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This tachometer is guaranteed to outperform any $50 tach available today or your money will be refunded. This tach belongs in the tool chest of every machinist, electrician, model maker, motor serviceman and inventor. A six position rotary switch enables you to select three speed ranges in either forward or reverse rotation. Three ranges—0—500, 5000 and 15,000—cover the gamut of rpms in the home workshop or laboratory on machine tools, such as lathe cutting speeds, motor rpm, drilling speeds and other motor driven tools where rpm is an important factor.

Pocket-Size Hearing Aid
New hearing aid design provides a minimum of 42 decibels of gain and is adequate for 75% of all cases of partial deafness. The aid weighs only three ounces and is smaller than a king-size cigarette pack. Uses latest electromagnetic earphone and miniature crystal microphone. Powered by a 10¢ penlight flashlight battery and has a switch for turning power off when not in use and a control that lets you adjust the volume to a comfortable sound level.

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Please send the S&M kits that have complete assembly plans, or the assembled and fully tested electronic aids checked below. I understand that if I am not completely satisfied I may return the kits within 10 days for a complete refund of the purchase price.

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JUNE-JULY, 1965
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June 1965—July 1965

VOLUME 18 No. 3

RADIO-TV EXPERIMENTER

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Some plain talk from Kodak about tape:

Print-through and sound brilliance

Put a magnet near a piece of iron and the iron will in turn become magnetized. That’s print-through. With sound recording tape, it’s simply the transfer of magnetism radiating from the recorded signal to adjacent layers on the wound roll. Print-through shows up on playback as a series of pre- and post-echoes.

All agreed. Print-through is a problem. There are some steps you can take to minimize it. You can control the environment in which you keep your tapes, for example. Store them at moderate temperatures and at no more than 50% relative humidity. Also store them “tails out” and periodically take them out for “exercising” by winding and rewinding them. You can even interleave the layers with a non-magnetic material. Any volunteers? A better way is to start with a tape that doesn’t print much...which leads to low output problems if you don’t make the oxide coating substantially more efficient.

And this is Kodak’s solution. It’s not simple, but it works. It starts with the selection of the iron oxide. In order to achieve low print-through, the oxide needles must have the proper crystalline structure. Kodak’s oxide needles have that structure...offering the highest potential of any oxide currently available.

Milling the oxide ingredients also is very critical. If you mill for too long a time, the needles will be broken up and print-through will be drastically increased. Too short, and the dispersion will be lumpy. But other factors in the milling process are equally important. Like the speed at which the ball mill turns. It can’t be rotated too fast, otherwise the needles will be broken up, and broken needles, you know, exhibit horrible print-through behavior. If you rotate the mill too slowly, the oxide and other ingredients will not be blended uniformly. Other factors such as temperature and the composition and viscosity of the ingredients must also be critically controlled. One more thing. You’ve got to make sure all the needles end up the same size (.1 x .8 microns).

A very important contributor to low print-through is the binder that holds the oxide particles in suspension. The chemical composition of a binder contributes nothing magnetically to a tape’s print-through ratio. What a binder should do is completely coat each individual oxide needle, thus preventing the particles from making electrical contact. And that is just what our “R-type” binder does. The final step is to take this superb brew and coat it just the right way on the base.

Print-through tests are a million laughs. We record a series of tone bursts...satisfaction, of course. We then cook the tape for 4 hours at 65°C, and then measure the amplitude of the loudest pre- or post-echo. The spread between the basic signal and the print-through is called the signal-to-print-through ratio. The higher the number, the better the results. Most of the general-purpose tapes you’ll find have a ratio of 46-50 db. Low-print tapes average about 52 db. You can see from the graph that our general-purpose tape tests out at 53 db., so it functions as both a general-purpose tape and a low-print tape—and at no extra cost. High-output tapes with their thicker coatings have pretty awful print-through ratios—generally below 46 db. Kodak’s high-output tape (Type 34A) has something special here, too. A ratio of 49 db—equal to most general-purpose tapes.

Kodak Sound Recording Tapes are available at electronic, camera, and department stores.

FREE! New comprehensive booklet covers the entire field of tape performance. Entitled “Some Plain Talk from Kodak about Sound Recording Tape,” it’s free when you write Department 8, Eastman Kodak Company, Rochester, N.Y. 14650.

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2 Phillips screwdrivers,
2 nutdrivers

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**BOOKMARK**
by Bookworm

Picking books for review is a difficult task for the ol' Bookworm. After all, what may be a complicated theory book for one reader of *Radio-TV Experimenter* may be a comic book for another reader. In this issue, your ol' Bookworm has singled 5 far out books for review that will reach into previously untouched corners of our readers' specialized interests. Read on, see if you agree with me.

**Transistor Texts.** John M. Carroll, the former Managing Editor of Electronics magazine (a McGraw-Hill business/technical publication) and presently Associate Professor of Industrial Engineering at Lehigh University, has compiled the best of transistor articles previously published in Electronics into three out-standing hard cover books. Only a brief synopsis of each text can be given in our limited space. More information on the texts can be had by writing directly to the publisher, McGraw-Hill Book Company, Dept. 740, 330 West 42nd Street, New York, New York 10036.

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Matt Stuczynski, Senior Transmitter Operator, Radio Station WBOE.

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Glenn Horning, Local Equipment Supervisor, Western Reserve Telephone Company.

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JUNE-JULY, 1965


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Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Trace, Square Wave Generator and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional methods. The "Edu-Kit" teaches you the principles and methods of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

**THE EDU-KIT IS COMPLETE**

You will receive all parts and instructions necessary to build 20 different radio and electronic circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, nickel, vacuum and power diode condensers, resistors, condensers, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

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

**SERVICING LESSONS**

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

**FROM OUR MAIL BAG**

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am ending the first quarter of 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 Tester works fine. Also like to have the EDU Kit, I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, Va.: "I thought it would drop me a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain could be had for $24.95. 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."

**PRINTED CIRCUITY**

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

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

Printed Circuits is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.
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PROGRESSIVE “EDU-KITS” INC.
BOOKMARK
(Continued from page 6)

apply transistors in military, industrial, and home-entertainment equipment. It covers typical transistor operating characteristics, important circuit parameters, transistor types, problems of temperature and gain stabilization, and a large number of typical transistor circuits, including newest transistor radios. Circuits are shown with actual component values and include those used in portable and automobile radios, audio amplifiers, military communications equipment, telemeters, servo amplifiers, computers, industrial and medical instruments, and hearing aids. Operating characteristics of over 200 commercially available transistors, representing all types, are listed.

□ Modern Transistor Circuits—Here is a comprehensive collection of modern transistor circuits, classified and arranged for easy reference. Almost 200 circuits are presented, with complete design information and electronic component values. The circuits are arranged both by generic types such as amplifiers, oscillators, power supplies, and pulse circuits, as well as by specialized applications such as broadcast equipment and home entertainment; audio and RF communications circuits; missile, aircraft, and satellite
telemetering equipment; test instruments; and industrial, scientific, and medical devices. Emphasis is given to new circuits combining transistors and electron tubes, and transistors and magnetic amplifiers. There are over 200 schematic diagrams, along with important block diagrams, performance curves and

(Continued on page 14)
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Single AC/Ohms/DC probe: 7 AC/DC/Ohm ranges; 1% precision resistors for high accuracy; frequency response ± 1 db from 25 cps to 1 mc; voltage doubler rectifier; simple circuit board construction; 5 lbs. Available wired, IMW-11, at $39.95.

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Sonotone audio products

Sonotone Corp., Electronic Applications Div., Elmsford, N. Y.

BOOKMARK

(Continued from page 10)

waveforms, and photographs illustrating construction of equipment. You can get immediate benefit from this book by using its circuits and data directly to design similar devices. It is based on more than 100 recent engineering articles in Electronics.

□ Design Manual for Transistor Circuits—

This comprehensive manual presents a collection of tested transistor circuits which design engineers may adapt to a variety of individual applications. In nearly all cases, all component values are given, and the transistors used are commercially available. Fundamentals of semiconductor devices and network applications are reviewed in the first chapter along with semiconductor materials, forward and reverse p-n junctions, transistor action, transistor load lines, hybrid matrix parameters, equivalent-T circuit, high-frequency transistors, and power transistors. Special devices are also included such as unijunction transistors, controlled rectifiers, thyristers, unipolar transistors, and integrated semiconductor circuits. The material dealing with basic circuits such as amplifiers, oscillators, and power supplies—has been grouped into 21 chapters for easy reference. They cover such specific applications as radio, f-m, and television receivers; test instruments; industrial and radiation measuring instruments; and computer circuits. Missile and satellite circuit information has been divided into two chapters for easy comprehension. One is devoted to telemetering circuits and the other to guidance circuits. Similarly, digital computing circuit informa-
tion is separated into one chapter on counting circuits and three chapters on computer applications. These latter chapters cover such material as switching and control circuits, memory circuits, and circuits for input and output devices. The field of industrial electronics is covered in chapters on solid-state switching, servomechanisms, and measuring instruments. The new tunnel diode is covered in an article describing the theory of the device, typical circuits, and applications. Design charts and nomographs have been reproduced to illustrate material covered. Typical problems dealing with operation, thermal design, and transistor operating loads are discussed and analyzed. The basic information, the scope of material covered, the ease of comprehension and reference, combine to make this manual equally suited to the engineer approaching the subject for the first time and to the experienced engineer searching out specific circuits for particular applications.

**Out In The Light.** A new hobbist manual, *Solar Cells and Photocells* by Stu Hoberman, has been placed on the bookshelves by publishers Howard W. Sams & Co., Inc. Solar cells and photocells are being used extensively in all types of modern devices—from electronic door openers to solar batteries in space vehicles. The basic objective of this book is to demonstrate the theory, application, and construction of light-sensitive devices. Chapter 1 discusses the basic principles of light-sensitive devices and light sources, or illuminators. The electrical characteristics and the symbols for these devices, as well as application data are given. Chapter 2 describes the various types of light beams employed and some typical applications of photoelectric controls in industry. The easy-to-build, low-cost projects presented in Chapter 3 are designed for students, experiment-
BOOKMARK

ers, and technicians. These projects range from the simple to the more complex—from light switches, photorelay drivers, and light meters to photologic circuits, remote controls, color comparators, etc. By constructing the projects presented in this book, you can acquire a greater insight into both the theory and operation of solar cells and photocells. (For more information write to Howard W. Sams & Co., Inc., Box RTE, 4300 West 62nd Street, Indianapolis 6, Indiana.)

Surplus. The past two decades have seen such national institutions as the hula hoop, N. Y. football Giants and the Edsel come into being and then sink into oblivion. There are only two things left from the past, Ed Sullivan and military surplus radio year. Surplus prices aren’t too different than they were after the war. You can still buy ARC-5 and 274N transmitters and receivers for under ten dollars. But the bargain is not a bargain unless you know how to convert them to peace-time use. Author Tom Kneitel’s new book, Surplus Conversion Hand-

book, is a neat packaging job of old magazine articles detailing all that is needed to convert many of the surplus items still on the market place. We can’t hope to list all the conversions in this book, but we can list a few of the equipments by military number: ARC-1, 3, 4, 5, 36, 49; BC-191, 224, 312, 314, 342, 344, 348, 375, 603, 624, 625, 779, 794, 1004, 1068A; Command transmitters and receivers; HQ-120, 129X; SCR-177, 188, 193, 399, 499, 508, 522, 528, 542, 608, 628; SP-200, 210, 400; and military crystals. (For more information write to Cowan Publishing Corp. Dept. TK-I, 14 Vanderventer Ave., Port Washington, New York.)

Master Index. Mr. M. M. Beitman of Supreme Publications has just announced the availability of the new 1964 Master Index to Supreme Publications. This booklet serves as an index to all 23 radio volumes and 17 TV volumes presently available. If you are interested in obtaining information and the schematic diagram for any U.S. radio made since 1926, or any U.S. TV set manufactured since 1951, this index becomes invaluable. As a special offer to Radio-TV EXPERIMENTER readers, Mr. Beitman offers single copies of the Index for only 10¢ to cover actual postage. Send your order and 10¢ to Supreme Publications, Box 706 1760 Balsam Road, Highland Park, Illinois. This offer can be withdrawn at any time.

Speak Up, Bud! Your ol’ Bookworm would like to know what books you have been reading during the first six months of 1965. Your reading habits will help me plan my reviews to coincide with your reading objectives. Don’t be bashful, send a postal card to the Ol’ Bookworm in care of Radio TV-EXPERIMENTER and list the books you’ve read. OK to mention other magazines, if you wish.

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Radio-TV EXPERIMENTER
Lightweight Extended-Range Stereo/Mono Headset

A new headset, Model AKG K-50, designed especially for stereo/mono music listening has been introduced to the high fidelity market by Audio Applications. The new headset features unusually lightweight construction totalling a mere 3.8 ounces, compactness and wide-range frequency response of 20 cps to more than 25,000 cps with extraordinarily low distortion. The manufacturer claims the AKG K-50 headset is the only unit that provides full bass response without requiring an air seal between the listener’s ears and the earphones. This combined with the extremely low weight completely eliminates fatigue and discomfort. The AKG K-50 headset can be worn for many hours without inducing “head clamp” sensations or self-consciousness. It is exceptionally efficient, normally requiring a power level of only 156 milliwatts for comfortable sound. The headset is finished with crystal-clear earcups and light gray ball and drive capsules that are easily adjusted on the unobtrusive headband. Mechanical construction is such that long, trouble free life is assured. A 1-year unconditional guarantee is given for materials and workmanship by Audio Applications, Inc., national sales and service representatives for
NEW products

the AKG K-50 headset. The unit is available at many local retail outlets for $22.50. (For more information and the location of your local dealer write to Audio Applications, Inc., Dept. RT31, 19 Grand Avenue, Englewood, New Jersey 07631.)

Solid-State Integrated Amp

Latest in the Harman-Kardon line of solid-state high fidelity components is the Model SA-2000 integrated stereo amplifier. This all-transistor unit provides 36 watts IHF music power output (18 watts per channel). The SA-2000 utilizes no output transformer, it is able to reproduce faithfully all frequencies from 8 to 25,000 cps, with a flat response within ±1 db at normal listening levels (1 watt). At full rated power, the unit reproduces 10 to 23,000 cps with a flatness of ±1 db. The intimate direct speaker coupling is said to enable the speaker to follow the signal more closely and to provide better speaker damping. The damping factor is 25:1. Square wave rise time is only 5 microseconds. This excellent transient response prevents blending of instrument voices, enabling the discriminating listener to pick out individual instruments. Harmonic distortion is less than 1% and hum and noise suppression is at least 90 db. Controls include the following: volume control with power switch; balance control; ganged bass, and treble controls; contour switch; low cut switch; high cut switch; tape monitor switch; and speaker defeat switch. The SA-2000 features a front panel earphone receptacle, two convenience outlets, a phono input, a tape amplifier input and two auxiliary inputs. It measures 13¼” wide x 4½” high x 8½” deep and weighs nine pounds. List price is $159.00. (Complete specs are yours for the
CB Transceiver

Sonar Radio Corporation has come up with their newest CB unit—the FS-23—which incorporates every functional feature demanded by today's experienced CB'ers including frequency-synthesizing circuits. The unit's continuous one control channel switching and low-noise Nuvistor receiver RF stage offer are just two of the many features necessary for full-time CB communications. The Sonar FS-23 uses 13 tubes, 2 silicon diodes, 1 germanium diode and 12 hermetically sealed crystals to perform in 19 stages aside from the power supply which uses 2 power transistors and 4 silicon rectifiers. The oscillators are of the fundamental frequency type as opposed to the overtone type and provide a higher degree of transceiver stability under all operating conditions. The receiver combination of a low-noise Nuvistor RF amplifier, selective IF system, gated noise-limiter, double conversion and voice-oriented audio system provides unparalleled reception in both mobile and base installations. The transmitter incorporates the best time-honored design techniques and is modulated to 100% by a class B push-pull modulator. The result is a clear penetrating signal ideal for crowded, noisy conditions. The Sonor FS-23 comes complete with microphone, power supply cables and under-dash mounting brackets; priced at $299.95. (For more information write to Sonar Radio Corp., Dept. 731, 73 Wortman Avenue, Brooklyn, New York.)

VTVM Measures L & C

The new EMC Model 107A, a wide-range vacuum-tube voltmeter (VTVM) for DC, AC, and resistance measurements, also pro-
NEW products

vides direct peak-to-peak readings on complex, asymmetrical voltage waveforms, direct capacitance readings, a zero-center scale, db scales, and indirect inductance measurement. Other features include a “wide screen” 6-inch meter faceplate for legibility and reading accuracy. This accuracy is furthered by 10 separately calibrated scales instead of combination scales. In addition to the capacitor test, the function switch includes separate positions for + or − DC. The meter movement is burnout-proof. Peak-to-peak voltage is measured in 6 ranges: 0 to 4, 28, 84, 280, 840 and 2800 volts. AC (rms) and DC, in 6 ranges: 0 to 1.5, 10, 30, 100, 300, and 1000 volts (up to 30,000 DC volts with accessory probe). Six resistance ranges cover from 0 to 1000 ohms (10 ohms center scale) up to 0 to 1000 megohms. Capacitance is measured in 6 ranges from 50 pf. to 5000 mf. Db is measured from −24 to +55 db in 6 ranges. Accuracy is 3 per cent on DC, 4 per cent on AC. Input resistance is 16.5 megohms or 1½ megohms per volt on DC, 1.5 megohms on AC. A complete instruction manual for the EMC Model 107A VTVM includes conversion charts to obtain inductance readings in henrys and correct db readings for standards other than 0 db at 6 mw. in a 500-ohm line. Available accessories include an RF probe useful to 200 mc. and a high-voltage probe useful to 30 kv. Model 107A comes with instruction manual and test leads; in kit form, $36.50, or wired and tested, $51.40. (Complete information is yours for the asking—write to Electronic Measurements Corporation, 625 Broadway, New York, N. Y. 10012.)

Hully-Gully To Fox Trot
It’s All On One Tape

A new album exclusively dance music called “Tapeotique” has been announced available by Roberts Electronics. Tapeotique is a compelling collection of current dance hits termed ‘Long Play’ for its length in excess of 3 hours. Music of Tapeotique is programmed 4-track stereo. Dancers find it difficult to resist its selections following in close sequence. No matter what your favorite dance is, it’s on this tape—Swim, Watusi, Frug, Bossa-Nova, Cha-Cha, Merengue, Samba, Twist, Hully-Gully and many others. Tape speed is 3¾ ips. with extraordinary fidelity for this speed. Sound reproduction is by Roberts Cross Field Sound, a process successful in delivering exceptional fidelity even at 1½ ips. Tapeotique is available from Roberts dealers who also handle the Roberts tape recorder line. It retails for $14.95. Dance tunes on this tape would cost $60 purchased as separate tapes. Tapeotique is also available as halftrack monaural at 3¾ ips. on special order. (For more information write to Roberts Electronics, Division of Rheem Mfg. Co., 5922 Bowcroft St., Los Angeles, Calif.)

Electronic Exposure Meter Kit

Allied Radio has come up with an electronic exposure meter kit which is so sensitive that it will get the right exposure even by moonlight. The Knight-Kit KG-275 meter uses a cadmium sulfide photocell, powered by two 1.35-volt mercury batteries. The unit will read light down to 0.014 footcandles. It reads reflected light from the subject, has built-in diffuser for incident light readings and push-
button range selectors for low and high light levels. Color-coded scales indicate proper lens openings and shutter speed combinations. Push-to-test button on back of case acts as built-in battery tester. Size is 4 1/4 x 2 1/4 x 1 3/8”—small enough to fit in the palm of the hand. The complete kit (assembly time 1 to 2 hours) is supplied with all parts, case, batteries, neck cord, wire, solder and step-by-step instructions for $15.88. (It is listed in the Allied Radio 1965 catalog, available free on request from Allied Radio Corp., Dept. RTV3, 100 N. Western Avenue, Chicago 80, Illinois.)

Press-On Label Holders
For Fast Filing And Finding

New self-adhesive press-on label holders are being introduced by Akro-Mils, Inc. to solve labeling, inventory control information, and indexing problems in a wide variety of applications for both industry and the hobbyist workbench. Made of durable extruded plastic, the pressure sensitive label holders are easy to apply and hold fast. Easy to change perforated insert cards supplied with the holders. The press-on label holders are ideal for file drawers, shelves, parts bins, ring binders and ledgers, all kinds of office books, with a wide market in stores, stockrooms, factories, hotels, hospitals, schools, mailrooms and libraries. Holders are easy to apply, simply by removing the treated paper backing and placing the press-on label hold-

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Silicon Thyristors. $1.95 @, 6 for $11.
ASK ME another

By Leo G. Sands

Radio-TV Experimenter brings the know-how of electronics experts to its readers. If you have any questions to ask of this reader-service column, just type it on the back of a 4¢ postal card and send it to "Ask Me Another," Radio-TV Experimenter, 505 Park Avenue, New York, New York 10022. The experts will try to answer your questions in the available space in upcoming issues. Sorry, the experts will be unable to answer your questions by mail.

Neon Relaxes

How can I determine the frequency of a neon lamp relaxation oscillator? It is not $t = RC$ because different voltages produce different frequencies.

—E. S., Springfield, Ore.

The time constant of the circuit shown in the diagram, without the neon lamp, is equal to $R$ in megohms times $C$ in microfarads. If $R$ is set to one megohm and $C$ has a value of one microfarad, it will require one second for $C$ to charge to 63% of the supply voltage.

![Diagram]

When the neon lamp is in the circuit, the supply voltage and the lamp characteristics have an effect on the period of the circuit. Suppose the neon lamp fires at 100 volts and extinguishes at 70 volts. If the supply potential (B) is 200 volts, $C$ will not charge to 63 per cent of the supply voltage (126 volts) because the neon lamp will fire when the
charge in C reaches 100 volts, which it does in about half the time required to reach 126 volts.

When the lamp fires, the capacitor discharges through it, but the charge only drops to 70 volts since the lamp goes out at this point. Then, the cycle starts again, the charge in C rising exponentially from 70 volts (not from zero) to 100 volts and then dropping abruptly to 70 volts.

There are fairly complex equations for calculating the frequency of a neon lamp relaxation oscillator which are applicable when the characteristics of the lamp are known and the voltage source is stable. The easiest way is cut and try. It is extremely important for the voltage source to have excellent regulation in order to achieve frequency stability.

Local Oscillator Kaput!

My 5-tube AC-DC superheterodyne receiver will bring in stations near one end of the dial. The rest of the band is dead. What is the trouble?

—T. K., Long Island City, N. Y.

