phone stereo headphone amplifier, which has concentric volume controls and two sets of headphone jacks; $48.00.

Superex SC-3 control box, with switch for headphones or speakers, and separate volume controls; $9.95.

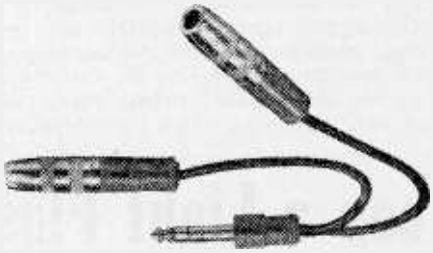
Souping Up. Another useful device is the *headphone amplifier*, available from Shure, Superex and Southwest Technical Products. A headphone amplifier is basically a low-power amplifier of 2 watts output or less with an input for a magnetic phono. To date, these devices have only volume controls (no tone controls). This device lets you drive the phones directly from the pickup without need for your main amplifier. The idea is, "Why run a 50 or 80-watt amplifier when you need less than 500 milliwatts for the phones?"

Since headphone amplifiers are smaller than a carton of cigarettes or a box of cigars, they make an ideal bedside companion for late-night listening. An inexpensive turntable, the amplifier and your phones are all it takes to replace Johnny Carson with Alice Cooper. And just in case you want *your* Alice Cooper, or Emily, or Celia to share your listening pleasure, the headphone amplifiers are fully compatible with two phone outputs.

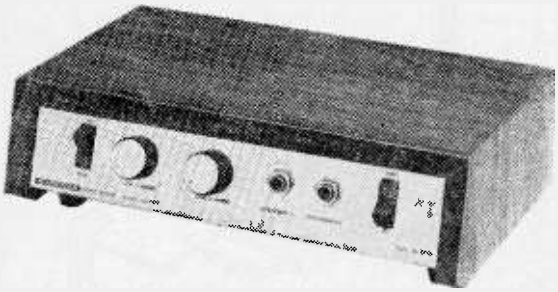
If the idea of a headphone amplifier bedside companion grabs you but you're turned off by the lack of tone controls (and no double entendre is intended), Stanton makes an interconnecting (extension) cable with built-in tone and volume controls, the 5741 *control unit*. Even if you don't have Stanton phones the control unit will probably work with whatever phones you're using. Take your headphones to your dealer and try them with the 5741, if you think they may not match. Superex has a similar unit, the STEX 15-VC with volume controls and a stereo/mono switch.

Finally, keep in mind that virtually every major headphone manufacturer has a complete line of accessories tailor-made for his own models. In most instances they are no better or worse than the blister-packed hardware your dealer displays on peg-board hooks—if he displays them at all; but if you think of some unusual accessory you can't locate, don't hesitate to write to the manufacturer. He most likely makes the item, even if you can't locate it. ■

Koss T-4 connector box, which provides private stereo listening for up to five people at one time; $7.95.



Switchcraft 353CP1 stereo adapter for connecting two headphones to a single amplifier output; $5.25.



Superex EA-500 stereo headphone amplifier, with two output jacks and separate volume controls for each channel; $79.95.

Koss T-5 remote-control station, featuring volume/balance controls for one headphone; the second jack is for headphones with earcup volume controls; $9.95.

Computers Read a Tag!

by Emmett Fluffin

Automated merchandise tag reading of retail data at the point of sale is now available through the Model 710 Magnetic Media Reader, a new component of Singer's MDTS* (Modular Data Transaction System) point of sale system.

☐ A new magnetic tag reader provides fast, accurate data collection for retail stores at the time of the sale. Singer Model 710 magnetic *media reader,* as the new device is called, captures information quickly and accurately because of its capability to begin the reading operation at either end of a magnetically coded tag. Readings will be accurate even when the code to be read is upside down.

The *media reader* is a small, hand-held device that reads Kimball memory labels and tags and Kimball multilanguage memory tags. Labels may be applied on nearly any type of merchandise since the 710 operates on flat, curved or irregular surfaces, both hard and soft.

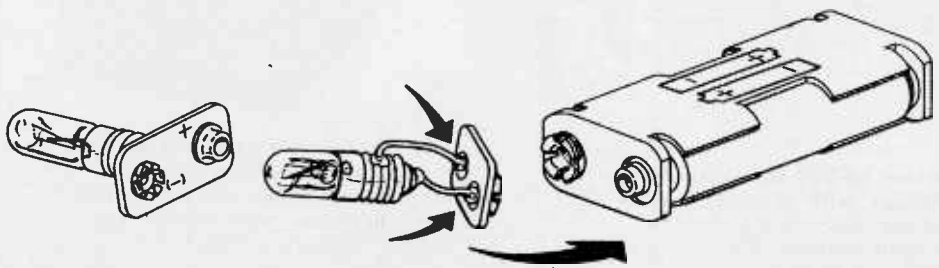
The unit is designed to interface with Singer's MDTS (Modular Data Transaction System), an electronic point-of-sale device. In addition to performing the function of a traditional cash register, the MDTS is a free-standing, intelligent terminal that captures extensive inventory information for the retailer. No keyboarding on the terminal will be necessary with the reader, which enters data into the terminal directly from sales tags and labels, credit cards and employee badges. The reader is simple to operate and provides automatic safeguards to ensure correct data entry. When the terminal receives a positive "read", it emits an audible signal. When data is read out of sequence, or when the same data is accidentally read twice, the terminal signals an error with a series of audible "beeps." ■

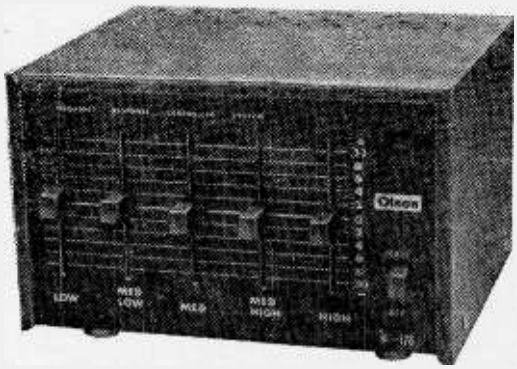
Keep a Light Flashing in the Window

☐ The night is dark, rain is falling and the parking lot is dismal. Where the heck is your car? That's easy—right over there under that twinkling star! Well, it's not a star but one of those 3-volt thermal-blink lights found in so many kids toys.

You, too, can be fortunate if you plan in advance. In fact, plan for others. Build a blinking light for your doorway or driveway, if all the houses on your street are similar. This way visitors can look for the twinkling star and find you pronto.

Hyman Wallin of Silver Spring, Maryland did just that and sent a sample to the Editors of ELEMENTARY ELECTRONICS. He soldered the bulb directly to a terminal strip yanked from a defective transistor battery. Next, he snapped it to a two-cell battery holder that mated the snap terminals on the battery strip. It's that easy. Mr. Wallin used C cells, but anything larger will be good and last longer. You can cement an alligator clip for fastening purposes. Lights out! —*Emmett Fluffin*





e/e lab checks...

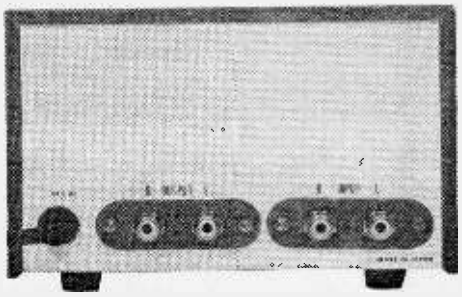
Olson's HF-176 Frequency Response Controller

Selective equalization for your stereo—at a budget price

Great! You've rushed home with Von Popinoff's latest recording—The Eruption of Mt. Vesuvius. You gingerly slip the disc onto your super-expensive component stereo. You've been planning and adding to this ultimate rig for years. When it comes to impulse power, you're a match for the starship Enterprise! Your rig is complete.

How come, then, the record sounds Blah? A component failure? Never. It's simply the record; it's been altered by a process that gives audio engineers an opportunity to add more playing time to each side. Of course, not all recordings are made this way; although very few are made without some form of selective equalization or limiting in addition to the normal RIAA pre and de-emphasis.

But there is something that can be added to almost all stereo systems large and small. It's a Graphic Equalizer—the same device recording engineers originally used to alter your record's response. Only this time you adjust the equalization to re-instate what the engineers reduced (it is possible to compensate for the built-in selective equalization since the sound has not necessarily been eliminated, just somewhat reduced as in our theoretical disc recording).



We normally produce selected equalization with a graphic equalizer—a device which boosts and attenuates at selected frequencies. Though the usual graphic equalizer is calibrated in ⅓ octave bands, the so-called hi-fi graphic equalizer usually covers full octave bands. Either way they are *expensive.*

Five Pot Performance. But now we have the Olson HF-176 Frequency Response Controller System which is priced at a rock-bottom $44.00. The secret behind the HF-176's low cost is the fact that it has only five graphic controls (linear potentiometers) at what Olson deems to be the important frequencies—110, 520, 1800, 3500 and 8600 Hz. Each control can produce up to ±12 dB equalization at the center frequency (110, 520, etc.).

The HF-176 has a single set of stereo input and output jacks which are connected to the amplifier's *tape* input and output. In this manner, the frequency response controller processes *all* signal sources. However, you do lose the amplifier's tape monitor function.

The HF-176's frequency response with all controls in the normal or center position measured ±0.5 dB. With a 300 mV input signal, the signal-to-noise ratio measured 69 dB. However, as the controls fade-in boost, they also fade-in hum, and at maximum boost the hum level is about 45 dB —just about equal to the noise from a cas-

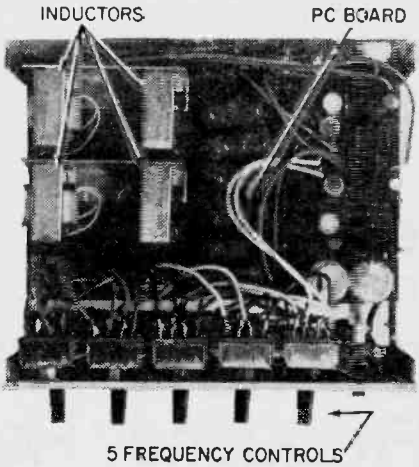
All that's required to put the Olson HF-176 Frequency Response Conroller to use in an audio system are 2-sets of input/output lines. Circle No. 55 on the Reader Service Page.

sette deck. At full boost the maximum distortion is 0.8% THD at 110 Hz and, nominally, 0.14% THD at the other frequencies.

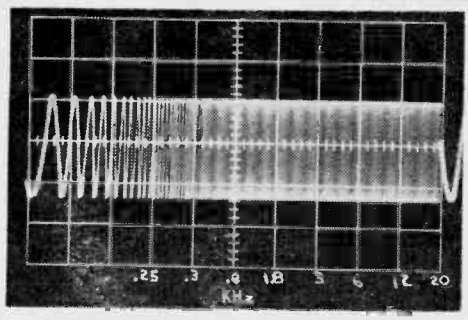
As a graphic equalizer, the Olson HF-176 works well as shown in the 'scope photos. Photo 1 is the 20 to 20,000 Hz output with all controls at the center flat position. In photo 2 we show the effect with all controls set to full attenuation. Photo 3 shows the same 20 to 20,000 Hz frequency sweep but with all controls set for full boost. In photo 4 we show one effect that can be obtained when some controls are at full boost and some at full attenuation. Naturally, you can obtain virtually any in-between equalization.

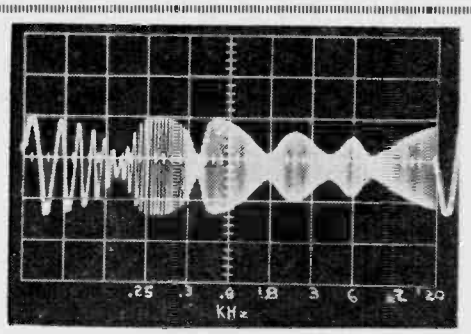
Listening Test. We tried the frequency response controller on several speaker systems. Considerable overall response variation was obtained. The listeners were able to filter high frequency resonances from pickups, increase presence with midrange boost, or pack bass into small bookshelf speakers. Unfortunately, the 110 Hz center frequency of the *low* control is too high for the average quality speaker system and pro-

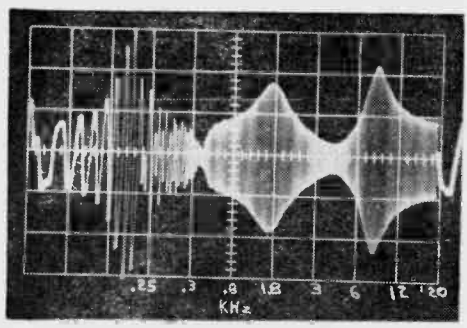
(Continued on page 101)



Inside there are five series resonant type circuits, each consisting of an inductor, capacitor and Q-reducing resistor circuit.







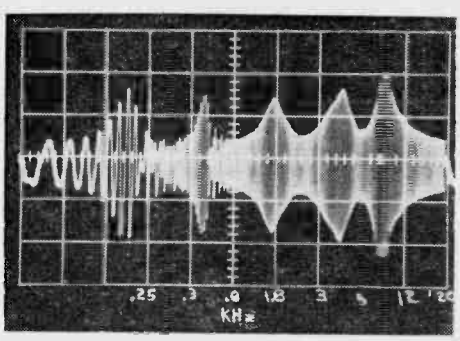


Photo 1, upper left, shows HF-176 handling 20-20,000 Hz frequency sweep, controls flat. Photo 2, upper right; notice how amplitude is selectively reduced from reference level. Photo 3, lower left, illustrates effect when controls are in their max-boost position. Photo 4, lower right, combines boost and cut; there's never more than 0.8% distortion in the HF-176, and usually much less. That 110 Hz peak is a headphone listener's bonus.

RMS

Root out what we Mean with some Square talk about...

by Norman Crawford

☐ One of the most frequently seen abbreviations in the electronics field is *rms*. A typical transformer output is 6.3 volts rms; an alternating current meter has its scale marked "rms volts," sensitive receivers have their ratings given in "signal-to-signal-plus-rms-noise ratio." Even the old familiar AC power line is nominally 117 volts rms. What is this ubiquitous abbreviation, anyway? What does it signify? And of what practical use is it?

The abbreviation *rms* stands for *root mean square*—which tells you little more than the abbreviation itself. Therefore, in our pursuit of the significance and practical uses of rms values, we shall also try to demonstrate the significance of the words *root mean square*, and show why they are used to describe this concept.

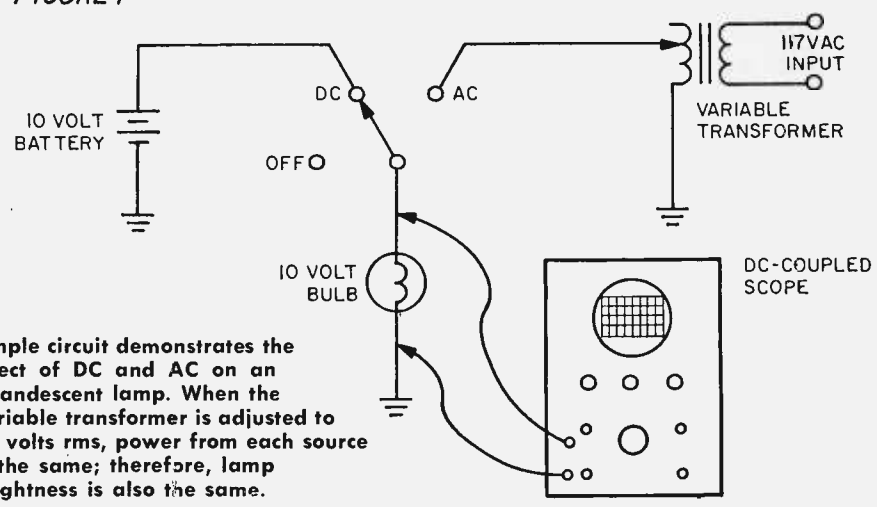
Alternating Brightness. One of the major purposes of the concept is to establish an equivalence between alternating current and direct current. For example, an incandescent lamp will light exactly as bright on 117 volts DC as it will on 117 volts AC, rms. But inspecting the alternating current waveform with an oscilloscope would show no obvious point in the waveform which could be labelled "117 volts." In fact, you'd wonder, as you stared at the waveform on the scope, just where this rms business arose, anyway!

To understand the why of rms, let us make a lab bench setup which can light a low-voltage bulb from either AC or DC, and use an oscilloscope to study the waveforms across the lamp. A convenient circuit would be as shown in Fig. 1.

To start the experiment, the bulb is lit by the 10-volt battery, and its brightness observed. The bulb is then switched to the variable transformer, which is adjusted to give the same brightness as before. Now, switching back and forth between battery and transformer should give no variation in the bulb's brightness. By looking at the bulb, you could not distinguish AC from DC.

By looking at the oscilloscope, however, you can see a marked difference. When the bulb is off, the scope trace is at rest in the center of the screen as shown in Fig. 2.

FIGURE 1



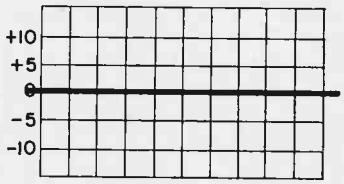
Simple circuit demonstrates the effect of DC and AC on an incandescent lamp. When the variable transformer is adjusted to 10 volts rms, power from each source is the same; therefore, lamp brightness is also the same.

e/e RMS

When the bulb is illuminated with DC, the scope trace jumps up (if it's a dc-coupled scope) and stays on the line representing +10 volts; see Fig. 3.

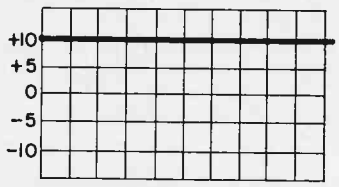
When the bulb is switched to the variable transformer, however, the scope traces out the familiar AC sine wave in Fig. 4. But

FIGURE 2



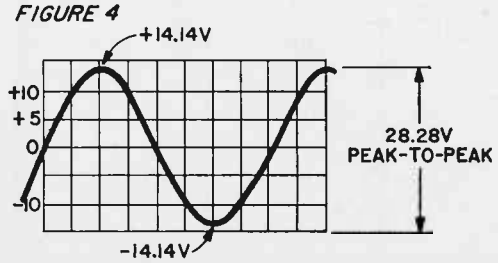
notice that, from positive peak to negative peak, the sine wave is over 28 volts in amplitude! Nowhere in the trace is there any obvious connection between the +10 volt line and this 28.28 volt sine wave. Yet, the bulb continues to glow at the same brightness, as though the similarity between +10 volts DC and 28.28 volts AC were obvious to everyone, and not just to bulbs.

FIGURE 3



White Hot. Now, the brightness of the bulb depends on the temperature of the filament. And, the temperature of the filament depends on the *power* supplied to it. And, the power in the filament is given by $P = E^2/R$, where E is the voltage across the filament, and R is the filament's resistance.

FIGURE 4



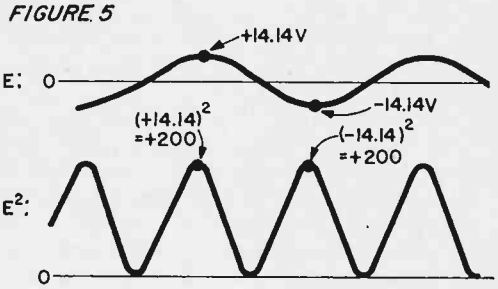
If we assume the filament's resistance is 2-ohms, the power in it when run from DC is

$$P_{DC} = E^2/R = (10 \text{ volts})^2/2 \text{ ohms}$$
$$= 100/2 = 50 \text{ watts.}$$

The AC power is a little tougher to calculate, since the voltage, E, is moving up and down between +14.14 volts and −14.14 volts, 60 times per second. However, the same formula applies if a way can be found to handle the constantly varying voltage.

The clearest picture of E^2 (which we need to plug into the $P = E^2/R$ formula) is obtained by squaring the instantaneous value of every point in the E waveform; see Fig. 5.

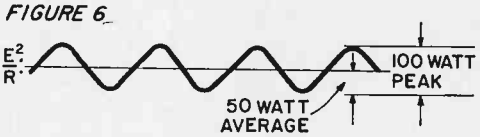
FIGURE 5



Since squaring a negative number yields a positive number, the entire E^2 waveform is positive and, therefore, lies above the zero reference line.

Power is Equal. The formula says that $P = E^2/R$. To get the power waveform, then, the E^2 waveform must be divided by R. If we divide every point in the above E^2 waveform by 2-ohms, the waveform simply shrinks to half size. (If it had been 3-ohms, it would have shrunk to one-third size.) Figure 6 is the power waveform.

FIGURE 6



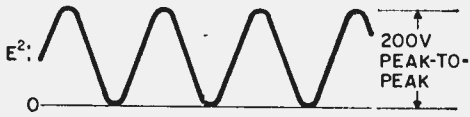
At the peak, 100 watts goes into the bulb for an instant, but at the next instant, as the waveform dives for the zero line, zero power goes into the bulb. The average, or *mean* for these two extremes, is 50 watts, the same power supplied by the 10-volt battery.

This merely verifies what our eyes have already told us; the same power, 50 watts, is supplied to the light bulb by a 10 volt battery or by a 28.28 volt peak-to-peak sine wave. But, although the word *mean* appeared

in the above paragraph, we still haven't demonstrated a basis for the phrase "root mean square," or shown how the rms value of an AC voltage can be equivalent to a given DC voltage.

From the above experiment, we now know that 28.28 volts p-p (peak-to-peak) of AC will produce the same heating effect as 10 volts of DC. We also know that the E^2 waveform of 28.28 volts of AC looks like Fig. 7.

FIGURE 7

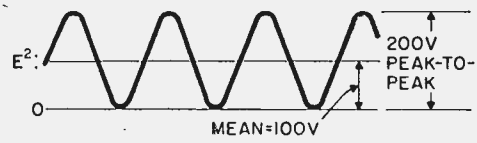


The average (mean) of this waveform is 100 shown in Fig. 8. It is the *mean* of the *squared* voltage. If we now take the square root of this mean, we get

$$E = \sqrt{100} = 10 \text{ volts},$$

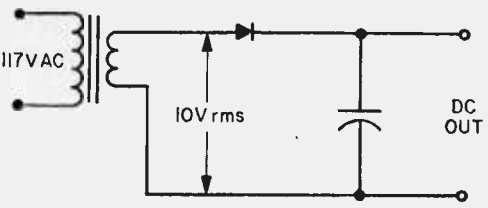
which is the *root* of the *mean* of the *square* of the original AC voltage. And, it's the DC voltage which has the same heating effect as the original (28.28-volt p-p) AC voltage.