Either the tuning condenser plates are shorting or you probably are experiencing oscillator trouble. The oscillator may cease to function except over a limited frequency range. The trouble is usually due to a defective converter tube, change in the value of the oscillator grip leak (R1) or in the value of the screen voltage dropping resistor (R2). It could be that by-pass capacitor C1 may be leaky causing the screen voltage to drop. Try a new grid leak (R1) of the same value as the original. If that doesn’t do it, change R2 and C1. Sometimes the oscillator coil (L1) absorbs moisture and its Q is lowered. Try drying it out by exposing it to an infrared lamp.

Radio Goes PA

How can I connect a microphone to an AC/DC radio so I can use its amplifier without using the radio circuit?

—A. S., Passaic, N. J.

Since the amplifier may not have enough gain for a crystal, dynamic or ceramic microphone, you can use a carbon microphone as shown in the diaphragm. Install a d.p.d.t. toggle switch, S1, on the chassis or the set’s rear cover. Mount microphone transformer T1, such as a Stancor A4705 on the chassis or rear cover, grounding transformer frame to chassis. Also install a battery holder (La-ayette 34G5005) on rear cover and slip a 1.5-volt battery (Burgess Z, Eveready 915, etc.) in the holder. Disconnect the “hot” volume control lead as indicated by “X” in the diagram. Wire the new parts into the circuit as shown, using the shortest possible leads (except microphone cord). Capacitor C1 may be an 0.01 mfd tubular.

Throw the switch one way for normal radio reception, the other way to use the mike. The volume control works for both. If there isn’t enough mike volume add more batteries. Using a telephone type carbon mike, you should get lots of sound.

An alternative is to use a Philmore Junior Microphone (Cat. No. 500) which can be connected directly to the plate and cathode prongs of the first AF amplifier tube by means of clips furnished with the mike. These are sold in many radio parts stores.
Still another, and the safest way is to get a wireless broadcaster (Knight, Lafayette, etc.) which does not have to be connected to the set and does away with the shock hazard.

**Instant Radio**

*How can I modify an AC/DC radio so it will operate instantly when I turn it on like some TV sets I have seen advertised?*

—S. R., Roosevelt Field, N. Y.

Connect a diode across the ON-OFF switch terminals of a typical AC/DC radio. With the switch turned OFF, the tubes should light but the set should not play. If it plays, reverse the polarity of the diode. Pick a diode that will handle at least 500 ma. and peak inverse voltage of at least 400 volts. They cost as little as 37 cents.

**Antenna Current**

*How can I determine how well the antenna of a marine radiotelephone is functioning after it has been installed?*

—R. J., Detroit, Mich.

Most marine radiotelephones have an antenna current indicator lamp whose brilliance is relative to antenna current flow. Some have an antenna ammeter or plate current milliammeter. If the radiotelephone does not have an antenna current ammeter, you can connect one temporarily between the antenna lead-in and the antenna binding post. Then tune the transmitter for maximum antenna current on 2182 kc, the most important channel. If the transmitter is designed so that it can be tuned for optimum performance on each channel, follow the procedures in the rig's instruction book. Some sets, like the Hartman, have a front panel antenna tuner with which the set can be adjusted for best performance after selecting a channel.

The efficiency of a typical marine radio antenna is very poor because it is not practical to make it big enough for maximum performance, except on large ships. And, the ground connection is as important as the antenna.

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ASK ME another

Trap It

On CB channels 9 and 19 I receive a local 1000-watt AM radio station about 34 miles away which operates on 1400 kc. I use a ground plane antenna. How can I eliminate this interference?


Disconnect the lead from the antenna relay to the receiver antenna coil and connect a wave trap in its place as shown in the diagram. You can use a shielded TRF coil such as a Miller A-320 RF with a 20 pf. capacitor connected across its secondary. Leave the primary disconnected. Mount the coil shield can to the chassis or rear cover of the set (if it is metal) and use the shortest possible leads. Tune the coil core until the interference is weakest or disappears. Try different values of capacity across the secondary if the suggested value doesn’t do the trick. Make sure the coil shield can is securely grounded to the set chassis.

BCB Noise

Without moving out of the New York City metropolitan area is there any way to get broadcast band reception? Using an HQ-100A and a 45-foot long wire I get good short wave but on the BC band I can’t hear 300 miles.

—P. F. A., Hewlett, N. Y.

Living near New York City can impose some hardships in regard to broadcast band DX because of the presence of so many stations in the area. Lengthening your antenna may compound your problems. Also, there are so few clear channel stations that you might have to stay up late to hear distant stations operating on the same frequencies which go off the air around midnight. Just before daybreak, you should be able to hear Cuban stations. Try 700 kc at night—you should be able to receive WLW in Cincinnati.

Two Receivers Go “Dual”

I have a short wave receiver with 1650-kc IF and another receiver with 455-kc IF. Would it be possible to feed the IF of the first receiver into the second receiver to get dual conversion? Would I get a worthwhile increase in gain or selectivity?

—A. L., Philpot, Ky.

It is possible, but you might run into some feedback problems. You can tap the 1650-kc IF signal at the cathode of the last IF amplifier as shown in the diagram. If the existing cathode bias resistor (R) has a bypass capacitor across it, disconnect the capacitor. Run the 1650-kc signal through low value capacitor C (5-100 mmf) and a short piece of shielded wire to the antenna (inner conductor) and ground shield terminals of the second receiver.

Connect the antenna to the antenna terminal of the first receiver and the ground wire to the ground terminals of both receivers. Disconnect the first receiver’s speaker and connect a resistor in its place. The resistor should have the same value as the speaker impedance. Tune the second receiver to 1650-kc and tune in the stations with the first receiver. The audio volume control of the first receiver will have no

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effect. The RF gain controls of both receivers can be varied to get the required gain.

Another way to tap the 1650-kc signal in the first set is to wrap the inner conductor of the shielded wire, but with the inner conductor insulation left on, around the lead from the plate of the last IF amplifier to the IF transformer. This forms a small capacitor.

Detector, Type Humaniod

Recently, you said that you heard someone say on a radio broadcast that he perpetrated a hoax a long time ago by claiming that he heard radio programs in his head, probably due to teeth fillings acting as a detector. I have information which leads me to believe that this has actually happened to many people.

—C. M., Rock Creek, Ohio

As a result of publication of my comments, one of the best informed electronics editors in the business called me to get more particulars. Perhaps the phenomenon has happened to people. However, if teeth fillings act as a detector, what serves as the transducer that converts demodulated RF (audio) into sound waves. Wonderful idea for radio paging if selective signaling can be added. Then there’s this Korean vet with a pin in his arm about the size of a 3-cm. quarter-wave stab used in radar antennas who can detect aircraft up to 300 miles away, and this other guy who pierced his ears...

Birth Certificate Not Necessary

What is the age limit for an amateur license?

—D. P., Ballinger, Texas

There is no age limit. There are quite a few ‘young’ hams. I got my general class ticket when I was 14, but that was a long time ago. I once saw a newspaper clipping of a 6-year-old boy who passed his General Class exam. So you see, if you’re reading this magazine, you’re old enough!

Headset-Speaker Tie-up

My old radio has four speaker wires. How can I hook up earphones to it and cut out the speaker?

—D. W., Bay City, Michigan

Two of the wires undoubtedly go to the speaker’s field coil. The other two go either (Continued on page 29)
QSO-ing the Meter

By H. E. Holland, WA4YKK

"Burglar? No, it's that ham fella wandering around with his field strength meter again."

"20 over 1900? He asked for a signal report, not the time!"

"Trying to check the output with an ohmmeter again?"

"I just finished building the receiver, OM, and got the meter in up-side-down."

"Wouldn't it be a lot cheaper to have your eye glasses changed?"
ASK ME another
(Continued from page 27)

directly to the voice coil or the primary of the output transformer, if the transformer is mounted on the speaker. Ignore the field leads. Disconnect the voice coil lead that goes to the output transformer (not to the hum bucking coil) as shown at "X" in the diagram. Add a 20-ohm potentiometer, R1, and connect it across the set’s output transformer. Also add an extra output transformer, T1, such as a Stancor TA-44, connecting its secondary as shown in the schematic diagram. Connect the headphones across its primary (high impedance side). The transformer type suggested has three taps. Try the 4, 8 and 16 ohm taps and use the one that gives best results. The purpose of the added transformer is to step up the audio voltage. To use the speaker, turn the potentiometer fully one way. Midway, both the headphones and speaker will operate (at reduced volume). When fully turned the other way, the speaker will be silent and the sound will be heard only in the headphones.

Dial Trouble
The dial of my short-wave set is inaccurate and far from the announced frequency. How can I improve it?

If the receiver has tuning trimmers, tune in a station at a known frequency. Then set the dial to indicate that frequency and adjust the trimmers until you get the same station. Or, tune in the station and disengage the tuning dial, set it to indicate the frequency of the station and then re-engage the dial. This is a cheap and dirty way out. If results are poor, you will need a signal generator alignment.

Intercarrier Buzz
There is a buzz in the sound of my TV set. When I adjust the fine tuning control to eliminate the buzz, the picture is not right. How can I get clear sound and pictures together?
—N. T., New Orleans, La.

Chances are your TV set employs “intercarrier” sound and a gated beam sound detector. The usual cause of buzz in the sound channel is receiver misalignment. To align the whole receiver properly a sweep and marker generator and an oscilloscope are required. If you don’t have these instruments available, try replacing the sound detector tube (6SN7, etc.). Also try tuning the gated beam detector “quadrature coil” for clear, buzz-free sound with the set tuned for the clearest picture. When tuning the coil by turning its ferrite core, use only a tuning wrench that fits. Some TV sets also have a potentiometer with which sound buzz can be minimized. Get a service manual for your
set so you can locate these components.

There are several types of Raysistors which are about the size of a crystal can. You can get complete application information on them from Raytheon Components Division, Newton, Mass.

Lecher Wire

*What is a Lecher wire and how can I measure transmitter frequency with it?*

—J. M., New York

A Lecher wire was popularly used years ago to measure frequency. As shown in the diagram, two bare copper wires are stretched tight, parallel to each other (one to six inches) and supported only at their ends.

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Y
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The closed end (X) is placed in the proximity of a transmitter's output tank coil. While monitoring transmitter plate current, a metal shorting bar is slid along the wires. The plate current will change with the shorting bar at points one half wavelength apart as in points A and B in the diagram.

Wavelength is determined by measuring the distance between two such adjacent points. Multiplying the length in feet by 0.656 or inches by 0.0547. If the distance is 200 inches, the wavelength is 10.94 meters. Frequency in megacycles can be calculated by dividing the wavelength into 300. In the example given, the frequency would be 27.027 mc within the citizens band.

*We're lucky! Look at all he has to go through to get a license.*
In mid-July, Mariner IV will fly by Mars and electronics will close the 45-million-mile gap of ignorance.

By K. C. Kirkbride
In the late Fall of 1964 a group of scientists met to announce a decision that could open new worlds to man for all time. Number-one goal of the United States space effort, the thirteen-man Space Sciences Board recommended to NASA, should be exploration of Mars. A series of flights could carry out physical and biological investigations, especially search for extraterrestrial life.

For man has long sought to solve the mysteries of the red planet. One noted astronomer of the 19th century believed he saw skillfully-built canals on the planet; another saw irrigation projects only an advanced civilization could have built. One Soviet scientist claims Mars vegetation is blue. Another astronomer theorizes Mars clouds are brown. Others see dark areas of blue-green land masses, white polar caps, red-brown deserts, seasonal color changes turning green to brown to grey within months.

Long Ago: While still another pictures a Martian civilization that lived centuries ago, one so advanced he built both extraordinary canals and irrigation systems to sustain themselves as oxygen and water escaped from their planet's atmosphere. Then, when the canals and systems could no longer sustain them, sent artificial satellites into space (we dub them the planet's moons), built space ships and hastened off to their new satellite homes. Others, some say, travelled to far distant stars.

The Cause. The fact renowned scientists and astronomers have viewed the planet and produced such contradictory theories may well be due to limited instrumentation.
For until recently we have studied this vital planet through, first: the naked eye, then crude, sometimes home-fashioned telescopes, more recently 100 to 200-inch telescopes, the spectrograph (some blame the spectrograph for lack of water news on Mars), and still more recently, ultra-violet and infrared photography, all limited instruments when viewing a planet that at its orbiting best is 35,000-000 miles distant in space.

Better Billing Does It. But recently sparked headline attention to Mars has spurred a group of young scientists to fashion a whole show of new electronic reporters to visit Mars personally and televise, telemeter and radio-probe until the mysteries of the red planet are solved.

First Reporter To The Scene. On November 28, 1964, a 575-pound windmill spacecraft atop a towering 100-foot Atlas-Agena flamed off the launches of Florida's Cape Kennedy. Mariner IV was headed for Mars!

At the end of a seven-months-long trip, when the spacecraft homes in on the planet, television cameras will turn on six to ten hours before the lights of Mars switch on the 330-foot long tape recorder.

When the recorder snaps on, it will signal the cameras into action, to scan 22 pictures two at a time through a reflecting telescope 8,600 miles from the planet. Half a day later the 200-line pictures, now stored on magnetic tape in digital form, will start beaming their way back to an eagerly-waiting audience on earth, while the craft itself soars on into space.

Why The Delay? Reason for the delay? The 250,000 bit pictures can be scanned at a speed of 10,700 bits per second but can only snail-pace their way home at a speed of 8.33 bits, taking a long suspense-ridden 8½ hours to completely reach earth-bound television screens.

What we will learn from this first reporter Mariner IV is anybody's guess right now. But Boeing Aircraft's young Frank S. Holman feels pretty impatient about the whole fly-by idea. He thinks we could send an orbiting instrument package to Mars by '69 that would report atmospheric news over a period of months. He sees such an orbiter dropping a round sterilized ball through the thin Martian air—sterilized because we dare not affect Mars' soil with germs from the earth.

Weighing thirty pounds and powered simply (probably by silver-cadmium battery) with a receiver-transmitter to send and respond to signals from earth, the 24-inch ball probe would tip us off as to problems future astronauts may expect from atmospheric pressures when they land on the planet.

The Carafe. For more advanced missions he pictures a series of double-decker crafts, one deck to circle the planet, the other to land and relay news from the planet's surface. The lander Holman visualizes would stand a noble six-feet tall, be built like a carafe, and carry an automatic drill to bore into Martian soil and analyze its contents chemically.

Better Yet, the Multivator. Stanford University's Dr. Elliott Levinthal says "Multivator" could make it to Mars by '67. The dark-haired brilliant young scientist refers to a lander ten inches tall, 2¾ inches round, now sitting atop Stanford research tables at Palo Alto, California. Multivator's aim in life is to seek out basic carbons common to all living forms. And when it finally does go into its act on Mars, a tiny vacuum cleaner device will first scoop up samples of soil, run the "dust" through a chemical process, and if any sign of life exists, a photomultiplier will scan the chemical change, the lander then radio the news to earth.

Levinthal claims his proud Multivator will be able to spot the present stage of Martian evolutionary development, says even if it reports a sterile Mars, we may find important clues to living processes if we detect historic traces of unsuccessful trials at life.

"Wolf Trap" Diets. At the University of Rochester, New York, Dr. Wolf Vishniac places a tiny three-ounce gadget (slimmed down from a robust 30 pounds) on his laboratory floor. A tiny door opens, and a small tube that looks like a miniature vacuum cleaner hose springs out. Swooshing its way around the floor, the tube draws dust into the "Wolf Trap" inner chamber. If the chemical "soup" inside turns cloudy, a beam of light
Multivibrator, a biological Mars probe, is designed to seek out basic carbon compounds of life. Left, unit and container; below, fluorescent light test chamber.

Inner sphere in Advanced Mariner Lander contains scientific payload and communications, and is protected by impact crush-up case.

Avco's concept of the Advanced Mariner spacecraft. Lander (top portion) will separate from bus (lower portion) and it'll be propelled on an impact course.

The entry and landing sequence for the Advanced Mariner on the Martian surface.
Avco’s concept of a Mars Voyager spacecraft shown in transit (above). The vehicle is oriented to keep the solar panels facing the sun. The lander will be separated and sent on an impact course to Mars. Space bus will then orbit Mars sending back to earth TV and other data. Below, Mars lander is shown after impact. Folding panels have been opened to expose scientific instruments and to allow communications antenna to aim at earth for data transmission.

Mars, the Red Planet

Mars is the fourth planet in order of distance from the sun. It has been observed from remote antiquity since its “red” or “ruddy” color and relatively rapid motion among the stars make it a very conspicuous heavenly body. Mars is best observed at opposition at midnight. The distance between earth and Mars at an average opposition is about 45,000,000 miles, but a favorable opposition occurs every 15 to 17 years when this distance is reduced to 34,000,000 miles.

Some of Mars’ statistics (and earth’s) are: radius, 4,200 (7,918); days in a year, 687 (365.26); million of miles mean distance from sun, 141.5 (93.0); escape velocity in mi./sec., 31 (7.0); surface gravity 0.38 (1.0); period of rotation, 25 hours, 37 minutes (24 hours).

will then scan organisms breeding in the chamber.

“Gulliver.” Wolf Trap and Multivator have another brother named “Gulliver” living on the West Coast. Gulliver rooms at the California Institute of Technology in Pasadena, has cut his weight to a slim 1 1/2 pounds, and boasts an organic chemical “soup” in his inner chamber labelled with radioactive carbon. When NASA books Gulliver to play the Mars circuit, small bullets will fire three sticky fingers of string, each 25 feet long, onto the Martian soil.

When the strings reel in they will haul back samples of soil and a radiation counter will then detect carbon dioxide gas if the samples show any signs of life.

Through Space Will Travel. But before these clever landers can perform their Martian best, they must travel a long 400,000-mile road up through space. For this purpose NASA books Mariner-Voyager missions to Mars over a ten-year period ending December 1975. Avco engineer Dr. Paul C. Dow, Jr., pictures just how these double-decker space missions will operate.

Same Start. Both will launch from Cape Kennedy, separate booster from craft in space, Mariner from an Atlas-Centaur launch. Voyagers to be Saturn’d, then unfold solar panels to pick up power from the sun. An onboard antenna will heed radio instructions from earth, and send back cosmic, magnetic-field and radiation news of the day.

When an Advanced Mariner carrying its 1500-pound payload reaches within half-million miles of Mars, its lander will leave the “bus.” The bus will then travel past the planet, snapping 100 TV pictures scanned at a distance of 4,000 miles, to relay to earth. Dr. Dow estimates these pictures may take as long as ten days to reach earth. The bus will then soar on its way round the sun.

The lander will speed toward Mars’ surface, an aluminum honeycomb “crush” protecting the instrument package as it surfaces. When the force of impact opens the lander, the enclosed instruments will arrange themselves on Martian soil, sample the planet’s dust, and report its findings to a nearby antenna to radio back to earth as long as power lasts, which will probably be only a few hours.

The Big Show In Space. What the Advanced Mariner missions, booked to soar to Mars, ‘69 on, don’t tell us about the red planet, the heavier Voyagers, slated for (Continued on page 119)
There’s an old African proverb that says: “Not enough is no good, while too much is even worse”; and while this sage advice originally applied to the number of girl friends, it holds true for radio reception. Whether you’re an amateur, SWL or DX’er, you’ve got to be able to hear many stations in order to derive full satisfaction from your hobby. But what happens when you hear too many stations? All you got is squeals and squawks; and it’s debatable whether too few or too many signals ruin what would otherwise be exciting hobbies.

While it’s relatively easy to snatch a few extra signals by using a better antenna or an RF preamplifier ahead of the receiver, short of spending a few hundred bucks for a super-selective receiver there’s not much you can do when poor receiver selectivity buries you in a sea of signals—all interfering with each other. At least there was little you could do until a few months ago, but now, a mechanical filter—the “selectivity heart” of the most modern quality receivers—can be yours for less than $20. That’s right, a real honest to goodness mechanical filter, the device used in the most expensive receivers when razor sharp selectivity is the prime objective.

Now we’re not talking in terms of relatively expensive receiving equipment. The mechanical filter we’ve got in mind can be used by virtually anyone, even the BC DX’er with a ten buck table radio. The only requirement is that your receiver (or radio)

Update your present receiver to cope with today’s crowded bands!
Pick up distant stations formally masked by strong local signals!
Achieve peak skirt selectivity with BCB, SW, AM and SSB receivers!
have a 455 kc. IF amplifier, no other frequency. If you fit this category stick with us and we'll tell you how to hear those rare weak ones that everyone except you seems to receive.

Selectivity. Let's take time out for a moment and review that magic thing called selectivity; for after all, you really can't get that most out of something if you don't know what in heck it's supposed to do.

The principle behind the superheterodyne receiver is the key to selectivity. The superhet uses a local oscillator to convert the received signal to a more useful frequency—one that can be easily amplified. For example, a 20 megacycle signal is not the easiest thing to amplify. If one tried to just build a string of 20 mc. amplifiers and then detect the amplified signal he would certainly run into regeneration unless heavy shielding was used, and the selectivity would be low because the tuned circuit Q's would be low, and it would take two or three times the required number of amplifiers. Now don't get us wrong, it can be done, but at a hefty expense—and it wouldn't be worth the time, effort or money. But look what happens if we take the same 20 mc. signal and push it through a superhet. By using a local oscillator to beat the signal to, say, 455 kc., we get a signal that can be handled easily. Today, it's a snap to design a high gain 455 kc. amplifier, and at 455 kc. the tuned circuits have sufficient Q to give decent selectivity; and it's selectivity that determines a receiver's effectiveness.

IF Bandpass. Generally, when only IF amplifiers are used to achieve selectivity the receiver's overall selectivity is determined by the number of IF amplifiers. As example, Fig. 1A (on page 48) shows the selectivity curve for a single stage of IF amplification.

Note that maximum gain occurs at the IF frequency with the gain falling off on either side of the center frequency. If there were two signals of equal strength separated by 5 kc., and you tuned in either one, the tuned signal would be received at maximum gain (the center frequency) while the remaining signal would be received 5 kc.
higher or lower (depending on its relationship to the tuned signal). Note, from Fig. 1A that a signal removed 5 kc. from center is attenuated (actually amplified less) 6 db. So, from the speaker you would hear two signals, the tuned signal at maximum volume and the second signal which will have one fourth (6 db less) the volume.

Now we all know that virtually all broadcast frequencies are just loaded to the hilt with signals, and even a 5 kc. spacing would be a luxury. Actually, there could be three, four, five, or more phone signals in a 5 kc. segment; and certainly, on the CW bands there could be ten or twenty signals. If we used a receiver with the selectivity curve in Fig. 1A we'd be drowned in a sea of incoherent signals (QRM). So manufacturers separate the signals by narrowing the bandpass.

If we take the IF amplifier which produces the Fig. 1A bandpass and add a second or third amplifier, and we use High-Q tuned circuits, we could obtain the selectivity curve shown in Fig. 1B. Note that the signal removed 5 kc. from the tuned signal will be attenuated 60 db—you'd be hard pressed to even know it's coming out of the speaker. Naturally, the signals even closer to the center frequency will be similarly attenuated. The narrower the bandpass is made the less the interference from signals adjacent to the desired signal. (As yet, there is no way to separate two signals on the same frequency.)

Bucks & Bandpass. But there is a practical limit to increasing selectivity through the use of IF amplification. The manufacturer designing a table radio to sell for ten to fifteen bucks certainly can't use more than one stage of IF amplification, so the BC DX'er using this radio wouldn't be able to separate the weak rare ones buried between two strong locals. And while the communications receiver manufacturer usually includes additional amplification for improved sensitivity and selectivity, selling price determines how much he can give you. (True, the modern budget receiver gives you a lot for your money, but they can always use extra selectivity.)
The Mechanical Filter. One of the best ways to achieve razor sharp selectivity is through the use of a mechanical filter. The filter consists of several sections made of nickel alloy resonators which pass virtually only the frequency to which they're tuned. Transformers at both ends couples the signal in and out.

Fig. 2 shows the selectivity curve of a typical mechanical filter. Now keep in mind that this is a single filter. Note the steep sided response: signals only two or three Kc. removed from the center frequency are very sharply attenuated. If we went back to our two signals separated by 5 kc. the interfering signal would be so sharply attenuated that you wouldn't even know it existed. Actually, even signals within two kilocycles or so of the center frequency would cause no reception problems. Within the general consumer market, it would take three, four or

five stages of specially designed IF amplifiers to achieve the bandpass characteristics of a single mechanical filter.

"Okay," you say, "The mechanical filter is great, but I use a table radio for BC DX'ing and a budget receiver for SWL'ing. So what good is a lot of theory about an item used in expensive receivers?" True, mechanical filters used to be thought of in terms of expensive receivers, but now you can consider installing one, even in a table radio.

The Lafayette Radio Mechanical Filter Part No. 99-0123, $19.95 has been specifically designed for easy installation by the average electronic hobbyist. It is supplied pre-mounted on a printed circuit board (see Fig. 3) complete with input and output transformers and soldering points. It is also pre-aligned to a high degree of accuracy; a signal generator is not required.

SW Receivers. The performance of this filter is the bandpass shown in Fig. 2; that's right, the nearly perfect illustration we used is the Lafayette filter. However, keep in mind that all is not perfect. The simplified receiver modification we will describe has one major problem: that is, the filter results in a loss of approximately one S-unit (6 db) in overall sensitivity. While this might be no problem for the BC DX'er and the SWL because even budget equipment has more than enough sensitivity up to about 7 mc, it will be sharply noticeable at those frequencies to which your receiver gives only marginal performance. But keep in mind that sensitivity can often be restored by using a preamp or preselector ahead of receiver.

Cheap Jobs. Table radios used for BC DX'ing require a little thought. Many, many, low cost models are pushed to the design limit so you must carefully consider whether it can stand a loss in sensitivity of one S-unit. First count the number of IF amplifiers (do this for communication receivers too). As a general rule of thumb the IF amplifiers number one less than the number of IF transformers (usually cans), i.e: two cans equal one amplifier—one can is the input and one the output;—three cans equals two stages. If your radio or receiver has two IF stages it most likely can stand the loss of a little sensitivity. But if it has only one stage take careful note whether you must "strain" to hear most stations, for if you must, the receiver probably cannot stand even a one-S-unit loss. On the other hand, if you're using one of those old, handsome (and expensive) table radios that "burst" with
signals, you'll probably get away with the filter's loss even though it has only one stage of IF amplification.

**Installing the Filter.** The filter is installed in the plate circuit of the 455 kc. mixer or converter tube; actually, it replaces the first IF transformer. (If your receiver is the dual conversion type make certain you connect into the 455 kc. mixer, not the high frequency mixer.) Fig. 4 shows a typical mixer circuit. Note that the B+ feeds through the transformer's primary, and the AVC voltage feeds through the secondary. Now look at the mechanical filter installation in Fig. 5; note that blocking capacitors, C1 and C2, are used to prevent the B+ and AVC voltages from entering the filter's coupling transformers. Do not try to feed the voltages through the filter's input and output transformers, it's a sure way to blow twenty bucks.

Resistors R1 and R2 are added to the circuit to provide a plate impedance for the mixer and an output termination for the filter; do not eliminate these components!

That's all there is to be filter's electrical installation, it should certainly present no difficulties. But the physical mounting is something else, and Radio-TV Experiment-er has worked out two procedures which should work for most of you.

**Installing the Filter.** Table radios are notoriously short on space and the filter is going to be a tight fit. Unsolder all the leads from the IF transformer's terminals and then remove the transformer. Orient the filter over the hole in the chassis that formerly passed the IF transformer's terminals and move it around until no part of the filter extends beyond the chassis (or the chassis won't fit back into the cabinet). The filter's transformer slugs should face towards the rear apron to allow adjustment. Place two pencil marks on the chassis to indicate the ends of the assembly and remove the filter. Next, place two gobs of silicon rubber adhesive just inside the pencil marks. The rubber is available under a variety or trade names; it is made by General Electric (GE) and goes under the name of RTV if purchased in a radio store, or a variety of names such as Auto Windshield Sealer or Clear Seal. It also comes in several colors. Regardless of the color or name it's essentially the same product so use whatever you can get.

Line-up the filter assembly with the pencil marks and press the assembly into the rubber all the way down to the chassis. Using masking or plastic electrical tape restrain the assembly so it will be vertical when the rubber hardens (about 24 hours). Then remove the tape and connect the filter into the radio's circuits. If you are careful, you can keep on working while the adhesive sets.

Don't use "floating" connections. All components should be tied down. Either a terminal strip can be secured through one of the IF transformer mounting holes, or if there are no holes, the terminal strip can be soldered directly to the chassis immediately adjacent to the filter. Don't use long leads; long leads can result in instability of the IF strip (the IF amplifiers self-oscillate). Keep the leads and connections as short as possible.

![Fig. 3. The Mechanical Filter (Part No. 99-0123), priced at $19.95, is available at Lafayette Radio, 111 Jericho Turnpike, Syosset, N. Y. 11791. Technical specifications are available on request to experimenters.](image-url)
and in the same relative position as the original connections.

You will note that the letters G and P are etched into the filter assembly. The connection terminals on the side marked G must connect to the IF amplifier's grid; similarly, the connections on the P end go to the mixer plate. As a general rule, you'll reduce possible instability by mounting the filter so the G terminals are nearest the chassis. Then the grid connections will be as short as possible.

Since a communications receiver generally has a lot more free chassis space, an easier and more rigid filter mounting can be made. Again, remove the first IF transformer; but now, strip it and save the mounting lugs. Mark the location of the mounting holes on the filter assembly, and then drill the PC board for a #2 or #3 screws. Attach the mounting lugs to the board and then mount the whole assembly just as the IF transformer was mounted. Use a nut on both sides of the chassis to insure rigidity. The electrical connections are the same as for the table radio installation.

Filter Effects. Turn on the radio and tune across any band to make certain the filter is working. Forget about the sound quality, all you're looking for is signals. If all signals are extremely weak—hardly distinguishable—or the receiver is inoperative, there is a wiring error. As we said, the filter is pre-tuned, so if you've made the installation correctly the receiver should work right off-the-bat.

When you're satisfied the installation is okay, tune in a very weak signal, and using an insulated alignment screwdriver, adjust the filter's slugs for maximum speaker volume or maximum S-reading. That's all there is to the adjustment. (In most instances the alignment will be perfect and adjustment will make no improvement.)

The first thing you'll notice when you use the receiver is that all signals sound bassy. This is normal. The sharp bandpass cuts a phone signals sidebands, and it's the sidebands that contain the high frequency energy. If you want "extra" highs just detune the signal very slightly from center tuning.

If you're monitoring CW, say with a 1 kc. pitch, and interfering signal comes on somewhat off-frequency and jams you with a, say 5 kc. tone, just detune slightly; you'll only change the pitch of the desired signal while the interfering signal disappears as if it stepped off a cliff (detuning puts the interfering signal outside or down the bandpass).

Some receivers—particularly of the budget variety—simulate selectivity by deliberately applying regeneration to the IF amplifiers (when you want it it's called regeneration; when you don't want it it's called instability). When a regenerative amplifier is combined with a mechanical filter the overall selectivity can be so great as to make the receiver useful only for CW reception or "rare" DXing for the purpose of obtaining QSL's. The extremely sharp selectivity will make phone signals extremely "muddy," certainly not enjoyable for straight listening.

And just for your reading pleasure, here's the practical results of the two conversions shown in the photos. The communications receiver, which delivered the typical decent performance common to budget equipment, became a superb CW receiver. Where we formerly had to suffer through the severe QRM on the 80 meter band we could now virtually separate every signal.

The table radio is actually one of those old AC/battery tube type portables with good sensitivity. Where formerly we could hear two local stations right next to each other, actually sort of "touching" each other, we now can not only separate them, but at night we pick up two Canadians in between in the clear. No reason why you can't expect similar results.
build the AQUA-COM

By Edward A. Morris

An inexpensive Scuba accessory for underwater communications

If you are letting a thin wallet stand between you and one of those expensive underwater diving intercoms, then the Aqua-Com is your answer! The Aqua-Com more than meets the needs of the average Scuba diver. It has a range of 10 to 15 yards, and will operate at depths of more than sixty feet. Best of all, the Aqua-Com will cost you no more than about $25 and several evenings of your spare time.

How it works. The Aqua-Com is really nothing, more or less, than a public address system that will work underwater. Your voice is picked up by the throat microphone, amplified by a transistor module and fed to an underwater speaker. Sonic vibrations generated by the speaker are transmitted through the water and when they reach your ears, they are detected as speech.

(Continued)
Detail drawings above provide the information necessary to pre-drill the aluminum case. Belt loops made from wire hangers.

Dimensions for the rubber traction pads used to mount 6-volt battery on air tanks.

The Aqua-Com should be constructed from materials that are immune to the corrosive effects of sea water. This means use only brass, aluminum, or nylon nuts and bolts. Steel, even chromed steel will corrode when exposed to salt water. Use wire with a solid plastic or Teflon insulation. There is *no suitable substitute* for the speaker specified in the Parts List. The one specified has a plastic-impregnated speaker cone and dust cap, plus an aluminum voice coil and a heavily zinc-plated frame. Although not specifically designed to operate under water, it does a good job when modified as shown, and holds up well when cared for properly.

Liquid silicon rubber is used to seal, join, and insulate various parts of the Aqua-Com. Both General Electric and Dow Corning produces silicon rubber for sealing and caulking use in bathrooms. The silicon rubber is applied from its tube like toothpaste.
Six-volt battery pack is strapped to diver’s air tanks (top photo). Aqua-Com is attached to diver’s belt except in bottom photo where it can be strapped to tanks.

Six and since dries to the touch.

The mercury cell, since the epoxy will prevent the positive terminal from making good contact with the battery clip.

Construction. The first step in the construction of the Aqua-Com is to remove the microphone plug on the T-2 throat mike and to splice on a 3-foot length of plastic lamp cord. After cutting off the old microphone connector, strip back the cable’s outer rubber insulation one inch. This exposes two rubber insulated wires. Strip ¼ inch of insulation from each of these wires, and solder on the lamp cord. Cover the connections with liquid silicon rubber to insulate. When the silicon is dry to the touch, tape a 2.5 inch section of coathanger wire over the splice. The coathanger wire serves to prevent flexing and possible failure of the splice. Cover the splice with plastic tape, then apply silicon rubber over the entire splice, including the end of the tape.

While waiting for the silicon rubber on the microphone cable to dry, remove the speaker from its original enclosure, cut off its mounting ears and smooth any ragged edges on the speaker with a file. This should leave the speaker frame more or less round. Coat the speaker’s cardboard rim and center dust cap with several coats of a rubber-based cement such as Ply-O-Bond. While the cement is drying, prepare a small quantity of epoxy cement according to the manufacturer’s directions. Apply the epoxy to the speaker’s terminal strip. Carefully coat the entire fiber strip, top, bottom and all four edges. Don’t allow any of the epoxy to drip onto the speaker cone or the terminals. Set the speaker aside and proceed with the transformer preparation.

If you use the transformer specified in the Parts List, cut the black, brown, and white wires close to the transformer body. Completely cover the transformer with silicon rubber, paying special attention to the areas around the leads. Be sure you leave no area of the transformer uncovered. Hang the transformer up by the leads to dry. If you use a different transformer than the one specified, make sure it has the same electrical ratings as the one specified.

Preparing the case. The mechanical layout shown in the detail drawings allows uncrowded and easy construction. Centerpunch and drill all holes in the case. The battery clip for B1 is mounted on the back cover plate with two 4-40 x ¼-inch screws. The screw heads should be inside the case and the nuts outside, otherwise the battery will not seat properly in the clip.

Form the belt loops out of coathanger wire. You will find the wire much easier to work if the ends are first annealed. Heat the
wire to a glowing orange-red in the flame of a blow torch or gas burner, allowing it to cool slowly.

Cut the speaker grille out of a piece of perforated aluminum. Make sure that the mounting holes match with the ones on the case. If they don’t, use a rat-tail file to coax them into alignment. Next, mount amplifier module PA-9 on the speaker. To be sure that the amplifier is mounted in the proper position, set the speaker on a table in front of you with the speaker lugs facing you. Place the amplifier module on the speaker frame so that it is on your right side. The leads from the amplifier should be coming out toward you. Now get down to the level of the table, and make sure that the top of the speaker frame is the highest point of the assembly. The top side of the amplifier module should be slightly below the level of the top of the speaker frame. Amplifier module is now attached to the speaker frame with silicon rubber. It is temporarily held in position with a “C” clamp, or a rubber band wrapped around the amplifier and the speaker frame. Silicon rubber is to be applied so as to form a bridge between the speaker frame and the amplifier module. Make several such bridges, one on each side of the

The pictorial diagram shown above should be used only if the terminal configuration in the amplifier module you purchase is identical with the diagram. Otherwise, follow the diagram supplied with the unit. Although the module may appear to be different, it is an exact electrical replacement.

Parts List

RCA VS1334 manganese alkaline cell
B2—Burgess TW15 6-volt pressurized battery (Allied Radio 55/114). Do not make any substitution except as noted in text.
Mic.—Throat microphone, surplus type T-30 (John Meshna, Dept. TVE, 19 Allerton St., Lynn, Mass., Fair Radio Sales Co., 2133 Elido Rd., P. O. Box 1105, Lima, O., and many other electronic surplus suppliers)
SPKR—Misco weather-proof speaker, model MS-38 (Lafayette Radio 44G5201—see text) T1—Transistor transformer; 500-ohms primary; 8-ohm secondary (Lafayette 9906129 or equiv.)
TS1—6-lug terminal strip, terminal 4 connects to ground
1—Amplifier PA-9 module (available at Gem stores. Also, Olsen Electronics as TR-37 and Lafayette as 19G1511)
1—4” x 4” x 2” aluminum box with two removable 4” x 4” sides, must be unpainted
1—Neaprene rubber, closed cell (see text and your Scuba supplier)
1—Cotton straps, as required
Misc.—Plastic-covered lamp cord, rubber grommets, plastic cable clamps, epoxy cement, tube of rubber cement (see text). 4” x 4” piece of perforated aluminum sheet, plastic tape, coat hanger wire, solder, plastic-covered wire, plastic hardware, etc.
Estimated cost: $25.00
Estimated construction time: 3 hours

(Continued on page 118)
Organs Without Pipes

Transistorized oscillators and exotic networks bring the sound of a church organ to your home.

Time was when an organ involved huge quantities of compressed air and yard upon yard of tuned pipes, altogether a machine of such size that nothing short of a cathedral or large theater could house one.

Electronics has changed all that, and now the electronic organ is commonplace. For do-it-yourselfers, organ kits have been available for several years—and recently the Heathkit people have come out with their version of the new Thomas "Coronado" all-transistor organ in kit form (Fig. 1 on next page).

But how can a handful of transistors and semiconductor diodes replace those yards of tuned pipes, and produce the same warm sound? Answering that question is what this article is all about.

Inside Music. For a starting point, we have to stop and look at the fundamental characteristics of music itself. "Music" can be defined as an ordered arrangement of sound tones—but if it's going to sound like music to our ears, the pattern of the

By Jim Kyle and Julian M. Sienkiewicz
tones must follow some definite rules.

For instance, the familiar musical scale consists of 12 tones. The tones follow a precise relationship. They're usually defined in terms of the frequency of the "A above middle "C", which is also known as "A3". The frequency of A3 is 440 cycles per second.*

All notes with the same name fall into even-harmonic relationship with each other. The A an octave above A3, known as A4, has a frequency of 880 cps, while A2 (an octave below our standard) is 220 cps.

The other 11 tones of the scale fall into fractional-harmonic relationship. Middle C, or C3, is at 261.626 cps. The next note up the scale, C sharp 3, is 277.183 cps. D3 is at 293.665 cps; the remaining tone frequencies are shown in Table of Musical Notes and their frequencies.

*The British Standard Concert Pitch for A above middle C has varied throughout the years and has not been in agreement with music societies of many other nations until 1939. Below is a list of dates and frequencies used by British musicians:

1813 Original Philharmonic Pitch 424 cps.
1846-54 Mean Philharmonic Pitch 432
1874 Highest Philharmonic Pitch 455.5
1896 New Philharmonic Pitch 440
1937-8 Average pitch reached in performance by selected British orchestras 443
1939 Standard Concert Pitch agreed to by international conference 440

Why the odd relationships? The answer to this one is hidden in the answer to still another question—why don't all instruments sound the same?

Voicing. The particular "voice" of a specific type of instrument is brought about by the harmonics or "overtones" of the note sounded, which are either emphasized or suppressed by the instrument. For instance, the violin's sound contains 60 per cent fundamental-frequency sound, 20 per cent second harmonic, an octave higher, 10 per cent third harmonic, and the remaining 10 per cent is made up of still higher harmonics. (See Fig. 2.) A flute, on the other hand, produces an almost-pure sine wave (single-frequency) tone, with very few harmonics present. Now you can understand why a violin and flute sound different even on the same note.

The fractional-harmonic relationship of the notes in our scale is also due to the high-harmonic content of the instruments. For instance, the third harmonic of C3 is almost exactly the same frequency as the fundamental of G4. (See table of Musical Notes.) Similarly, the third harmonic of E3 is the same as C5.

These relationships between the notes of our scale are what make the difference between music and discord; if all the high harmonics present blend together smoothly, we have a "pleasant" sound. If not, we have "discord".

Character of Sound. And without half trying, we have slipped over into the area of "complex waveforms" without so much as a pause for breath. This somewhat frightening name is simply a way of saying "a sound waveform made up of a fundamental and a number of its harmonics, all at the same time." Since the harmonics give individual instruments their character, it's obvious that music is made up of complex waveforms.

However, the character of a musical instrument comes from more than just the harmonic content of the sound. Equally im-

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**Fig. 1. For 60 hours of soldering fun, a kit builder can save over $400 by assembling the Heathkit/Thomas GD-983 transistor organ. Seventeen rich and true organ voices with countless melodious chime variations pour forth from the GD-983's semiconductor heart.**

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**Fig. 2. Breakdown of the fundamental frequency and harmonics in a violin's sound.**
important is the speed with which the sound starts and stops. For instance, a piano and an organ can be voiced with almost identical harmonic content—yet will sound far different, since in the organ the sound continues so long as the key is held down, while in the piano the sound hits rapidly, then dies away. Differences in reverberation time can make two instruments of the same type sound radically different, as for instance the “honky-tonk” piano versus the concert grand. And the rapid flutter of pitch known as “vibrato,” or its absence, does much for establishing the individuality of the instrument.

Once we know the various factors that make an organ sound like an organ, rather than like a piccolo or a piano, we can readily design electronic circuits to duplicate the sound of the organ—and we’re in business, without the pipes.

The Organ. An organ keyboard contains 88 keys, like a piano, but they are arranged in two “manuals” or separate keyboards, known as the “swell” and the “great.” In addition to the 22 manual keys, a pedal register is included, with 13 more tones as in the Heathkit/Thomas version (Fig. 3).

This would be a total of 101 different tones—except that an organ has a number of different stops*, and each stop produces a separate voice-tone from the same key. Thus, an organ having 16 voicing stops is capable of producing 1,616 different tones from its 101 keys, if only one stop is used at a time. Since more than one stop can be in use simultaneously, the number of different voice-tones which an organ can produce is almost unlimited.

Early electronic organs used a different tone generator or oscillator for each of the 101 keys, and some designs used additional tone generators for some of the different stops, leading to several hundred oscillators or tone generators per instrument. The mod-

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* A stop on an electronic organ is a switch that adds a sound character to the organ output. If more than one stop is switched on, their different sounds mix as would the sounds from instruments in an orchestra. Stops are given names which describe their characteristic sound, such as violin, saxophone, French horn, bass clarinet, flute, etc.
Fig. 7. Switching in the GD-983 is a very simple affair (see photo right). One contact wire per key (below) serves as the wiper of single-pole, double-pole, spring-loaded switch.

Table of Musical Notes and Their Frequencies

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<th>cps</th>
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The Tone Generators. The heart of the instrument consists of the tone generators, which in the GD-983 cover the notes from F♯4 (739.989 cps.) to F5 (1396.913 cps.) by master oscillators, and produce lower notes by “counting down” in frequency dividers. The master oscillators and fre-
frequency dividers are connected as shown in Fig. 6.

The oscillator itself is designed to produce an output rich in harmonics, to assure that the voice circuits have enough of the right harmonics to form any desired waveform. The dividers are identical to the flip-flops used in digital computers, and their outputs are square waveforms.

Square waves contain all the odd harmonics of their fundamental, but none of the even ones. Since most of the voice circuits require both even and odd harmonics, the output of each divider is mixed with a part of the output of the preceding divider stage to form a staircase-shaped wave having both even and odd harmonics. This mixing is done by the resistors shown in Fig. 6.

**Keying.** From the tone generators, the tones pass through a multi-conductor cable to the keying circuits. Each tone, F1, F2, F3, and F4, to use the four F notes as an example—has a separate line on this cable.

To get the extra-low pedal tones, additional divider circuits are used, driven by the dividers of the main tone generators. The fifth octave is synthesized, when needed, in the voice circuits which we'll look at a little later.

The keying circuits are operated by the manual and foot pedal keyboards, and it is here that the attack and decay times of the sound signals are shaped to meet organ specifications. In days past, the keying circuits consisted of multi-contact switches of intricate mechanical design, mounted across the back of each keyboard. (See Fig. 7.)

**Diode Switching.** However, computer circuitry makes another appearance in Heath's GD-983, with the use of diode-switching circuits for keying of the swell and pedal keyboard circuits. Use of the diodes reduces the switch requirement on the keyboard itself to a single contact per key, except for the 28 swell keys which produce chime notes. These must have 3 extra contacts per key, to sound the chimes.