FIGURE 8



Use Current. A similar explanation could show that the rms value of a 28.28-ampere AC *current* is 10 amperes, and this peak-to-peak AC current would have the same heating effect as 10 amperes of direct current flowing through a given resistor. As you might suspect, the discussion for current would use the power formula $P = I^2R$, and would produce *current* waveforms similar to the voltage waveforms of the above discussion.

A very common practical use for the rms concept in electronics is in calculating the dc output voltage of a power supply, given the input AC voltage in rms volts. For example, the 10-volt (rms) transformer of the above discussion, if used in a half-wave rectifier power supply, will present to



To find the output voltage of this simple half-wave power supply, you must multiply the root mean square value of the 10 volt winding by 1.414 to obtain the peak output. Figure 9 below includes a 0.6 V diode loss.

the filter capacitor a half-wave rectified waveform which is approximately 14.14 volts in amplitude as shown in Fig. 9. Since the filter capacitor tends to hold the *peak* voltage applied to it, the DC output of this power supply will be approximately 14.14 volts, less about 0.6 volts lost across the silicon diode.

In general, the peak value of a sine wave can be found by multiplying its rms value by 1.414 which is the square root of 2. Also, given the peak value, you can obtain the rms value by multiplying by 0.707.

All this discussion has been based on the most common AC waveform—the sine wave. Any AC waveform—pulse, triangular, or even random noise—has an rms value which defines its equivalent heating effect in dc volts. However, each one has a different conversion factor (the 1.414 factor for sine waves won't work). For example, to get the peak value of a sawtooth wave, multiply its rms value by 1.732, which is the square root of 3.

However, no matter what the waveform, the equivalent DC voltage having the same heating effect can be found by taking the *root* of the *mean* of the *square* of the voltage—the rms value. ■

FIGURE 9

SAVE BIG MONEY ON TV REPAIRS

DO WHAT YOUR SERVICEMAN SHOULD DO . . . AND SAVE OVER ONE-HALF THE REPAIR BILL!

OTHER than replacing a color CRT one of the most expensive TV repairs is the tuner—the *front end* as it is often termed. Most repair shops charge to $32 to "fix" a tuner, yet in most instances the repair shop will send the tuner off to a professional tuner rebuilding service such as PTS Electronics, Inc., who for something like $9.50 will rebuild the tuner to like new performance.

In short, less than $10 represents the cost of repair, the remaining $20 or so is charged for simply changing the tuner. Since changing a tuner usually involves nothing more than a few screws and some minor soldering, you might as well do it yourself and put the $20 or so in *your* pocket.

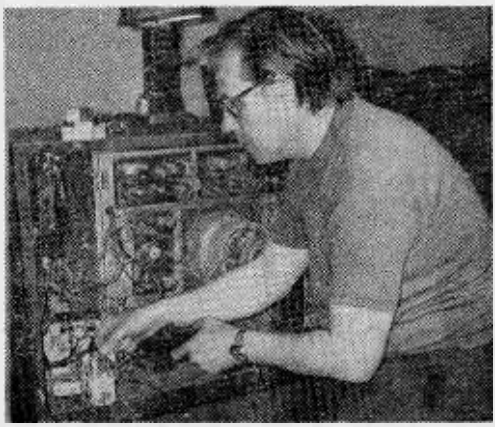
The important thing to keep in mind before you tackle your tuner is that, contrary to rumor you do not have to make any electrical adjustments if you use a tuner repair service, such as PTS Electronics. The tuner is returned to you completely overhauled, aligned and air-checked. A certificate included with the repaired tuner indicates exactly what checks were made, and the best you can do is to keep your hands off the adjustments. In fact, worn components that don't cause trouble at the present will also most likely be replaced. In the tuner shown, new coils were substituted for coils with worn, though operable, contacts.

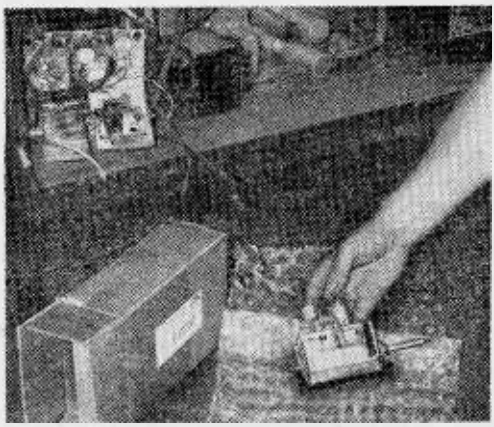
How to. First step is to remove the tuner from its mount. This usually involves simply removing two to four screws. Next, remove any plug-in cables which might come from an associated tuner, or which might be the connection to the main IF amplifier.

Make a diagram or sketch of the tuner and indicate where the plug-in cable was connected. Then, using a small soldering iron or gun, remove the power and control wires. To avoid a mixup when the "new" tuner is installed, tag each wire as it is removed and indicate its connection point on your sketch.

Remove all knobs, drive shafts, etc. from the tuner—but leave the tubes in place—and ship the tuner off to the repair service. If the repair service has sent you a complaint card, make certain you check off those complaints that most accurately reflect what is wrong. If you don't have a complaint card be sure to include a *short* description of the problem.

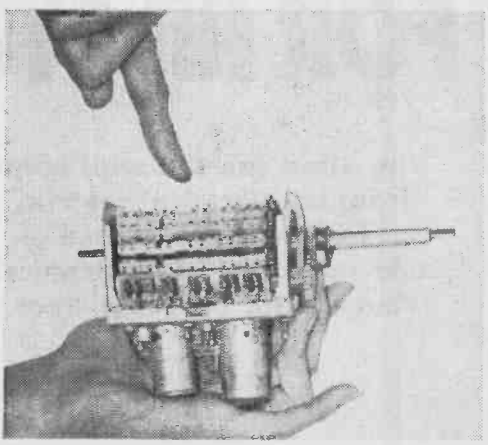
Back in. In about a week you'll have





Three easy steps save you TV tuner repair money: 1. Remove the defective tuner. 2. Mail to tuner repair center. 3. Solder and remount repaired tuner in TV set.

by THE ELEMENTARY ELECTRONICS EDITORIAL STAFF



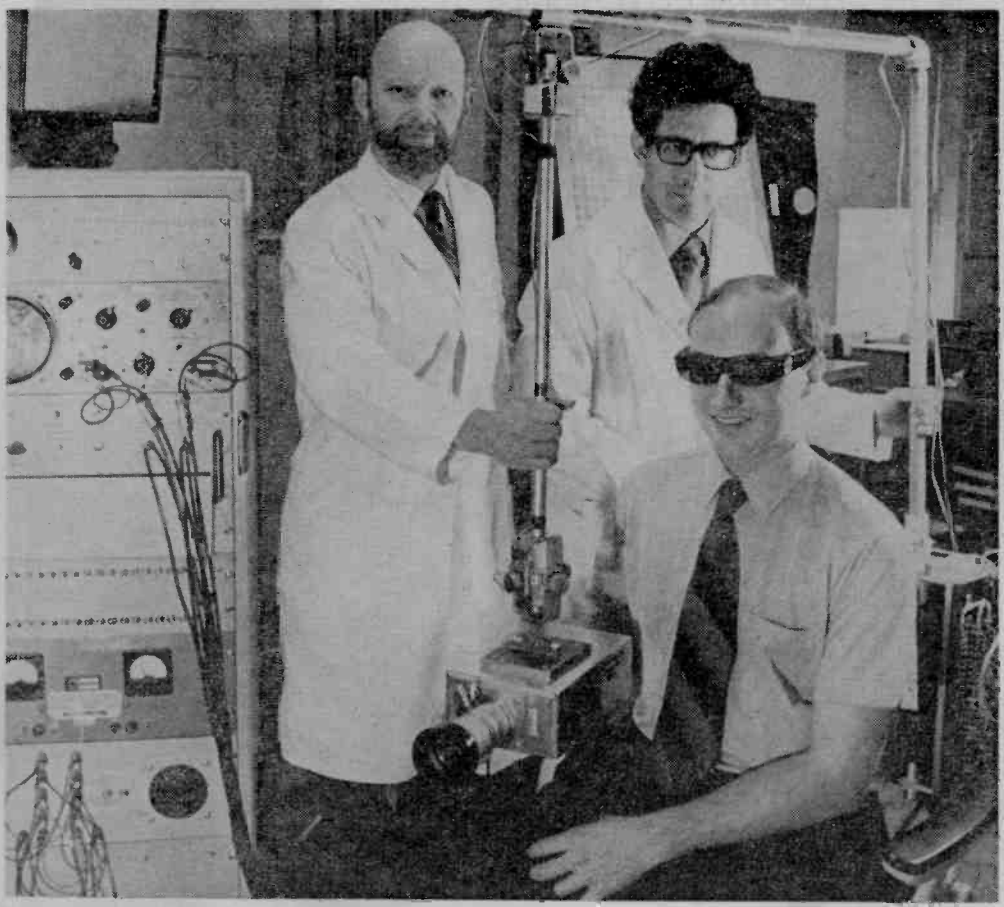
PTS Electronics, Inc. replaced tuner coils Circle No. 49 on the Reader Service Page.

your tuner back rebuilt to like-new specs. You'll note it is packaged for a trip to the moon! It is now a delicate instrument and should be handled as such.

Resolder the connecting wires, taking extreme care to double-check the tags and your sketch. Plug in the wires with connectors and secure the tuner to the cabinet or chassis with the original hardware. That's the whole bit. Your TV is ready for use, and you have an extra $20 or so in your pocket.

Of course, the question comes up: "What happens if my tuner is just beyond repair?" Such an instance is rare, but if it happens

(Continued on page 101)



Progress is miniaturization—original Seeing-Eye system (top) gives way to micro-optics (above) in the new system.

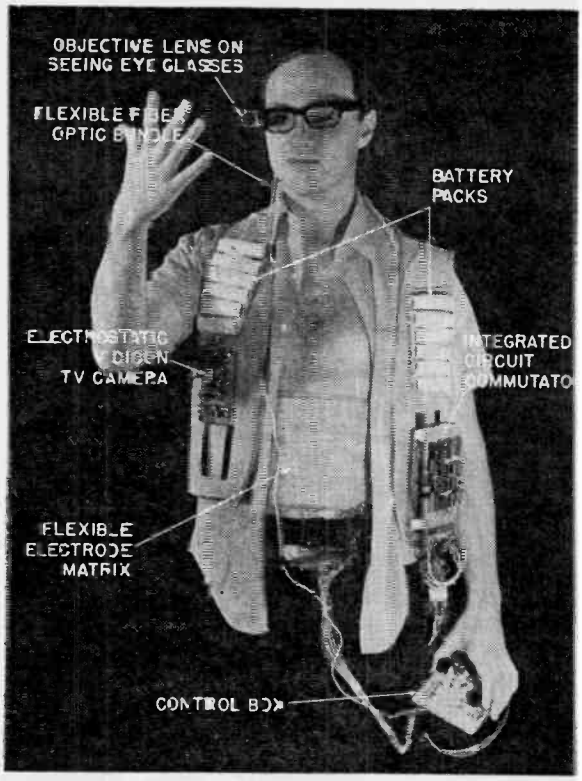
AN EYE FOR AN EYE

The blind can see with help from an electrical matrix, fiber optics, TV and new advances in electronics! And it's all portable, too!

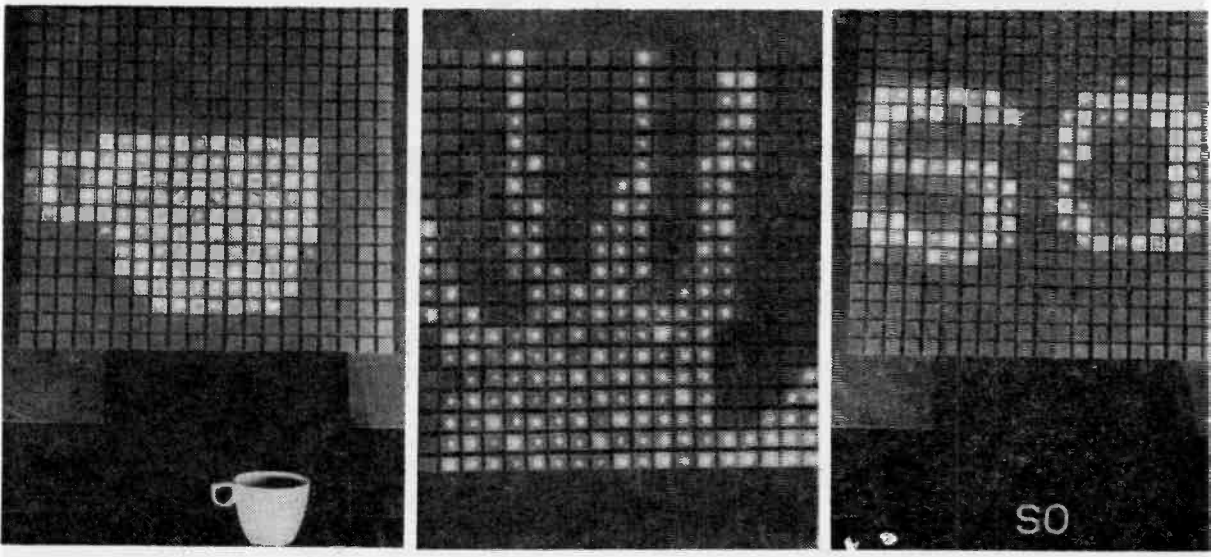
By Emma Fluffin

The blind can see without their eyes! And it's made possible with the aid of an electronic matrix that electrically stimulates the skin surface of their stomach. The combination of modern scientific methods, and the latest electronic equipment will revolutionize rehabilitation techniques for blind people throughout the world. A new portable "Seeing-Eye" system can train the blind in less than 10 hours to "see" simple objects, even read.

"See through touch" vision is transmitted through new portable equipment called the Vision Substitution System. This new 5-pound system is an improvement from the original 350-pound unit which included a 15-pound television camera and a dentist-type chair that was developed four years ago. Now science and technology have produced an effective unit which includes a small lens weighing less than one ounce (28 grams), attached onto a pair of eye glasses. The subject wearing the special glasses moves his head in the direction of an object, the lens picks up the image which is optically conveyed to a one-pound TV camera. Someday perhaps an electronic eye small enough to be implanted in an eye socket with direct connections to the brain will be possible! ■



Still a bit clumsy, but toteable, the new Seeing-Eye system can be transported by a man comfortably. Here, trainee sees outline of his hand for first time.



Imagine each light on demonstration panel corresponds to an electrical pulse on your stomach. In left photo you would see a coffee cup; center photo, a hand as it appears to trainee shown above; and right photo, the word "so".

10 New Heathkit Projects

499.95* less cabinet

NEW Heathkit 21V Color TV — Solid-State Plus Detent UHF Tuning

The new Heathkit GR-271 is the 21-in. (measured diagonally) version of our famous GR-900, the most advanced color TV we've ever offered. The GR-271 has the same state-of-the-art tuning convenience with power detent selection of all VHF and any 12 pre-selected UHF channels; exclusive angular tint control for consistently better flesh tones; voltage controlled varactor UHF tuner & MOSFET VHF tuner for unmatched sensitivity; exclusive MTX-5 matrix tube with etched face plate for increased contrast, less glare. Plus, the GR-271 has built-in dot generator, convergence panel and volt-ohm meter — full remote control options, too. It's Heathkit TV at its finest in a space-saving size.

Kit GR-271, less cabinet, 121 lbs. 499.95*

Assembled GRA-501-21, table model cabinet shown, tough walnut Marlite® finish, 33 lbs. 54.95*

689.95*

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Kit TO-1160, 211 lbs. 689.95*

64.95*

NEW Heathkit Engine Analyzer

For 3, 4, 6 and 8-cylinder engines. The CM-1050 includes leads and accessories for testing conventional, transistor, and magneto ignition systems, regardless of voltage or grounding. Uses 3 "C" batteries (not included).

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39.95*

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Kit CP-1060, 4 lbs. 39.95*

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A compact, solid-state multimeter with digital readout — at a fantastic kit-form price. The new Heathkit IM-1202 has four overlapping ranges to measure voltages from 10 mV to 1000 V on DC (either polarity), 10 mV to 700 V rms on AC, 10 uA to 2.5 A on AC or DC current. Five resistance ranges measure from 1 ohm to 2 megohms. Front panel polarity switch reverses inputs without changing leads.

Kit IM-1202, 6 lbs. 79.95*

169.95*

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The Heathkit IB-1100 gives 1 Hz to over 30 MHz counting on a full 5-digit readout with 8-digit capability. The lighted overrange indicator makes misreading virtually impossible. Stable time-base circuitry assures accuracy better than ±3 ppm from 22° to 37° C. Diode protected J-FET gives improved triggering over 100 mV to 150 V input range. Solid-state circuitry mounts on one large board.

Kit IB-1100, 6 lbs. $169.95*

to Brighten Anybody's Christmas!

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NEW Heathkit 6-Digit Electronic Alarm Clock

The exciting Heathkit GC-1005 Digital Clock displays hours, minutes and seconds on highly visible cold-cathode readout tubes. A gentle "beeper" alarm can be set for 24-hour cycle and features a snooze switch that gives you seven more minutes of sleep before the alarm sounds off again. The all-solid-state circuitry is designed to display either conventional 12-hour or 24-hour international time (Manual shows you how to wire it for the readout you prefer). Includes am/pm indicator light to facilitate setting time and alarm. Special fail-safe circuit flashes all "eights" on display if 60-cycle line voltage is interrupted.

Kit GC-1005, 4 lbs. 54.95*

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NEW Heathkit 8-Channel VHF Band-Scanning Monitor with digital readout

Crystal-controlled monitor tunes any selected 9 MHz segment of the 146 through 174 MHz band — gives you police, fire, marine, ham 2-meter, etc. Features either manual or automatic scanning with numerical readout, channel lock-out buttons. Priority channel "0" takes precedence over all other channels when in the automatic mode. Also has built-in speaker and rear-panel jack for remote speaker; Gimbal bracket and mounting plate for either base-station or mobile use. Operates on either 120/240 VAC or 12 VDC. Includes crystal OSC/Mixer signal source for easy alignment. Order up to eight Crystal Certificates with kit, fill out and return for speedy delivery of the frequencies you need.

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GRA-110-1, Crystal Certificate, postpaid ..... each 4.95*

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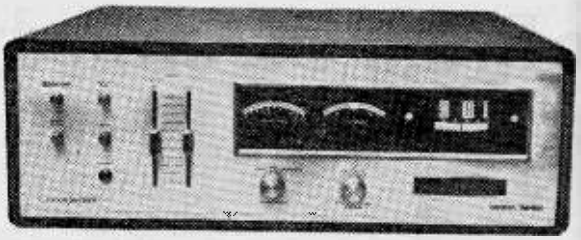
CIRCLE NO. 1 ON PAGE 17 OR 103

e/e checks out the first FM tuner with Dolby...



THE HARMAN-KARDON CITATION FOURTEEN

ACCORDING TO PROPONENTS of Dolbyized FM broadcasts—and we do not dispute their tests or reasoning—using the Dolby system will result in an 8 to 10 dB improvement in signal-to-noise ratio. But what does this mean in plain terms, and how will it affect the typical user?

As a starter, 8 dB is the gain of a Yagi directional antenna—the type that requires an expensive rotator installation. In short, the Dolby would allow you to use an ordinary, less than $5, turnstile antenna in place of the Yagi installation (assuming you have no multipath problems requiring a Yagi). And 8 to 10 dB is often just a little bit more than is needed to turn a noisy FM stereo signal into good reception; it's like boosting a 100 *u*V input signal to, nominally, 300 *u*V.

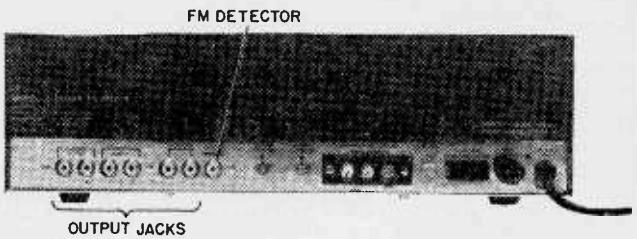
As far as the broadcasters are concerned, Dolby restores coverage lost when they switched from mono to stereo. So from every point of view—from the listener's pleasure to the economics of FM broadcasting—Dolby is *in!*

The First FM Tuner we have seen specifically designed to capitalize on the advantages of Dolby FM is the new Harman-Kardon Citation fourteen, which is very simply a darn good basic FM stereo tuner.

Performance. The sensitivity measured 1.6 *u*V IHF with full limiting at 4 *u*V and 55 dB quieting at 5 *u*V. Full mute release was obtained at 12 *u*V with the factory-set mute level (can be user-adjusted). At standard test level the frequency response measured +0/-2 dB non-Dolby from 20 to 15,000 Hz: +0/-3 dB Dolby. Distortion measured 0.11% THD, and was essentially unmeasured at 15,000 Hz. Non-Dolby signal-to-noise ratio measured 74 dB. The Dolby delivers an additional 8 dB of noise suppression. The stereo separation exceeded the 48 dB limit of our test equipment. Of note, the Dolby circuit supplied an additional 6+ dB suppression of the unwanted channel, for the Dolby sees leakthrough as noise. The selectivity was excellent. Maximum output level was 500 mV.

For Exacting Tuning. In the Citation fourteen the Dolby is keyed to a new type of tuning meter. Unlike the average tuner which might have a signal strength meter and/or a center-channel tuning meter, the Citation fourteen has a *tuning* meter and a *quieting* meter. According to H-K, the quieting meter is the more precise, as its maximum indication shows the precise tuning for minimum distortion and maximum signal-

(Continued on page 99)



All output jacks for oscilloscope, variable level, fixed level and the tape output on the front panel are after the Dolby circuit. An FM detector output, for future discrete 4-channel FM broadcast accessories, is before the Dolby.

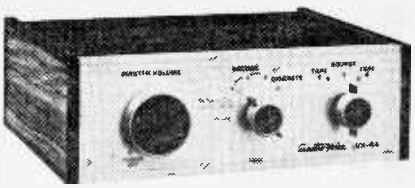
HEY HERB

THE AUDIO ANSWER MAN

by Herb Friedman

Hey Herb: I've really flipped over 4-channel sound and would like to buy the necessary gear, but my dealer has left me in total confusion. He says there are different types of something called *encoding* and the sound won't be good if I don't match the playback equipment to the record. Is this for real? Does he mean I will be limited to only certain 4-channel records?