Fig. 8 on page 92 shows a simplified schematic of the diode switching used in the GD-983. Only a part of the circuitry is shown—just enough to illustrate how the diodes route the tone signals from the generators to the various signal-output bus lines. Actually, each of the 44 keys on the swell manual keyboard of the GD-983 has six diodes associated with it.

The parts shown in Fig. 8 include two keyswitches, one for F2 tone and the other for F3 tone, and the diodes which route the F2 tone signal to the proper output bus lines when each of the keyswitches is closed.

With both keyswitches open, as drawn in Fig. 8, negative voltage from the B- line is applied to diode SD6 (F3). This reverse-biases the diode, preventing signal from passing through it.

When keyswitch F2 is pressed, it connects resistor R1(F2) to the +15-volt bus line. As soon as capacitor C1 charges, the +15 volts is applied to resistor R8(F2), and thence to diode SD4(F2). This forward-biases the diode, and allows the positive voltage to appear also at the anode of diode SD6 (F3). Since resistor R8(F2) and R11(F3) are both 47K ohms, the voltage applied to SD(F3) will be approximately half of +15, or 7½ volts, forward-biases this diode also.

With SD6(F2) forward-biased, signal from the F2 output of the tone generators can flow through SD6(F3), SD4(F2), and resistor R7(F2) to the 8-foot output bus.

The F2 tone is prevented from reaching the 16-foot output bus associated with keyswitch F3 because the 7½ volts appearing at the junction of SD6(F3) and SD4(F2) is also applied to SD4(F3), and reverse-biases this third diode.

Clicks and popping noises generally associated with audio switching are prevented by the capacitor on the keyswitch line; this capacitor must charge before any diodes can switch. The click caused by the mechanical switch dies out before the capacitor charges enough to allow signal switching.

Additional diodes are used to control the attack and decay characteristics through panel-mounted stop switches. They switch additional capacitors and resistors in and out of the keying circuits, to control the time delay between keyswitch action (either opening or closure) and actual signal switching. In addition, they offer the possibility of imitating percussion instruments, by routing the keyswitch action to special control circuits and taking the outputs of these circuits to control signal-switching diodes. With the percussion option, sounds such as those of the piano, guitar, and similar instruments can be created.

**Chimes.** For chime tones, three additional keyswitches are added to 28 keys of the swell manual keyboard. When "chimes" are selected, these keyswitches are connected in parallel with the switches of other keys, so that when the F3 key (for example) is

(Continued on page 92)
The Baltimore Light, once diesel-powered, receives its atom-powered generator (top photo). The cut-away view of the reactor (middle-left photo) contains 20 pounds of strontium titanate pellets in 14 circular cells—enough for ten years of service. The heat generated from strontium-90 pellets is converted to electricity by 120 pairs of thermocouples.

The pile that powers the light is radiation proof and tamperproof but a warning is nevertheless posted (middle-right photo) in case of unwary trespassers. Coast Guard officer inspects pile (bottom photo) regularly for stray leakage with radiation counter.
Baltimore has a reputation for pioneering with new lighting devices. In 1817 it was the first American city to illuminate its highways with the new-fangled gas. Now it is the first city to have an atom-powered lighthouse to light up its “Highway to the Sea”—Chesapeake Bay.

The lighthouse, known as the Baltimore Light, is over half a century old and has been converted to run on atomic power by a unit developed and manufactured for the Atomic Energy Commission by the Martin Company’s Nuclear Division. The unit, known as SNAP-7B (Systems for Nuclear Auxiliary Power) is approximately the size of a trash can—$34\frac{3}{4}$" high and 22" in diameter—that weighs 4600 pounds. It is fueled with strontium titanate, a safe form of strontium-90—a waste product of large nuclear reactors. The decaying radioisotope develops heat which thermocouples convert into electricity for the 60-watt Baltimore Light. This type of generator is designed to provide trouble free, long-lasting sources of power for remote locations where refuelling and maintenance would pose severe problems, and for operating transmitters on space shots and satellites. The Baltimore Light is not a “remote” station, however, it has been provided with atomic power as a testing ground convenient both to the manufacturer and to the Coast Guard’s Testing and Development Unit at Curtis Bay, Md. Eventually the atomic generator will be installed in some remote and inaccessible site where it will operate for ten years without attention.
By Forrest H. Frantz, Sr.

You've read a lot about the possibilities of using laser-beam communications, but did you know that ordinary light could be modulated to carry messages also? You can set up a simple light-beam communications demonstrator in about half an hour and for less than $15, and all the components can also be used for other experiments and gadgets later.

How It's Done. The basic techniques for light-beam communication consists of converting sound energy to electrical energy and then using the electrical energy to modulate a beam of light. The modulated light beam is picked up by a photocell, and converted back to electrical energy. The electrical energy serves to drive a speaker which produces sound energy at the receiving end of the apparatus.

The complete apparatus that is shown in the photos is intended for demonstration purposes only, and will not work over long distances. To simplify construction two ready-made low-cost ($3.75 each) transistor amplifiers were used, one for the transmitter and one for the receiver.

Refer to the photo of the transmitter setup, the schematic drawing and parts list. Although the photo shows only one 1.5-volt bias cell in the transmitter's lamp circuit, experiments have proved that 3 volts worked better and two series-connected dry cells should be used. No need to observe polarity when connecting lamp bias cells. The reason for using the bias battery in the output-lamp circuit deserves mention. The bias battery sets a steady light level. This light level serves as a carrier for the audio signal from the amplifier just as radio frequencies serve as the carrier in a radio transmitter. Another reason for the bias is that the lamp will respond better to the amplifier signal when
Here's a Science Fair project easy enough to assemble without any help from your Dad—it's a sure-fire winner!

Putting It Together. In the actual setup, it is desirable to add a parabolic reflector to the lamp. The author used a reflector from an old flashlight and glued it to a lamp socket as shown in the photo.

The receiver employs a solar battery as a sensor whose output is fed to an amplifier that drives a loudspeaker. The solar battery is mounted in a mailing tube (for shielding against "light noise") that is pointed toward the lamp. The paper tube's diameter isn't critical—1½ or 2 inches is fine. Length should be 8 to 12 inches. Cut two slits about ½-inch apart and about 2-inches long in the tube and bend down the resulting tab. Fasten the solar battery in the tube with cellophane tape as shown in the drawing with the tab replaced. Try reversing the solar battery leads—output may be increased somewhat.

If you own an amplifier with sufficient gain, you may use it in place of one of the amplifiers but if it has too much power it may blow out the #48 bulb.

Getting More Range. The arrangement described is for demonstration purposes and (Continued on page 91).
Here's a lousy voltage regulator
By Jim Kyle, K5JKX

Whether you're designing, servicing, or just experimenting with a semiconductor circuit, you've probably already learned via the expensive route that semiconductor junctions are capable of destroying themselves much more rapidly than are fuses.

Thus, for general bench work, an "instantaneous fuse" which would interrupt current flow before the speediest semiconductor could be capable of melting would be a handy device.

The Current Clamp will, within certain limits, perform this function. While it won't interrupt the current flow, it will clamp it to a pre-set maximum value, and will not permit current to exceed this maximum. If the technician chooses his maximum current setting wisely, the semiconductors won't be harmed by excessive input.

Putting It Together. Construction and operation of the Current Clamp is so simple that one can be put together in a few minutes for any particular application, though it's handy to have a wide-range unit on hand for instant use. The author's unit has a range of zero to 25 milliamperes (although the zero-current position is more likely due to a defective variable resistor rather than to design).

The schematic diagram of the Current Clamp and the photos show how the unit can be constructed. The schematic diagram also serves to illustrate the how-it-works discussion below, essential to your ability to tailor one to fit any specific job.

Total parts requirements are two resistors (R1, R2), a voltage-reference diode (D1), and a transistor (Q1) capable of handling the maximum current flow.

The Current Clamp uses an inexpensive top-hat 750-ma. 400-piv silicon diode as its voltage reference, and a 2N1302 npn transistor. The Clamp's circuit works equally well with 2N107 and other experimenter-grade units so long as they are capable of passing the desired current and dissipating the necessary power. The 2N1302 will pass 300 ma. and is rated to dissipate 0.3 watt, more than ample safety margins for a 25 ma. Clamp.

Use of the silicon diode (D1) as a voltage reference is not merely an economy measure. It's fairly well known by now that these diodes have a relatively stable 0.5 to 0.7 volt forward drop, and by choosing such a small reference voltage the Clamp has much less effect on the circuit with which it is being used than would a conventional current generator with a higher reference voltage. To explain the reasons for this, however, we must first discuss briefly the manner in which the Current Clamp operates:

How It Works. Current flow in the load
that is ideal for replacing power supply fuses!

![Graph showing voltage vs. current](image1.png)

**Schematic diagram for the Current Clamp**

shows output current passing through Q1's emitter-collector circuit. Graph at left shows current limiting for 1.5-volt input.

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**PARTS LIST**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>750-ma., 400-PIV silicon diode (GE 1N539 or equiv.)</td>
</tr>
<tr>
<td>Q1</td>
<td>2N1302 transistor (see text)</td>
</tr>
<tr>
<td>R1</td>
<td>500-ohm, 5-watt potentiometer (Mallory Type VW or equiv.)</td>
</tr>
<tr>
<td>R2</td>
<td>1,800-ohm, 1/2-watt resistor</td>
</tr>
<tr>
<td>Misc.</td>
<td>Perforated phenolic board, flea clips, wire, solder, etc.</td>
</tr>
</tbody>
</table>

Estimated cost: $3.00
Estimated construction time: 1 hour

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The circuit connected to the “output” terminals must be through transistor Q1’s collector lead. By the beta-multiplication effect inherent in transistors, the largest part of this current must flow through the collector-emitter path; very little can flow in the base circuit. Thus, most of the load current flows through Q1’s emitter lead.

Resistor R1 is in this lead, and the current flow through it develops a voltage which is proportional to the current. With an npn transistor, the emitter will become more positive than the source (at the “input” terminals).

The transistor’s base, meanwhile, is held at a fixed potential which is more positive than the source by the amount of voltage dropped across reference diode D1.

So long as the base remains more positive than the emitter, Q1 is biased to saturation and the flow of current is impeded only by R1. Since a typical value for R1 is less than 100 ohms, this offers little restriction to current.

When the voltage developed across R1 drives the emitter positive to the base, however, the transistor is cut off by the resulting reverse bias and current flow in the load ceases to be as described. Instead, load current is restricted to a value which holds the emitter voltage just exactly enough negative to the base to permit that amount of current to flow.

**Feedback.** The action is an “infinite-negative-feedback” affair, somewhat akin to the clamping of grid bias in a cathode follower vacuum-tube circuit. As more current attempts to flow, the transistor bias acts to reduce current, and vice versa. The result is that load current is restricted to a fixed value, even if the “output” terminals should be shorted together.

Note that all load current (or at least all but 1/beta of it) must flow through R1 to...
Top—current clamp set up to fuse 3-volt supply from potentiometer load. Bottom—short across pot load should drain batteries. Note meter in photos indicates no current increase. Current Clamp is doing its job.

Front view (top photo) and rear view (bottom photo) of the Current Clamp showing location of parts and method of assembly. Entire unit can be installed in a plastic case.

develop the control voltage. This means that the output resistance of the Current Clamp, before it goes into action, cannot be less than the value of R1. As a matter of fact, it’s equal to R1 + R_s, where R_s is the “saturation resistance” of the transistor. Since typical values of R_s are usually well under one ohm, for all practical purposes the output resistance can be said to equal R1.

This is why the low-cost silicon diode with its low reference voltage is a key factor in making the Current Clamp useful. The value of R1 is chosen, or adjusted, so that at the desired clamping current level it develops a voltage approximately equal to the reference voltage. To develop 0.6 volts with a current flow of 100 ma., just for an example, requires a value of 6 ohms for R1. Were a more expensive higher voltage Zener diode used as a reference, it might require as much as a 6-volt drop. This would raise the value of R1 to 60 ohms. A 6-ohm added impedance in series with the power supply has far less chance of upsetting circuit action than would a 60-ohm addition.

The rectifier-type diode does, however, have one major disadvantage which must be admitted. Its voltage drop varies with the current flow through it. This means, in practice, that a value for R1 which would be correct to clamp at 25 ma. with a 3-volt supply would not be correct for clamping at 25 ma. with a 30-volt supply. The variations can be minimized by running a fairly stiff current through the diode, on the order of 100 ma., but it has been found more convenient to run from 1 to 10 ma. through the diode and to simply live with the variations in setting of R1.

Values shown in the schematic diagram are those employed in the wide-range unit designed by the author; for use in other ranges of either current or input voltage, make R1 equal to the diode voltage divided by desired maximum current, and R2 equal to 100 times the input voltage. Units are (Continued on page 94)
By C. M. Stanbury II

Spanish language broadcasts from the Voice of America, WRUL and the mysterious Radio Americas are well known to every SWL. But did you know that at least four privately owned broadcast band AM stations carry on a constant battle with the Castro regime? Not only does this quartet help counteract the Communist island's broadcast monopoly but they also spread Castro's jamming facilities paper thin.

Miami's WGBS. Possibly the most important station in this war of ideas is WGBS at Miami. By day WGBS carries regular English language programs and is a CBS affiliate but starting at 1:00 AM and continuing throughout the wee hours of the morning, it serves as an integral part of the Radio Cuba Libre network. In fact WGBS is probably the most strategic transmitter in the whole net. Its potent 10 kilowatt directional signal on 710 kc completely blankets Cuba. So effective is WGBS that it was one of the very first stations to be jammed by the Castro regime. WGBS own ID slogan is Radio Miami. Its transmitter, antenna and ground system are located in the Everglades, Florida's famous tropical swamp.

WKWF and WWL. Radio Cuba Libre is sponsored by the Cuban Freedom Committee which has its headquarters at 1737 H Street N. W., Washington, D. C. and is headed by Representative Roman C. Pucinski of Chi-
Chicago. In addition to WGBS, Radio Cuba Libre is also carried by two other private U.S. broadcast stations, WKWF on 1600 kc. at Key West is a little closer to Cuba but has less power. WWLM 870 kc. owned by Loyola University at New Orleans is of course further from the communist island but is blessed with a mighty 50-thousand watts. WKWF is now heavily jammed and there is some jamming on the 870 kc. spot too. Radio Cuba Libre is also re-broadcast during the evening hours by several Latin American stations including the well known short-wave broadcaster Radio Santo Domingo.

WMIE. Meanwhile another Miami station carries a myriad of less spectacular rebel programs. This is WMIE on 1140 kc. During the daytime its Spanish language programs are intended for the Cuban refugee population in Miami, a strictly commercial venture. WMIE estimates that this market is worth to its advertisers 5 million dollars a week. At night, and all night, WMIE's 5 kilowatt output is beamed directly toward Cuba and thus it becomes yet another station jammed by Castro.

Possibly the best known WMIE revolutionary program is "El Periodico del Aire" (The Newspaper of the Air). This was the name of a well known Habana broadcaster before the Communist takeover. In Habana it operated CMCK on 980 (still on the air but now under red control of course) and COCO which some of our veteran SWL readers may recall. WMIE's version of El Periodico del Aire is directed by Juan Amador Rodriguez, a Cuban rebel leader.

Others to use WMIE include Arturo Artalejo (a noted Cuban news commentator), La Voz del Pueblo, and during the Cuban Missile crisis, the Voice of America itself. In fact, it was immediately after this confrontation that WMIE decided to go on a 24 hour a day basis and otherwise drastically increased its Spanish language schedule.

Success with Words. Is the campaign waged by WGBS, WKWF, WWL WMIE successful? Do they really help fight Communism and undermine Castro's dictatorship? The answer must be a resounding yes. If not the reds would never expend so much of their radio facilities and technicians in an effort to jam these transmissions. Further, so far as we know, these are the first stations anywhere in the world which are wholly under private ownership that have been jammed by a foreign power. Even more startling, we find Castro puts out more effort jamming this foursome than he does blocking Voice of America BCB transmitters in Florida. Needless to say, this is of great aid to the VOA. And incidently, we wonder how Habana explains all that jamming.
How would you like to hear the phantom signals of the FM band? FM stations which in many instances play hour after hour of pleasant “wall-to-wall” type music with few, if any, interruptions by an announcer extolling the virtues of the station or Vat Aged Snake Oil. You think we’re pulling your leg? Not so. There is such a thing as FM phantom signals.

In many communities the only way an FM station can stay in the black is by selling “background music”; soft, unobtrusive arrangements intended for banks, restaurants and fancy apartment house elevators. This music is transmitted simultaneously with the regular program and is called the SCA—short for Subsidiary Communications Authorization.

What Is SCA. The SCA signal deserves the description phantom because it’s there but it’s not there. To your regular FM or stereo tuner the SCA signal doesn’t exist; you’ll never know if a station is using SCA. But tune across the band with an SCA receiver and the opposite happens; the regular FM stations disappear and nothing is heard until the music of an SCA station suddenly “pops in.”

While SCA stations rent receiving equipment, you can have the pleasure of continuous music in your home without paying a rental charge. All you need do is connect an electronic gadget called the Raymer Model 471 SCA Adaptor to your present FM tuner and voila, wall-to-wall music. Of course, you might say, “Who needs it. I’ve got a terrific record collection.” But it’s ten to one you don’t have more than one or two records with SCA type music. Remember we said SCA music was unobtrusive—no loud crescendos, no soaring violin slides fading into the noise level. SCA music is specially arranged as “background music” for eating, working or just plain resting.

Hook Up. The Raymer Model 471 Adaptor connects between the tuner and the amplifier, and while it has no on-off switch other than for power, it doesn’t interfere with normal tuner operation. The adaptor’s input jack is connected to the tuner’s multiplex (MPX) output jack; the jack provided on late model monophonic tuner for the connection of an MPX adaptor for FM stereo. The adaptor cannot be connected to the tuner’s AF output because the built-in de-emphasis which compensates for the high frequency boost (pre-emphasis) applied at the transmitter also attenuates the SCA signal.

The adaptor’s output is then connected to any amplifier auxiliary input. This arrangement allows you to receive regular FM programs with the amplifier mode set to

Semiconductor circuit offers long term trouble-free performance. Two jacks on rear panel connect to FM tuner and amplifier input.
Then simply adjust the fine tuning control on the adaptor's front panel for best sound and sit back and enjoy the music. If you aren't sure which stations transmit SCA just connect the adaptor and tune until you hear the signal; adjust the tuner for best sound and then give it a final touch up with the fine tuning.

The sound quality delivered by the Model 471 Adaptor depends to a large degree on the tuner. If the tuner has a wide-band IF response the sound is pretty good—not hi-fi because the SCA transmission itself isn't hi-fi. If the tuner has a narrow response, thereby attenuating the SCA signal before it ever gets to the adaptor, the overall sound quality will be best described as decent—just about passable for background music.

One very good feature of the Model 471 Adaptor is the positive-acting noise squelch circuit which eliminates all hash during intervals between music selections. Also, the adaptor had absolutely no measurable crosstalk, that is, the main FM channel does not ride through and mix with the SCA broadcast.

Physically the Model 471 adaptor consists of transistorized circuits on two printed circuit boards. One board contains the user adjusted oscillator (fine tuning) and the second board contains the SCA detector. The adaptor has been simplified to a minimum number of circuits—high-price commercial quality is not needed in the home—and in conjunction with transistors and PC boards the adaptor should give long term trouble-free performance.

Overall handling is very easy, and it takes but one or two tries before you're an expert in tuning in SCA signals.

While we derived considerable enjoyment from the Raymer Model 471 SCA Adaptor, and we suspect you will too, there is a note of caution. Before you run out to purchase an adaptor make certain you can receive an SCA station. Most large cities have at least one SCA station; but if yours is a small town with only one or two FM stations it is quite likely the only thing the adaptor will deliver is absolute silence. One positive way to find out is to call your local FM station business office and ask them whether they have an SCA service or not.

If you are interested in the Raymer Model 471 SCA Adaptor or would like to know more about other Raymer products, write to Trutone Electronics, Inc., Dept. RTE, 14660 Raymer Street, Van Nuys, California. The Model 471 costs $64.50 postpaid.

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**tuner and SCA signals when the amplifier is set to auxiliary input.**

Since the difference between a tuner's MPX output and the AF output is only the de-emphasis network (actually a resistor and capacitor) it is a simple matter to add an MPX output to mono tuners not so equipped. The schematic diagram shows the two typical FM detectors—the ratio and discriminator types. Regardless of the actual detector circuit the de-emphasis network consists of R1 and C1 (Note that it is a low pass filter; the higher the frequency the greater the attenuation.) At point “X”, the input to the filter, the signal has no de-emphasis and an MPX output is provided by connecting point “X” through a .05 MF/500 vdc capacitor to a jack which can be installed on the rear apron. Check your tuner very carefully, ours had a test MPX jack hidden on the MPX sub-assembly intended for the manufacturer's test equipment during alignment.

**Checking it out.** Using the Model 471 Adaptor couldn't be easier. Just tune in a station which is known to broadcast SCA and connect the adaptor to the amplifier. You'll hear some sound—usually distorted. Then simply adjust the fine tuning control
The KLH Model 18 tuner is an all transistor stereo tuner which is built as transistorized equipment should be built—extremely small. Extend your fingers, place the KLH on your palm and it just about covers the hand. Place the KLH on a bookshelf and you still have room for books—no dangling halfway off the shelf. Stand it sideways and it takes up less space than the collected works of Shakespeare.

But though it is compact the Model 18 has all the features needed for good stereo reception; nothing has been left out. The tuning is the more or less "instrument type" single dial with a very smooth vernier drive; and the calibration is excellent. It is almost possible to pre-set the tuning to a desired station before the tuner is turned on due to the dial's accuracy across the entire band. A full-time stereo indicator is provided which also doubles as a marginal station indicator. Whether the mode switch is set to mono or stereo the lamp lights if a station is transmitting stereo. If the stereo indicator flickers on a stereo broadcast it means the signal is marginal and will be subject to considerable noise. The noise can then be eliminated by orienting the (indoor) antenna until the lamp stays on full-time or an antenna booster amplifier should be switched in. An SCA filter is provided to remove the "hash" which is heard when an FM stereo station also broadcasts SCA.

The KLH is provided with one of the best tuning indicators—the center tuning meter. This meter does not indicate relative signal strength, rather it insures that the tuner is set to the received station's exact center frequency. While modern wide-band tuners do an excellent job at receiving mono even if the station is slightly off-tune, for best stereo reception the tuner must be set to the exact "center frequency." On the KLH Model 18 you simply tune in a station until the tuning meter pointer is at the center scale mark, and you are assured of optimum stereo reception. Two audio outputs are provided, a fixed level output and volume controlled out-

A real "bookshelf" component—the KLH Model Eighteen FM tuner fits on a standard eight-inch shelf without overhang. Note "instrument type" tuning dial with smooth vernier drive—calibration is excellent.
How does KLH make it so small? The multiplex circuit is mounted on the top plate and folds over the chassis when the plate is installed. Note the extensive use of shielded cables and cover-plate metal shields—neatness helps.