Your dealer has a point. There are at least four types of 4-channel encoding on records. There's SQ (CBS), QS (Sansui), "standard' (Electro-Voice) and some Dyna encoding—



Electro-Voice EVX-44 Decoder

though the first three are the biggies. Until the industry straightens itself out and decides which system will be standard, I recommend an Electro-Voice EVX44 decoder (not the EVX4). It does a very fine job on all forms of 4-channel encoding. None come out quite optimum but all are good. My personal feeling is that SQ has the staying power and you wouldn't go wrong with an SQ decoder, receiver or amplifier. In a few more months I believe all major 4-channel record releases will be SQ.

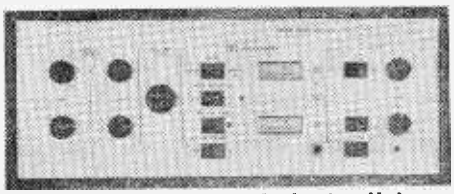
Hey Herb: In addition to dynamic and continuous power ratings my new Pioneer amplifier is rated for something called *20-20k*. Just what is this new specification supposed to mean?

It means honesty: Instead of all the garbage power specifications intended to prove that a pipsqueak amplifier equals 100 watts, the *20-20k* means that your Pioneer amplifier will produce that *rms* power at *every* frequency from 20 to 20,000 Hz. If you look again you will find a 20-20k distortion rating that means the *maximum* distortion at any frequency. In short, the *20-20k* rating takes into account power output and distortion at all frequencies. It's the best and *most honest* rating. Though many organizations are claiming credit, the specification originated about two years ago in ELEMENTARY ELECTRONICS sister publication, the HI-FI STEREO BUYERS' GUIDE.

Hey Herb: I record my school's plays and musicals by using four parallel connected mikes to feed the P.A. system; I bridge two Sony cassette recorders across the mike output cable. A teacher connected another Sony cassette to the mike line and I ended up with a tone of about 3000 Hz just below the program level. Got any ideas what happened and how I can eliminate the tone?

Get rid of the teacher and his recorder first. Then get your recorders off the mike line. I have never heard of this cassette problem before, but it sounds as if one of your recorders and the teacher's recorder have record bias leakage at the microphone inputs. Some non-linear element in your recorder is beating the two bias signals, causing the tone to be recorded. I have seen this with several professional recorders so I guess it can happen with cassettes. Your best recordings will be made by bridging the cassette's *aux input* across the P.A. amplifier's line or accessory output.

Hey Herb: I have an Advent Dolby unit. Could I use it to reduce the noise on sound tracks I prepare on magnetic striped movie film.



Advent 100A Noise Reduction Unit

Yes, it does a terrific job. The photo crowd hasn't discovered Dolby yet, but it's their answer to the *waterfall* 8 mm. sound tracks.

Hey Herb: What would cause a very strong hum from an Empire Troubadore turntable? I've tried two models with the same results.

Connect the ground wire that comes out of the turntable's output cable to the amplifier

e/e HEY HERB

Empire 598II Troubadore Turntable

ground. Most high performance turntables have an independent motor ground that *must* be connected to the amplifier. On less expensive turntables the ground wire, if there is one, is usually redundant because the output cable's shield is usually connected to the motor's frame or ground connection.

Hey Herb: I am taking a trip to Europe. I've read some great reviews of equipment in an English hi-fi magazine. Would it pay me to have the equipment shipped back and pay duty after it arrives?

Better re-read those reviews. I have found that European magazines can twist just about anything to look good in print. Also, with few exceptions such as Warfedale speakers, Radford amplifiers, Thorens turntables, and Garrard machines and Tandberg recorders, European gear is *third rate*. The DIN specs are the most overrated hogwash since the Titanic was spec'd as *sinkproof*. For example, the DIN accepts −47 dB noise as "acceptable for cassettes". Man, the American and Japanese gear passed that a long time back. And whle the Europeans snicker at our stupid dynamic power ratings, their continuous average power (which we term *rms*) is spec'd to bandwidth (not 20-20k). Finally, they consider 20 watts rms as *high power*. Just try to fill your livingroom with that. When you cross the big pond take a look at the prices on American and Japanese gear; they are astronomical because the local governments tax the behind off foreign gear. Why?, because the people would flock like lemmings to buy what we get here at *low prices*. In Denmark, noted for quality sound products, discount stores and decent pay for a day's work, a typical hi-fi rig would be Panasonic or JVC receivers and amplifiers, Sony or TEAC tape deck and Advent speakers. (Yes, Advent.) And when they really want to splurge there's a Scott receiver on the most wanted list. Then you'll get to France, well noted for starvation wages. You'll find the prices for gear originating outside the common-market justify 14 kt. gold plating. If you want qualty gear at reasonable prices your best bet is to buy it here. And don't overlook that a piece of gear can cost you about $50 in shipping and "handling" fees, import duty, and an import broker's fee unless you feel like showing up at the pier with a set of tools and handling your own customs clearance. And if you don't live near the docks, there's another shipping charge from dock to you.

Hey Herb: What type of microphone would you suggest for recording classroom lectures?

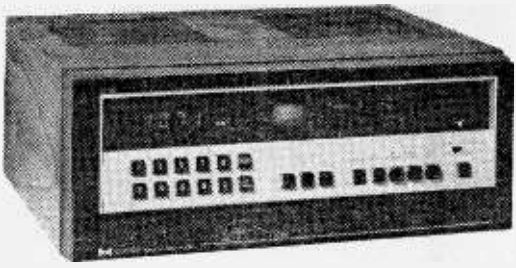
Any good unidirectional. The more *uni*, the better. Extraneous noise from the rear and sides would be attenuated.

Herb would like to answer all the questions our readers send. However, he can only sample the questions received and answer as many as possible through this column. Sorry, it's impossible to answer questions by return mail. Questions of a personal listening nature cannot be answered. Send your questions to Hey Herb, ELEMENTARY ELECTRONICS, 229 Park Avenue So., New York NY 10003.

She Shoots a Killer Whale Twice a Day

Seeing a killer whale like Baby (right), a mere three ton beastie, leap through the air with the greatest of ease, is quite a sight. Problems can and do arise with a mammal of this size especially when the whale happens to have a fever. How do you take the temperature of a killer whale? Answer —simple, shoot it! This is what the pretty Ms. does at Windsor Safari Park in England where Baby is a star attraction. The other baby, the Ms. to our way of thinking, uses an infrared emmision therometer which detects temperature of objects up to 100 feet distant. This is easier than a giant rectal therometer. —*Emmett Fluffin*

e/e builds a Heathkit...



DIGITAL FM STEREO TUNER

3 STEPS AHEAD:
Electronic Tuning • Digital Detector • Repeatable Performance

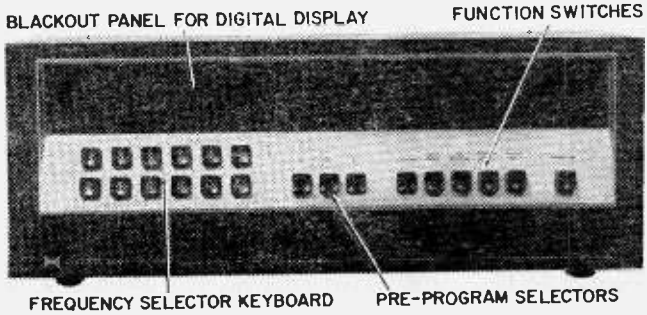
What would you like in an FM stereo tuner? Would you like selectivity so sharp that it cleanly receives a weak, distant station when there's a strong local on the adjacent channel? Would you like automatic tuning that's so precise every station is instantly tuned for minimum distortion and maximum stereo separation? Or how about digital frequency readout with touch-key tuning like touch-tone telephones? The plain fact is that any important and desired FM tuner feature, and the peak in FM performance, will be found in the Heathkit AJ-1510 FM Stereo Tuner.

It is somewhat difficult to itemize the features of the digital FM tuner, because except for the usual line level and oscilloscope multipath indicator output jacks, everything about the AJ-1510 is new and different.

First, the AJ-1510 is an all digital design; not only is the frequency indicator digital, but the actual tuning and FM detector systems use digital techniques. For example, in the typical FM tuner, even those with digital readout devices, there is a tuneable oscillator that beats against the incoming signal to produce a 10.7 MHz IF. The tuneable oscillator is 10.7 MHz above the frequency of the incoming signal. Whether the tuner uses a variable capacitor or a varactor (capacitor diode) for oscillator tuning makes no difference, the user still must literally tune-in the station.

PLL Tuning. In the AJ-1510, however, the user does not tune the oscillator. Instead, by pressing the appropriate keyboard touch-keys, he selects a countdown ratio by which the tunable oscillator is digitally divided. The output of the countdown chain provides one input of a phase locked loop, known as a PLL. A 100 kHz crystal controlled oscillator is divided to 25 kHz and also fed to the PLL. When the PLL "sees" a difference between the 25 kHz reference frequency and the tuning oscillator, it generates a correction voltage that is applied to a varactor diode in the tuneable oscillator. The varactor then instantly tunes the oscillator to the correct frequency.

Because the reference oscillator is crystal controlled, every station is automatically tuned precisely to the center channel with more accuracy than is possible with center



Not a knob in sight! That's the first hint that this state-of-the-art FM tuner is just that. The most advanced design available to the consumer today. For more information about the AJ-1510 Digital FM Tuner, read on—then circle number 1 on the Reader Service Page.

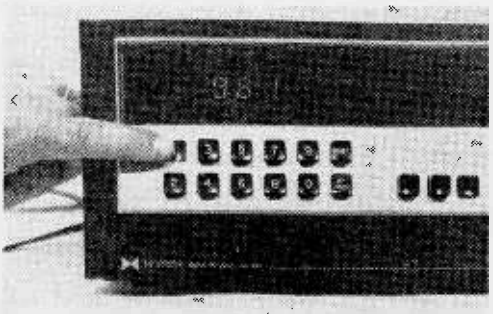
channel or signal strength tuning meters.

Since the touch-key PLL tuning system was already in the tuner, it was easy for Heath to also provide sweep tuning. Press a button and the tuner locks onto each FM channel as it incrementally sweeps down from the top of the band, stopping only at a signal strong enough to be received cleanly. Finally, Heath provides three pre-programmed stations. By inserting three user-notched cards in concealed front panel slots, a favored station is instantly selected by simply pressing a button; the notched card provides the proper countdown control.

Noise squelch is provided not only for interstation noise muting, but it also mutes the receiver during an automatic tuning sweep. The noise squelch trigger level is adjustable so it can be used to squelch signals too weak for good reception—just as the sweep circuit has a user adjusted AGC control so tuning stops only on signals strong enough for good sound quality.

The rest of the tuner circuits are, similarly, as modern as the state-of-the-art will allow. The multiplex decoder is also a PLL, thereby insuring a very high stereo separation. Even the FM detector is new. Heath's engineers have put the first digital-type detector in consumer FM gear. With it, absolutely no adjustments are made to the FM detector itself, because there are no tuned circuits.

By The Sea. Unlike the usual tuner whose selectivity is determined by tuned circuits, the AJ-1510 derives virtually all its selectivity from a passive multipole filter whose selectivity is so high that its



Not the fastest, but the most interesting way to tune. . . . Just push buttons in a 961 sequence and you're perfectly tuned to 96.1 MHz. Heath provides an FM station listing.

One of the three user programmed cards that fits into the AJ-1510. Heath provides 10 blanks, more are available if you want them.

numerical value—95 dB IHF—is meaningless without an explanation. The FCC has spaced local stations on *alternate* channels —a separation of 400 kHz—to avoid interference caused by poor receiver selectivity and transmitter spillover. An excellent tuner is one that can cleanly receive alternate-spaced stations. Stations located on *adjacent* channels are usually distant stations which get swamped by your local, adjacent station. In the Heathkit AJ-1510, however, the selectivity is so good it is actually possible to receive cleanly a weak distant station when the adjacent station is a strong local. For example, we are located about fifty miles south of New York City on the New Jersey coast. Our eighty foot elevation puts our antennas virtually in a line-of-sight condition with the FM and TV broadcasters topping the Empire State Building. With the AJ-1510 we were able to slice between WNYC, a New York City station at 93.9 MHz, and WJLK, a local on 94.3 MHz, right through to WYSP in Philadelphia, Pennsylvania—a station 70 miles distant on 94.1 MHz. Now *that* is performance of the highest degree.

The AJ-1510 tuner is available only in kit form for $539.95. The pecan finished cabinet is an extra $24.95. The overall dimensions of the cabinet mounted tuner are 16⅜-in. W x 6-in. H x 14¾-in. D.

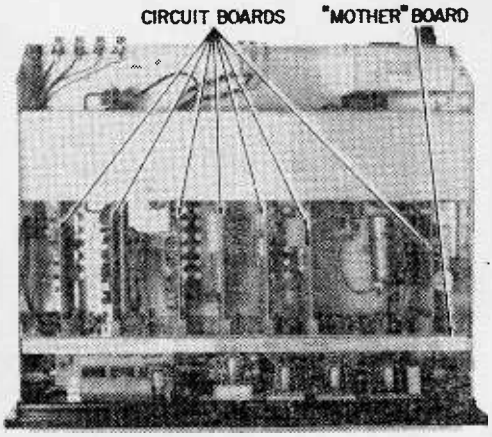
Among its many features are the previously mentioned digital readout and tuning, digital keyboard frequency selection, automatic sweep tuning, three user programmed frequencies, a stereo beacon, FM noise squelch, MPX filter and a signal strength meter that also doubles as a multipath indicator.

There are no visible front panel controls. The main panel has keyboard-type push

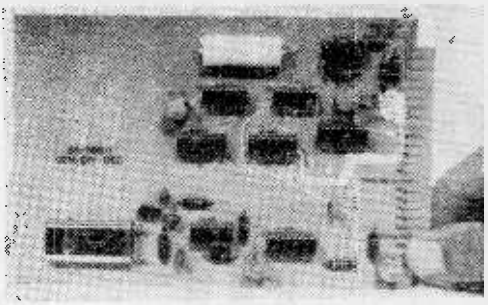
buttons for frequency selection (0 to 9), frequency *reset*, *automatic sweep*, automatic sweep station *bypass*, *keyboard* selector, *PRE-program A*, *B* and *C*, a *squelch defeat*, a *stereo only* selector and a *power on* switch

Hidden Controls. A strip across the bottom edge of the panel swings down to reveal a concealed space with controls for auto-sweep *speed*, *noise* squelch level, auto-sweep stop level (*AGC squelch*) and switches for *signal* or *multipath* meter indication and stereo/mono/MPX filter. The three pre-program cards also fit into the concealed space. The rear apron contains the audio and oscilloscope output jacks, 75/300 ohm antenna terminals and an unswitched AC outlet.

As you would imagine the assembly is a rather formidable undertaking in terms of time and effort. The kit we tested was assembled in something over 30 hours by Peter Dexnis of the e/e staff. Fortunately, though there are many, many individual components, the layout is an absolute dream. If you were given the task of designing a kit assembly that would present the least amount of goof-proof effort, you would most likely come up with exactly the layout Heath used for the AJ-1510. Just about everything is broken down to small PC board plug-in assemblys, with the matching sockets mounted on a "mother board". In a sense the AJ-1510 consists of a series of small individual kits, which when inserted into matching sockets, somehow turns into what many consider to be the state-of-the-art in FM stereo tuners.



If you've seen a lot of high quality rack-mount digital equipment, you know it looks just like this birds-eye view of the 1510. Reference crystal oscillator is shown above.



Extensive use of ICs makes construction an easy and pleasant chore, although expect to spend about thirty-five hours building it.

As is typical of all modern audio equipment by Heathkit, the tuning/multipath meter also serves as a test and checkout instrument whose test leads are an integral part of the tuner; they are normally stored inside the chassis frame. There are pages and pages of illustrations indicating the correct meter readings for just about every circuit in the tuner. If the meter reads correctly the tuner should work as soon as power is applied. If you have made a wiring error —which is a bit difficult in this kit—the meter instantly indicates the problem area.

But . . . Is it worth $500 for a kit of parts? One of the unfortunate aspects of high quality or high performance equipment is that measured performance can often appear not much better than lesser priced, inferior equipment. For example, the measured performance of the AJ-1510 as adjusted by Pete (no factory adjustment) was a sensitivity of 1.8 *uV* IHF and a stereo separation of 41 dB. At standard test level the frequency response measured +0/-0.5 dB from 20 to 15,000 Hz at a distortion of 0.39% THD and a 68.5 dB signal-to-noise ratio. Now this is performance typical of any good-to-excellent tuner. The difference lies in those performance levels rarely specified. For example, the Heathkit AJ-1510 produces *both* full limiting and 55 dB quieting at 3 *uV*. In plain language this means that the AJ-1510 produces clean, excellent reception of signal levels too weak to be received noise-free on most other tuners. In short, in terms of reception we have never seen an equal to the AJ-1510

Also, how can one express clarity of sound that must be heard to be believed. Yes, we feel the AJ-1510 is worth the $539.95, for its performance is the goal to which others must now strive.

For additional information circle No. 1 on the Reader Service Page. ■

JOURNEY TO JUPITER

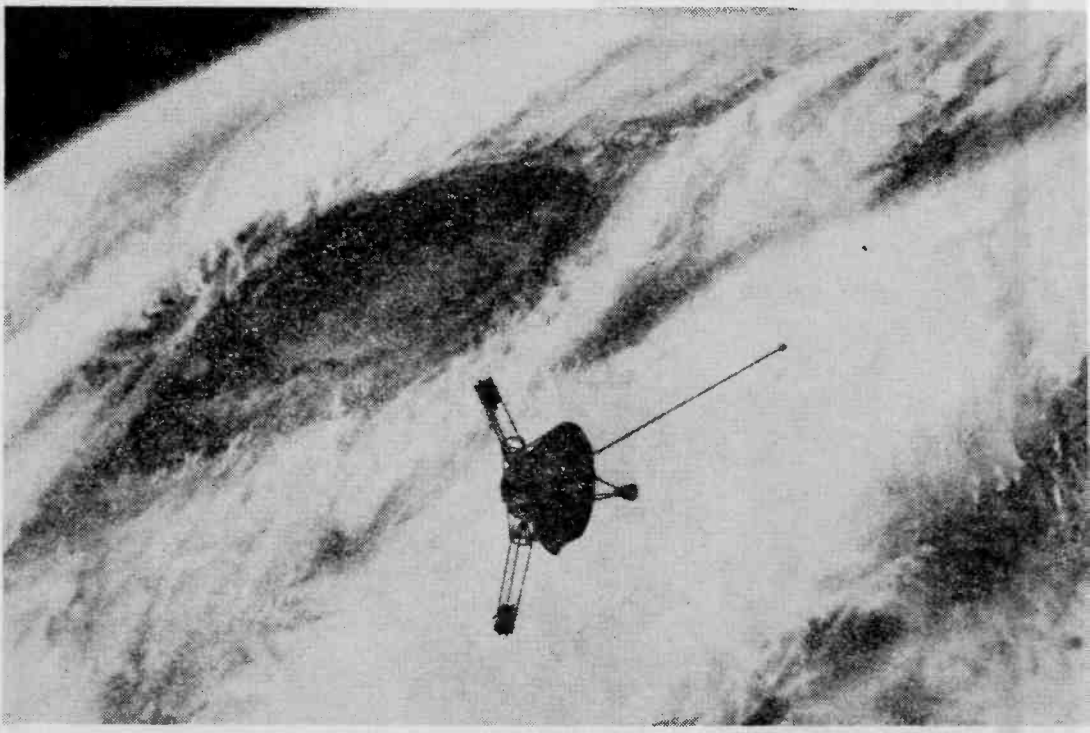
by Frank Giusi

JUPITER spins brightly far out in space, half a billion miles away. But this distance has not stopped man's curiosity about this planetary giant. Galileo first observed it through a telescope in 1610 and discovered the four largest of its 12 moons.

The planet is a seething, gaseous, multihued mass of mystery, swaddled in thick clouds. Viewed from earth, it is one of the more brilliant bodies in the sky, striped across its girth in shades of orange, yellow, pink, blue, and gray, with a huge red oval, measuring 30,000 by 8,000 miles, floating in its southern hemisphere.

Jupiter is the largest planet in the solar system, 1,000 times the size of earth, its mass more than twice that of all the other planets combined. An unmanned, instrument-laden spacecraft, Pioneer 10, is now on its way to the Jovian giant.

Just before Christmastime in 1973, if all goes well, the mission is scheduled to culminate in a looping flyby that may take the spacecraft as close as 87,000 miles near to the planet for four days. And man will get his first good look at Jupiter. The National Aeronautics and Space Administration hopes the mission will yield valuable new knowledge of the planet, the outer solar system, and our galaxy.



Artist's conception of Pioneer 10 during its fly-by of Jupiter about 87,000 miles above the surface near a strange red spot.

The long, 21-month journey began on the evening of last March 2 with the liftoff from Cape Kennedy of an Atlas-Centaur rocket, its second stage powered by two engines fueled by liquid hydrogen and producing combined thrust of 30,000 pounds.

Normally a two-stage launcher, the Atlas-Centaur was fitted with a third, solid-fueled stage for the Jupiter voyage. The new top stage hurled Pioneer 10 through space faster than any man-made object has ever gone before. At 32,000 miles an hour, the escape velocity required to reach Jupiter, the spacecraft sped past the moon's orbit in 11 hours, compared to the three days it takes an Apollo spacecraft. For the first week, Pioneer gobbled up space at an average rate of half-a-million miles a day.

The Perils of Pioneer. The mission, so lengthy and complex, is beset with uncertainties. Since last summer Pioneer has been braving the hazards of cosmic debris found in the asteroid belt. The belt is about 175 million miles thick encircling the sun between the orbits of Mars and Jupiter. It contains perhaps 50,000 larger asteroids, or solid chunks, ranging in diameter from 480 miles to one mile, in addition to hundreds of thousands of smaller fragments and concentrations of dust particles.