...put. Either one can be used; it's just a convenience which allows the user to control the volume at the tuner or at the amplifier.

On Antennas. The tuner comes equipped with two antennas, a plain section of wire attached to the antenna terminals and a moulded folded dipole. It should be pointed out that KLH does not recommend either of these antennas. In a rather good, simplified antenna section, KLH explains that best performance is obtained with a directional antenna and they specifically suggest several satisfactory "outdoor" antennas. However, KLH understands that not everyone can employ an outdoor antenna so they provide the two indoor antennas, with good instructions on how to use them, for the audiophile cursed with an uncompromising landlord.

How It Checked Out. In the performance department the KLH Model 18 is outstanding. With the antenna disconnected there is absolutely no noise from the tuner, no hum and no 'transistor hiss.' In fact, you cannot even tell the tuner is on; it is probably the quietest piece of hi-fi equipment we have heard. If you've been concerned with those persistent rumors that transistor tuners have a "built in hiss" forget it; maybe the first attempts at transistorizing tuners resulted in hissing, but not anymore. The same goes for those rumors that transistor tuners overload on strong signals. On the strongest of signals, even when we used a booster to deliberately force the signal to an overload level, the KLH did not overload—there was no cross modulation, self oscillation or distortion normally associated with overload. In fact, the KLH was even able to receive cleanly two strong adjacent signals which normally cause overlay on some tube type tuners.

The sound quality is magnificent, about the cleanest we've yet to hear; even flutes at high modulation levels were reproduced without stridency. And of course, the absence of any noise produced what has often been called "transparent sound." The stereo separation is excellent, if not outstanding.

Even the AVC (automatic volume control) is good. With the rare exceptions of extremely weak stations, tuning across the FM band did not produce thundering crashes interspersed with barely audible sound. Nearly all stations were at equal volume.

From its smooth as silk sound quality to its high styling (with oiled walnut cabinet) the KLH Model 18 must be rated at the very least excellent. Even the audio purest who spends his entire life looking for "better sound" would find no fault with the Model 18. In fact, this tuner deserves a better name than the Model 18—Mighty Midget would be more to the point. Priced at $129.95, the Model 18 offers top quality performance in the moderate-price audio showcase. For more details and complete specifications on the Model 18 write to KLH Research and Development Corp., Dept. VC-1, 30 Cross Street, Cambridge, Mass. 02139.

What's Been Lab-Checked

Many readers write to us asking whether we have reviewed a particular high-fidelity component or not in Radio-TV Experimenter. To answer these questions and many more that may come, the list below gives the component reported on and the issue in which it appeared.

- Harman-Kardon SR-300 Transistorized FM/Stereo Receiver, April-May, 1965
- Bozak E-300K-Urban Enclosure Kit and Bozak B-207A 2-way Speaker, April-May 1965
- Elpa PE-34 Manual Stereo Turntable, April-May, 1965
- Heathkit AR-13A AM/FM 64-watt Stereo Receiver, Feb.-March, 1965
- Electro-Voice Coronet Speaker System Kits, Feb.-March, 1965
- AR XA Manual Hi-Fi Turntable, Feb.-March, 1965
- Knight-kit KG-870 Stereo Amplifier, Dec.-Jan., 1965
- EICO 2200 FM-Multiplex Stereo Tuner, Oct.-Nov., 1964
- Dynakit SCA-35 Stereo Control Amplifier, August-Sept., 1965
Audiophiles who wish to add stereo tape record and playback features to their high-fidelity systems should seriously consider the Knight KP-70 stereo preamplifier and KN-4000A stereo record/playback transport. In this Lab-Check report, we have reviewed each component individually, however, they are ideally suited to operate in combination.

Knight KP-70. While so-called professional type flexibility is usually a dream rather than actuality in low cost recorders, the Knight KP-70 Stereo-Record/Playback Preamp does offer the average tape fan true "studio facilities" at budget prices. In fact, the operating features are equal to studio recorders and then some.

Both low level (microphone) and high level (tuners, recorders, etc.) mixers are provided for each channel, and the channel levels can be individually or tandem controlled through friction clutches. The low and high level inputs can be mixed so that one could combine narration and background music when recording, say, a sound track for a home movie. A single mode switch determines stereo, left or right channel operation for both record and playback.

Either sound-on-sound or echo effects are obtained by activating a single switch. No need for juggling of connecting cables for sound-on-sound or echo since all circuits are pre-set by the single selector switch.

Separate front panel jacks permit either single or dual plug stereo phones to be used (though they must be the crystal type). This arrangement also permits the use of mono phones when monitoring sound-on-sound recordings. A panel switch determines whether the phone monitor circuits are switched to the signal source or the playback head (on three head transports).

Similarly, the two VU meters indicate the source or playback levels; their function being determined by the phone monitor switch. An extra feature is the use of the VU meters to indicate the bias currents, which while of no extreme importance, does allow the audio purist to keep track of any changes in bias current caused by component aging.

On the electronic side the KP-70 is designed to be used with virtually any tape transport. Either Knight's matching stereo transport, stereo transports of other manufacture, and even old reliable mono-transports which have been upgraded with stereo
heads. All critical head matching circuits are user adjusted; this includes the bias and erase currents, the high frequency equalization and the recording level. Provision is even made for matching low, medium and high impedance heads. (An optional erase head is available for Sony tape transports.)

Performance. Of course, features are really second to performance, for what good are features if the sound doesn’t please. With the KP-70 you’ve got no worries because the electronic flexibility allows almost precise matching to any brand of tape. For example, while Knight’s specifications hold true for the tape they suggest (Scotch 111) the same bias and high frequency adjustments might result in poor high frequency performance from tapes of other manufacture. (This is not unusual, fixed bias tape recorders generally deliver optimum performance with specific tape brands or types. In fact, the KP-70 gives superior performance with 1.0 mil tapes, and though not mentioned in the instruction manual Knight suggests the use of “thin” tape.)

But the KP-70’s electronic flexibility allows the preamp to be matched to virtually any tape (or heads). The curves shown are for white box tape, and even we must admit they look good—they sounded good, too.

Alignment. Knight gives two procedures for adjusting the bias and erase currents: instrument and by “ear.” We found the instrument alignment delivered poor performance on tapes other than Scotch 111 and we do not recommend its use. The “ear” alignment is more useful. Knight provides a special test jack and adapters, and the user simply adjusts a few controls for specific meter readings. While this technique was reasonable, it still left a lot to be desired in the way of top quality sound.

We preferred our own alignment technique which appeared to allow more flexibility in the selection of tape brands. Select a quality tape brand and starting from the full counterclockwise position adjust the bias control for maximum tape output while recording a 400 cycle signal 10 db under maximum recording level. (As the bias current is increased the tape playback output will also increase.) At some bias setting the tape output will start to drop; keep advancing the bias current until the output drops 1 to 4 db. If the bias control locks-up before you can go through peak output back-off the bias current till the output drops about 4 db. The bias metering will tell you whether the current is increasing or decreasing. Next, feed in a 15 kc. signal (at 7½ ips) or a 10 kc. signal (at 3¾ ips) at the same —10db level and adjust the high frequency equalizers so the high frequency playback level is within 3 db of the 400 cycle reference. If you cannot obtain sufficient high frequency equalization at the 7½ ips speed set the equalization to maximum and very slowly adjust the bias current for flat playback response. While this adjustment may appear complex keep in mind that this is how professionals compensate for different tapes—you can pull this trick with few budget recorders.

What We Heard. Overall sound quality ranked high, with good signal to noise ratio (low hiss level). However, there was one peculiarity which should be noted. While not heard when recording program material, test tones at about 15 kc. resulted in low fre-
quency beat notes, which though at low levels, were clearly audible. We feel this was due to the bias oscillator frequency which in our particular unit was below specs. Checks with Knight certified the bias frequency is normally higher, thereby placing any beats outside the audio range and outside the preamp’s frequency response range. Should this occur in your unit the bias oscillator frequency can be changed by repositioning the oscillator coil slug; though the

Even though most components are on circuit boards, considerable wire and shielded cables are used to interconnect all audio circuits.

adjustment requires a signal generator and an oscilloscope. However, keep in mind that the beats are inaudible with normal program material.

The KP-70 is available wired ($139.95) or in kit form ($89.95). While the kit is quite complex, printed circuit boards for most of the electronics and card indexed resistors do reduce the possibility of wiring difficulties. While there are no really jammed-packed corners, there is just no room for sloppy layout or solder joints. It is best to try your hand at wiring an amplifier or tuner before taking on the KN-70. With one kit under your belt, the KN-70 kit will be a snap and an enjoyable experience.

Knight KN-4000A. The Knight KN-4000A Tape Transport ($129.95) is the matching unit for the KP-70 preamp. It differs markedly from most budget equipment in that three separate motors are used: one for supply reel, one for take-up and one for capstan. (This is a lot better than one motor doing everything through a series of belts and pulleys: there’s less to go out of wack.) Also, there are none of the familiar brake mechanisms. Dynamic braking is developed by feeding DC to the take-up and supply motors. The result is a very gentle braking action. Even stopping from the notably high rewind speed places no undue strain on the tape. The transport handles even the extra-thin (extended play) tapes without difficulties such as stretch. Rewind time is about 45 seconds for a 7 inch 1.5 mil reel.

A shut-off switch is provided which removes power from the take-up motor when the tape runs through. Unfortunately, the switch doesn’t work for rewind, and the high speed rewind could use an automatic shut-off.

The transport comes complete with three heads, a digital counter of the reset type, tape lifters and piano-key controls—all necessary for 4-track stereo operation.

Speed constancy at both 7½ and 3¾ ips even at the end of the reel is excellent. Wow and flutter is inaudible.

Our only gripe with the transport is that no mounting base is available—you’ve got to make your own or use an optional portable carrying case ($24.95) designed to hold both the transport and preamp. An optional metal case ($4.95) is available for the preamp.

Roundup. While the KP-70 and the KN-4000A are available as separate units from Allied Radio Corp., 100 N. Western Avenue, Chicago, Illinois 60680, they are sold as a package unit ($209.90 with preamp in kit form) at a slight savings over the unit prices. Frankly, the Knight KP-70 preamplifier and KN-4000A transport combination is the best budget buy available to audiophiles today. You would have to more than double the price before you can purchase comparable tape setups of equal quality and performance.

Note three motors and large capstan stabilizer weight. Finger points to power supply which supplies DC for dynamic tape braking.
While all areas of the world can be heard, sometimes with difficulty throughout most of the day, short-wave reception from each continent has its peak listening period lasting from three to twelve hours depending on the continent and your listening area. For this edition of Propagation Forecast, we have added a table, Peak DX Periods, showing these approximate DX listening periods. It should be noted, however, that fair European short-wave reception will be experienced most of the time on the East Coast and a similar situation applies with Asian short-wave reception on the West Coast.

Good DX hunting.

### Peak DX Periods

<table>
<thead>
<tr>
<th>Area</th>
<th>Local Time—North America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe, North Africa, &amp; Near East</td>
<td>Eastern 1200-2400</td>
</tr>
<tr>
<td>Africa (South of Sahara)</td>
<td>Eastern 1500-2400</td>
</tr>
<tr>
<td>Asia (except Near East)</td>
<td>Eastern 0300-1200</td>
</tr>
<tr>
<td>South Pacific</td>
<td>Eastern 0000-0600</td>
</tr>
<tr>
<td>Latin America</td>
<td>Eastern 2000-0100</td>
</tr>
</tbody>
</table>

To use the table put your finger on the region you want to hear and log, move your finger to the right until it is under the local standard time you will be listening and lift your finger. Underneath your pointing digit will be the short-wave band or bands that will give the best DX results. The time in the above propagation prediction table is given in standard time at the listener's location which effectively compensates for differences in propagation characteristics between the east and west coasts of North America. However, Asia and the South Pacific stations will generally be received stronger in the West while Europe and Africa will be easy to tune on the east coast. The short-wave bands in brackets are given as poor second choices. Refer to White's Radio Log for World-Wide Short-Wave Broadcast Stations list.
Make a master test tape for your tape machine!
Check its head alignment and frequency response!

If you ever get a chance to spend a few days hanging around a professional recording studio one of the first things you'll notice is how often the tape recorders are checked for frequency response. And if you stop to ask questions you'll discover that the technicians are primarily interested in the high frequency response. For even if the heads are worn to a frazzle and has a coating of dirt this thick the recorder can do a good job on the low and mid-range frequencies. But get just a little headwear, or let the alignment (head azimuth adjustment) change ever so slightly, and that golden voiced soprano sounds like she's singing through a pile of straw. In fact, the less costly the recorder, the greater the sensitivity to head defects. Lower the tape speed from the professional's 30 or 15 ips to the hobbyists 7½ and 3¾ ips and head alignment becomes extremely critical—particularly so with 3 head recorders where the playback head must be in exact alignment to the record head.

All tape heads wear and go out of alignment, some faster than others; so for optimum frequency response both head wear and alignment should be checked frequently. While a technician generally uses somewhat expensive test equipment and alignment tapes when adjusting tape recorders, you can do a creditable job—a darn good job—with the Tape Tester, a low cost (less than $20) tape recorder test set specifically designed for the tape fan and music lover with a minimum knowledge of tape recorder electronics.
tape testing

What It Can Do. With the Tape Tester you can check-out your recorder quickly and conveniently, with a minimum of fuss and bother. It tells you if your head needs alignment and when they should be replaced. It lets you make a master test tape (like the pros use) so you can periodically check the recorder against original performance.

The tester contains a two tone signal generator and an adjustable output meter. The generator produces a 1 kc reference signal and an 11 kc alignment signal at the same level as the reference. Both signals are adjustable to 100 millivolts, suitable for either high or low level inputs. The output meter provides an amplifier termination and indicates the recorder's playback performance. The ratio between the two test signals as measured on the output meter (or on the recorder's built-in playback meter if it is so equipped) indicates head wear and misalignment; and the same two signals are used to align the heads.

Construction. The model shown is built on the main section of a 3 x 4 x 5-inch Minibox. Parts layout and lead dress aren't critical as long as they're not sloppy. But take extra care that all components are tied down tightly—the unit is useless if the signal level drifts or pulsates.

Function/power switch S1 can be any four pole triple throw; we have used the model specified in the parts list—even though it has extra contacts—because it is small and low in cost.

Frequency determining capacitors C2, C3, C4 and C5 don't have to be the precision type; any standard brand 10 or 5 percenters will do. Just be certain not to use salvage or "reject" capacitors. C2 and C3 determine the

PARTS LIST

B1—9-volt or 221/2-volt (see text)
C1—25-mf., 25-vdc electrolytic capacitor
C2—0015 mf., 100-vdc capacitor
C3—00015-mf., 100-vdc capacitor
C4—2-mf., 100-vdc capacitor
C5—2 or .22-mf., 100-vdc capacitor

Capacitors C2, C3, C4 and C5 should be either 5% or 10% units.

C6—1-mf., 75-vdc ceramic disc capacitor
J1, J2—RCA phono jack
L1—80-mh. RF choke (Meissner 19-2709)
M1—VU meter (Lafayette 99G5024)
Q1—2N586 transistor (RCA)
R1, R2—10,000-ohm, 1/2-watt resistor, 10%.
R3—5,000-ohm miniature potentiometer (Lafayette 32G7355 or equiv.)
R4—50,000-ohm audio taper potentiometer
R5—See text
R6—100,000-ohm audio taper potentiometer
S1—2-gang, 9-pole 3-position rotary switch (Lafayette 99G6170 or equiv.)
1—3" x 4" x 5" aluminum chassis box BuD CU2105A or equiv.
1—4-post (one is the ground terminal) terminal strip
Misc.—hardware, solder lugs, wire, tubing, battery holder, solder, etc.

Estimated cost: $17.00
Estimated construction time: 3 hours

Schematic diagram for the Tape Tester—keep S1 set at off during playback of test tape.

Inside view of the Tape Tester is uncluttered and easy to wire. Note that VU meter circuit is physically isolated from the oscillator.
high frequency output and the values indicated will produce about 11 kc. which we have selected as an effective value for most hobbyist recorders. If you desire a slightly higher frequency, say 12 kc., use a .01 and .001 mfd. respectively. If you desire an even higher frequency, say 15 kc., you'll have to do a little experimenting as the lead dress will affect the output frequency—start with .008 mfd and .0008 mfd and add small padders until you hit 15 kc.

Regardless of your choice for C2 and C3 they are connected in-circuit as shown, they have no effect when the 1 kc. capacitors, C4 and C5, are switched into the circuit.

The terminal strip is mounted directly on L1 and is retained by L1's mounting screw. Warning:—don't substitute for the specified L1.

The high frequency level adjust, R3, is the subminiature type and is mounted inside the cabinet to insure its adjustment is not accidentally changed. It is mounted to an L bracket which can be made from a straightened ½ inch wide cable clamp.

Keep the leads to Q1 short and use heat sinks, such as an alligator clip, on each lead when soldering.

R5 is a 5 or 10 watt resistor equal to the recommended external speaker load. For example, if your recorder specifies an 8 ohm external speaker use a 7.5 ohm resistor (nearest value to 8 ohms).

Connect the VU Meter, M1, directly to R6 as shown; disregard the instructions and resistor packed with the meter.

9 V vs. 22½ V. Battery B1 is selected after the wiring is completed. First, try a standard 9-volt transistor radio battery (any type). If you can obtain both the 1 kc. and 11 kc. signals all is okay, install the battery. If you can obtain only the 11 kc. signal use a 22½-volt transistor radio battery (again, any type). While the tester will always work with a 22½-volt battery it pays to make the test because 9-volt batteries are less than one-half the price. Miniature batteries such as used in transistor radios will fit a standard penlight battery holder, as shown in the photograph.

Adjustment. Connect a high impedance level indicator, such as an AC VTVM, to J1 and set S1 to 1 kc. Advance level control R4 to the mid-position and carefully note the indicator's reading. Then set S1 to 11 kc. and adjust high frequency level control R3 until the 11 kc. output is exactly equal to the 1 kc. output. Switch back and forth a few times to make certain you have the proper adjustment.

Using the Tester. Maximum convenience is obtained if a Master Test Tape is made when the recorder is new, has seen only a few hours of service, or has known good heads in perfect alignment. (See the special service note at the conclusion of this article on how you can align a recorder with a combination record/playback head without the need for an alignment tape.)

Connect J1 to the recorder's input jack, set R4 to off, and set the recorder's gain control full open. Then set S1 to 1 kc. and
tape testing

adjust R4 until the recorder’s level indicator reads -10 db. If your recorder uses neon lamp indicators set R4 so the normal lamp just flashes; make certain the peak lamp doesn’t flash. On recorders equipped only with a peak level indicator—such as a “magic eye tube” or lamp—set R4 for a level 10 db below the level needed to close the eye tube. (The signal level must be about 10 db down to allow for the recorder’s pre-emphasis applied to the high frequencies).

Record about 30 seconds of 1 kc., then kill the tone for about 10 seconds and then record about 2 minutes of 11 kc. This tone sequence will be the master test tape only for your recorder.

Set the recorder’s volume control to normal, connect J2 to the speaker output jack, and play the tape. When the 1 kc. signal comes through adjust R6 so M1 indicates “0” VU. When you see M1 collapse to zero—the 10 seconds “dead air”—you know the 11 kc. tone follows. When M1 indicates the 11 kc. signal adjust the recorder’s tone control(s) for “0” VU—the “flat” setting. Using grease pencil or tape mark the tone control’s “flat” position. You are now set to test the recorder quickly and simply at all times.

For example: You purchase a pre-recorded tape and the highs are missing completely. Set the tone control to the marked position and play your test tape. If the two tones playback within a couple of db your machine’s okay, the pre-recorded tape is at fault. But if the 11 kc. signal plays back several db below the 1 kc. reference the head(s) is probably out of alignment. Naturally, if realigning the head doesn’t restore high frequency performance the head is probably worn. If yours is a two head recorder, aligning for playback automatically insures record alignment since the same head is used for both functions.

But if yours is a three head recorder alignment is slightly more complex, both the record and playback heads must be aligned to each other. If after alignment, the 11 kc. response is still down, examine the heads for excess wear.

Of course, high frequency loss is not always due to worn or misaligned heads, there are such things as electronic breakdowns, but it is rare for an electronic defect to affect only the high frequencies. A more common fault is the bias adjustment. At the slow tape speeds used by home recorders, a slight change in bias current can translate into a large change in the high frequency response. Also, a given bias current can produce different output levels and high frequency performance among tapes of differing manufacture. In fact a given bias current can produce varying performances between various “lines” of the same manufacturer. It is perfectly possible that even with good heads in perfect alignment one tape will deliver a “flat” frequency response while another gives reduced output and high frequency response.

While most recorders have provision for adjusting the bias for optimum response and output, the adjustment usually requires the services of a technician. However, with the Tape Tester you can test various tape brands to determine which performs best on your recorder. With the heads in perfect alignment, record the two tones on several brands (Continued on page 91)
So you think that a good stereo is expensive. Well, if you have an open mind, this article will show you just how inexpensively a good stereo system can be constructed. If you would like a couple of watts for that quiet living room late at night—or you have a small apartment that could use some real fine music...the Stereo Compact is for you. The only things you need are the use of a friend's power saw for fifteen minutes, a little glue, a soldering iron, a pair of pliers, a screwdriver, wire cutters, and something less than $50.00. The Stereo Compact is built from commercially available amplifier modules and standard parts available from any electronic supply store and mail order houses. The Compact compares favorably to any commercially manufactured item costing three times as much. It has excellent bass response and does not distort at low volume. Best of all, if you should drop off to sleep while it is playing, it shuts itself off completely—amplifiers, power supply, and all.

This system is adaptable to almost any kind of place. It was built out of scrap plywood and covered with “Contact”—that sticky paper that looks like walnut, marble, pink hearts, or any one of two hundred different designs. You can match it to your den, wallpaper, end table, or if you happen to like gold fleur-de-lis on a silver background, the choice is yours.

Assembly. OK—let’s get to work. The parts list and schematic diagram tell you what is needed to put the Stereo Compact together. The record changer came from Olson Radio in Chicago, as did the amplifiers and speakers. The grill cloth for the speakers came from a remnant shop in Oak Park, Illinois. The nuts, bolts and screws from my junk box, and the appreciation from my girl friend, her girl friends, and several male types who have fruged and hully-gulled to the Compact’s output beat. When I bought the amplifiers a schematic diagram came with each one of them. The schematic diagram said I could do several things with these amplifiers. The two volume controls are what they said they should be (100 K

**BUILD A STEREO COMPACT**
Stereo Compact

each) and they work like a charm. All you have to do to get that nice bass sound is put a .03 condenser across each pot like the diagram says. There is no magic about mounting the parts. The amplifiers are glued to the cabinet with Elmer’s Glue. The power transformer is screwed to a 1” x 4” wooden block, as is the terminal strip on which I mounted the four rectifiers to make the bridge power assembly. At $9.99 for four of these units, you can’t go very far wrong. The capacitors are out of a Lafayette’s catalog, as are the two resistors that stabilize this power supply. Sure . . . I thought of zener diodes for voltage regulation and all that jazz, but who needs it? Three 500 mfd. condensers glue down the regulation like it was going out of style. Zeners at $4.95 we don’t need.