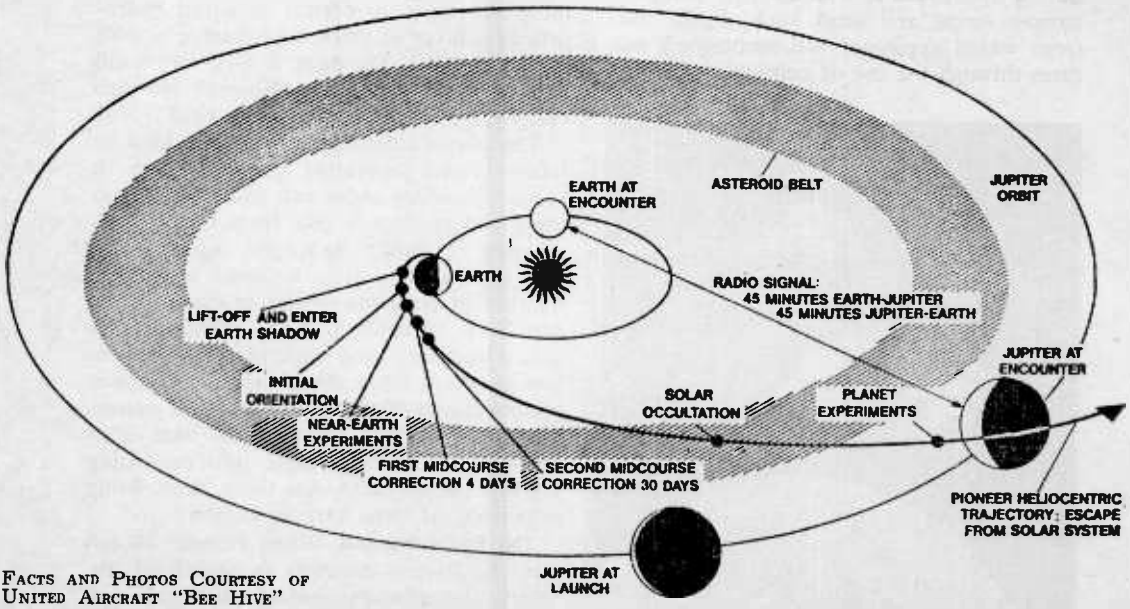
Will Pioneer 10 be knocked out by asteroids?

The answer is "No." NASA calculates that the threat of collision with an asteroid large enough to cause damage or destruction is negligible. Pioneer 10's designers tried to give the spacecraft a margin of safety to withstand the unestimated smaller bits in the belt.

Some scientists believe the asteroids may have condensed individually from the gas cloud which formed the sun and planets, or they may be debris from the breakup of a very small planet. Orbits for 1,776 asteroids have been identified and calculated by astronomers. But much more knowledge of the asteroid belt and its contents is essential to deep planetary exploration. Because the belt is too thick to fly over or under, all missions to the outer planets must pass through it. Instruments will be busy collecting all kinds of information about the clutter as Pioneer flies through.

Still another peril to face Pioneer as it draws closer to Jupiter is the planet's radiation, estimated to be as much as one-million times more intense than the earth's Van Allen belts. It could cripple or destroy a spacecraft coming too close.

A Long-Awaited Arrival. When it arrives at Jupiter, the 570-pound Pioneer will have voyaged more than 600 million miles in a



FACTS AND PHOTOS COURTESY OF UNITED AIRCRAFT "BEE HIVE"

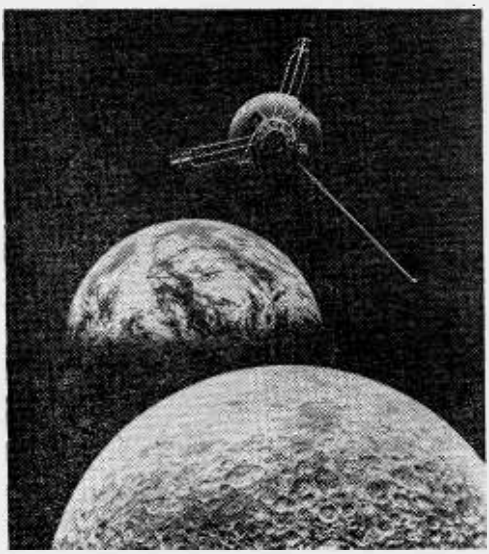
It will take Pioneer 10 nearly two years to reach Jupiter, its prime target, after a "heliocentric" six-hundred million mile trip through uncharted space including the 175-million mile thick asteroid belt. Nuclear generators supply power to all systems.

curving course from Cape Kennedy. The planet is so far away that radio commands from earth will take 45 minutes to reach the vehicle. By contrast, it takes an earth signal eight minutes to get to Mars, two seconds to get to the moon.

Pioneer's *eight watt* signal, transmitted from Jupiter, will reach earth at a power so low that, if it were collected for 19 million years, it would light a 7.5-watt Christmas tree bulb for only one-thousandth of a second. To carry out the mission, the advanced communications technology of NASA's Deep Space Network, with outposts in California, Spain, Australia, and South Africa, will be strained to the limit.

Solar energy is so weak at Jupiter that Pioneer could not draw on the sun to generate on-board electricity. Instead, the spacecraft is getting its 140-watt electrical power entirely from nuclear generators.

Pioneer 10 is carrying 65 pounds of scientific instruments to carry out 13 experiments, including picture-taking. A camera-like device, called an imaging photo polarimeter, will take ten images of Jupiter during approach. It will scan the planet in narrow strips and send back digital data from which engineers will reconstruct pictures through the use of computers. The resulting images should be better than the best obtained from earth. Even more important, they will be taken from viewing angles impossible to get from earth.



Besides taking pictures, Pioneer 10 is to make 20 types of measurements of Jupiter's atmosphere, high-energy radiation, temperature distribution, moons, magnetic fields 20 times stronger than earth's, and other phenomena. The instruments may also be able to send back data about the heliosphere, the sun's atmosphere created by gases flowing out from the solar surface; and about such spatial things as cosmic rays, interplanetary dust and interstellar gases.

Secrets of the Mysterious Giant. From centuries of observations and analyses, scientists know something about Jupiter. There is much more they don't know but hope to learn through the Pioneer mission.

The planet is wrapped in heavy clouds. Although temperatures at the cloud tops are more than 200 degrees below zero, room temperatures are believed to exist in much of the atmosphere below the clouds. Estimates of the atmosphere's depth under the clouds range from 60 to 3,600 miles. What lies beneath the atmosphere? Does the planet have a solid surface? Or does it, as some suggest, go from a thick gaseous atmosphere down to oceans of liquid hydrogen, to a layer of slush, and then to a solid hydrogen core? Or does it lack any solid material at all, as some believe? No one really knows, though theories abound.

The planet apparently has some kind of internal heat-generating process, since it seems to radiate about two and a half times more energy than it gets from the sun. Its makeup is mostly hydrogen, with helium also present, and it is believed to have a mixture of elements similar to those on the sun. So it probably also has abundant oxygen, which may have combined with hydrogen as water. Since the planet also contains ammonia and methane, it could well possess the chemical ingredients—plus heat—that are believed to have gone into producing the first life on earth. Are there, then, living organisms of some sort on Jupiter?

The Flight Beyond. When Pioneer 10 enters the Jovian environs in search of answers, the planet's gravitational pull and orbital velocity will speed up the spacecraft from 20,000 to 78,000 miles an hour. After the flyby, Pioneers will be whipped on past

(Continued on page 102)

by Kathi Martin KAI0614

KATHI'S CB CAROUSEL

Shades of Radio Amateurs! SSB (single-sideband) operation on the Citizens' Band is as hot as my XKE running flat out. There are so many SSB CBers in this girl's neck of the woods that we've had to set aside SSB channels just like the Hams did years ago.

It wasn't much of a problem when just a few of us locals started using SSB; there was always a vacant channel somewhere. But it seems that just about everyone has latched onto the greater range possible with SSB, and almost every channel wound up with the SSBers hacking the AMers with monkey chatter while AMers clobbered SBers with heterodynes.

So we did just what the Radio Amateurs had to do, we set aside several unofficial SSB channels. We stay on these while the AMers use the rest. While it does restrict the operation to some degree, at least we all get a chance to run 100% copy transmissions.

To illustrate just how much SSB has taken over CB, it's only necessary to look at the latest in SSB gear—and virtually all CB manufacturers now turn out at least one SSB model. Gone are the old black boxes that looked like 1938 military equipment. The modern SSB transceiver is sleek with modern, round styling, plenty of trim and a lot of favorite features.

Now . . . A typical example of the modern solid-state SSB rig is Pearce-Simpson's Simba SSB. The Simba is housed in a rounded 15 1/16-in. W x 6 1/4-in. H x 11 5/16-in. D cabinet. The front panel is a combination of bright-metal and wood-grain, with a digital clock centered behind a black glass insert. The digital clock has the usual alarm switch with an extra position that automatically applies power to the transceiver at a preset time.

In addition to the usual SSB transceiver features such as *volume* and *squelch* controls, *RF gain, clarifier* and *USB, LSB* and *AM* modes, the Simba also features metering for signal strength, RF output, SWR and percent modulation. So you get not only a transceiver but all the extra accessories you would usually use to insure optimum performance.

Naturally, if you're wondering why there's a modulation meter and not just a glow lamp to show you're modulating the rig, it's because the Simba has a *mike gain* control. You don't have to settle for some sort of average gain that might not match your

Just one "Break" tells you the Simba SSB packs more than a pretty face. For one thing, there's no need for a special measuring accessory—meter on left is a full-time SWR indicator, and on right, an S/RF and % modulation meter. Circle No. 47 on the Reader Service Page.

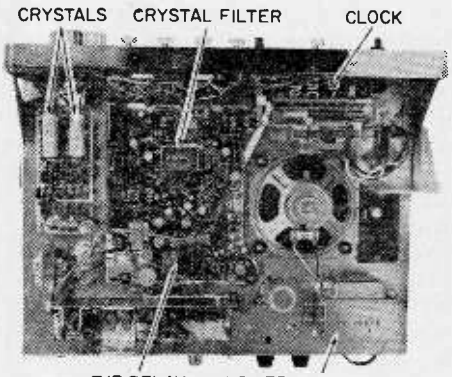
own voice level. On the Simba you set the mike gain to exactly the level that's needed.

And as if all this were not enough, the Simba has a noise blanker, and the usual PA and external speaker jacks (on the rear apron) as well as a front panel headphone jack.

Something Extra. And just to round out this package of goodies, the Simba is supplied with a plug-in mike that looks as if it came from the NASA space center. The heavy, weighted base has an oversize touch-to-operate bar, and the mike is mounted on the end of a relatively long, adjustable boom. Just sit back and position the mike where you want it; there's no need to hunch over a fixed desk mike or keep your fingers clamped around a mobile mike.

Though the Simba SSB is essentially AC powered, there is a DC input (12 volts) socket for mobile and portable service.

There's no need for me to tell you about the innards because SSB transceivers are loaded with hardware. What's more important is performance, and the Pearce-Simpson Simba SSB is really heavy in that department.



Built-in mike preamplifier has front panel gain control and percent modulation meter for precise modulation control and checkout.

The receiver sensitivity is a signal-inhaling 0.9 μV for 10 dB S+N/N on AM. SSB signals can be read right down into the mud at better than 0.4 μV. The AM adjacent channel rejection (selectivity), always worse on AM than SSB, clocked in at a razor-sharp 55 dB. The SSB selectivity is so sharp I couldn't force in any adjacent channel interference with the lab signal generator running wide-open. Image rejection was an outstanding 74 dB.

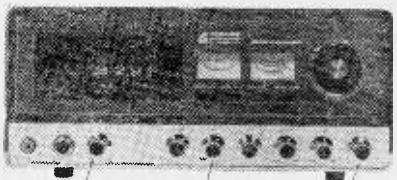
Rear panel has normal complement of jacks plus an adjustable TVI trap. A DC input is for fixed-portable twelve volt operation.

The AGC action, that is, the change in audio output (speaker) volume for an input signal range of 2 to 10,000 μV was 14 dB, about average for a tube rig, but out of sorts for solid-state equipment. If you have the gain cranked wide open to hear a weak signal buried in noise, a strong station coming on the channel blasts through. This is a minor complaint, though, in comparison to the overall *hot* receiver performance.

S9=6dB. An S9 signal on the meter represents a 100 μV signal, and the remainder of the S-meter calibrations aren't the usual relative signal strength readings. Above S6 each S-unit represents 6 dB; it's been a long time since I've seen a real, calibrated S-meter!

The transmitter put out 3.4 watts RF (AM) into a 50-ohm load. The modulation proved to be of excellent quality, and though there isn't 100% modulation limiting, there's no problem because the modulation is fully metered.

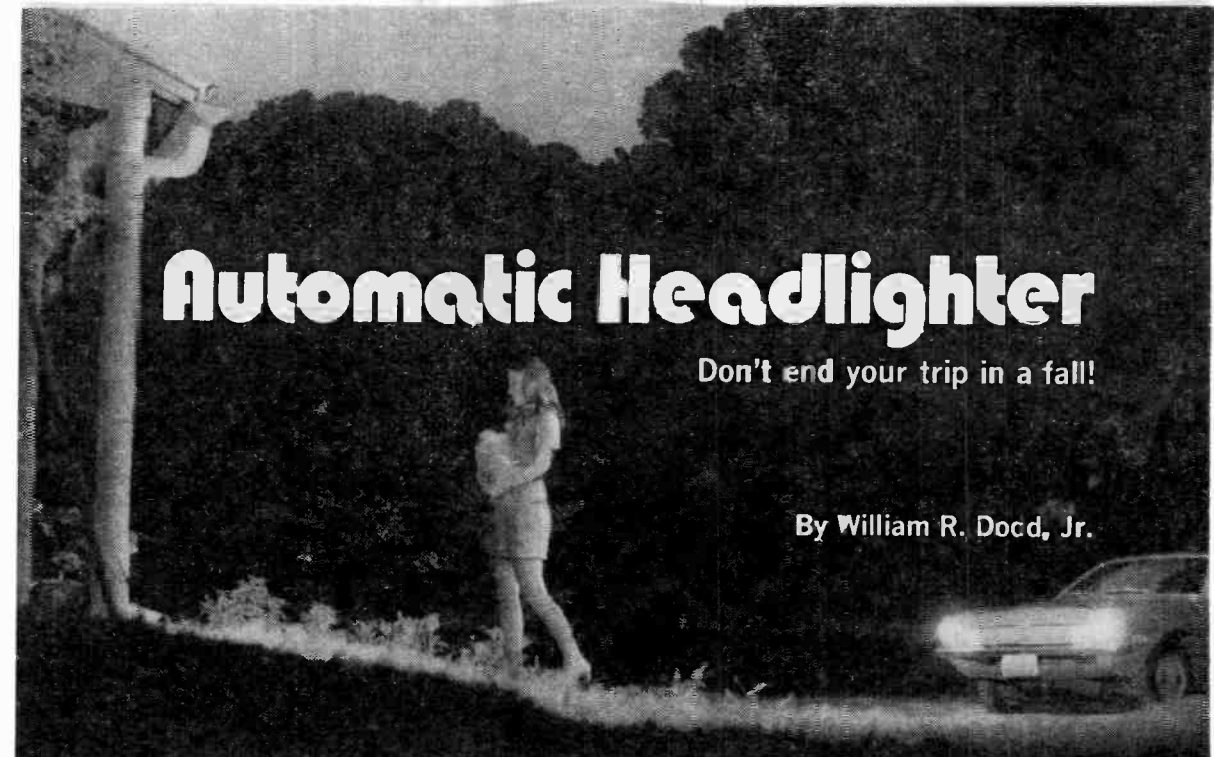
Finally, to give you a practical illustration of how good the Simba SSB really is, I heard a distress call just above the noise,



Check our cover again for a full color on-the-air view of the Simba in operation.

and the operator appeared to be saying "AM or sideband." I switched to SSB and had no trouble helping him out. Later, I found out not one of the other local CBers even heard the guy. Now that's performance.

If you want more information about the $429.95 Simba SSB rig, Circle No. 47 on the Reader Service Page. ■



Automatic Headlighter

Don't end your trip in a fall!

By William R. Dodd, Jr.

THE night may be dark and dismal when you pull in your driveway, but thanks to your Auto*matic* Headlighter you'll have no trouble seeing the way to your doorstep. This automatic headlight timer is a two-transistor circuit that keeps your headlights illuminated for 60 seconds after you leave your car. A simple ten-dollar project (all new parts), it's connected in parallel with your existing auto headlight switch and is operated by a single pushbutton. The timer has been field-tested for over a year and has been proven extremely reliable. It is for installation in a 12-Volt negative ground electrical system, but installing the unit in positive ground systems is a snap for hobbyists.

THE HOW OF IT. When the driver depresses pushbutton switch S1, timing capacitor C1 charges to 12 volts and turns on transistor Q1, which drives power transistor Q2 into conduction. This, in turn, energizes the relay which has its contacts connected in parallel with the headlight switch. The relay will stay energized until C1 discharges to the Q1 turn-off level. The lights-on period is determined by the value of C1, R1, and the characteristics of transistor Q1. With values shown on the schematic, about 60 lights-on seconds are provided.

WHAT TO DO. Construct the timer in a small 3¼-in. x 2⅛-in. x 1⅝-in. mini-box where all components except the relay and pushbutton switch S1 are mounted on a 1⅞-in. x 1¾-in. printed circuit card. The circuit card may be made by any of the conventional methods.

Special attention must be given in mounting some of the components on the printed circuit card. Capacitor C1 must be mounted with its + terminal connected to R1. Also, special attention must be given to spacing the transistors at least ⅛-in. away from the circuit card to avoid overheating during soldering. Two insulated washers are used to mount power

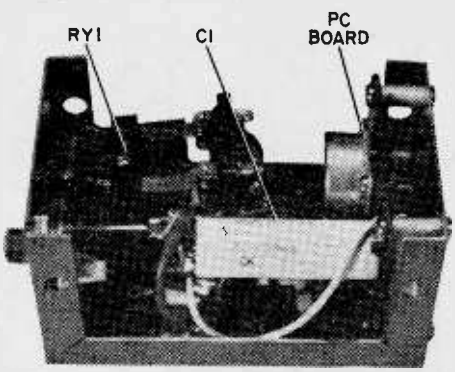
transistor Q2 to the printed circuit board.

Interconnecting wires from the circuit board should each be at least 4-in. long. They can be cut to proper length just before wiring in the mini-box. Mount RY1 and S1 in the mini-box, with heavy gauge (#14) wires soldered to the relay terminals as shown on the schematic. Make these wires about 24-in. long and mark "+" and "Lights" for easy identification during installation. The last step is to mount and connect the printed circuit card in the mini-box.

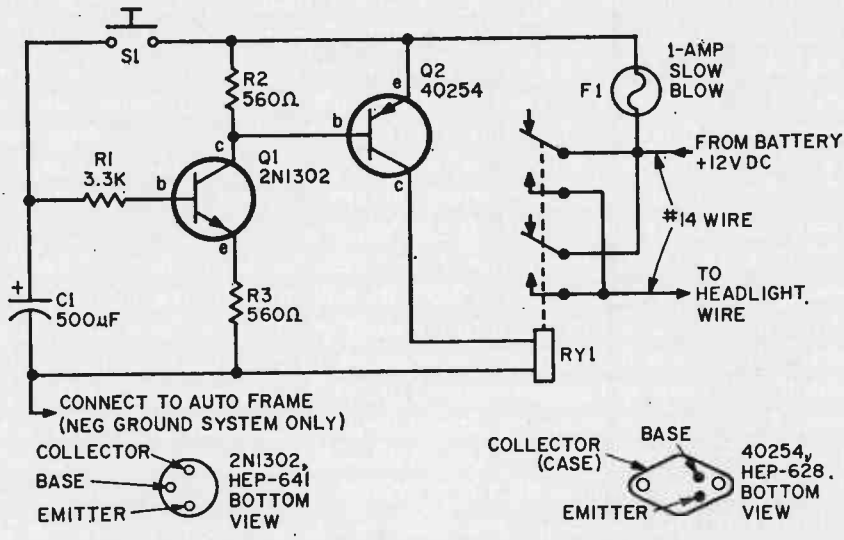
Under the Dash. The protruding mounting screw of RY1 may be used to mount the timer under your dash, or make a bracket of your own design for your particular automobile and installation. Just make sure the timer chassis is well grounded to the dashboard frame before proceeding.

At the headlight switch, find the wire coming from the headlamps and select a convenient point (probably a wire right on the switch) to tap into the 12-Volt battery power. You can locate these two wires by checking for voltages with a VOM at the headlight switch. A +12-Volt battery wire will be the only wire that will read +12 volts with the headlight switch in the *off*

(Continued on page 100)



With the relay mounted on left, PC board at right, all parts fit conveniently into the 3¼-in. x 2⅛-in. x 1⅝-in. minibox case.

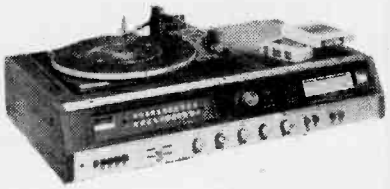


PARTS LIST FOR AUTOMATIC HEADLIGHTER

C1—500 μF electrolytic capacitor, 15 VDC or better
Q1—NPN transistor, 2N1302, HEP-641
Q2—PNP transistor, RCA 40254, HEP-628
R1—3,300-ohm, ½-watt resistor
R2, R3—560-ohm, ½-watt resistor
RY1—Relay, DPDT, 10-amp contacts, 12 VDC coil resistance at least 100-ohms, Potter and Brumfield type MR11D or equiv. (BA stock no. 19A387, Lafayette stock no. 30-20047 or Allied type KN105-2C-12D.)
S1—SPST pushbutton switch, normally open (time-start switch)

Misc.—3¼-in. x 2⅛-in. x 1⅝-in. case, 1-amp SB fuse with pigtail leads, #14 wire, hook-up wire, printed circuit material, harware, solder, etc.

E/E looks at new...
4-CHANNEL COMPACTS



◀ The Fisher 40 has 100 watts of music power, enough to drive four main and four remote speakers. The 40 features a 4-channel cartridge player and a 4-speed automatic record changer. A classical/popular switch optimizes the recovery of rear ambience information in classical recordings, and affords maximum side/rear directionality in pop discs. The Fisher 40 is $500. Circle No. 36 on Reader Service Page.

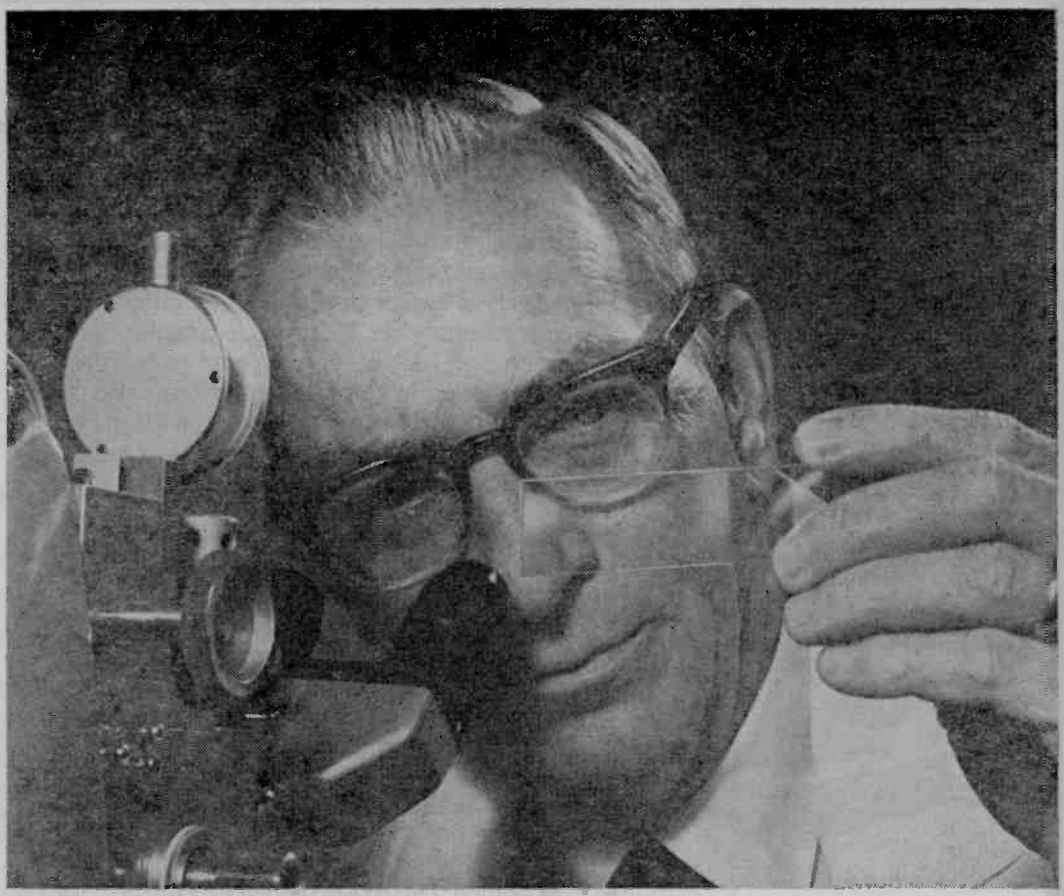
◀ Panasonic's Holbrook, model SW-4040, operates on 48 watts of peak music power, and is $300. It contains a 3-speed record changer and an 8-track cartridge player with pushbutton program selector and lighted program indicators. Panasonic's direct-coupled circuits eliminate unnecessary transformers and capacitors. Jacks are included for 4-channel remote balancer and stereo headphones. Circle No. 38 on Reader Service Page.

◀ Sansui's MQ2000 delivers 74 watts of music power, and has a Perpetuum-Ebner 2032 changer with Shure M75-6 pickup. A 4-channel indicator glows when in quadraphonic mode. Jacks are provided for connecting a cartridge, cassette or open-reel tape deck. The Sansui MQ2000 comes with two speakers, as most people have a stereo pair, and is $550. Circle No. 39 on Reader Service Page.

◀ The Sanyo GXT-4880 has a cartridge deck with a precision cueing system making it easy to start and stop the tape for recording particular selections. It will eject at the end of each track or all four tracks, and is under $370.

The similar GXT-4650 has a cassette deck and inputs for microphone recording, and is priced under $330.

Circle No. 37 on Reader Service Page.



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(James Gupton's address available upon request).

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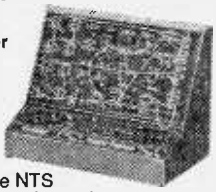

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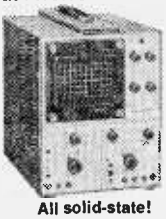

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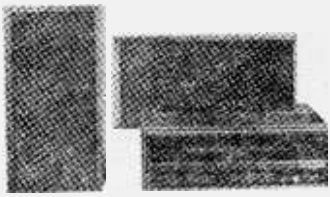

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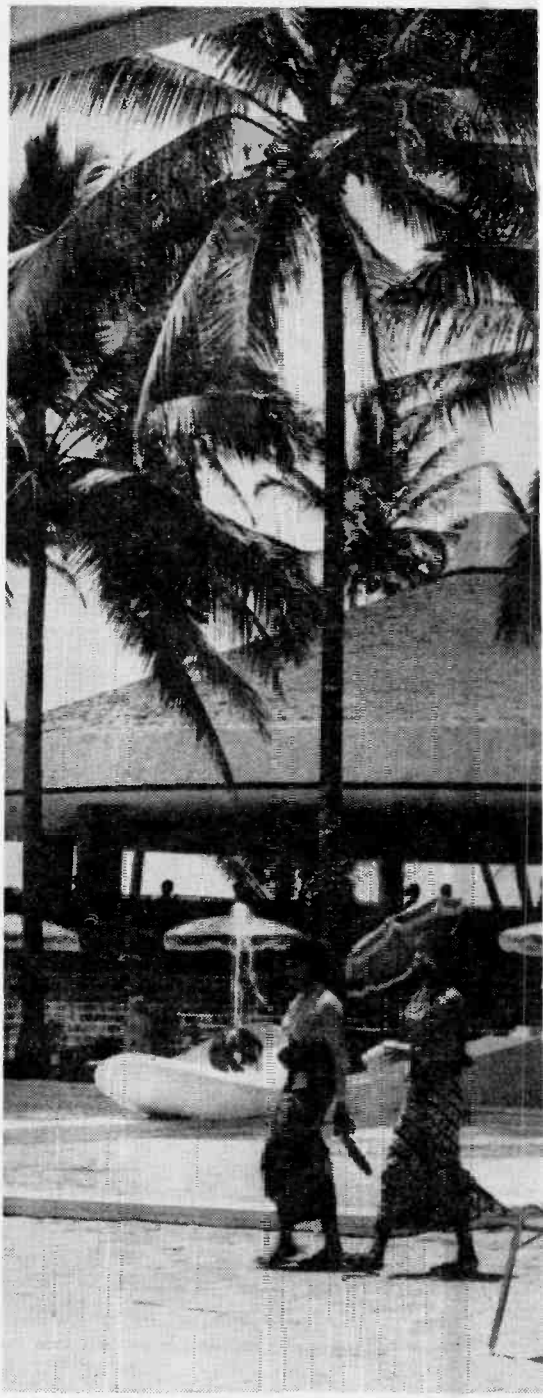
CIRCLE NO. 17 ON PAGE 17 OR 103

Indonesia



You don't need a geiger counter to tell that when it comes to shortwave "radioactivity", Indonesia is one of the hottest spots around. Few other countries have as many shortwave radio stations. And Indonesia is unique in the broadcasting world; virtually all of radio activity is on the shortwave frequencies. There are only a bare handful of medium wave outlets in this island republic of 100 million people. Well over 100 shortwave stations, ranging in power from one kilowatt to 125,000 watts, provide SWL's, beginners and veteran listeners alike, with plenty of DXing potential.

Some History. Indonesia, the former Dutch East Indies, is some 3,000 tropic islands—the largest of which are Borneo, Java, Sumatra and Celebes—plus Irian Barat, the western half of New Guinea. It is a far flung audience and to reach it, and the world, the government has created a vast shortwave network, *Radio Republik Indonesia.*

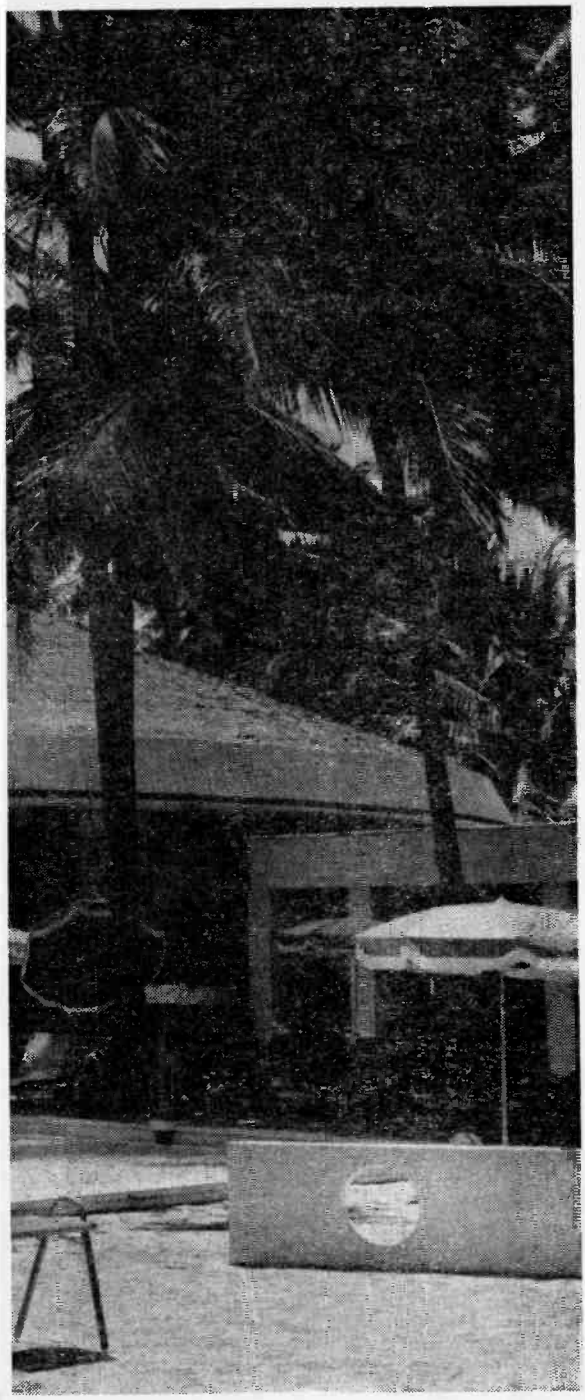
RRI's foreign service, *Voice of Indonesia* is the ticket if you prefer your shortwave fare in English. These programs are aired by powerful shortwave transmitters at Djakarta, the nation's capital.

Voice of Indonesia has a daily, hour-long transmission beamed to North America at 1430 GMT, on two frequencies, 9,585 and 11,795 kHz. Another English language service, directed to Australia, New Zealand and the Pacific, is broadcast at 1100 GMT, on 9,585 kHz.

When it comes to verifying listeners' reports, *Voice of Indonesia* has a rather spotty record. Once, a gal who signed QSL cards, "Miss Suzy," kept the verifications flowing. But when Suzy became a Mrs., QSL replies dwindled. Now, fortunately, the verification situation has taken a turn for the better. SWL reports of reception go to *Voice of Indonesia,* Box 157, Djakarta, Indonesia.

Besides its foreign service, RRI also has about 120 home service stations, located in 46 different cities and towns, from Palembang, Sumatra, to Djajapura, West Irian. In addition to local programming, these also relay some broadcasts, mainly

the SWL's "Radio-Active" Hotspot



BY DON JENSEN

news, from the Djakarta headquarters. Also there are regional studios, producing the "Nusantara" (homeland) insular services, at Makassar, Jogjakarta and Medan.

Bird Call. The song of the perkutut is music to Indonesian ears, for this ugly brown native bird is something of a symbol of the country. If you lived in Java, no doubt your own pet perkutut would sing from his cage, atop a pole outside your door. But in Jersey City or Jacksonville, you can still hear his call, a tuning signal used by the *Radio Republik Indonesia*'s station at Jogjakarta, Java.

RRI, *Studio Jogjakarta,* its official name, is one of the few domestic Indonesian stations to program any English. While not necessarily a daily feature, sometimes you'll find an English newscast about 1145 GMT on its 5,047 kHz frequency. If you want to hear the perkutut's call, try listening at 1230 GMT.

Watch the Language. There may not be much English spoken on RRI's home service shortwave stations, but there's plenty of familiar music. U.S. popular tunes, some of them the golden oldies of a few years back, are frequently aired.

Far more exotic, though, is the uniquely Indonesian gamelan. This native music is played on bamboo flutes, brass gongs, drums and harps. It skitters over and around the gentle oriental melody, somewhat melancholy, but not sad. You'll hear gamelan music on any of the RRI stations, but one of the easiest to tune—sometimes even easier than the *Voice of Indonesia's* signals —is the outlet at Ambon, the major city in the Malucca group, one of Indonesia's island clusters.

RRI's *Studio Ambon* puts out a solid signal on 7,140 kHz with its 10,000 watt transmitter. Try for this one around 1200 GMT, and again at 1300 GMT, when it relays, like most of the domestic RRI shortwavers, the Indonesian language newscast from Djakarta.

Hopscotching across the Indonesian islands, you'll find *Studio Makassar,* broadcasting on 4,719 kHz. Makassar, chief city on the spider-shaped island of Celebes, is

e/e INDONESIA

Modern Indonesia's morning rush hour at a place called Djalan Djenderal Soedirman, in Djakarta. At left, the front cover of the Voice of Indonesia's printed bulletin. Send reception reports to the Voice of Indonesia, Box 157, Djakarta, Indonesia.

headquarters for one of Indonesia's three regional networks.

Irian Barat, or West Irian, was the last piece of Dutch territory to become Indonesia. It was less than ten years ago that Holland relinquished its rights to what had been called Netherlands New Guinea.

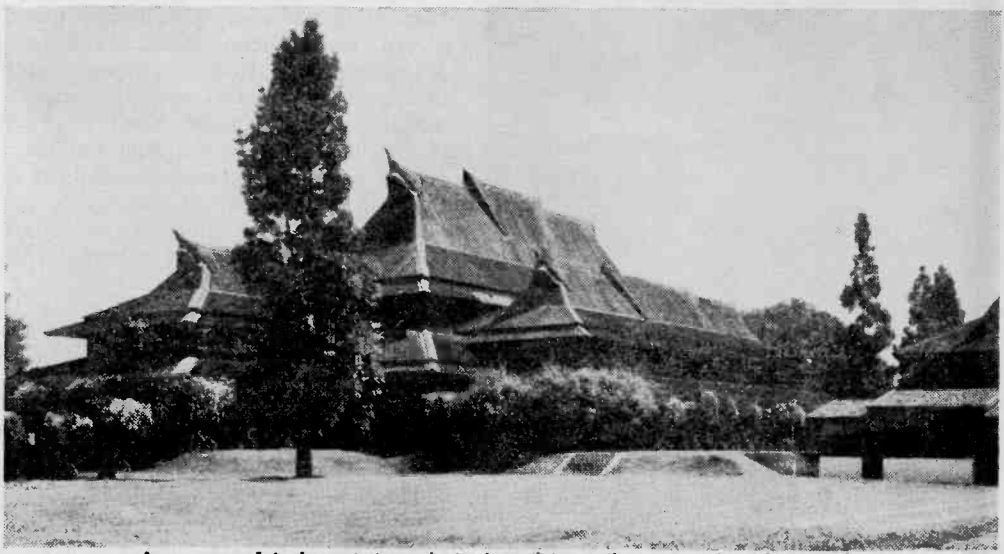
Near the western tip of this huge island is the oil town of Sorong. In the old days, the Dutch New Guinea Petroleum Company operated its own shortwave station, with programs for its own riggers, drillers and field hands. When Indonesia took over New Guinea, the station was incorporated into the Radio Republik Indonesia Network. Today, with a new frequency and a new, more powerful transmitter, the station operates as RRI, *Studio Sorong,* on 4,872 kHz.

Sumatra is well represented by shortwave outlets, but one of the most widely logged by Stateside DXers is the one at Medan, broadcasting on 5,084 kHz. Also reported from time to tome are the transmitters at Palembang, 4,855 kHz., and Djambi, 4,927 kHz.

Borneo, Kalimantan to the Indonesians, is considerably harder to log. The best chance seems to be Pontianak on 3,345 kHz. As will most Asian stations, best reception from these low frequency RRI shortwave broadcasters will be about dawn, or a little after, wherever you live.

Outside the Net. While most Indonesian shortwavers are part of the Radio Republik Indonesia net, there are a handful that aren't. Widely heard, for example, is *Radio*

(Continued on page 101)



A source of Indonesia's technical training. These Batak-styled roofs house university buildings for all fields of engineering in Bandung.

Orbus III keeps watch on traffic passing on Highway Spur 303 in Arlington, Texas. Here, four units cover an eight-mile stretch providing a photographic record that the local Justice of the Peace chuckles over. Bottom photo shows sample picture taken by Orbus III with data in upper right corner.

GOTCHA!

ELECTRO-OPTICAL SNOOP TATTLES ON SPEEDERS

by Emma Fluffin

What, a new "Big Brother" is watching. Yes, we now have Orbis III for Highway Safety. This is the latest electronic space age system for highway safety. Your road habits are checked by Orbis III through electro-optical and computer techniques. It is excessive speed that is doing the major part of killings on our highways! More people are killed on the roads here each year than soldiers have been killed in the Vietnam War in the past ten years. With Orbis III, safety can be brought to a maximum. Not only does Orbis III take a photograph of the vehicle, but it provides a permanent photograph of the driver and the license plate. Included in the photograph are time and date, location, posted speed limit and the speed at which the driver traveled. A passing car runs over sensors in the roadway, and a computer then measures the car's speed. A high-resolution photograph is obtained by the use of a special high-speed camera and an illumination system which can penetrate the strongest headlight and windshield glare. Orbis III protects us from ourselves. A flashing red light tells the driver that he has committed an offense and warns him against repetition. Human error is eliminated and personal complaints greatly reduced. The present cost for some 2,000 radar-type units is $92 million. This radar system only covers 6,000 of the 3,600,000 miles of road in America. Orbis III can cover almost 100,000 miles for the same price. Americans depend heavily on automobiles for business and pleasure—what cost is high for safety? ■

HEARTS ARE TRUMP

POLICE BRING 'EM BACK ALIVE IMPROVING A HEART PATIENT'S CHANCES FOR SURVIVAL.

By Joe Gronk

☐ Deaths caused by heart attack can be beaten hands down. Every other man living in Western countries is being attacked by coronary catastrophy. *Time* is the critical factor in rescuing a coronary victim from the grips of death. Almost 60% of coronary victims die before they arrive at a hospital. But now, on-the-spot hospital care is possible through the team work of specially trained

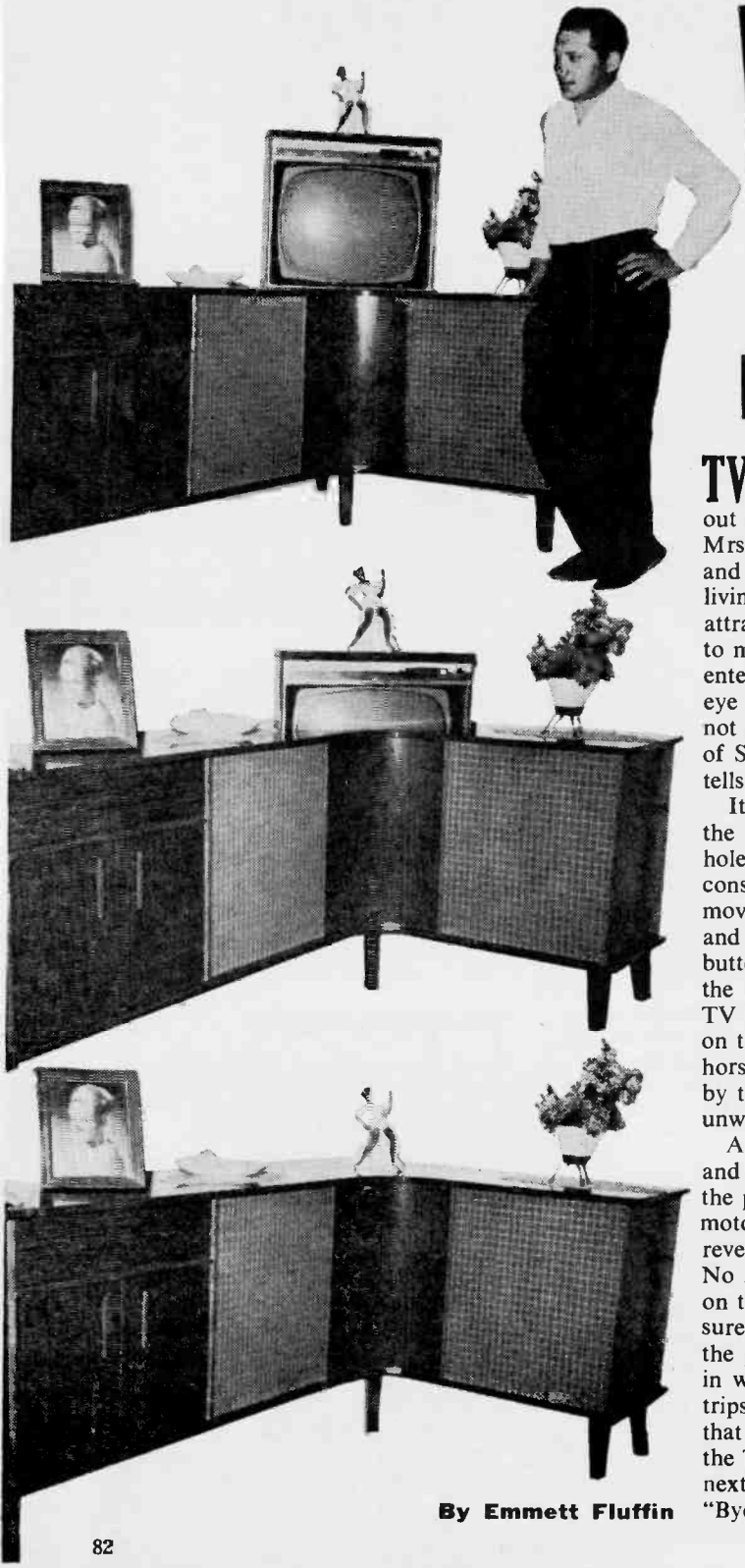
On these pages are photos of the Nassau County (New York) Cardiac Alert Program in action. Fifteen new ambulances equipped with VHF radio, not to mention some very special equipment. Once on the screen, a cardiologist radios therapy to be administered by the medical technician aboard the ambulance. Therapy begins at once and continues during the victim's trip to the hospital.

At the scene of the accident (top) the cardiac victim is given advanced first aid by the trained police officers. The patient's heart action is transmitted via UHF radio to the hospital where it is translated to an oscilloscope picture and an electro-cardiagramic record. In the ambulance, on the way to the hospital, (right) the defibrillator is applied while verbal contact is maintained.

police, and medical technicians. Uniquely equipped ambulances make possible this life saving communications system. This equipment senses heat activity from the patient's chest and then modulates it to a sound tone in an audable range. The sound is then transmitted to the medical center where it is electronically translated into an oscilloscope and again into an electrocardiogram and is then read by a cardiologist, who radios therapy instructions to police in the ambulance. The "Cardiac Alert Program," is a darn good warfarer against this nations number one killer.

Emergency service is a must. But, you must learn the latest scientific measures to *prevent* heart disorders and keep your heart a winner!

At no time is the doctor out of contact with the ambulance (right, top), in fact, the police officers come right into the treatment room (right). Note that the electronics is still attached to the patient. This unique method of treatment actually brings the doctor to the scene of the attack. At left, officers and doctor review events as part of training .