A few points to observe, make sure you tie the ground end of the pots (R1 and R2) used as volume controls to their own cases. It keeps hum out of the system. And I didn’t tell you—this system is all solid state, so no worry about heat. One other point—keep those audio leads from the cartridge out in the middle of the cabinet—low level audio just do not mix. Don’t argue—just believe me. No fuse was inserted in the primary leads of the transformer on the power supply. The schematic says you can use one if you want, but you just add $.65 to the system, and that buys a pretty good Martini where I come from.

The record changer comes with a template that tells you how to cut out the mounting board. I recognize that $12.95 is pretty cheap for a record changer, but that’s what it costs. It has four speeds and an “On and Off” switch as an integral part of the unit. Oh! You want to use a Garrard. OK, but remember, the audio amp modules are not designed for that Pickering or Shure cartridge, and besides the Ronette cartridge that comes with this outfit has enough oomph to drive the amplifiers to drink.

Use a couple of insulated staples to hold the wires in place. The resistors in the power supply came with mounting hardware attached. You also need a roll of vinyl tape to insulate the leads that come out of the.

### Parts List

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1, A2</td>
<td>Audio amplifier module (Saxon Mity module, Olson AM-218, Lafayette 19G4401, or equiv.)</td>
</tr>
<tr>
<td>C1, C2</td>
<td>3-mf., 100-volt paper capacitor</td>
</tr>
<tr>
<td>C3, C4, C5</td>
<td>500-mf., 25-vdc electrolytic capacitor</td>
</tr>
<tr>
<td>D1, D2, D3, D4</td>
<td>500-ma., 100-piv diode rectifier (GE 1N91, Olson kit of 4 #RE-70, or equiv.)</td>
</tr>
<tr>
<td>J1</td>
<td>3-circuit headphone-type jack (Switchcraft Little-Jax or equiv.)</td>
</tr>
<tr>
<td>J2, J3</td>
<td>Double phone jack (H. H. Smith 1214 or equiv.)</td>
</tr>
<tr>
<td>P1, P2, P3, P4</td>
<td>Plug, phono (Switchcraft 3501-M or equiv.)</td>
</tr>
<tr>
<td>R1, R2</td>
<td>100,000-ohm, audio taper potentiometer (IRC Q13-128 or equiv.)</td>
</tr>
<tr>
<td>R3, R4</td>
<td>20-ohm, 8-watt resistor (Sprague “Brown Devil” or equiv.)</td>
</tr>
<tr>
<td>R5</td>
<td>50,000-ohm, 1/2-watt resistor</td>
</tr>
<tr>
<td>SPKR</td>
<td>6” x 9” speaker, 3.2-4-ohms (2 required) (Olson 5-278 or equiv.)</td>
</tr>
<tr>
<td>T1</td>
<td>Power transformer, 117-v. primary, 23-v. secondary (Olson T-290, Knight 61G421, Stancor P-6469, or equiv.)</td>
</tr>
<tr>
<td>J1</td>
<td>Record changer with Ronette cartridge (Olson RP-222 or equiv.)</td>
</tr>
<tr>
<td>Misc.</td>
<td>Wood (see text), shielded wire, hookup wire, nuts, bolts, screws, knobs, terminal strips, rubber feet, insulated staples, etc.</td>
</tr>
</tbody>
</table>

Estimated cost: $50.00 or less depending on wood costs and available spare parts.

Estimated construction time: one weekend.

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Schematic diagram for the Stereo Compact does not show amplifier details because these circuit sections are purchased modules. Note use of shielded cables on input circuits—dress these leads away from AC.
amplifiers. Solder those leads together. They carry as much as 700 mills when you get those real bass notes. I have shown the leads from the Mity Modules like I bought them. If you get yours from Lafayette, or Radio Ham Shack, or Courtland Street, then observe the identification as shown on the schematic diagram instead of the colors on those leads. The manufacturer gives both right on the amplifier.

**Working With Wood and What Not.**

The grill cloths are fastened to the speakers as shown. Cut a piece of cardboard as shown in Speaker Grill Detail Drawing, and then use old tire cement, rubber cement, airplane glue, or just plain glue, to fasten down the cloth. Cut the cloth about one-half inch bigger than the cardboard mounting and fold it over the edges of the cardboard. If you use rubber cement, place a thin layer on the cardboard first and then a thin layer on the cloth. After they are dry, they stick together like a pair of magnetic kissing dolls. Do you want to know why I made the speaker cabinets 8½ x 11? I just happened to have two pieces of bond typing paper to make templates for the speakers. How was it done? Simple—1 put a cloth towel on a table and laid a piece of bond paper on a towel. I centered the speaker on the paper and pressed a little hard on the back of the speaker frame. Voila! When I picked up the speaker there was the outline of the speaker gasket—nice and plain. I took a pencil and outlined the inner edge of the gasket outline which gave me the template for my 6x9 speaker opening in the speaker cabinet.

How did I fasten the speaker frame to the cabinet? I glued it. Try epoxy. Then you don’t have to worry about screws sticking through your grill-cloth when you place it on the speaker cabinets.

Oh yes, that piece of 6” x 4” x 1” wooden block you used to mount the power transformer, the terminal strip and the rectifiers—it will also hold the filter condensers (C3, C4 and C5) and the filter resistors (R3 and R4). The block is glued in place after it is completed. Elmer’s glue or epoxy will do. One more thing... the record changer has a ground lead. Tie that ground lead to the
positive terminal of your power supply. It gets rid of objectionable hum.

You will notice that there is a jack included in the system for a pair of stereo headphones. You might like to listen all by yourself, and the neighbors don't like your two watts at such high volume.

The Cabinet. The assembly of the cabinet is very simple. All of the panels that comprise the cabinet are of ¼" plywood. You need the following pieces to assemble the woodwork:

2 pcs—14" x 1-½" (front and rear panels)
2 pcs—13-½" x 1-½" (side panels)
1 pc —14-½" x 13-½" (top cover panel)

The five pieces described above comprise the cover and are assembled as shown in Cabinet Detail Drawing #1. Use glue on the edges and ½" wire brads in your assembly process. Wipe off the excess glue after the parts are nailed together. Be very sure that the small panels that are the sides of the cover are held square as the glue sets and the top cover panel is nailed on.

2 pcs—14" x 8-½" (front and rear panels)
2 pcs—13-½" x 8-½" (side panels)
4 pcs—11" x ¼" (supports)
1 pc —14" x 13" (record changer board)

The nine pieces described above comprise the main cabinet and are assembled as shown in Cabinet Detail Drawing #2. When its dimensions are laid out prior to cutting it to the proper size, it is suggested that the pencil lines be actually cut out to allow the motor board to be placed within the cabinet after having been covered with "Con-tact" without binding on the sides of the cabinet.

Determine what edges are to be the top edges of the first four pieces cut in this section. Identify them and mark a line on each 4½" from each top edge and parallel to this top edge. Glue one of the 11"x1½" pieces on each of the four side panels in conjunction with the line previously drawn and at the 4½" distance from the four top edges. These pieces should be placed on the side panels equidistant from each edge. These pieces are the supports for the board that holds the record player.

Assemble the four side panels in the same fashion that the side pieces for the cover were assembled, observing that the two side panels overlap the front and back panels to create a cabinet whose interior dimensions are 14"x13". Use glue and wire brads to assemble these side panels and observe that the cabinet must be maintained in its square configuration.

Speaker Cabinets. Having now assembled the cabinet for the record player and amplifiers and associated controls, we can turn our attention to the two speaker cabinets. Refer to Speaker Cabinet Detail Drawing. You need the following pieces to make the two speaker cabinets:
Here is the completed Stereo Compact with the rear panels left off the speaker cabinets and the phono cabinet resting on its side to show all the electronics. Notice how neat the wires and cables are routed to modules.

2 pcs—11" x 8 1/2" (front and rear panel)
4 pcs 8 1/2" x 4" (side panels)
4 pcs—11 1/2" x 4" (top and bottom panels)

These pieces are all fashioned from 3/4" plywood. The side pieces are assembled over the part that creates the mounting board for the speaker. After the 11"x8 1/2" pieces have been cut, the template that was created before to show the outline of the 6"x9" speaker is placed on top of these pieces and the outline of the speaker gasket is transcribed to the wooden pieces. The speaker opening is cut from these pieces prior to assembly by the use of a coping saw or saber saw if you happen to have one. The pieces are assembled to make a cabinet that is 11 1/2"x9"x4". As before, the sides and top are assembled with glue and wire brads with an eye to their being essentially square. The side panels are overlapped on the speaker mounting panel to complete the speaker cabinets.

Finishing Up. It is essential that the assembled cabinets, speaker and changer board be prepared to accept the Con-tact covering. All wooden parts should be coated with white shellac or lacquer after sanding to insure a good level of adherence between wooden surface and the Con-tact covering that you use. One piece of advice . . . you can always paint the cabinets from that spare paint that you have stored away if it matches the decor of what you have in mind as a permanent resting place for the system. Having covered the parts with Con-tact or painted the surfaces, assemble the top to the bottom with 1"x1" butt hinges and acquire a side lid support that will allow you to change records with no effort when the cabinet lid is in the open position. Having now assembled all of the cabinetry, from a piece of wood 3/4" square and about one foot long, cut into four equal pieces about 3" long. Place glue on two sides of these pieces and place them in the four corners of the record cabinet below the surface of the mounting board with the bottom ends of the pieces at the exact bottom end of the cabinet proper. These will later accommodate the four rubber feet that will support the entire cabinet assembly 1/2" above the surface on which it will rest and allow a convection type ventilation for the power transformer which may tend to warm up a bit.

Determine which face of the larger cabinet you intend to make the front face of the unit, and drill four 3/8" holes in the face as shown on Cabinet Detail Drawing #2. These holes will accommodate the two volume controls for the Left and Right channel, the On-Off indicator and the headphone jack.

In evaluating this unit against many others which are a great deal more expensive, it is only fair to say that 2 watts of audio cannot compete with the 70 or 80 watt monsters that can drive 15" speakers to sound like the Staten Island Ferry in a fog bank. One thing I am sure you will say is that the lovely quiet sound when you need it is about equal to any other unit at the same volume level that this unit will give you. Anyway, you spend less than $50.00 to make the Stereo Compact and I would like some commentary on the reception you get from your friends who are romantically inclined.
Power Transistor Tester

By James A. Fred

Transistors are like vacuum tubes—they can become leaky or go bad.

There are many transistor testers available for low power or small signal transistors but very few, if any, reasonably priced power transistor testers are available.

Those of you who service modern transistor auto radios have had many opportunities to check leakage and gain of power output transistors if only a power transistor tester were on the workbench. The transistor manufacturers people would like to have us believe that transistors have indefinite life, and never need to be replaced. But those of you at the repair benches and home workshops know better, and it was with this thought in mind that we designed the tester described in this article.

Design Features. The most important section of the power transistor tester is its constant voltage power supply. A conventional full-wave bridge rectifier is used to provide about 18 volts of DC which is then regulated to 12 volts by a Zener diode.

The transistor leakage is indicated on a 0-100 mA DC meter. One of the important characteristics of a power transistor is the leakage between the emitter and collector with the base floating. This tester applies a maximum of 12-volts DC to these elements and leakage should not exceed 50 ma. A variable resistor provides a voltage that can be adjusted between 0 and 12 volts so that you can detect 50 ma leakage without burning out the meter. The other important thing to measure is gain by applying a small bias voltage to the base. If the transistor has gain it will show up as an increase in current on the meter. The increase in current will vary depending on several factors, but should be at least two to four times.

This tester was styled to match the author's Lafayette Transistor Analyzer Kit, model 223. However, a standard aluminum chassis box can be used to replace the plastic cabinet. Slide switches were used although toggle switches would have done as well. Any meter of the proper range can be used as long as it will physically fit the space allowed.

The front panel was made from .050-inch-thick aluminum that was etched in strong lye water to give it a satin finish. When etching aluminum in this way do it either out of doors or in a well ventilated room. Do not make the lye water too strong or it will turn the panel black. Mix common household lye in hot water in an enameled pan or stoneware crock. Do not mix in an iron or aluminum container. After etching rinse carefully in cold water and dry with a soft cloth without touching the front of the panel. Apply black decals or any other type of lettering and spray with a protective coating.

The bridge rectifier can be built up with four separate rectifiers or one of the new potted types may be used. The filter capacitors are necessary to make as pure a DC voltage as possible so that no ripple will be introduced into the transistor under test which would upset the gain measurement. The
All the parts are assembled on an aluminum panel cut to size of plastic case.

Don't guess and replace power transistors blindly—test them first.

Schematic diagram for the Power Transistor Tester. Actual connection to the transistor under test is made through flexible leads with alligator clips. Switch S2 can be a spring-loaded slide or toggle unit. Refer to text for computation of resistor R2 value.

The transformer used in our tester was salvaged from a piece of Minneapolis-Honeywell equipment although any transformer with a secondary of 18 to 24 volts, rated for a current of at least 200 ma. can be used. In order to determine the resistance of R2, the Zener current limiting resistor, for a different secondary voltage use the following equation.

\[ R2 = \frac{V_s - V_o}{1.1 \times I_{\text{max}}} \]

\( V_s \) is the supply voltage at the output of the bridge rectifier, \( V_o \) is the input voltage to wirewound control R3, or in this case 12 volts, \( I_{\text{max}} \) is the load current maximum or in our case 100 ma. As an example let us say that our bridge rectifier is putting out 24 volts DC. Subtract 12 volts from 24 volts leaving 12 volts. 1.1 times 100 ma., which is our maximum load current, gives .110 amperes. Dividing gives a value for R2 of 109 ohms. A standard value 100 ohm resistor at 2 watts.
Power Transistor

Although parts location is not critical for proper operation of the unit, builders will find it difficult to squeeze parts into the plastic case if they ignore author's layout.

would be satisfactory. The wattage rating of Zener diode Z1 can be arrived at by multiplying the voltage rating of the Zener, which is 12, by the maximum current through it, or 1.32 watts. Our tester uses a 1 watt Zener, but we have secured it tightly against the front panel with a cable clamp and it runs cool. The front panel thus serves as a large heat sink. Unless you want to do the same you had better use the 10-watt unit specified in the parts list. Construction is straight forward with only one safety tip, and that is, “Don’t over heat the silicon rectifiers or Zener diode. Use a heat sink when soldering them.”

Just in case you are wondering why there is no npn-pnp reversing switch, forget it. Power transistors used in auto radios are pnp units almost without exception. Just in case you run up against an odd-ball, you can jury-rig a test setup using the testers power supply. Just do things upside down, that is reverse the power supply leads coming from the Zener diode to the testing circuit. Watch M1’s polarity.

Using the Tester. After assembly, wiring and testing the instrument is ready for use. Place Gain-Leakage switch S2 on Leakage, rotate the voltage control to the counterclockwise end of rotation, attach the pnp power transistor (out of its circuit) to the test leads, and turn on the power. Advance the voltage control and observe the meter. If the meter reads 50 ma, STOP! If not rotate the control to its full clockwise position. If the meter reading hasn’t exceeded 50 ma., it has passed the leakage test and may be tested for Gain. Set the voltage control back to seven on its dial. Push the switch to Gain and the current reading should increase. On transistors with appreciable leakage the increase in current will only be from two to four times. On units with very little leakage the current increase may be as much as twenty-five times. Power transistors with high leakage and low gain can be used, but will not perform nearly as well as low leakage high gain units. As you gain experience in using the tester and the tested transistors in actual sets you will learn to appreciate the difference in power transistors. Keep a record of leakage and gain and actual circuit operation of each power transistor you test and you will soon be able to interpret your readings like an expert. There aren’t any real tight specifications on power transistors that the average serviceman can use.

Experience is still the best teacher when it comes to testing and using power transistors.

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**PARTS LIST**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1, C2</td>
<td>1000-mf, 25-vdc electrolytic capacitor</td>
</tr>
<tr>
<td>D1, D2, D3, D4</td>
<td>1N911 (four required) or 1 bridge rectifier module (Mallory FW50 or equiv.)</td>
</tr>
<tr>
<td>M1</td>
<td>0-100-ma, DC meter (EMICO Model RF-2½4 C or equiv.)</td>
</tr>
<tr>
<td>NE1</td>
<td>Neon lamp NE-51H or Tineon Indicator 36N2311-6 complete with jewel and internal resistor, or equiv.</td>
</tr>
<tr>
<td>R1</td>
<td>56,000-ohm, ½-watt resistor (not required if NE1 is a Tineon Indicator)</td>
</tr>
<tr>
<td>R2</td>
<td>See text</td>
</tr>
<tr>
<td>R3</td>
<td>800 to 1,000-ohm, 4-watt wirewound potentiometer</td>
</tr>
<tr>
<td>R4</td>
<td>56,000-ohm, 1-watt resistor</td>
</tr>
<tr>
<td>R5</td>
<td>33-ohm, 2-watt resistor</td>
</tr>
<tr>
<td>S1, S2</td>
<td>5-0.157” slide or toggle switch</td>
</tr>
<tr>
<td>T1</td>
<td>Transformer; 115-volt pri.; 18-25-volt sec. at 200 ma.</td>
</tr>
<tr>
<td>Z1</td>
<td>1N2976 zener diode (Mallory ZA12 or equiv.) (see text)</td>
</tr>
<tr>
<td></td>
<td>1-6-13/16” x 5-9/32” x 2-5/16” plastic case (Allied Radio 87P886 or equiv.)</td>
</tr>
<tr>
<td></td>
<td>Alligator clips with 3 different colored insulators</td>
</tr>
<tr>
<td></td>
<td>1-Dial plate (Mallory #389 or #390, or equiv.)</td>
</tr>
<tr>
<td></td>
<td>1-7” x 5” aluminum sheet for front panel (see text)</td>
</tr>
<tr>
<td>Misc</td>
<td>Line cord, knob, terminal strips, wire, solder, hardware, decals, lye, etc.</td>
</tr>
</tbody>
</table>

Estimated cost: $22.00
Estimated construction time: 4 hours
Let's face it, yours truly has been around. If someone hung a sign on my back, This Engineer for Hire, he'd be close to right. SWL'ing wasn't enough, I had to travel. So when I got my degree as an electronics engineer, I took a job in Bhutan, setting up a British owned commercial SWBC station atop the Himalayas. Then it was Colombia for a couple years where I put together a BCB network. Which brings me to this job for the bearded one—Ammer Ded—second-in-charge of his secret relay station in Southern Adindan near the Egypt-Sudan border. As you can see, I'm pretty neutral. I'll work for anybody. You might also call me a DX fanatic. Before I started on these travels, I would dream about DX and DX places, complete with nightmare static. I had to travel.

In charge of the Adindan operation was one Professor Von Kirk. After a couple weeks on the job, I decided he was crazy. Not so far gone he couldn't function, but still crazy. I had gone looking for him with paper work, official reports to be signed. His office was empty.

So I went down to the professor's quarters. Knocked. Silence. But the door was unlocked and I went on in. In the center of the room Von Kirk's large desk. To the right and left of me were banks of computer racks. The set-up looked like something from the late, late horror show.

"Professor." Nothing, so I shouted louder, "Professor."

More silence.

An open book was on his desk. I moved in closer to get a look at it. Curiosity killed the cat but then cats have nine lives.

The Light of the Near East, Volume I by Thomas H. Burgoyne. It was opened at Section III, Chapter III, "The Dark Satellite."

I just skipped over the words quickly. Some jazz about this satellite populated by evil beings, supernatural races or something like that. And about their agents on the earth, the Inversive Brethren.

Von Kirk came in then. Followed by two of our local Arab workers, unskilled but with plenty of muscle. They carried in a crate. He motioned and they put it down behind his desk. Then he saw me. "What do you want? These are my private quarters!"
I showed him the reports. Von Kirk took them, pointed for the Arabs to go. I started to move out behind them—

"Wait!" He crossed the room, shut and locked the door.

Like locked in the tiger's cage. Beside that weird book and way out electronics gear, there was the professor himself. If ever there were doubles on Earth, Von Kirk and Boris Karloff qualified.

"I am in complete charge of this base. You understand that. My word is law."

I nodded.

"What you see here is my own personal project financed with my own resources. It has nothing to do with the Adindan government." He fiddled with **The Light of the Near East** on his desk.

I nodded again.

He considered me a moment. "I need a qualified assistant." Hesitated. "I am willing to pay you an amount in addition to your regular salary."

"How much?" Play it safe, play along.

"If this does not interest you, then apply to Cairo for a transfer." Von Kirk circled me a couple times.

"How much?"

"$50 a week, U. S. money."

I spread my hands. "Good enough." Why not! All I had to do was humor this crazy old man and pile up the extra moola.

Von Kirk shut his book with a bang. "Then it is settled." He sat down. "Unpack that crate while I explain to you what is involved here."

It was quite the bit. Von Kirk had found that dark satellite. It revolves inside the earth which is hollow. The inhabitants of this satellite use static, that's right, atmospheric noise to communicate with their agents on the earth, those **Inversive Brethren**. Because this dark satellite is nearer the surface in the tropics, their messages were considerably louder, other scientific theories to the contrary. By the use of computers, Von Kirk hoped to break their code.

I got the crate open. Inside—a TV set!

"The messages may take either aural or visual form."

So every day and part of the night, too, we kept at it. I didn't mind working during the hours of darkness, but days—that heat from the desert sun made his lab almost unbearable. But Von Kirk wouldn't wilt or rest.

"When I began my work in Baden many years ago, time was expendable. Now there is not much left." Von Kirk made the station a real funland.

His approach was simple enough. With a broadband receiver (one he invented himself) he would pick up all the frequencies below 3 mc., feed them into a speaker and TV picture tube—but the signals were first rearranged in sequence and comparative volume via those banks of computers. I took the left bank, him the right.

We did get voices of course, however, these were usually traceable to one of the high powered BCB stations in the Near East, like Cairo itself on 773 kc. and Omdurman down in the Sudan on 572. But then a voice did come through we couldn't identify. At 2.00 AM, female, soft and deep. She said quite clearly "prepare to relay intelligence to the South African resistance command," then slipped off into the noise.

Von Kirk circled the room swiftly noting computer settings. "That was Tefnut, daughter of the primeval being, princess of the Dark Satellite."

I concluded **Tefnut** summed up his whole project pretty well.