POP-UP TV MAKES THE SCENE

TV's big eye can bug the decor out of any room setting. The Mrs. spends considerable time and your hard cash to make the living room or play room an attractive area for the family to meet, entertain and be entertained. But the big ugly eye scans the scene even when not in use. So, H. L. Miller of Sarasota, Florida tells his TV to bug out.

It is easy to do provided you take the pains. Mr. Miller cut a hole in the top of his hi-fi console and installed a movable platform that goes up and down at the press of a button. Guide rails eliminate the shimmy and shake as the TV is raised and lowered on the platform. A fractional horsepower motor does the work by turning a drum that winds or unwinds a pully system.

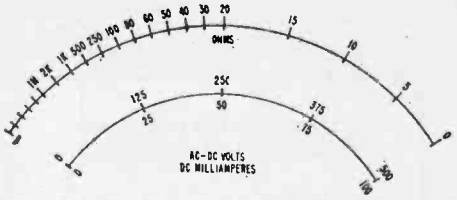
A limit switch at the top and bottom travel position of the platform turns off the motor automatically reversing it for the next trip. No modifications are required on the TV whatsoever—just be sure to leave enough slack in the power cord and antenna lead-in wire. Also, the platform trips an on/off power switch that controls the juice to the TV. Think of pop-up TV the next time you want to say, "Bye-bye," to the big eye! ■

By Emmett Fluffin

e/e's ALL NEW BASIC COURSE in ELECTRICITY & ELECTRONICS

This series is based on
BASIC ELECTRICITY/ELECTRONICS,
Vol. 4, published by
HOWARD W. SAMS & CO., INC.

UNDERSTANDING MULTIMETERS PART 1



What you will learn. With this course you can become familiar with the multimeter—the instrument most frequently used by electronic technicians and engineers. It is a basic course that introduces you to the function, internal-workings and operation of the Volt-Ohm-Milliammeter (VOM) type of multimeter. In Part 1 of this course, you will become familiar with how multimeters work. In Part 2, you can learn how to properly use the instrument for its intended purpose (the transfer of information from the circuit to the technician) by learning how the function and range circuits work during actual measurements.

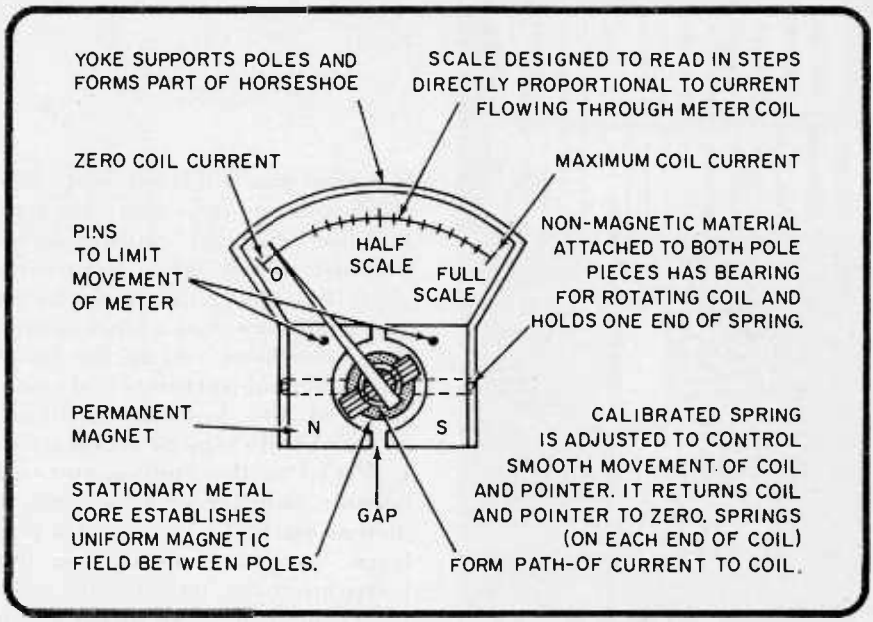
BASIC CONCEPTS

A **multimeter** combines the features of a **voltmeter**, an **ammeter**, and an **ohmmeter** in a single instrument having but one meter movement. A multimeter can be used to measure voltage, current, and resistance within the limits of several ranges of values. From the technician's point of view, all multimeters consist of three basic sections—meter, circuitry, and front panel.

The meter coil moves a pointer across a calibrated scale to a mark that indicates the measurement being taken. The circuitry is a network of components that determines the functions (ohmmeter, ammeter, voltmeter) and ranges. The front panel contains the controls and jacks that permit operation of the instrument.

Most meters have moving-coil movements. As the name implies, the movement has a coil of wire that is free to rotate between the north- and south-seeking poles of a permanent magnet. Current flowing through the coil sets up a magnetic field. This field reacts with the field existing between the poles of the magnet and causes the coil to rotate. A pointer attached to the coil moves to a position on the meter scale; the position of the pointer depends on the amount of current passing through the coil.

BASIC CONSTRUCTION OF A METER



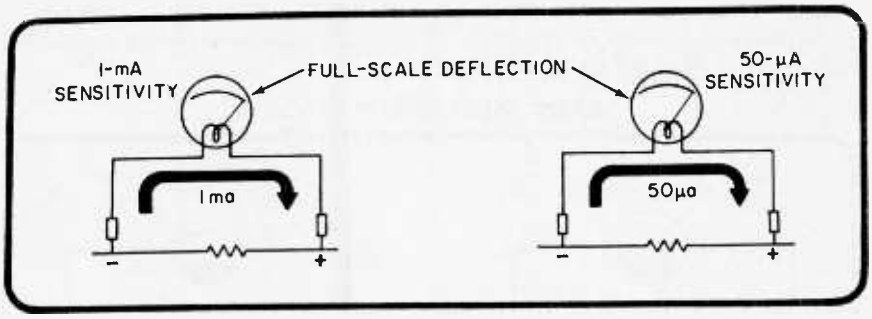
Meter Sensitivity

Meter sensitivity is expressed in two ways—**current** sensitivity and **ohms-per-volt** sensitivity. Current sensitivity is determined by the amount of current required by the meter movement to cause full-scale deflection of the pointer. Ohms-per-volt sensitivity expresses the amount of resistance (in ohms) that must be in series with the meter when full-scale deflection occurs with 1 volt applied.

Current Sensitivity—Current sensitivity depends on the number of turns in the meter coil. It also depends on the strength of the permanent-magnet field.

Current sensitivity is expressed as the number of milliamps (mA) or microamps (μA) required for full-scale deflection. Typical meter movements have current sensitivities of 1 mA and 50 μA.

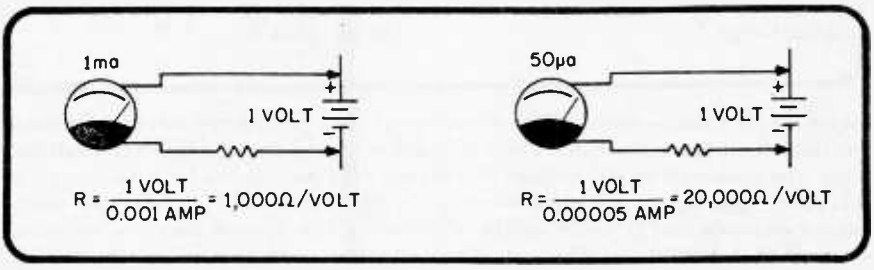
CURRENT SENSITIVITY OF METERS



Ohms-per-Volt Sensitivity—Ohms-per-volt sensitivity is determined by the total resistance that must be in series in the meter circuit to obtain full-scale deflection when 1 volt is applied. The resistance value can be determined by Ohm's law:

$$R \text{ (ohms/volt)} = \frac{E \text{ (1 volt)}}{I \text{ (current sensitivity)}}$$

OHM PER VOLT SENSITIVITY OF CURRENT METERS



For a 50-μA (0.00005 amp) meter, the resistance is 20,000 ohms, resulting in a sensitivity of 20,000 ohms per volt.

QUESTIONS

Q1. Which meter will have a greater number of turns in its coil, a 40-μA or a 2-mA movement?

Q2. If the coil rotates, how does current get from the meter circuity to the coil?

Q3. What is the ohms-per-volt sensitivity of a meter with a current sensitivity of 2 mA?

Q4. If the resistance in a DC voltmeter circuit is 10,000 ohms for full-scale deflection at 1 volt, what value of resistance must be substituted to measure 10 volts full scale?

ANSWERS

A1. The 40-μA meter moveent will have a greater number of turns in its coil.

A2. Calibrated springs, one at each end of the coil, form the current path to the coil.

A3. A meter movement of 2 mA has a sensitivity of 500-ohms per volt.

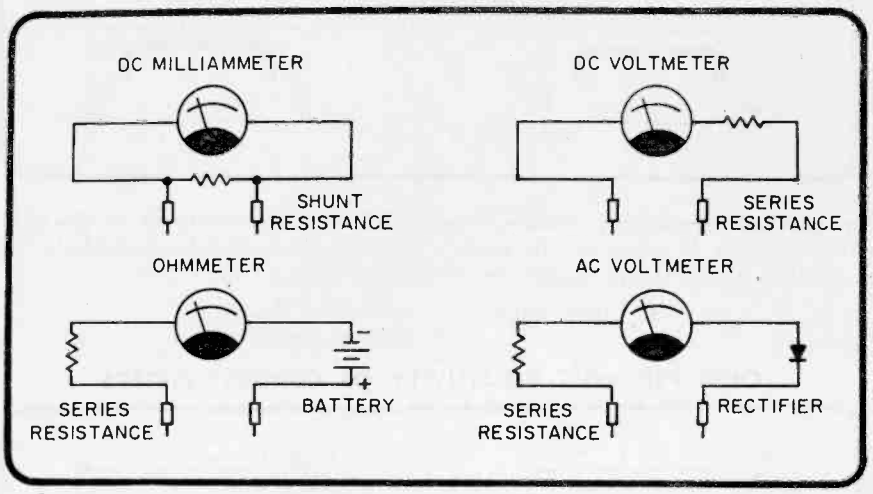
A4. 100,000-ohms

Meter Circuitry

A meter is a current-reading device. To provide accurate readings, the electrical values of its circuit components must be fairly precise. The circuit design must provide for all of the types of measurements to be made by the meter.

If a meter measured only one characteristic (voltage, current, or resistance) and if it had only a single range (10V, 1 mA, or 1,000-ohms, for example), the design would be relatively simple. Without considering ranges, there are four basic types of circuits found in multimeters.

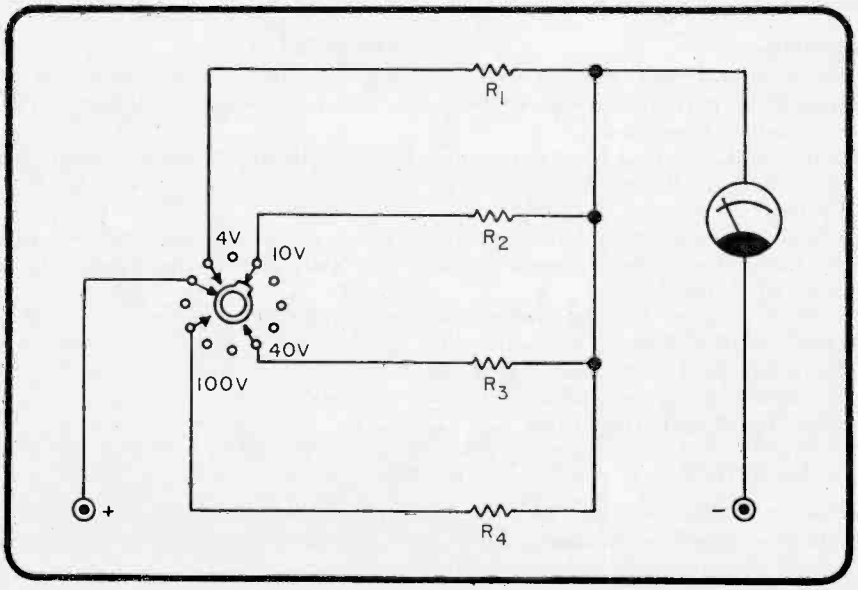
BASIC MULTIMETER CIRCUITS



Meter-Circuit Components—The figure shows that multimeter circuitry requires series and/or shunt resistances, a battery for measuring ohms, and a diode for limiting current direction when measuring AC voltage. To obtain different ranges for volts, amps, or ohms, resistances of selected values must be used in the circuit. The circuits are connected to front-panel controls that provide means of selecting the desired function and range.

Rotary Wafer Switches—These switches are often used to provide range selection. As

CIRCUIT WITH A WAFER SWITCH



seen in the schematic diagram below left, a metallic wafer can be rotated to one of several positions. The blade of the wafer engages taps, or contacts, that are connected to appropriate parts of the circuit.

A multimeter may have only a single rotary switch with enough wafers to select both the function (ohmmeter, milliammeter, DC voltmeter, or AC voltmeter) and the appropriate range for each function. In a multimeter having two rotary switches, one switch usually selects the meter function, and the other selects the range.

QUESTIONS

Q5. In the schematic below left, to which resistance is the positive test lead connected?

Q6. What multimeter function does the circuit provide?

ANSWERS

A5. The test lead is connected to R_2.

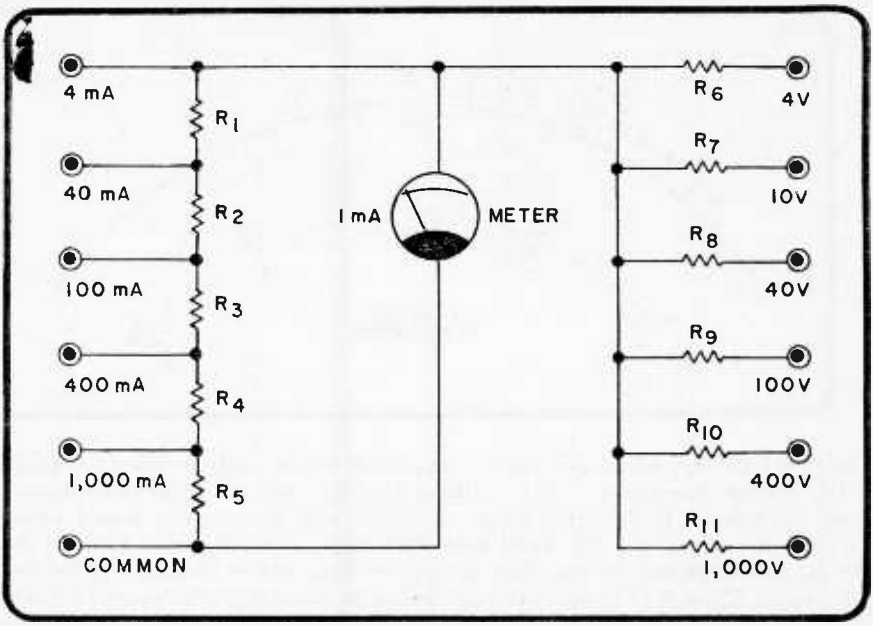
A6. The switch and circuitry indicate that the circuit can be used to measure DC volts.

METER FRONT PANEL

The front panel of a multimeter has a scale for reading values, and provision for setting, or adjusting, the position of the pointer. Means for selecting the type of measurement to be taken and the desired ranges are also provided. Jacks for inserting test leads are mounted on the panel.

One means of selecting measurement and range scales was shown above—rotary wafer switches. In some multimeters a combination of a rotary switch and pin jacks is used. The switch selects the desired range. The red test lead is inserted in a pin jack marked with the quantity to be measured, and the black test lead is placed in the pin jack marked ***common*** or —.

MULTIMETER AND TEST-LEAD JACKS



Another method often used employs a number of pin jacks on the front panel. Test leads are inserted in the desired positions—one in the jack marked ***common*** and the other in the jack marked with the desired measurement. A schematic diagram of a circuit for DC voltage and current measurement using this arrangement is shown above.

Whatever the arrangement might be, always check the settings before taking a measurement. It the switch is positioned in the wrong function or in too low a range, the meter could be damaged.

QUESTIONS

Q7. If the test leads were in the common and 400 mA jacks in the schematic, what resistances would be shunting the meter?

Q8. With the test leads in the common and 1,000V jacks, current will flow through the meter and which resistances?

Q9. With the voltage values shown, which resistance would have the larger value, R_8 or R_9?

ANSWERS

A7. R_4 and R_5 would be shunted across the meter R_1, R_2, and R_3 woud be in series with the meter.

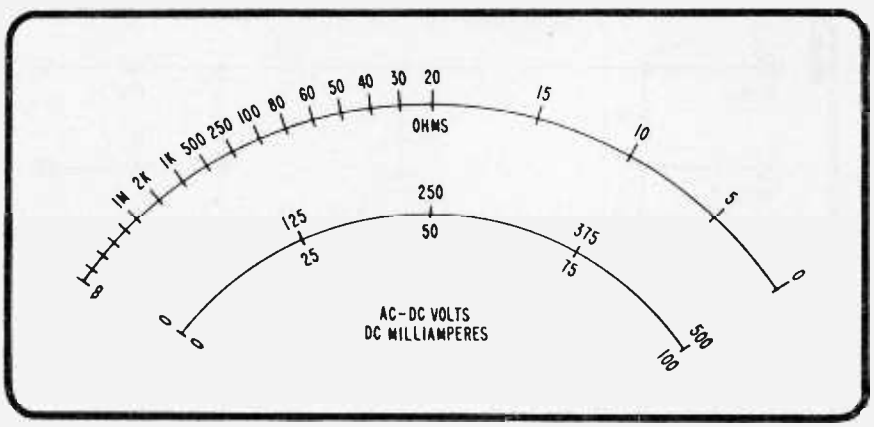
A8. Current will flow through R_1, R_2 R_3, R_4, R_5, and R_{11}.

A9. R_9 would be larger than R_8.

CURRENT AND VOLTAGE SCALES

Scales on a multimeter are usually calibrated to measure the quantities marked on the selection switches or jacks. A single scale can be used for more than one function and range. If a separate scale were used for each type of measurement and each range, the meter face would be cluttered and difficult to read. The types of measurements you have learned about thus far can be made using a meter face with either two or three scales.

METER FACE WITH TWO SCALES



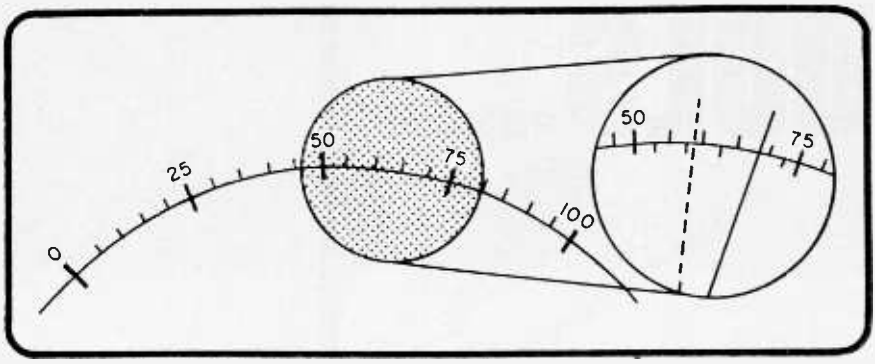
The figure shows a two-scale meter—one scale for ohms and the other for AC-DC voltage and DC current. The lower scale is calibrated so that each mark has two values. The value to use depends on the selected range. A meter with three scales would probably have separate scales for *ohms, DC volts and Milliamps, and AC volts.* Each of the separate scales for the different functions may have more than one set of numbers for the divisions on the scales. Thus, it is possible to read values on more than one range for each function.

Multimeter scales for reading voltage or current are usually linear. This means that the divisions on the scale are spaced equal distances apart. On a scale that measures from 0 to 100, for example, the halfway mark would be 50. Midway between 0 and 50 is 25. If major divisions are marked off in smaller units, the spaces between subdivisions are also equal.

Reading Linear Scales

A linear scale is not difficult to read if care is taken. To keep the scale uncluttered, only the major divisions are numbered. If the pointer rests between numbers or marks, the correct quantity can easily be estimated by determining the units in which the subdivisions are calibrated.

Major divisions are 0, 25, 50, 75, and 100 on the scale shown. The magnified portion shows subdivisions of five units each. There are additional marks halfway between these subdivisions.

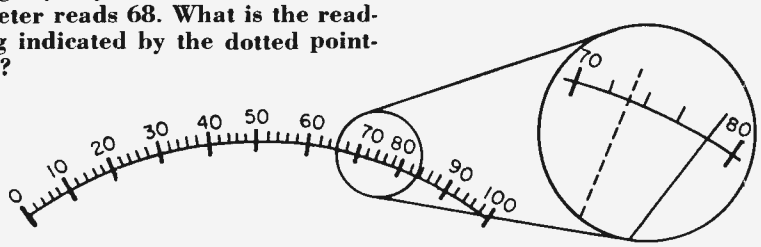


QUESTIONS

Q10. The solid pointer in the diagram above is between 65 and 70 and slightly beyond the midmark. The meter reads 68. What is the reading indicated by the dotted pointer?

ANSWERS

A10. 58.



Q11. The solid pointer reads 78 in the above diagram. What does the dotted pointer read?

A.11 73.

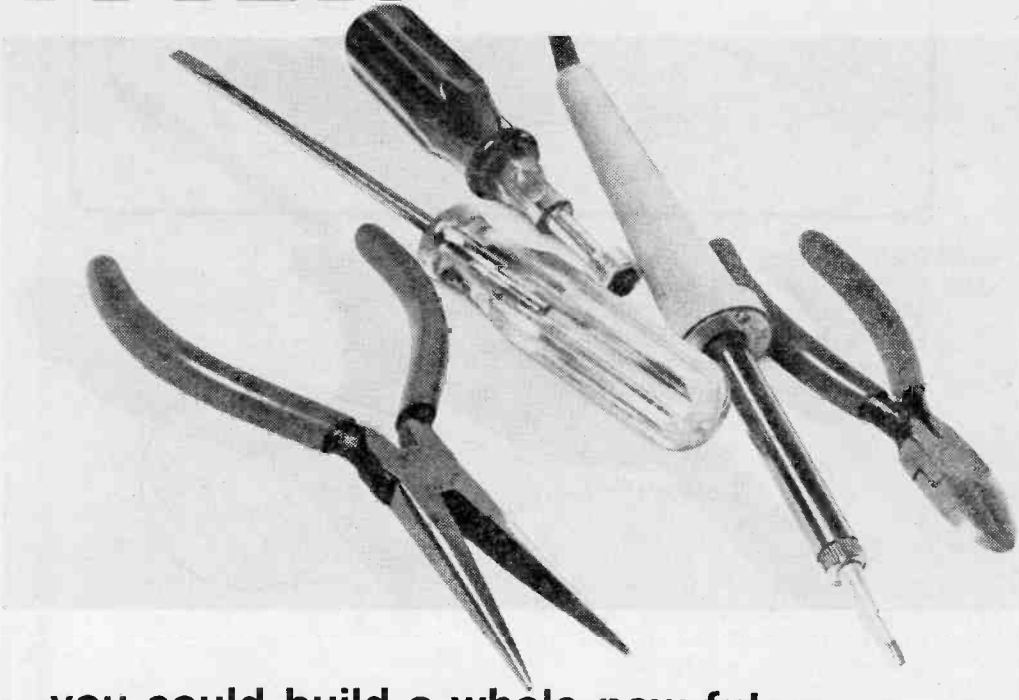
Linear-Scale Markings

There is no standard system for marking linear scales. The left end of the scale is usually zero. On rare occasions, however, zero may be on the right end. This only means the pointer will move from right to left. The other end may be 10, 15, 25, 40, 50, 60, 100, or some other number. To use the scale, determine the quantity contained between numbered markings and values of the indicated subdivisions. You should have no trouble if you make this determination with care.