When he finished, Boris, I mean Von Kirk, stopped dead and just stared at me. "You found her voice attractive?"

I laughed and nodded.

"You must be careful. She will try to tempt you and recruit you into the Inversive Brethren." Von Kirk considered the danger briefly. "We will have to risk it. Tomorrow night at the same time!"

After which I went to bed, exhausted from the heat, and dreamed about DX again for the first time in a couple months. Only now the station I wanted was Tefnut. Static, oceans of static, with her voice audible on occasions. Then on came Radio Berlin International and blocked out the frequency.

I woke up in a cold sweat.

After being stuck in Adindan for three

(Continued on page 94)
If your TV set can receive any of the 70 UHF-TV channels then it's time for some top-level thinking on your roof.

The FCC requirement that, as of March, 1964, all TV receivers intended for interstate shipment must be capable of receiving UHF channels, coupled with the cropping up of many new UHF stations in all areas of the country, indicate that UHF TV is finally here to stay. This boils down to the fact that in all probability UHF either has, or is about to be coming to your town. The question is . . . are you able, or will you be able to receive it? Even though you may have purchased a new TV receiver capable of receiving all 82 channels, or added a UHF converter to your present set, there is much more to receiving a good UHF signal than hanging a wire out the window or simply tying on to your present VHF antenna. UHF signals are a bit trickier to handle than the old familiar VHF. Let's take a look at why UHF is around in the first place, as well as at the UHF signal itself and how we may best capture it for feeding to the receiver.

Why UHF? Originally, when the 13 VHF TV channels were created, it was felt that they would provide adequate capacity for the TV market. It was subsequently found, that additional channels would be required to handle the desires of many areas for additional outlets. Another reason for UHF is that it permits two channels of the same frequency to operate relatively close together.
UHF ANTENNA INSTALLATION

... say in adjacent cities. This has been a problem with VHF; the advent of more powerful transmitters and more sensitive receivers has resulted in interference between like channels in relatively widely separated areas. Thus, in a nutshell, UHF permits: 1. a larger number of available channels, and 2. these channels may be spaced more closely together than in the case of VHF channels.

Now that we've seen why we have UHF, let's take a look at the basic UHF signal in order to get a better idea of how to handle it. The first and most obvious difference between the VHF and UHF signals is their frequency. Both VHF and UHF signals are high enough in frequency so as to travel in a straight line (like a searchlight beam) rather than following the curvature of the earth as do lower frequency signals. However, lower band VHF TV signals are susceptible to a phenomenon known as "skip" as shown by the sketch, Fig. 1. This "skip" occurs when the transmitted signals bounce off the ionosphere (a layer of charged particles encircling the earth) and return to a receiving point many miles from their point of origin. This "skip" explains some of those amazing TV-DX accounts we hear about.

This "skip" effect is non-existent at the UHF TV channels thus eliminating the chance of interference between widely sepa-

![Fig. 1. VHF signals skip to distant receivers—UHF signals pass through ionosphere.](image1)

rated channels. The UHF TV signals are more readily blocked by relatively small objects such as buildings, etc. due to the much shorter wavelengths involved. The cumulative effect of this again cuts down the range of UHF signals. Also, the radiated signal strength of UHF signals is generally lower than in the case of VHF signals. Other factor is their reduced coverage when compared to VHF.

UHF signals are also more directional than lower frequency VHF signals, and as a result, ghosting due to multi-path signal reception is more of a problem with VHF signals.

Capturing the UHF Signal. The most logical starting place is at the antenna. UHF antennas pretty much follow the same basic types as found in VHF—the dipole, folded

![Fig. 2. A log periodic UHF antenna with 21 cells—good for working stations 80 miles.](image2)

![Fig. 3. Four individual bays are stacked one on top of the other for greater gain.](image3)
dipole, conical, yagi, etc. However, the physical construction of UHF antennas differ considerably from corresponding VHF types. For one thing, all UHF antennas are considerably smaller than their VHF counterparts. The reason for this, of course, is the shorted wavelengths up in the UHF spectrum. Remember, the element length(s) of any antenna, dipole, yagi, or what have you, is a direct function of the wavelength being received.

The smaller physical dimensions of the UHF antenna make possible many arrays not practical with the larger, more bulky, lower frequency VHF antennas. For example, look at the log-periodic UHF antenna pictured in Fig. 2. The design of this type of antenna for VHF frequencies would be very difficult due to the considerably longer element lengths required as well as the greater spacing between elements. Maintaining structural strength would be extremely difficult, and the increased weight would also be a problem.

Fig. 3 is another example of the physical advantage gained with UHF antennas. A large number of individual bays are easily stacked for increased gain without taking up an unreasonable amount of space or becoming unwieldy or overly heavy.

The smaller dimensions of UHF antennas offer still another advantage... much better performance. As just mentioned, a fairly large number of arrays may be stacked by increased gain. It is also feasible to employ the parabolic antenna design (similar to those microwave dish antennas). This design, somewhat similar to using a reflector behind a searchlight to increase intensity... only in reverse, results in greatly increased antenna gain (sensitivity). Fig. 4 pictures an antenna using this approach. Note the curved reflector which resembles a section of a parabolic reflector. It's pretty obvious that this type of construction would be just about mechanically impossible with a VHF antenna.

Fig. 5 shows another type of UHF antenna construction. Actually, a dipole with reflector, this unit differs from the VHF dipole and reflector in that a number of...
individual reflectors are used in place of a simple tubular rod reflector element. This screen improves antenna gain and sharpens its selectivity.

Besides providing increased gain, the "fancier" arrays possible with the smaller UHF antennas offer sharper pickup patterns. Just what this means is shown in Fig. 6. As we mentioned earlier, UHF signals are particularly prone to ghosting as a result of multiple path reflections. Notice that the sharp reception pattern of the multibay UHF antennas effectively reduced the pickup of multiple path reflections as well as signal pickup from its rear.

In areas where a strong UHF signal is present, "bowtie" UHF dipole antennas such as pictured in Fig. 7 will be satisfactory. Fig. 8 shows an indoor antenna of unusual shape, a UHF log periodic trapezoid.

The Antenna to Receiver Path. Although the installation of a UHF antenna is essentially the same as for a VHF, you still have to lug it up to the roof or up to the attic. There are also a number of differences that you should note:

For one thing, signal losses are much greater at UHF frequencies, as we mentioned before. This means that care must be taken to reduce or eliminate all sources of possible signal loss between the antenna and receiver, or converter, input terminals.

Beginning at the antenna itself, make sure that lead-in cable connections to the antenna terminals are tight and that the antenna terminals themselves are free from all corrosion. While in this area, don't overlook the antenna terminal block and antenna insulators. Avoid getting any oil or grease on these parts, as these substances make excellent signal-killing dirt catchers.

The type and care of the lead-in wire or cable is especially important at UHF frequencies. A source of signal loss at VHF frequency, signal loss in the lead-in, is a considerably larger problem at UHF frequencies. The least "lossy" type of lead-in is the "open-wire" type such as shown in Fig. 9. As you can see, it consists of two parallel wires, separated at regular intervals by low-loss spacers. Due to air being the only dielectric between the wires, except for the widely spaced insulators, this lead-in has extremely low loss at UHF frequencies. The
one disadvantage of this type of lead-in, however, is that it is more difficult to handle than the other types of lead-in.

The next least lossy type of lead-in is the tubular type. The advantage of the tubular lead-in as compared to the flat type is that, being circular, it provides a longer leakage path between conductors. One point though . . . be sure to seal the ends of tubular lead-in with either a match flame or hot soldering iron after it has been installed to prevent any water from getting into it.

In areas where interference, such as automobile ignition noise, is a problem, shielded coaxial cable is your best bet. Since this cable is usually 75 ohms unbalanced line, a matching transformer will probably be needed at the antenna as most antennas have a nominal impedance of around 300 ohms. Similarly, a second transformer will be required if the converter or TV’s input is rated at 300 ohms.

When installing the lead-in, it’s of course important to keep it well away from other objects, especially metallic ones. Also, the length of lead-in from antenna to set should be kept as short as possible to minimize signal loss.

While still on the subject of signal loss, it’s important to keep in mind that some types of lightning arrestors can cause severe signal loss at UHF frequencies. If, after completing your UHF installation, you find that you are losing signal, check the lightning arrestor. If the signal improves without it, replace with a higher quality unit.

Orienting the antenna for best picture is a bit trickier at UHF frequencies. Since the UHF signal bounces around more than VHF, careful orientation can be a bit touchy . . . only a change of a few degrees can make the difference between no picture and a good quality picture. Likewise, raising or lowering the antenna just a foot or so can make all the difference in the world. In some instances, it’s possible to get a stronger signal from a reflected signal rather than the direct signal from the transmitter.

**UHF Converters and Boosters.** If your TV set is not equipped to receive UHF, then obviously you must obtain a UHF converter in order to be able to receive any UHF stations. One exception to this is if your receiver’s tuner is of the type which will receive UHF strips. In this case, you simply obtain the strip for the desired UHF channel.

UHF converters come in all sizes, shapes, and forms nowadays . . . a typical unit being shown in Fig. 10. Some manufacturers offer transistorized converters which offer the advantages of low power consumption and cool operation. Converters are available which may be placed on top of, or near, the receiver. Others may be placed unobtrusively behind the set.

There are a few precautions to watch when installing a UHF converter. To prevent converter oscillation (indicated by either interference bars or excessive “snow”

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**Fig. 10. Typical UHF converter made by Jerold selects UHF channel and provides boost.**

**Fig. 11. Wide-band UHF signal boosters are mounted on antenna masts just under the UHF antenna. Tele-Amp unit is shown above and Jerold unit below. Power to units is supplied through TV lead-in wire from indoor supply.**
in the picture), keep the converter’s input and output leads well separated. Also, keep the leads from the converter’s output to receiver antenna terminals as short as possible.

Heat is an enemy of UHF converters . . . especially transistorized ones! To minimize converter drift due to excessive temperatures, keep the converter well isolated from such relatively high temperature spots as the rear of a TV that is placed smack against a wall.

UHF boosters are now available. Similar in results to VHF units, they give the UHF signal extra “oomph” before it reaches the converter or receiver. Fig. 11 shows two types of antenna mounted UHF boosters which amplify the signal before it is sent down the lead-in. This is an advantage as the stronger signal tends to override the noise and interference picked up by the antenna lead-in.

UHF “two-set” couplers are also available . . . a typical unit being pictured in Fig. 12. These couplers are designed for minimum signal loss at UHF frequencies and provide better performance than a conventional VHF coupler.

Equipped now with the scoop on UHF and a clear picture of the reception process, you’re ready to start pulling in those ultra-high frequency broadcasts.

Workbench Tips

■ A frequent cause of hum (and sometimes even whistles from radios) is an improperly grounded can-type filter capacitor. Most can installations rely on their twist lock for connection to ground. In time an oxide forms—a high resistance circuit occurs. To prevent trouble, always solder at least one lug to ground in kits and when replacing.

■ Ordinary paper clips (thousands are discarded hourly) make handy, quick detachable, connectors for electrical wire ends with only slight alteration. Simply straighten out one end of the clip and attach the wire. The wire end may be spot soldered or inserted in a loop, then the loop is squeezed together in a vise or with pliers. The remaining portion of the paper clip may be used as a washer with the tab end under a terminal nut or as a simple hookup as shown in photo at right.

■ If your SW ear phones weigh heavy on your head, take a tip from the makers of hi-fi headsets and pad them with foam rubber. Foam rubber powder puffs are ideal for the purpose and are available at most cosmetic counters. To install, simply cut a ¼” hole in the puff’s center, and cement in place as shown in photo at left. Install puffs wherever headband meets top of your head.

Fig. 12. Since anyone can splice wire, far too often two set couplers are eliminated in installations causing loss of signal, ghosts.
If you're looking for a useful construction project, which can help you test salvaged parts or log rarer DX, the Winky-Dink isn't for you. But if, like most of us, you enjoy a strictly fun gadget from time to time, then Winky-Dink is what you have been looking for.

Winky-Dink is a one-hour project leaving the remainder of the evening free to experiment with different blink rates. Only eight components are employed, and total cost should be under $3.00 (less if you're lucky and have some of the parts in your junkbox).

The completed Winky-Dink does nothing more than sit on the table and wink its two light-bulb eyes back and forth continually, but it's a conversation-stopper to non-electronic-minded visitors. In a home lab crammed with exotic (and expensive) equipment, Winky-Dink easily steals the show when anyone drops in.

If you must be practical, it makes a fine toy for a young child. To use it for this, perform simple surgery on a stuffed animal. Remove the sewn-on eyes and replace them with Winky-Dink's bulbs; then provide a zipped compartment for batteries and pack the tiny circuit board into the animal's interior.

Construction. Arrange the two transistors, the capacitors, and the resistors on the circuit board and solder the leads to a home-made printed circuit board. See Detail Drawing. Use a small, hot iron and work rapidly; the transistors are rated to withstand soldering-iron heat for no more than 15 seconds at a distance of 3/8-inch from the case.

Rather than using the etched board, you may prefer to lay out the components in similar arrangement on perforated hardboard. Stiff cardboard is also an excellent "chassis" material; necessary holes can be punched with the point of a drawing compass or with an ice-pick.

Leads to the bulbs can be connected either by soldering them directly to the bulb bases, or by using sockets. Since either #48 or #49 pilot lamps can be used (electrically they are identical), you can use either screw or bayonet-type lamp sockets—whichever you have in the junk box.

Battery connections are best made by using a battery holder, although with care you can solder directly to the two cells. The holder is recommended as Winky-Dink draws approximately 60 milliamperes from a fresh pair of D cells, which will require battery replacement from time to time. If the large ignition-type cells are used for power, they should last their shelf life.

Thumbnail Theory. Winky-Dink is an astable collector-coupled multivibrator, sim-
Winky-Dink circuit board all wired and ready for lamp and battery connections. Be careful not to overheat transistor leads.

plified to the most extreme degree possible. The transistors function as switches to turn the bulbs on and off, and the capacitors make one transistor stay "off" whenever the other is "on."

For instance, if transistor Q1 happens to be "on," its collector voltage will be nearly zero. This places the positive end of C2 at ground level. However, if Q2 is "off" at the same time, its collector voltage will be the same as that of the battery—3 volts. Thus C1 is charged to 3 volts, through bulb 12.

While C1 is charging, the current flowing to charge it passes through the base-emitter junction of Q1, keeping Q1 "turned on." When C1 reaches full charge, however, this current flow ceases, and Q1 tends to "turn off."

This raises the collector voltage of Q1 positive to ground, then the change in Q1’s collector voltage is transferred through C2 to the base of Q2, tending to turn Q2 "on."

This action, in turn, causes the collector voltage of Q2 to drop. The change in collector voltage of Q2 is transmitted through C1 back to the base of Q1, further tending to turn Q1 "off." In addition, the 3-volt charge on C1 adds to the change, so that the base voltage of Q1 is 3 volts more negative than the collector voltage of Q2. This action is cumulative, and rapidly switches Q1 "off" and Q2 "on."

So long as the 3-volt charge remains on C1, Q1 will be held in cutoff and cannot conduct. C1 "reverse charges" through R1, until the base of Q1 becomes sufficiently positive to allow conduction to begin. Then Q1 begins to turn "on" again, turning Q2 "off" as just described. The process continues indefinitely—as long as the battery lasts.

**Parts Substitutions.** Almost any of the parts may be changed to fit your own availability situation. *n/np* transistors were used because they were on hand. *PNP’s* can be used by reversing polarity of the battery and the capacitors. Resistor values for R1 and R2 can be anything between 4700 ohms and 33,000 ohms; the larger values will produce a slower wink rate. The capacitors can be larger but appreciably smaller ones are not recommended; the wink rate becomes so rapid the effect is lost. However, do not substitute the more common No. 47 pilot bulbs; they require 250 milliamperes for proper operation, which results in abnormally short battery life.

Should Winky-Dink fail to wink for you, the trouble should not be hard to find. If both lamps light dimly, you probably have a defective or disconnected capacitor. If one bulb lights brightly while the other is out, the capacitor connected to the same collector as the dark bulb is probably shorted. If both lamps light brightly, either both capacitors the shorted or your transistors are defective (either event is rare). If the bulbs wink, but dimly, you probably have weak batteries.

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**PARTS LIST**

C1, C2—30-mfd., 6-v electrolytic capacitor, sub-miniature type for printed circuit boards (Lafayette 99G6076 or equiv.)(#49 (screw type) or #49 (bayonet type)

Q1, Q2—2N1302 transistor (RCA) (nnp, average beta—100)

R1, R2—10,000-ohm, ½-watt resistor

Misc.—Printed circuit board (optional), sockets for pilot lamps (optional), wire, solder, etc.

Estimated cost: $3.00

Estimated construction time: 1 hour without printed circuit board

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Be sure to connect positive leads of electrolytic capacitors to Q1 and Q2 collectors.
Talk on a Light Beam  
Continued from page 55

Table-top setup for talking on a light beam is shown in the photos. Above, the transmitter or light amplifier is shown, and below, the light-actuated sound amplifier.

Tape Testing Made Easy  
Continued from page 72

of tape: the tape which plays back the two tones within a few db of each other is obviously the tape to use. But note that there may well be a difference in output levels, and a tape may deliver several db greater output. Do not be influenced by output level, since the high level tape might deliver a poor high frequency response from your recorder (it might be great tape for another recorder). Standardize on the tape that delivers the best high frequency response, any recorder has enough extra gain to compensate for a lower output level.

Special Service Note. The average tape recorder user often does not realize that a single combination record/playback (R/P) head goes out of alignment. This is because even if the head goes severely out of alignment, the playback azimuth is exactly the same as the record azimuth—it must be because the same head is used. However, should the user attempt to playback a pre-recorded tape—which is usually in perfect alignment—then he would notice a muddy muffled sound. Even if you never use pre-recorded tapes your R/P head should be in perfect alignment—it's the only way you'll be able to swap tapes with friends and still get maximum fidelity.

Even if you lack an alignment tape, alignment is a simple procedure; and once done, you can use the tester to make a Master Test Tape. Preferable, borrow a pre-recorded tape (alignment tapes are hard to borrow). If you can't, use an old tape—one made when the recorder was brand new.

Run the tape through the recorder, set the tone control to full treble boost, and using the edge of a Q-tip or your finger, gently skew the tape up and down right after the R/P head (as close as possible). If the highs increase as the tape is skewed in either direction the head is out of alignment. Demagnetize a screwdriver (or wrench) and adjust the alignment screw for maximum high frequency response—the head is now in perfect alignment. Immediately, clean the heads (erase head too) and make a Master Test Tape. (If yours is a three head recorder the playback head can be aligned using the same procedure.) Once the Master Test Tape is made you can use the simple tests and alignment procedure previously given.
Organs Without Pipes  
*Continued from page 51*

pressed, the switches operate for not only F3, but also for F4 (the over tone), C4, (the fifth tone), and A2 (the hum tone, which is the third tone one octave lowered). The simultaneous sounding of all these keys creates the effect of a chime.

**Voicing.** From the keyer circuits, the chosen signals go to the voicing circuitry. Here, certain harmonics are removed from the signals by filters so that the remaining signal will be similar to that created by a pipe stopped to the degree chosen by the musician.

Voicing for the swell manual includes 10 stops; four of these are known as "flute" voices and the other six are called "complex". (See Fig. 9 of Heathkit organ.)

The flute voices are low in harmonic content, while the complex voices have strong harmonics. To obtain the flute voices, the tone signals are passed through low-pass RC filters which remove the higher harmonics. Since F4, for instance, is the eighth harmonic of F1, a number of different filters must be used to allow F4 to be passed while the harmonics of F1 are blocked (the F1 tone goes through a filter which blocks F4, while the F4 tone goes through a different filter which blocks the harmonics of F4). The four flute voices differ only in pitch. The 16-foot flute sounds tones an octave lower than the keyboard would indicate. The 8-foot flute sounds the normal flute note. The 51/2-foot flute or "quint" sounds the tone a musical fifth above the keyboard note selected, and the 4-foot flute or "flute d'amour" sounds an octave higher than the keyboard.

The fifth octave of the frequency range—the one above that covered by the master oscillators—is created by bandpass filtering in the flute circuitry; it is used only to sound the upper notes of the keyboard when the "flute d'amour" stop is chosen.

The six "complex" voices of the swell include three 16-foot stops, all of which sound an octave lower than the note struck; and three 8-foot stops, which sound the note selected. The 16-foot stops are "diapason," "bass clarinet," and "trumpet," while the 8-footers are "English horn," "violin," and "oboe."

All are created by passing tone signals through high-pass, low-pass, and bandpass filters in various combinations, to remove all undesired harmonics and leave only those present in similarly-named stops of a pipe organ.

The great manual offers a choice of four voicing stops, all of which produce the notes chosen on the keyboard rather than producing notes an octave or more away. All four of these voices are complex; they are produced by filtering action also.

The pedal keyboard has two stops, "8-foot" and "16-foot," plus a third switch which selects both together. The 8-foot stop sounds the note selected, while the 16-footer sounds an octave lower. If both are chosen, both notes will sound together when a single pedal is pressed. The pedal tones are filtered through a low-pass RC network to remove most high harmonics, leaving a "full-bodied" tone composed primarily of fundamental frequency.

**Reverberation.** While the "color" or voicing, as determined by the voicing filter circuit, is an important part of the "organ sound," it's not all there is. An equally important component is the reverberation pattern created for a pipe organ by the large number of pipes spread over a wide physical area. In electronic instruments, this pattern is simulated by use of a device known as a Leslie speaker.

**Tremolo & Vibrato.** The Leslie speaker consists of a speaker coupled to a special horn; the horn rotates at right angles to the direction of the speaker, and disperses the sound over a wide area while at the same time impressing a combination of amplitude and phase modulation upon all of the sound waves, by its rotation.

**Speed of rotation of the Leslie speaker is**

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under control of the musician. Two speeds are available. In "tremolo" position, the horn rotates at about 360 RPM, or 6 cycles per second, adding a tremolo effect to the music but not producing a discernible tone of its own. In "celeste" position, rotation is slowed to 42 RPM, or 7/10 cycle per second, producing a "fluttering" effect very like that of a large pipe organ. If desired, the Leslie speaker may be turned off and the conventional main speakers used alone.

In some instruments, the proper reverberation pattern has been achieved by use of electromechanical reverberation units. However, such units have not been seen wide acceptance; the Leslie speaker is used on the majority of today's instruments.

Another characteristic of organ sound is a vibrato effect. In the original pipe organs, this was due to random variations in air pressure. In the electronic instruments, it is produced by special vibrato circuits which frequency-modulate the master oscillators to produce an almost undetectable fluctuation of pitch during each note. Frequency variation is at the rate of about 6 cycles per second, when vibrato is selected by the organist. Like all other effects in the organ, vibrato may be turned off when desired.

Amplification. To build the final organ output signal up to proper loudness (a pipe organ has a big sound), an amplifier must follow all the tone generating, keying, and voicing circuits. This amplifier is much the same as an ordinary hi-fi circuit—and in fact, hi-fi amplifiers have been used in many home-built organs.

Following the amplifier, of course, comes a speaker to convert the signal to sound. Unlike the amplifier, though, the speaker need not be the ultimate in hi-fi. When the designer plans the entire organ, he can frequently hold cost down somewhat by using less perfect speakers which do have some coloration and character of their own—and then taking these speaker characteristics into account in the design of his voicing systems. Thus the speaker must be considered as a part of the complete organ, rather than as simply a conversion device hung onto the end. An excellent example of this technique is the use of the Leslie speaker already described, to produce the reverberation pattern.

Or, in other words, attempts to "improve" upon an organ by putting in a high-grade hi-fi speaker will usually result in noticeably poorer and less life-like sound from the instrument.

Other Electronic Instruments. The organ is not the only instrument which may be duplicated by electronics. At least one firm markets an electronic piano, which allows private practice by the use of headphones. In addition, a number of purely-electronic instruments such as the Theremin have entered the musical field—and several motion pictures have been produced in which the entire music background has been produced by electronic instruments.

What's more, a number of scientists have worked out systems in which digital computers are programmed to follow the rules of musical composition, then compose and perform non-human works, by controlling electronic instruments. The similarities between electronic organs and computers have already been brought out in this article. Maybe in another 100 years or so musicians, too, will suffer from "technological unemployment!"
Current Clamp
Continued from page 58

ohms, volts, and amperes. Take 0.6 volts as the average diode voltage for a silicon power diode and trim R1 as needed in use.

Measured performance of the Current Clamp is shown graphically. You can see that output voltage changes very little until the clamping point is reached, at which time current holds virtually constant and voltage drops off. These measurements were made with ordinary bench instruments, and no corrections for resistor tolerance or meter error have been included: thus you find such items as 1.25 volts driving 11 ma. through a 100-ohm load. Settings for the tests were 1½ volts supply and 24-ma. clamping level. A 100-ohm variable resistor furnished the load.

Set Up. To set up the Current Clamp, once built, follow this procedure. First remove the load and connect a VTVM across the “output” terminals (where it remains throughout the tests unless needed elsewhere), and connect the “input” terminals to an adjustable regulated power supply. Then adjust the power supply for desired value of output voltage as read on the VTVM.

Next, set R1 to its maximum value, connect a milliammeter of appropriate range to the “output” terminals of the Clamp, and short-circuit the output side of the meter. Now set R1 for any desired maximum current flow.

Then connect a load of sufficient resistance to approximate the expected current flow in the circuit to be checked, and measure the output voltage to see how much of it has been changed by the adjustment of R1. If it has changed, readjust the power supply to compensate. Then again short the output terminals and re-set R1 for desired maximum current. This process sometimes must be repeated a third time, but more frequently the initial adjustment holds without even a touch-up.

When the milliammeter indicates maximum desired current on short-circuit load, and the VTVM indicates desired output voltage with approximately the desired load, remove the load resistors and connect to the circuit to be tested, confident that no components are going to be cooked by excessive current before you can turn things off. It's a most secure feeling!

Static Caper
Continued from page 62

months, a temptation would have really hit the spot. But suddenly it began to bug me, I was actually taking Tefnut seriously. Like maybe if I hung around much longer, yours truly would be as crazy as Von Kirk.

That following night (which was complete with sand storm and zero visibility outside) we set exactly the same computer combination with some very slight variations as calculated by the professor.

Just like clockwork her voice came through. “This is Tefnut calling Inverse 7.” Then we got a picture on the screen too. Tefnut was everything we lacked in the local Adindan talent. If you can imagine the rarest of DX in female form, that’s Tefnut.

Von Kirk was so excited his hands were trembling.

“You are to dispatch agent 63333 to Southern Adindan and abduct he who is second-in-command at the secret radio relay station there.”

I turned several different shades of aqua.

“Ignore the old man. He is already considered slightly insane and will not be believed.” Tefnut stood up. “But the younger one is a suitable subject for rehabilitation.”

Von Kirk dashed across the room and threw the main switch. “You must take the government plane and fly out of Adindan at once.”

Calm now, I pointed to the storm outside. “When there is visibility.”

So now I have two choices. That storm will probably move on before Inverse agent 63333 arrives. Or I can stick around and find out just how good a temptress Tefnut really is.
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7. Whether you buy surplus or new, you will be interested in Fair Radio Sales Co.'s latest catalog—check full of buys for every experimenter.

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

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

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

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

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

13. No electronics bargain hunter should be caught without the latest copy of Radio Shack's catalog. Some equipment and kit offers are so low, they look like mis-prises. Buying is believing.

14. Unusual surplus and new equipment/parts are priced "way down" in a 32-page flyer from Edie Electronics. Get one.

HI-FI/AUDIO

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

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

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

18. Two brand new full-color booklets are being offered by ElectroVoice, Inc. that every audiophile should read. They are: "Guide to Outdoor High Fidelity" and "Guide to Compact Loudspeaker Systems.""}

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

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

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

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

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

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

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

28. Very pretty, very efficient. That's the word for the new Betacom intercom. It's ideal for stores, offices, or just for use in the home, where it doubles as a baby-sitter,-ap.

30. Tone-arms, cartridges, hi-fi, and stereo preamps and replacement head and conversions are listed in a complete Shure Bros. catalog.

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

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

33. Become the first to learn about Norelco's complete Carry-Corder 150 portable tape recorder-outfit. Four-color brochure describes this new cartridge-tape unit.


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

HI-FI ACCESSORIES

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

39. A 12-page catalog describing the audio accessories that make hi-fi living a bit easier is yours from Switchcraft, Inc. The cables, mike mixers, and junctions are essentials!

KITS

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

42. Here's a 100-page catalog of a wide assortment of kits. They're high-styled, highly-versatile, and Heath Co. will happily add your name to the mailing list.

Literature Library

Numbers in heavy type indicate advertisers in this issue. Consult their ads for additional information.

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43. Want to learn about computers the easy way? Brochure from Dictation Electronics describes its line of transistorized kits.

44. A new short-form catalog (pocket size) is yours for the asking from EICO. Includes hi-fi, test gear, CB rigs, and amateur equipment—many kits are solid-state projects.

AMATEUR RADIO

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

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

CITIZENS BAND SHORT-WAVE RADIO

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

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

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

51. If you’re a bug on CB communications or like to listen in on VHF police, fire, emergency bands, then Regency Electronics would like to send you their latest specs on their receivers.

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

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

55. Interested in CB or business-band radio? Then you will be interested in the catalogs and literature Mosley Electronics has to offer.

Also see item 46.

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

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

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

60. Facts on accredited curriculum in E.E. Technology is available from Central Technical Institute plus a 64-page catalog on modern practical electronics.

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

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62. Information on a new lab transistor kit is yours for the asking from Arkay International. Educational kit makes 20 projects.

63. A complete booklet and price list giving you the inside data on the other Organ are yours for the asking.

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

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In this issue of White's Radio Log we have included the following listings: U. S. AM Stations by Call Letters, U. S. FM Stations by Call Letters, Canadian AM Stations by Call Letters, Canadian FM Stations by Call Letters, Cuban and Mexican AM Stations by Call Letters, and the World-Wide Short-Wave Section.

In August-September, 1965 issue of RADIO-TV EXPERIMENTER, Volume 44, No. 1, the Log will contain the following listings: U. S. AM Stations by Frequency, Canadian AM Stations by Frequency, U. S. Television Stations by States, Canadian Television Stations by Location and the World-Wide Short-Wave Section. In the event you missed a part of the Log published during the first half of 1965, you will have a complete volume of White's Radio Log by collecting any three consecutive issues of RADIO-TV EXPERIMENTER during the remainder of the year. The three consecutive issues are an entire volume of White's Radio Log that offers complete listings with last minute station change data that are not offered in any other magazine or book. If you are a broadcast band DX'er, FM station logger, like to photograph distant TV test patterns, or tune the short-wave bands, you will find the new White's format an unbeatable and up-to-date reference.

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www.americanradiohistory.com

Radio-TV EXPERIMENTER
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<th>Location</th>
<th>KM</th>
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<td>KPPC Pasadena, Calif.</td>
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<td>KMA Shenandoah, Iowa</td>
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<td>KGUB San Diego, Calif.</td>
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<td>KPRC Houston, Tex.</td>
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<td>KMXN Sioux City, Iowa</td>
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<td>KOH Reno, Nev.</td>
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<td>KPRD Riverside, Calif.</td>
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<td>KMAJ Madison, Wis.</td>
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<td>KPLL Pass Robles, Calif.</td>
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<td>KOMA Omaha, Nebr.</td>
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<td>KPORT Park Ridge, Ill.</td>
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<td>KMMI Canton, Ohio</td>
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<td>KOKO Shreveport, La.</td>
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<td>KPSX Colorado Springs, Colo.</td>
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<tr>
<td>KMAK Lincoln, Neb.</td>
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<td>KOKQ Half Moon, Ill.</td>
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<td>KQBR Shreveport, La.</td>
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<td>KAQQ Magna, Utah</td>
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<td>KOKL Okmulgee, Okla.</td>
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<td>KQNM San Antonio, Tex.</td>
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<tr>
<td>KBFD Bozeman, Mont.</td>
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<td>KQPS Mc Allen, Tex.</td>
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<td>KMAM Great Falls, Mont.</td>
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<td>KQKY Little Rock, Ark.</td>
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<td>KQSB San Antonio, Tex.</td>
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<td>KAQT Kansas City, Mo.</td>
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<td>KOLD Tuscon, Ariz.</td>
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<td>KQSD San Antonio, Tex.</td>
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<td>KOLI Quinlan, Tex.</td>
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<td>KQSW Portland, Ore.</td>
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<td>KOLM Houston, Tex.</td>
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**Note:** The table above lists radio stations and their corresponding locations. The columns represent the station identifiers (e.g., KLZ, KMAK, etc.), followed by the city and state where each station is located. The data is as of June-July 1965.
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<td>WWIL</td>
<td>Lauderdales, Fla.</td>
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<td>WWIS</td>
<td>Black River Falls, Wis.</td>
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<td>WWIT</td>
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<td>WWKB</td>
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<tr>
<td>KDF -FM</td>
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</table>

Abbreviation: (s)—broadcasts stereo
### Canadian FM Stations by Call Letters

Abbreviations: (s) broadcasts stereo

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<th>Ke.</th>
<th>C.L. Location</th>
<th>Ke.</th>
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<td>CKNB Campbellton, N.B.</td>
<td>950</td>
<td>CKPC Brandon, Ont.</td>
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<tr>
<td>CKNL Fort St. John, B.C.</td>
<td>950</td>
<td>CKMG Prince George, B.C.</td>
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<tr>
<td>CKNW New Westminster, B.C.</td>
<td>950</td>
<td>CJKP Port Arthur, Ont.</td>
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<td>CKNY Winnipeg, Ont.</td>
<td>950</td>
<td>CKPT Peterborough, Ont.</td>
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<td>CKDG Hamilton, Ont.</td>
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<td>CKQQ Sudbury, Ont.</td>
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<td>CKDK Pembroke, B.C.</td>
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<td>CJSW Swift Current, Sask.</td>
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### Cuba and Mexico AM Stations by all Letters

The broadcast stations listed below carry regular program material and transmit with 5000 watts or better power output during at least part of their broadcasting day.

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<th>Ke.</th>
<th>Location</th>
<th>C.L. Location</th>
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World-Wide Short-Wave Stations

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

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

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

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

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

More on QSL's. In the last issue of Radio-TV Experimenter we discussed the collecting of QSL cards from broadcasting stations, one of the finer aspects of the art of DX'ing. When our issue came out we received considerable mail asking about the possibilities of QSL cards from non-broadcasting radio stations, such as hams, police, ships, etc.

Ham stations generally swap QSL cards with each other after a "contact," and a good percentage of ham operators will also QSL a monitoring report if they find it useful. The addresses of ham operators may be obtained from The Radio Amateurs Callbook which may be purchased at Ham radio stores or by mail from any of the major parts supply houses.

Police stations, ships, and other "odd ball" stations sometimes QSL, but generally they will ignore your report unless you include with it a prepared QSL card (stamped, too) which they can sign and return to you without much bother. The radio-telephone stations frequently heard with test tapes on single-sideband are tough to QSL because they prefer to keep their transmissions as unpublicized as possible.

Citizens Band operators will frequently QSL SWL reports, but finding their addresses is a problem because of the absence of adequate callbooks. Each month there is a listing of about 1000 CB operators in S9 Magazine, which is available on many newsstands throughout the U. S. and Canada.

In our December-January issue we had an item about a station calling itself "Radio Free Dixie." In a report just received from Bill Brubaker of Miami, Fla., we understand that they are on from 2300 to 2400 EST on 690 kc's with a powerful signal. Programs consist of jazz music and commentaries. Our expert on "weirdo stations," Tom Kneitel, K3FLL/WB2AAI, says that this is a bootleg station operated in Cuba by Castro, designed to stir racial unrest throughout our southern states.

In our listings, a station or frequency marked with an asterisk (*) indicates a non-broadcast station or frequency. This might include aeronautical, maritime, military, or other type of transmission, either in regular AM or single sideband (SSB). In instances where many non-broadcast stations use the

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same frequency, we have given you a clue as to the type of stations to be found there, rather than pin down only one station.

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

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

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

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

Tom Kneitel, New York, N.Y.
Dave Matyka, Steger, Ill.
Richard F. Kline, Englewood, N.J.
Dale Koby, Van Nuys, Calif.
Robert Luke, Canton, Ohio

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<td>Curacao, Neth. Ant.</td>
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Roger Camile, Manchester, N.H.
Harvey Conley, Rockaway, N.J.
Bob Pressey, Glenview, Ill.
Peter Grenier, Fall River, Mass.
Alan Kapala, Lodi, N.J.
Warren Lambard, Alexandria, La.
Irwin Tatelman, Chicago, Ill.
Glenn W. Dye, Wildwood, N. J.
P. Richmond, Chilliwack, B.C.
Gerald W. Dickson, Scarborough, Ont.
Walter L. Read, North Bend, Ore.
Dale Slack, Springfield, La.
Walter P. Pyne, Hagerstown, Md.
L. P. Ackerman, Phoenix, Ariz.
John Engle, Mankato, Minn.
Ralph J. Monson, Lancaster, Va.
Mike Poulter, San Angelo, Texas
 Bruce Meyer, Portland, Ore.
Lawrence Whitehead, Wewoka, Okla.
Sol Nussbaum, Brooklyn, N.Y.
Ronald Smeltzer, Montreal, Que.
Shaler Hansich, Hartford, Conn.
Peter De Hart, Middletown, Pa.
Doug Lamerson, Richmond Hill, N.Y.
A2C Manuel Borges, Walker AFB, N.M.
Rick Slattery, Miami, Fla.
Dr. Gerhart Heinisch, Winnipeg, Man.
W. T. Grubb, Dubuque, Iowa
Julian M. Sienkiewicz, Brooklyn, N.Y.
Steve Wilkes, Dallas, Tex.
Dennis Letendre, Miami, Fla.
Edward F. Wiegano, Rochester, N.Y.
Frank J. Voltz, Trenton, N.J.
Norman Hopkins, Nelig, Nebr.
Robert Wilson, Flushing, N.Y.
Karl Simmons, Jacksonville, Fla.
Gordon Amey, Jr., Baltimore, Md.
Melvin Hickman, Walla Walla, Wash.
Barry L. Schneider, Flushing, N.Y.
Bolling Smith, Cameron, N.C.
Frank Fox, Inman, Kans.
Steve Shimko, Baltimore, Md.
Carl E. Ebbets, Travis AFB, Calif.
Geoff Check, Lacon, Ill.

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*Meet Ed, our ace high-voltage expert!*
amplifier module. After the silicon rubber is applied, set the speaker aside to dry.

**Final assembly and testing.** The grommets are installed in “B” holes and the strain reliefs are mounted with 6-32 x 3/4-inch screws in holes “A” and “F.” Center the speaker in the opening of the case, the speaker should be mounted face down in the case as shown in the Detail Drawing with the speaker lugs facing directly away from the two grommet holes “B.” If done correctly the speaker cone will be facing the open end closest to grommet holes “B.” The two strain reliefs in the case should face toward the back of the case.

Next prepare the 6-volt cable. Cut a piece of plastic lamp cord 3-feet long, and strip off 3/4-inch of insulation from the end of each wire. Solder terminal lugs on the wires as shown in the photos. Knot one wire of the pair at each end of the cable to identify the positive lead. Using the silicon rubber carefully coat the area of the terminal lug where the wire is soldered and the insulation is stripped off. This seals water out of the cable safeguarding the copper wires from corrosion. Leave enough of the terminal lug free of silicon rubber so the lug can make good electrical connection with the battery terminals.

Solder 8-inch leads to B1’s battery clip. Coat the terminals on the battery clip with silicon rubber. Pass these leads through the cable clamp mounted in hole “F” on the back cover plate. It may be necessary to wrap several layers of plastic tape around these wires so they can be gripped by the cable clamp. Pass about 8 inches of wire from the microphone and 6-volt battery cable through the cable clamps in the side of the case, but don’t tighten the clamps yet.

Wire the unit according to the detailed wiring diagram. When complete, recheck all connections and the polarity of the battery connectors. Remember the end of the battery cable with the knot is the positive lead. When you wire terminal strip TS1, dress the leads so they come out straight away from the terminal strip. Don’t mount TS1 until the unit has been tested and coated with silicon rubber. Tighten the cable clamps.

Install B1 in its holder, noting that if you use the mercury cell, the case is positive, **not** negative, as in the alkaline cell. Connect the 6-volt battery cable to B2.

**Testing.** Adjust the microphone on your throat, positioned just above the adams apple. The microphone elements should be equally spaced on both sides of the throat. When you speak, you should hear your amplified voice coming from the speaker. When you’re sure that the unit is working, coat and seal TS1 with silicon rubber. Pay special attention to the points where the leads emerge. Mount TS1 with 4-40 x 3/4-inch hardware.

Mount transformer T1 between TS1 and the rear lip of the case. Connect the leads from T1 to terminal strip TS1, and cover everything over with silicon rubber.

The battery harness is assembled from two cotton straps. One strap is cut down to 18 inches and sewn onto the second strap, at a right angle, seven inches from the buckle of the first strap. The two rubber pads are cut out of 3/4-inch closed-cell neoprene rubber. This is the same material that wet suits are made of. If you can’t obtain this rubber in a 3/4-inch thickness, use the more common 1/4-inch thickness. These rubber pads are used to provide a non-slip surface between the tank and the battery.

**Use and care.** When you’re using the Aqua-Con, speak slowly and enunciate each word carefully. If your Scuba rig uses either a single-, or a double-hose system, you won’t be able to pronounce some sounds. You won’t have this difficulty if you use a full face mask.

Adjust the microphone strap for a snug, but comfortable fit with the elements positioned so they are spaced equally on both sides of the neck, just above the adams apple.

Don’t forget to remove both B1 and B2 between dives to conserve battery life. After the last dive of the day, remove the batteries and rinse all parts of the Aqua-Con including the batteries with clear water. Try to keep the Aqua-Con out of enclosed hot areas and out of direct sunlight as temperatures over 140 degrees may damage the transistorized amplifier. Incorrect connection of battery B2 may also permanently damage the battery. Remember that the positive lug is the one with the knot on it. If the Aqua-Con is treated with the same care normally accorded to Scuba equipment, the only maintenance likely to be needed is the replacement of the batteries when necessary. See you at 10 fathoms.
launching in the 70's, should. For Voyager missions as planned are a true triumph in electronic staging. An eight-foot-diameter antenna is to ride on a large scientific platform to televise the planet's surface for a period of months. Its landers will take separate television pictures of the surface as it zeroes in toward the planet's surface.

Voyager landers will place five-foot parabolic antennas on the planet's surface to report soil findings, while another VHF self-levelling antenna beams its back-up news to the orbiter to be relayed back to earth separately. Voyager missions are even going to pick the spot where they'll land. Right now they hope to find a nice polar cap to land by or a spot in the dark areas astronomers have studied for centuries. And if all goes well, these sophisticated electronic reporters hope to keep telling Mars' story over a period of six months, and get the answers to all the questions man has asked about the red planet.

They're the Tops: To ease the suspense about just what we will learn from these vitally-important Mariner and Voyager missions, RADIO-TV EXPERIMENTER scanned the field, chose two of our top Mars authorities to question.

Dr. N. H. Horowitz, of the California Institute of Technology in Pasadena, one of the biologists to work out our present theory of life's origins, says that if we find chemical make-up of organisms on Mars resemble those on earth, we can assume living matter was transported from one planet to the other. He says "There is already some spectroscopic and other evidence suggesting that life may exist on Mars."

Dr. Stephen H. Dole of the Rand Corporation, who has written two books on habitable planets, isn't quite so optimistic about Mars. He doubts human life can exist there. "Mars is too small to produce or retain an atmosphere suitable for human beings."

He does believe, though, that there are 600,000,000 habitable planets in outer space, and that "The universe may be inhabited by varieties of men who are not only of separate species but whose criteria of habitability on planets may not be the same" as ours. In this context, there could be men on Mars. Dr. Dole sees future colonies of earth-men traveling through space and settling down on far planets, a process which may bring amazing evolutionary changes in man.

He thinks man may create new variations of himself as he adjusts to new atmospheres and new gravities, and that he will adapt fast genetically, thus changing his whole appearance.

Dr. Dole thinks future colonies of men will travel to Mars to live, folks who will draw water from rocks, live in hermetically sealed "hot houses," grow their own food in the soil, though still be dependent to some extent upon supplies sent from earth.

The Antenna Hairdo. But before we sell the hard-won business or sublet the family household or start visualizing just what we will look like as outer-space citizens, this writer suggests we wait until Mariner and Voyager report "live" from Mars.

For we might possibly find ourselves confronted by the one-eyed fellow with the spike head and antenna hairdo our TV script writers envision. And in turn, spike-head might think earthlings with their two eyes, two ears, and their two legs were strictly weirdies from the pages of science fiction, and send us rocketing right back to earth.

When we do hear all the news from the six Mariner-Voyager missions, we should have an idea whether or not there are small men or no men on Mars. Whether the missions report a live Mars or a dead Mars, blue vegetation or only lichens andlonely plantlife—and this writer predicts we will find just that, lichens and plants and perhaps the records of a deceased civilization—we can never turn back after we have electronically landed on Mars.

For we will have challenged a new coastline, much as Columbus did five centuries ago, a new coastline that will beachhead new landings, not only in space, but in thought. Perhaps the most awesome element about man's latest electronics venture is we may be forced, when we know all we seek to know about Mars, to change our whole concepts of life and its origins.
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