MULTIMETER ACCURACY

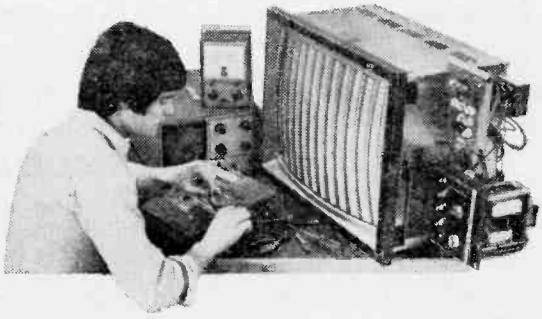
The electrical values of components are never precise. You have learned that resistors vary as much as ±20% of the stated ohmic value. Better resistors have tolerances of 10% and 5%. The tolerance rating of the resistors used in the multimeter affects the accuracy of the meter readings.

IF YOU CAN USE ANY OF THESE TOOLS...



...you could build a whole new future...

and build yourself a Bell & Howell solid state color TV while you're at it!



If you're already handy with a set of tools, here's a way to pick up a pretty thorough knowledge of electronics: build yourself a solid state color TV as part of a complete learn-at-home program from Bell & Howell Schools.

This important project gives you valuable "hands on" experience with solid state circuitry—the kind of *practical* experience you'll need to build a successful career. It's a vital part of your total electronics education.

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With your new skills, you can build and service stereo-hi-fi systems — including FM-AM radios . . . phonographs . . . open reel tape recorders and cassette or cartridge player/recorders. You could even build yourself a complete "home entertainment communications center"—complete with the new gadgetry of cartridge television when it comes out. The skills you build up by following this brand-new program are more than enough to service almost *any* type of home entertainment electronic device.

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No matter where you look, the amazing technology of electronics is becoming a bigger and bigger part of the picture. More and more automotive parts and diagnostic instruments are electronic. Many large manufacturing plants use sophisticated electronic systems—controlled by a few skilled electronics technicians. The increasing use of two-way radio . . . the huge promise of cable television . . . the astonishing growth of electronic data processing all open doors to exciting new career opportunities for the man with thorough training in electronics. In fact, the day may come when the man who does *not* have electronic skills will be severely handicapped in many industries.

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■ **Bell & Howell Solid State 25-inch color TV.** Ultra-rectangular 315 sq. inch screen lets you view more of the image. 25,000 volts . . . 46 transistors . . . 57 diodes . . . 4 IC's with another 54 transistors and 15 diodes . . . 3-stage solid-state, high-gain IF . . . 24 channel detent UHF/VHF power tuning . . . varactor UHF tuner . . . automatic fine tuning.

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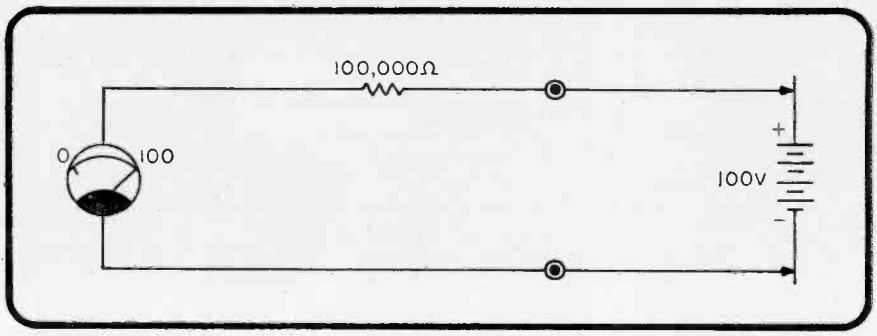
In the diagram, a 100,000-ohm resistor was selected to give a full-scale meter reading of 100 volts. If the resistor had a tolerance of 20%, the full-scale reading could be off about 20 volts in either direction. A 10% resistor could cause readings between the extremes of about 90 volts and 110 volts. A 5% resistor could result in an error of 5 volts above or below 100 volts. None of these readings would be close enough for most purposes.

METER COMPONENTS AND ACCURACY



Most multimeters employ ±1% resistors. In the example given, a 100-volt reading would not be off more than 1 volt, a 1% error. This is close enough for most measurements.

The meter movement itself may give some error. For example, its readings might be off 1 volt throughout the 100-volt scale. One volt off at 100 volts is a 1% error, but a 1-volt difference at 10 volts is a 10% error. For this reason, *voltage and current readings should be taken on the upper half of the scale if possible.*

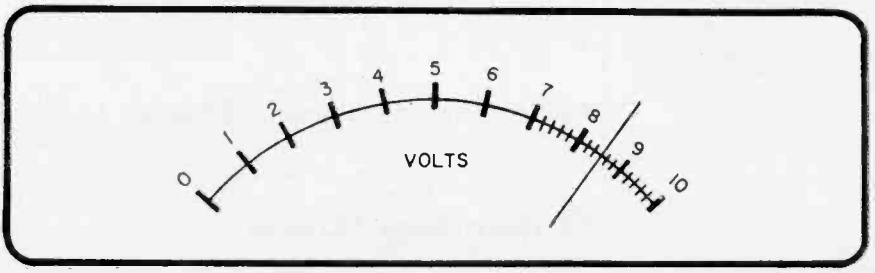
LINEAR-SCALE RANGES

It is sometimes necessary to take measurements as high as 100 volts or even 1,000 volts; at other times a reading of only a few volts will be called for. A 1,000-volt scale would provide any of these readings, but the accuracy of a 6-volt measurement would be very poor. Also, small differences on a 1,000-volt scale would be difficult to read. To overcome these limitations, multimeters have several ranges.

Multiple-Range Scale Reading

The scale below is marked in divisions from 0 through 10. When the range selector is set for 10V, the exact measurement is read directly from the actual scale markings. If the selector is set on 100V, the scale readings are multiplied by 10 to obtain the measured value. If 10 volts were the measured value, the pointer would show a full-scale reading if the meter were on the 10V range. On the 100V range the pointer would come to rest over the mark—10 times 1 equals 10 volts.

A SCALE CAN BE MULTIPLIED



QUESTIONS

Q12. What voltage is being measured with the pointer below left?

Q13. A multimeter has ranges of 10V, 50V, 100V, and 500V. Which range should be used to read 45V?

ANSWERS

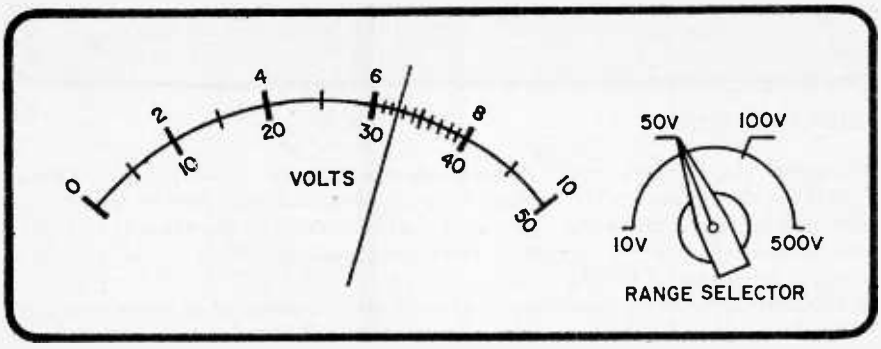
A12. 8.5V.

A13. The 50V range.

Dual-Marked Scales

Another example is a single scale having two values for each of its markings. This type is used in multimeters whose ranges are not multiples of ten times a single full-scale quantity. Study the scale and range settings in the diagram. The principles used in the preceding example still apply. With the range shown, the meter reads 32.5 volts.

SCALES WITH DUAL MARKINGS



Multimeasurement Scales

A linear scale can be used to measure more than one electrical characteristic. The preceding examples used voltage readings. These could have been either AC or DC volts as far as the scale or range settings were concerned. The same scale can also be used to read milliamperes..

QUESTIONS

Q14. On which range should a meter be set when making the first measurement of a circuit quantity?

Q15. Your meter has range settings of 10V, 50V, 100V, and 500V. You wish to measure the voltage across a load and suspect a voltage of 90V. To which range should you set your meter to read this voltage?

ANSWERS

A14. When taking the first reading, set the meter on the highest range for the meter function being used.

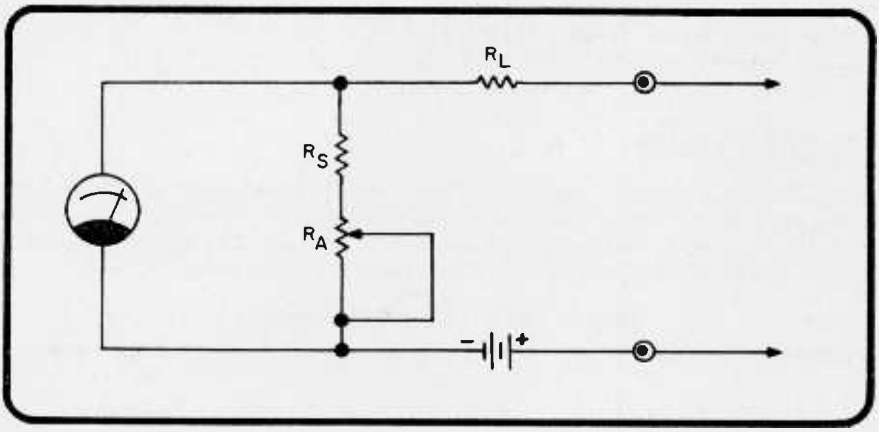
A15. The meter should first be set on the 500V range. This setting will insure against meter damage.

OHMMETER SCALES

The scale and range selection for the resistance-reading portion of the multimeter are a little different from those already discussed. The scale reads from 0 to infinity (∞) instead of from 0 to some number. Unlike the volt and milliampere scales, the resistance scale is not linear. Range selection is indicated by multipliers (R $\times$ 1, R $\times$ 10, R $\times$ 100,

etc.) instead of a quantity indicating full-scale deflection. These differences will become apparent as you examine the basic ohmmeter circuit.

BASIC OHMMETER CIRCUIT



Ohmmeter Circuits

An ohmmeter circuit must supply its own source of current. Usually a self-contained battery is used for this purpose. The voltage of the battery is determined by the sensitivity of the meter, the arrangement of the series and shunt resistors in the circuit, and the size of the external resistance to be measured. Depending on the design of the ohmmeter, the battery might be from 1.5 to 22.5 volts.

RL in the Basic Ohmmeter circuit is a current-limiting resistance in series with the meter. Its value is determined by the amount of current required to cause full-scale deflection. RA and Rs form a shunt across the meter. Therefore, only a fraction of the total current in the circuit flows through the meter. The current through the meter is determined by the ratio of the meter resistance to the shunt resistance. RA, controlled by the *ohms adjust* knob on the panel, establishes the value of total shunt resistance that will cause the meter to register accurate readings.

Determining Ohmmeter Scale Markings

In the diagram (opposite page), resistance values in the parallel network—RM (meter resistance), Rs (shunt resistance), and RA (zero ohms adjust)—are such that full-scale pointer deflection will occur when 1 mA enters the network. If the battery voltage is 1.5V and the circuit resistance is 1.500 ohms, 1 MA (I = E/R) will flow when the test leads are shorted (touched together). The meter will show full-scale deflection of the pointer, or zero ohms. When the test leads are parted, no current flows, and the pointer returns to its normal position. The ohmic reading becomes infinity (∞). This is the reason for zero being at the right-hand end on most ohmmeter scales.

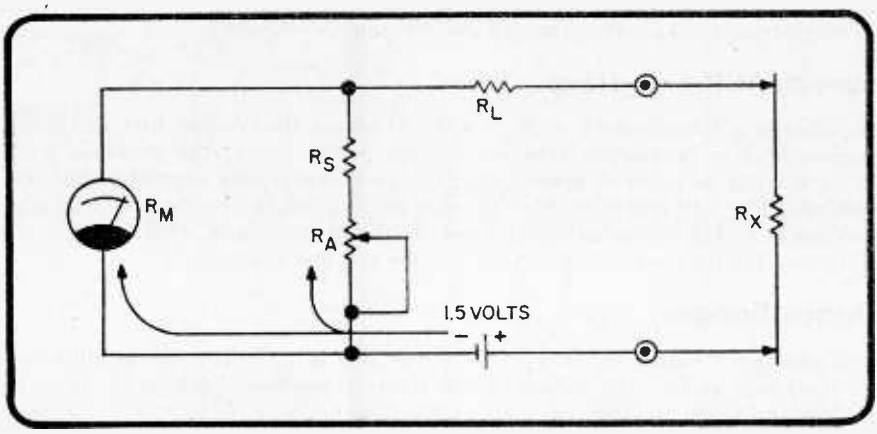
Using Ohm's law, plot the value of current and resulting scale positions when resistances (Rx) of 500, 1,500, and 4,500-ohms are measured. If Rx is 500-ohms and the resistance of the ohmmeter circuit is 1,500-ohms, the total resistance is 2,000-ohms.

$$I = \frac{1.5V}{2{,}000\ \Omega} = 0.00075 \text{ amp } (0.75 \text{ mA})$$

As far as the meter is concerned, it will receive the same ratio (or fraction) of any current flowing into the parallel network. Since 1 mA is required for full-scale deflection, 0.75 mA will move the pointer to three-fourths of full scale. Calculating current for the other values of resistance, you should be able to plot a chart that looks like the one shown.

R_X	R_L	R_T	I_T	Scale Deflection
0	1,500	1,500	1 mA	Full
500	1,500	2,000	0.75 mA	¾
1,500	1,500	3,000	0.50 mA	½
4,500	1,500	6,000	0.25 mA	¼
Inf.	1,500	Inf.	0.00 mA	Zero

METER AND SHUNT CURRENT FLOW



QUESTIONS

Q16. What factors determine the voltage of an ohm-meter battery?

Q17. What factors determine the fraction of the total current that flows through the meter coil in an ohmmeter circuit?

Q18. The zero reading is usually on the ----- end of an ohmmeter scale.

ANSWERS

A16. The sensitivity of the meter, arrangement of the shunt and series resistors, and size of the external resistance to be measured.

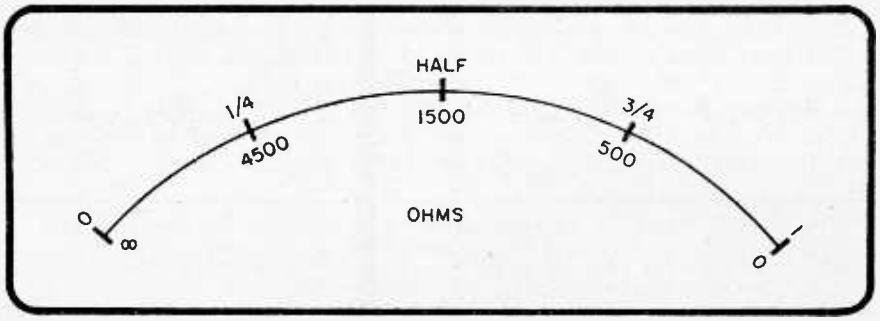
A17. The ratio of meter resistance to shunt resistance.

A18. The zero reading is usually on the right end of an ohmmeter scale.

Ohmmeter-Scale Design

Starting at the right, compare deflection and ohmic readings at the quarter points on the

BASIC OHMMETER SCALE



ohmmeter scale shown. The first quarter covers 500-ohms; the second quarter, 1,000-ohms (1,500-500); the third 3,000; and the fourth, infinity. Such a scale cannot be calibrated in linear divisions.

Reading Accuracy

Because of the nonlinearity of ohmmeter scales, readings should be taken with the pointer in the most readable area of the scale. A rule used by many technicians is to read values in the area of the scale bounded by 1/10 and 10 times the value of the midscale reading.

If only one range is available, such a rule is not practical. For example, if a meter reads 10-ohms at midscale, all desired resistance measurements will not fall between 1 and 100-ohms. Therefore, several ohms ranges are provided in a multimeter.

Measurement Precautions

When making a measurement, make a habit of taking the reading first on the highest-value range. Such a precaution prevents damage to the meter. For example, a 500-volt measurement taken at a 10-volt range setting will cause excessive current to pass through the meter coil. This will result in either burning out the coil or bending the pointer against the retarding pin. Therefore, unless you are absolutely certain of what range to use, set the multimeter for the highest-value range to take the first reading.

Resistance Ranges

Typical ohmmeter ranges are R × 1, R × 100, and R × 10K. Some multimeters have multipliers as high as R × 10 *million*. Using the rule mentioned above, the R × 1 range provides low resistance readings (0 to about 200-ohms).

The R × 100 range will give useful readings between 100-ohms and 10K, and the R × 10K range will be satisfactory for readings from 10K to 1-megohm. Higher readings may be estimated with fair accuracy. If an R × 1M range is available, resistances up to about 100-megohms can be measured.

WHAT YOU HAVE LEARNED

1. A multimeter is an instrument used to measure ohms, AC and DC volts, and DC milliamperes.
2. A combination of switches and jacks on the front panel of a multimeter permits the instrument to measure these electrical characteristics with a single meter.
3. Meters vary in sensitivity. Sensitivity can be stated in two ways—in current and in ohms per volt. Current sensitivity, rated in milliamps or microamps, indicates the amount of current flow through the meter coil necessary to cause full-scale deflection of the meter pointer. Current sensitivity of most multimeters ranges from 2 mA to 50 μA. The smaller current rating means greater sensitivity. Ohms-per-volt sensitivity is determined by the amount of meter-circuit resistance that will result in full-scale deflection when 1 volt is applied to the meter leads. A 2 mA current sensitivity would be rated at 500-ohms per volt (R = E/I). A 50-μA meter movement would have a sensitivity of 20,000-ohms per volt. The latter meter is preferred, since it adds less loading effect to a circuit being measured.
4. Most multimeters have a variety of ranges for each of the four meter functions—ohms, DC volts, AC volts, and DC milliamperes. Ranges are obtained by selecting internal circuit arrangements through the use of switches or jacks.

This series is based on material appearing in Vol. 4 of the 5-volume set, BASIC ELECTRICITY/ELECTRONICS, published by Howard W. Sams & Co., Inc. @ $22.50. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

Citation fourteen

Continued from page 58

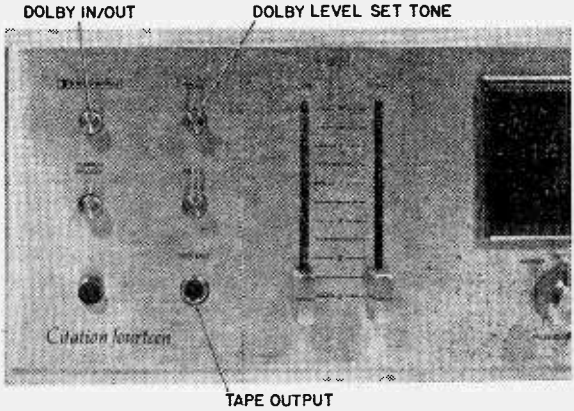
to-noise ratio irrespective of what is indicated on the *tuning* meter. Since center-channel type tuning meters are notoriously inaccurate for stereo station tuning, we very carefully checked out the *quieting* meter.

In all tests, for minimum distortion, stereo separation and best signal-to-noise ratio, the *quieting* meter was absolutely as H-K claims —the only accurate way to tune a signal. And it is interesting that on the Citation fourteen minimum distortion, maximum separation, and best noise ratio all occur at the same tuning—a somewhat rare occurrence on all but a handful of FM stereo tuners.

So, to an already excellent receiver with a tuning system insuring the best standard signal-to-noise ratio, Dolby was added.

The Dolby section is a straight Dolby de-equalizer. Because an FM tuner's audio output level is responsive only to the transmitter's modulation and not the signal strength (once the signal level reaches full limiting), no external user calibration is necessary. The Dolby level is simply factory-adjusted for 50% modulation, the FM Dolby reference level. So to use the Dolby the Citation fourteen's owner need only push a button.

Friend's Level. We were fortunate in obtaining the services of a local FM station's Chief Engineer who gave us the Dolby test signals from his station. The H-K tuner was within 1 dB factory-adjustment of the Dolby level, and a 1 dB variation is excellent—there will be no problems with proper Dolby reception.



Next, we received the signal from WQXR, New York City's full-time Dolby FM station, at a location best described as "too noisy for acceptable stereo quality." With the Dolby switched in, it was the unanimous opinion of our listening panel that the WQXR reception was "good stereo."

We, therefore, conclude that where the signal strength is not sufficient for good stereo reception, the Dolby is an effective way to obtain a good signal-to-noise ratio (in preference to a complex antenna).

All Citation fourteen output signals are after the Dolby, which can create a monitoring problem in some circumstances. For example, to record a Dolby tape the user would leave the Dolby switch off, and the Dolby FM station's signal would be recorded on the tape with the Dolby pre-emphasis. It would be de-equalized on playback. But under these conditions, monitoring the tuner would result in the user hearing the pre-emphasized signal with boosted highs. Of course, for average listening the Citation fourteen's Dolby would be switched in, but tape recordings would not be Dolbyized unless the recorder was so equipped. It's a small point, but it would not be difficult for H-K to provide an output before the Dolby to be used as a Dolbyized recorder feed.

To insure optimum Dolby recordings, that is, when the tuner's signal is recorded directly on tape without the de-equalization (and later de-equalized on playback so maximum noise suppression of both FM signal and tape noise is obtained), the Citation fourteen is equipped with a *level set tone* equal to 50% modulation of the FM signal.

The tone is generated by pressing a button on the front panel, and the recorder is simply adjusted so its meter indicates zero VU or whatever Dolby reference meter reading is used on the recorder. It's a lot better than waiting for a Dolby FM station to transmit the Dolby reference level tone.

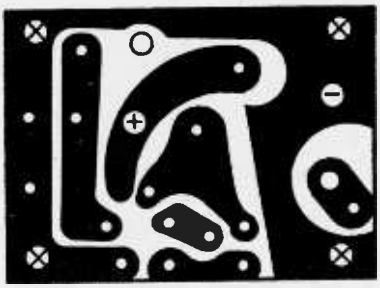
Notwithstanding our minor nit-picking about a full-time non-de-equalized output, the Citation fourteen and the idea behind it are certain to be the means whereby optimum stereo reception is brought to an even larger listening audience. It's well worth the $525 price tag. Circle No. 53 on the Reader Service Page for more info. ■

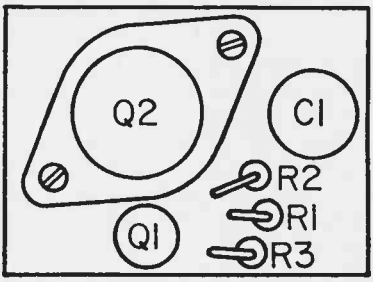
Operation of the Dolby is extremely easy. One pushbutton turns it on and another provides a Dolby-level tone.

AUTO HEADLIGHTER

Continued from page 70

position. The wire that reads +12 Volts only when the headlights are *on* is the other correct one; it normally runs directly to the foot dimmer switch. After locating these wires and marking them "+" and "Lights," disconnect the battery cable at the battery so there will be no accidental shorts. Remove ½-in. insulation from the two under-dash headlamp and battery wires you have located. Now connect each timer wire to the corresponding automobile headlamp and battery wire. Wrap electrical tape over the exposed wires and arrange them in an out-of-the-way spot under the dash. Reconnect the + battery cable and the timer is ready for use.



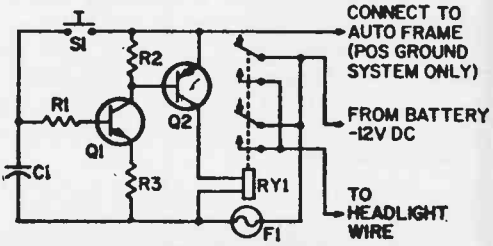


Actual size copper (bottom) side of your board on left and component (top) side on right.

Modifications Anyone? If more than 60 seconds delay is desired, a larger capacitor can be installed in place of C1. For example, a 1,000 μF capacitor will give two minutes or more of time delay. If you wish, a 10K trimmer resistor in series with R1 will allow exact adjustment of the time interval.

Several fixed timing periods such as 60, 30 and 15 seconds can be chosen with a switch wired to select different discharge resistors connected in parallel across capacitor C1. All of these modifications combined would give a longer delay period and a variable delay with your choise of lights-on times.

Positive Ground? To modify the basic timer for a 12-Volt positive ground system, do not ground the printed circuit board to the chassis. Instead, use insulated stand-offs when mounting the circuit board in the mini-box. Ground the "+" point on the *circuit card* to the chassis using a solder lug mounted under one standoff. Run a wire from the circuit card negative points to the relay. Operation will be identical to negative ground systems. ■



Use this schematic in positive ground cars only. There are no connections made to the normally open contacts of the relay. Use the same printed circuit board. All of the necessary changes are made around a board.

Olsen HF-176

Continued from page 46

duces a heavy, somewhat boomy bass—unless, of course, the record was altered to reduce this general frequency range.

The heavy bass effect of the *low* control started us thinking about headphones since many models can use considerable boost around 100 Hz. With just about any headphone we selected, from the least to the most expensive, the Olson HF-176 produced what many listeners termed *spectacular* performance. Most headphones have extensive frequency response variations at just about the frequencies of the Olson HF-176, so the 176 does an admirable job at improving overall headphone sound. With very rare exceptions, just at the low end the Olson controller produced notable improvement in headphone performance. Improvements at the higher frequencies can be considered an extra gift. We would recommend the HF-176 Frequency Response Controller to anyone who does a considerable amount of headphone listening.

One Note. Most of the equalization is obtained at the extreme ends of the control adjustment range. Very little equalization takes place between the center (flat) position and the extreme ends. So don't be surprised if you advance the controls and, at first, hear very little change in overall sound quality.

For additional information on the Olson HF-176 Frequency Response Controller circle No. 55 on the Reader Service Page. ■

Save Big Money

Continued from page 51

the professional repair service will tell you so and will generally offer you a brand new tuner replacement for about $5 additional; a lot cheaper than you'll get from a TV repair shop.

Rebuilt or all new, doing your own tuner repairs keeps lot of extra money *in* your pocket. ■

DX Indonesia

Continued from page 78

Angkatan Udara, the voice of the Indonesian Air Force. It transmits, currently, on a rather off-beat, out-of-band frequency, 11,323 kHz.

In part, *Radio Angkatan Udara's* programs are aimed at a military audience, similar to our American Forces Radio and TV Service (AFRTS), but, it is said, there are plenty of Indonesian civilians that tune its programs as well. Unlike AFRTS, *Radio Angkatan Udara* operates as a commercial

DXING INDONESIA

(kHz)	Station	Location
3,345	RRI, Studio Pontianak	Pontianak, Borneo
4,719	RRI, Nusantara I	Makassar, Celebes
4,770	RRI, Studio Djakarta	Djakarta, Java
4,855	RRI, Studio Palembang	Palembang, Sumatra
4,872	RRI, Studio Sorong	Sorong, West Irian
4,900	RRI, Studio Gorontalo	Gorontalo, Celebes
5,047	RRI, Nusantara II	Jogjakarta, Java
5,084	RRI, Nusantara III	Medan, Sumatra
5,270	Radio Chusus Pemerintah Daerah Kabupaten Poso	Poso, Celebes
7,140	RRI, Studio Ambon	Ambon, Mollucas
9,585	Voice of Indonesia	Djakarta, Java
11,323	Radio Angkatan Udara	Djakarta, Java
11,795	Voice of Indonesia	Djakarta, Java

venture, selling advertising "spots". Thus, supposedly, it is self supporting and, who knows, anything left in the kitty may go for an extra couple of gallons of aviation gasoline or a new propeller.

If you manage to hear this station, your reception report can be sent to *Radio Angkatan Udara,* 51 Djalan Tijpinang, Tjempedak I, Polonia Djatinegera, Djakarta. With that address you'd better use a jumbo-sized envelope!

Now if you don't mind tongue-twisters, how about Radio Chusus Pemerintah Daerah Kabupaten Poso—Whew! In addition to being almost impossible to pronounce, it is also one of the hardest non-RRI stations to hear!

Translated, its name means Local Government Radio Station, Poso Regency. If you want a rough parallel, the operation is equivalent to a broadcasting station run by your local county government.

Its transmitter is a puny 250 watt job, its schedule is short, 1100 to 1400 GMT, and it broadcasts on 5,270 kHz. You've got to be lucky to catch this rarie, but it was heard several times in North America last winter.

We've only scratched the surface, but that should give you an idea of the DX action that awaits when you tune for the stations of "radio-active" Indonesia. ■

BART's Magic Token

Continued from page 40

magnetically on the ticket before it is returned through a pop-up slot to the passenger. If ticket value equals trip cost, the gate retains the ticket and the barrier opens automatically. If remaining value is less than trip cost, the barrier remains closed, the ticket is rejected, and an illuminated message informs the user he has underpaid and should take his ticket to an addfare machine to pay the amount needed to cover the cost of the trip. When the appropriate amount is deposited in the addfare machine, the old ticket is returned magnetically upgraded to the new value and the patron may use it to open the gate. Well, that's the end of the lead slug folks! ■

"It overheats!"

Journey to Jupiter

Continued from page 66

the planet at solar escape velocity. It is destined to become the first man-made object to leave the solar system.

As it flies away from Jupiter, the communications distances will grow longer and longer. Signals from the spacecraft will get fainter and fainter. And, the time required to issue ground commands from Pioneer and get responses will lengthen to hours. Only the most intensive and advanced efforts by NASA's Deep Space Network will allow communication with the spacecraft at all, if it still functioning, as it penetrates far space well beyond any regions reached directly by man and his machines.

The basic Pioneer mission is designed to last three monhs after the Jupiter encounter. With rare good fortune, space trackers may possibly be able to receive the spacecraft's waning signals for as long as three years thereafter when the vehicle will be more than one-billion miles from the sun. Eventually, all contact will be lost. The vehicle will sail on and on, crossing the planet Uranus' orbit nearly two billion miles from the sun eight years after launch, moving farther and farther away, out among the stars, free of the solar system and cruising forever after at a permanent speed of 25,000 miles an hour.

Even now, as Pioneer 10 travels to Jupiter, NASA is planning to send a second, almost identical probe to the planet. It will be launched in April 1973.

Jupiter beckons. ■

ELEMENTARY ELECTRONICS

READER SERVICE PAGE

• The Editor of ELEMENTARY ELECTRONICS offers readers an easy way to get additional information about products and services advertised in this issue. Also, if you would like more information about any new product mentioned in our column "Hey, Look Me Over," it's yours for the asking. Just follow the instructions below and the material you requested will be sent to you promptly and at no cost.

• The coupon below is designed for your convenience. Just circle the numbers that appear next to the advertisement or editorial mention that interests you. Then, carefully print your name and address on the coupon. Cut out the coupon and mail to ELEMENTARY ELECTRONICS, Box 886, Ansonia Station, New York, N.Y. 10023. Do it today!

JANUARY/FEBRUARY 1973 — Void after May 31, 1973

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DX Central Reporting

Continued from page 29

couple of QTH's (addresses) for those of you seeking verifications from Cuba and South Africa. *Radio Havana* Cuba's address is Box 7026, Havana, and reports to the South African should be sent to *Radio RSA*, Box 4559, Johannesburg.

A Canadian reader in Grimshaw, Alberta, Bruce Veidt says, "The Australian Post Office has a time station on 12,000 kHz at 0659 GMT."

It certainly does, Bruce. The station that ticks away the hours similarly to our own WWV and WWVH, is VNG, and is located near Melbourne. Early mornings it should be well heard in most parts of the country.

One of our correspondents, Larry Magne passes along the word that according to R.W. Fisher, Sales Manager of Hammarlund in Red Bank, N.J., production of the HQ-180A receiver has been discontinued! This is, indeed, sad news for Dxers! Though its design was nearly 20 years old, the "180" had the reputation as one of the very best DX machines around.

Speaking of receivers, our good friends Perry and Jeanne Ferrell of Gilfer Associates, Inc., report that the company now is handling the full line of British-made Eddystone receivers and the much-talked-about Barlow-Wadley portable from South Africa. For more information, write Gilfer Associates at P.O. Box 239, Park Ridge, N.J. 07656. (Many will remember that Perry was the Editor of Popular Electronics for many years.)

For many months now, DX Central has spotlighted a different SWL or DX club, affiliated with the Association of North American Radio Clubs, each issue.

Let's recap the list of clubs, updating their addresses where necessary. If you're interested in joining one or more, drop them a line for more dope:

- American SWL Club, 161 Ballad Lane, Huntington Beach, California 92649
- Canadian International DX Club, 169 Grandview Avenue, Winnipeg 16, Manitoba
- International Radio Club of America, 6059 Essex Street, Riverside, California 92504
- Midwest DX Club, P.O. Box 8522, Miami (University of Miami Br.), Florida 33124
- National Radio Club, Box 99, Cambridge, Massachusetts
- Newark News Radio Club, c/o 13-50 30th Street, Astoria, N.Y. 11106
- SPEEDX, P.O. Box 321, Santa Ana, Calif. 92702
- North American SW Association, P.O. Box 8452, South Charleston, W. Va. 25303
- Worldwide TV-FM DX Association, P.O. Box 163, Deerfield, Illinois 60016 ■

Ask Hank, He Knows

Continued from page 22

and plan to do so in my retirement. My problem is that I can no longer get free parts from my employer. Where can I get parts wholesale, or for less, if you know what I mean?

—B.V.D., New York NY

You have a problem that others have had in the past. So I have sent your letter to the experts who have helped these people—the New York City Police Department.

Needs More Experience

While tuning the bands with my Realistic DX-150 receiver, I have noticed that on certain occasions there is a great deal of atmospheric static. This characteristic is esjecially present in the summer months. My problem is finding a way to eliminate this atmospheric noise. I've tried to eliminate this noise by adding a Lafayette antenna tuner but the noise is still present.

—W.K., Milford CN

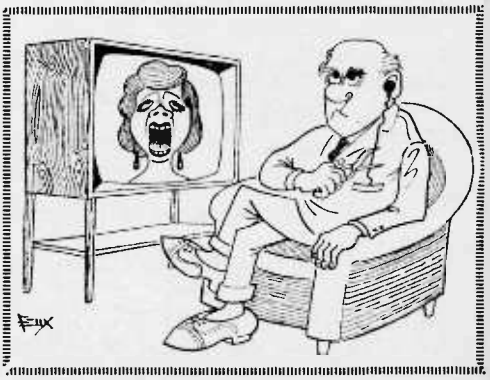
You can bet the noise is present. All the Lafayette unit can do is boost the noise along with the signal. What you need to do is switch to a band with no, or less, noise. The DX-150 is a good unit. Learn to use it correctly.

An Organizer

A few of my SWL buddies are thinking of forming a DX club, and wonder if we could get in touch with the North American Shortwave Association. Where can we get in touch with this well known club? Thanx for any help you may give.

—M.A., Waldwick NJ

The address for the NASWA is P.O. Box 8452, So. Charleston WV 25303. If you read Don Jensen's DX Central Reporting column, you'll notice a SWL club mentioned in each issue. Read what Don has to say. He really knows his business, or is it hobby? ■



Hey, Look Me Over

(Continued from page 13)

feature Talk and Dictate controls and either Remote can initiate *private* calls to the Master. Both Master and Remote Stations feature 3-in. x 5-in. combination microphone-speakers for crisp, clear sound reproduction. Low-profile, mist-green cabinets have plastic feet for desk, shelf or tabletop use at home or at the office. And pre-drilled mounting holes in the top and bottom of the cabinet allow for wall mounting. For further information, circle No. 1 on Reader Service page.

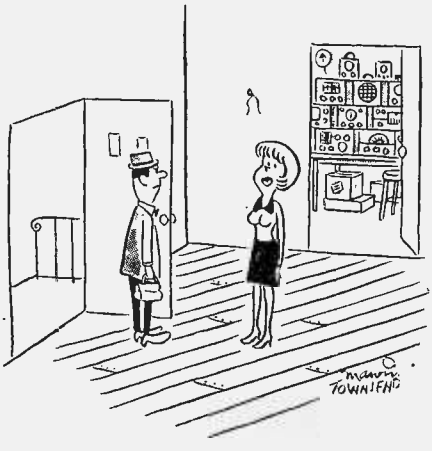
Smoothe

A new Black & Decker two-speed belt sander with dustless attachment is just great for sanding speaker cabinet projects in areas where the dispersion of dust must be limited. Designed with a low center of gravity, the motor is between the pulleys to assure smooth sanding without digging or gouging. The unit has a selection of high speed for fast material removal or a low speed for better control and smooth finishing. Sanding dust is forced by the motor into a large collection bag that detaches easily for material disposal. The sander uses 3-in. by 24-in. belts and operates at 1200 sanding feet per minute. The ¾ H.P. unit weighs just nine pounds. The #7460 two-speed dustless belt sander is available at $69.99 from all retail outlets handling the Black & Decker product line. For more information, circle No. 56 on Reader Service page.

For Wheels

Now being offered as an option by several auto manufacturers, capacitive discharge ignition systems are said to improve engine performance and economy, and provide more complete fuel combustion, thus reducing air pollution. Radio Shack has introduced the Archerkit Deluxe Capacitive Discharge System which is said to develop 50% more spark energy for more complete combustion, and increase spark magnitude to 3-5 times normal for faster acceleration and quicker starts even in sub-zero weather. This performance will reduce the need for tune-ups by increasing point and plug life from 3-10 times, and provide 10-20% better gas mileage. The Archerkit System may be assembled in a single evening, and installs in a few minutes. No rewiring of the vehicle's original ignition system is needed, and an In-

Out switch permits instant performance comparisons. The unit may be used with any 4, 6, or 8-cylinder engine having a 12 VDC negative ground electrical system. It has a weather sealed case, 3x5x3½-in. The Archerkit Deluxe Capacitive Discharge Ignition System is priced at $39.95. Archerkit products are available from more than 1500 Radio Shack and Allied Radio Stores, and through Radio Shack Authorized Sales Centers, nationwide. Want more information? Circle No. 52 on Reader Service page. ■



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INDEX TO ADVERTISERS

NewScan

Continued from page 14

those carried on manned Gemini and Apollo missions. Astronauts will prepare their own meals on a special food tray with heated compartments which conform to the food containers. The tray also keeps the containers from floating around in zero gravity. Frozen foods will be stored in a freezer in the Skylab orbital workshop. In addition to being the tastiest menu carried into space thus far, the Skylab food system is designed to meet the requirements and objectives of an important series of medical investigations. Dr. Malcom C. Smith, chief of food nutrition at the NASA Manned Spacecraft Center, explained that the medical investigations are profoundly influenced by the nature and amount of food that the astronauts consume. The Skylab food system will maintain a caloric level between 2,000 to 2,800 calories per meal. More than 70 different food items are now under consideration for use during Skylab missions. The final menu selection will be made by each crew member.

More Shorty News: For more newsy featurettes, see *Computer Reads a Tag* on page 44 and *BART's Magic Tokens* on page 40. ■

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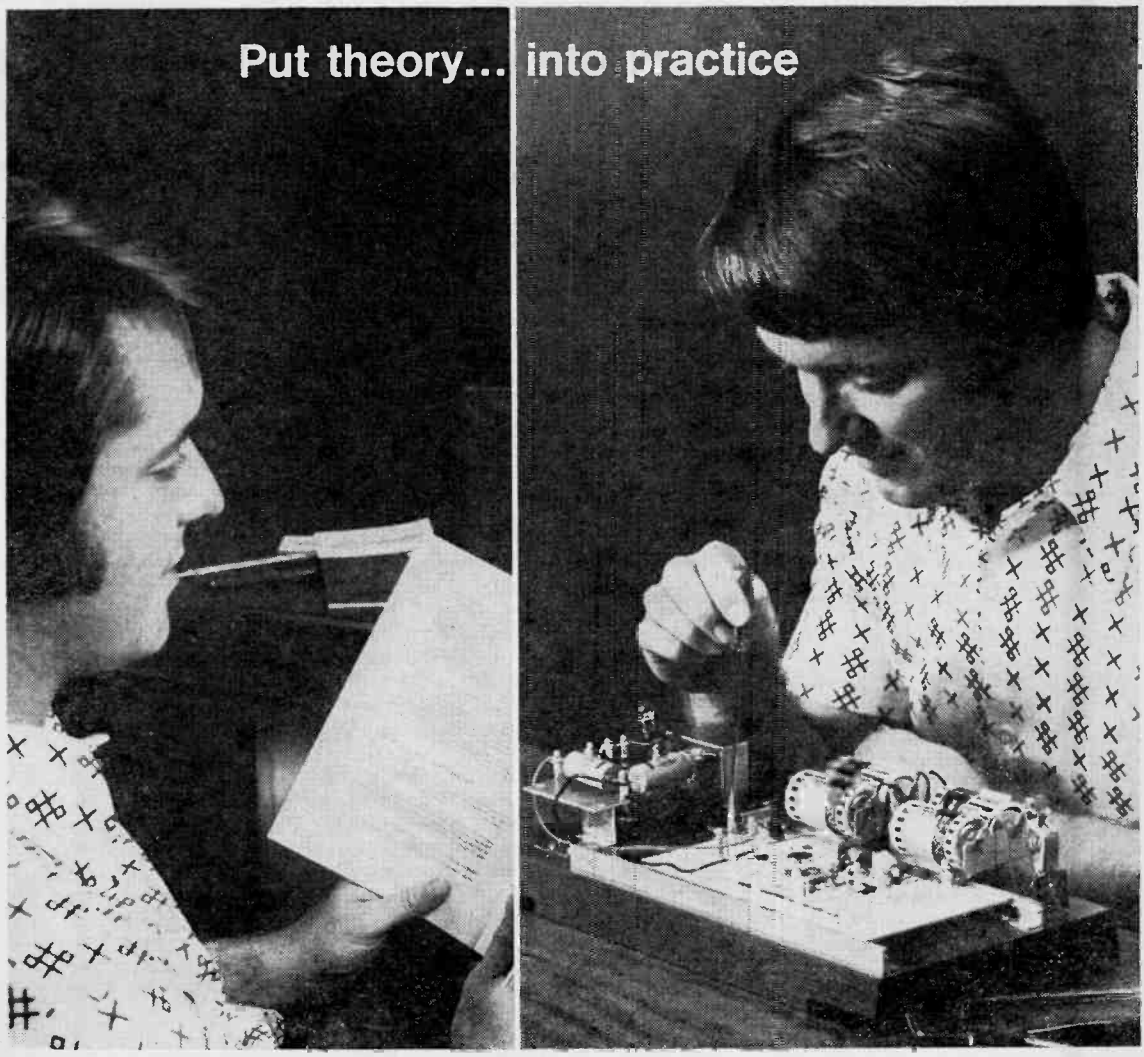

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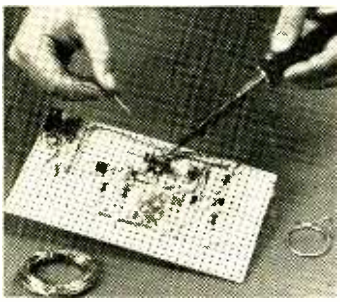

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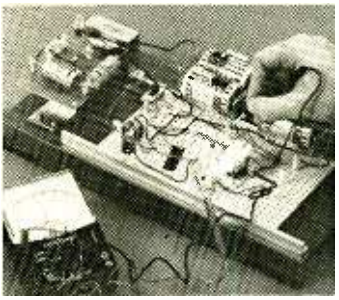

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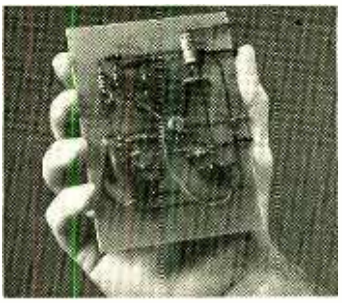

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CIRCLE NO. 5 ON PAGE 17 OR 103

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

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

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CIRCLE NO. 14 ON PAGE 17 OR